Disability, Utilization, and Costs Associated With Musculoskeletal Conditions United States, 1980

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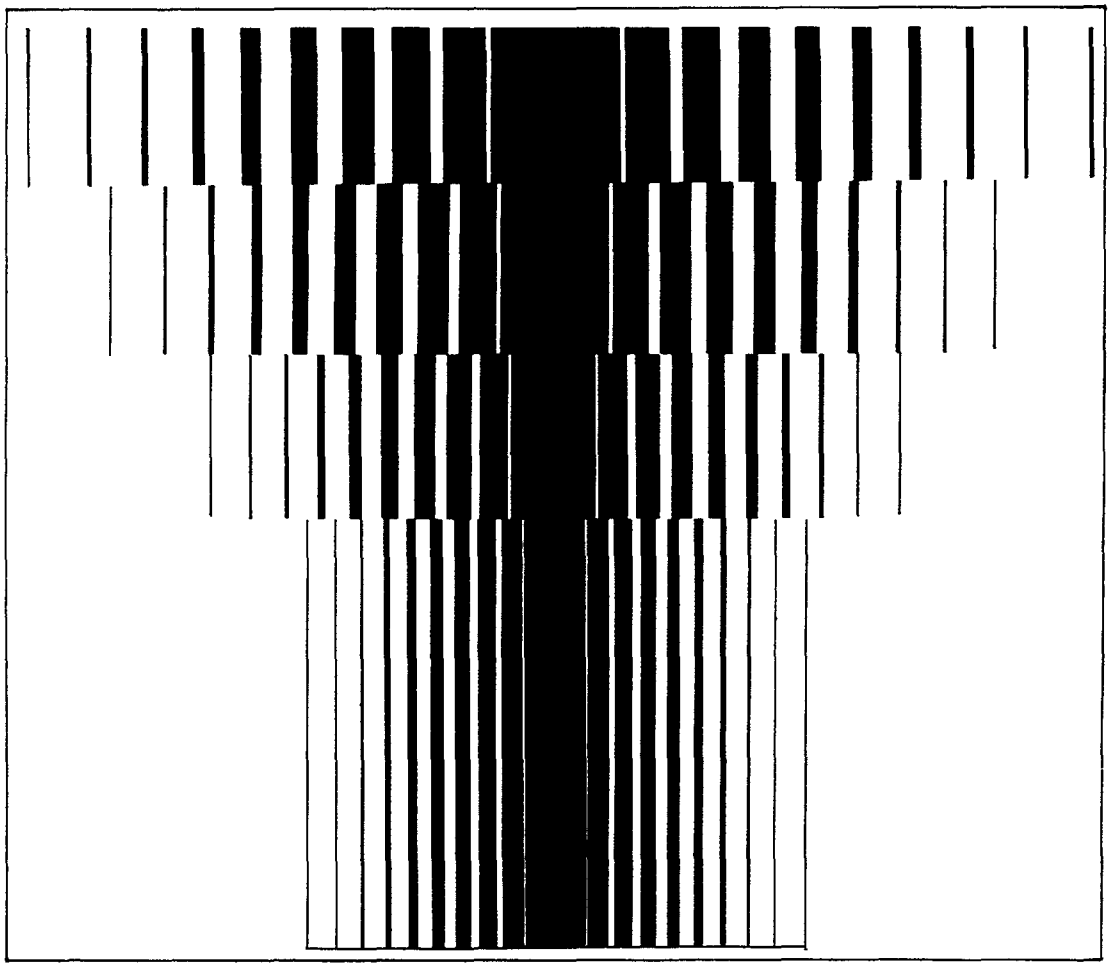

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National Medical Care Utilization and Expenditure Survey

The National Medical Care Utilization and Expenditure Survey (NMCUES) is a unique source of detailed national estimates on the utilization of and expenditures for various types of medical care. NMCUES is designed to be directly responsive to the continuing need for statistical information on health care expenditures associated with health services utilization for the entire U.S. population.

NMCUES will produce comparable estimates over time for evaluation of the impact of legislation and programs on health status, costs, utilization, and illness-related behavior in the medical care delivery system. In addition to national estimates for the civilian noninstitutionalized population, it will also provide separate estimates for the Medicaid-eligible populations in four States.

The first cycle of NMCUES, which covers calendar year 1980, was designed and conducted as a collaborative effort between the National Center for Health Statistics, Public Health Service, and the Office of Research and Demonstrations, Health Care Financing Administration. Data were obtained from three survey components. The first was a national household survey and the second was a survey of Medicaid enrollees in four States (California, Michigan, Texas, and New York). Both of these components involved five interviews over a period of 15 months to obtain information on medical care utilization and expenditures and other health-related information. The third component was an administrative records survey that verified the eligibility status of respondents for the Medicare and Medicaid programs and supplemented the household data with claims data for the Medicare and Medicaid populations.

Data collection was accomplished by Research Triangle Institute, Research Triangle Park, N.C., and its subcontractors, the National Opinion Research Center of the University of Chicago, Ill., and SysteMetrics, Inc., Berkeley, Calif., under Contract No. 233–79–2032.

Co-Project Officers for the Survey were Robert R. Fuchsberg of the National Center for Health Statistics (NCHS) and Allen Dobson of the Health Care Financing Administration (HCFA). Robert A. Wright of NCHS and Larry Corder of HCFA also had major responsibilities. Daniel G. Horvitz of Research Triangle Institute was the Project Director primarily responsible for data collection, along with Associate Project Directors Esther Fleishman of the National Opinion Research Center, Robert H. Thornton of Research Triangle Institute, and James S. Lubalin of SysteMetrics, Inc. Barbara Moser of Research Triangle Institute was the Project Director primarily responsible for data processing.

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Symbols

---	Data not available
...	Category not applicable
-	Quantity zero
0.0	Quantity more than zero but less than 0.05
†	Sample size is less than 50
‡	Sample size is less than 25

Disability, Utilization, and Costs Associated with Musculoskeletal Conditions

By Hillary A. Murt, University of Michigan, P. Ellen Parsons, National Center for Health Statistics, formerly of the University of Michigan, William R. Harlan, J. William Thomas, James M. Lepkowski, Kenneth E. Guire, Sylvester Berki, and J. Richard Landis, University of Michigan

Executive Summary

In this report, data from the 1980 National Medical Care Utilization and Expenditure Survey are used to present health characteristics, types and quantities of services used, and the charges for these services for persons with musculoskeletal diseases. Slightly more than 44 million people, or 19.8 percent of the U.S. civilian noninstitutionalized population, were reported in the survey to have at least one musculoskeletal disorder. These data are generally consistent with those from other health surveys, which show that the prevalence of musculoskeletal disorders increases for successive age categories, that such disorders are more common among women than among men, and that they are less prevalent among black persons than among persons of other races.

In terms of both functional limitation and perceived health status, persons with musculoskeletal conditions are, with some notable exceptions, in relatively poor health. Persons having back problems in addition to problems with peripheral joints (such as the knee, hip, or shoulder) were more likely to rate their health as "fair" or "poor" compared with persons having only back problems or compared with persons in the civilian noninstitutionalized population as a whole. Musculoskeletal disorders accounted for a considerable proportion of all disability days reported by the total civilian noninstitutionalized population: 13 percent of restricted-activity days, 8.8 percent of bed-disability days, and 11.2 percent of all work-loss days were directly attributable to musculoskeletal conditions. The disabling effects of musculoskeletal problems pose a significant economic burden; they accounted for a total of $3.9 billion in lost productivity costs during 1980 for employed persons in the work force and for homemakers.

For persons with musculoskeletal problems, the mean number of ambulatory visits per year was nearly twice the rate of 5.2 for the general civilian noninstitutionalized population. Of ambulatory visits made to all health care providers by persons with these conditions, 35.6 percent were related in some way to the treatment of their musculoskeletal problems. Musculoskeletal conditions are somewhat different from many other illnesses because their treatment is within the professional domain of several types of health care providers. Approximately 13 percent of persons with any type of musculoskeletal disorder received care from chiropractors during the year and this figure rose to nearly 30 percent for back problems only. However, nearly 33 percent of persons with musculoskeletal problems made no visits for treatment of their condition. This relatively high percent can be explained in part by the wide availability of over-the-counter medications for the treatment of pain (pain being the most common symptom reported by persons with these conditions) and in part by the self-limiting nature of acute recurrent episodes of selected musculoskeletal problems. In addition, it may also reflect the inability of the health care system to provide successful treatment of symptoms associated with musculoskeletal ailments.

Despite the fact that a relatively large proportion of care administered to patients with musculoskeletal problems was provided in ambulatory settings, approximately 59 percent of the charges generated by the treatment of musculoskeletal conditions were attributed to inpatient hospital care. Total charges generated by the treatment of these conditions amounted to more than $12 billion, which represented 8 percent of the Nation's total health care costs for the civilian noninstitutionalized population in 1980. These charges of $12 billion are high relative to the low costs for each individual with a musculoskeletal problem because of the high prevalence of these disorders. More than 50 percent of persons with musculoskeletal problems generated condition-related per capita charges of less than $50 in 1980. About 23 percent of all charges for the treatment of musculoskeletal conditions were paid directly by the recipients.

NOTE: This report was prepared by the University of Michigan by contractual arrangement with the National Center for Health Statistics (Contract No. 282–83–2118). The authors are grateful for the support received during all stages of the preparation of this document, both from colleagues at the University of Michigan and from the staff of the National Center for Health Statistics. At the University of Michigan, Sharon Stehouwer contributed greatly to initial analyses of the NMCUES data and to identification and correction of several problems encountered in the data base. Drs. Catherine McLaughlin, Richard Lichtenstein, and Leon Wyszewianski provided valuable

conceptual help. Quality secretarial support in the preparation of the many tables included in the report came from Jan Feldman, Carolyn Parker, and Johanna Haaxma-Jurek. At the Institute for Social Research, University of Michigan, Nan Collier developed software for calculating sampling errors, and Judy Conners performed many of the analyses for generating sampling errors for national estimates.

Continual support and guidance were received from the National Center for Health Statistics and in particular from the Project Officer, Dr. Mary Grace Kovar, Special Assistant for Data Policy and Analysis. The authors are indebted to Dr. Robert J. Casady, Chief of the Statistical Methods Staff, for writing the major section in Appendix I in which the NMCUES survey design and estimation methodology are described. When potential errors in the data were identified during the analyses, Robert Wright and Michele Chyba quickly solved the problems. Editors in the Publications Branch provided valuable assistance during all stages of this report, especially preparation of the detailed tables.

Introduction

In the United States, musculoskeletal conditions exact a heavy toll in terms of disability days, including work-loss days, as well as in the use of medical services. Usually chronic and often disabling, they impose an economic burden on both affected individuals and society at large in lost earnings, lost productivity, and health care costs.

Diseases of the musculoskeletal system, including arthritis and lower back pain, constitute one of the most common categories of chronic health problems experienced by people in the United States. Physican examination data from the National Health and Nutrition Examination Survey of 1971–75 (NHANES I) indicate that nearly 34.7 million people from 25–75 years of age (32.6 percent) are afflicted with symptoms involving the musculoskeletal system, including joint swelling, tenderness, limitation of motion, and pain during motion (Cunningham and Kelsey, 1984). According to Kelsey (1982), musculoskeletal problems rank first among disease groups in terms of their effect on the quality of life as measured by the magnitude of disability, impairment, handicap, and activity limitation.

Musculoskeletal conditions have been shown to rank second in total annual economic costs, which include health care expenditures and the costs of lost productivity. It has been estimated that musculoskeletal disorders cost the Nation about $20 billion (1972 dollars) annually (Cooper and Rice, 1976). Although musculoskeletal diseases ranked only 10th among disease groups in health care costs in 1972, they ranked 1st in costs attributable to lost earnings and services from nonfatal disease (Kelsey, 1982). Musculoskeletal problems are prevalent among all age groups; however, they are most common, and often most severe, among the elderly. Because the number of elderly persons is expected to increase considerably over the next several decades, the impact of musculoskeletal problems in terms of both demand for health care services and economic costs is expected to become greater.

Knowing the frequency of occurrence and the demographic characteristics of persons with musculoskeletal impairments is an important first step in estimating the health care needs and costs associated with these conditions. National health surveys, such as those conducted periodically by the National Center for Health Statistics (NCHS), provide the data necessary to document the prevalence of musculoskeletal conditions, as well as the extent of disability and the use of medical services attributed to such conditions. Some of these surveys, such as NHANES I and II, are specifically designed for investigating the epidemiology of selected diseases, as well as the demographic characteristics of the population groups most affected. In contrast, data from the 1980 National Medical Care Utilization and Expenditure Survey (NMCUES) are best suited for analyzing the annual use of personal health services and related charges for individuals afflicted with musculoskeletal problems, as well as the magnitude of disability associated with these conditions as many musculoskeletal problems are episodic in nature. These data are more likely to be complete and accurate because they were obtained from a panel survey, which provides for the collection of data at frequent intervals throughout the year, rather than from a cross-sectional survey.

This report is organized as follows. First the scope of the medical conditions is defined, and the NMCUES data and their limitations relevant to this report are described briefly. The next focus is on selected demographic and socioeconomic characteristics of persons with reported musculoskeletal conditions, the influence of these conditions on disability and activity levels, and the costs associated with lost productivity. Patterns of health care utilization, including the use of nonphysician providers, are analyzed, and the cost consequences of musculoskeletal conditions are presented in terms of health care resources. The report concludes with Appendixes I–V, which contain information on the sample design; data collection, modification, and processing; analytical strategies; sampling errors; and definition of terms.

Definition of Condition Categories

The focus of this report is on chronic and acute recurrent musculoskeletal problems involving the joints and adjacent soft tissue and bone. There are both similarities and differences within this wide array of illnesses ranging from the more severely debilitating rheumatoid arthritis to nonspecific and often transient lower back pain. These conditions are similar in that they are not usually the direct cause of death, they are generally chronic in nature, and they are characterized by similar symptoms such as joint pain and swelling. Differences in this heterogeneous group of illnesses include a variability in prognosis and a varying degree of disability associated with each, ranging from little or no interference with daily activities to total incapacitation.

Only musculoskeletal problems that are chronic in nature are included in this report. Consequently, some conditions that are often classified as musculoskeletal problems are excluded. For example, acute traumatic injuries such as fractures, sprains, and dislocations are excluded because utilization patterns and levels of disability generated by these impairments are likely to differ considerably from the more chronic musculoskeletal problems. The chronic sequelae of traumatic injuries, on the other hand, are included in our definition of musculoskeletal problems. Congenital musculoskeletal defects and diseases of the connective tissue are excluded because of their small sample size.

This report examines both musculoskeletal conditions that are classified using the Ninth Revision of the International Classification of Diseases (ICD) (World Health Organization, 1977), as adapted for use with household surveys by the National Health Interview Survey (National Center for Health Statistics, 1979); and conditions classified as impairments. Impairments are classified by means of a special supplementary code used by NCHS rather than by an ICD code. For example, chronic lower back pain, unrelated to a specific disease, is an orthopedic impairment; whereas osteoarthritis is a musculoskeletal disease that is classified using an ICD code. Structural deformities, such as curvature of the spine, also are classified as impairments.

The focus of this report is on relatively broad categories of musculoskeletal disorders, rather than on specific musculoskeletal diseases such as rheumatoid arthritis or osteoarthritis. The principal reason for electing this approach is that with data reported by household informants, such as in NMCUES, there is likely to be a certain amount of nonspecificity and misspecification of reported diseases.

Persons with any musculoskeletal problem included in this analysis are classified into one of the following three mutually exclusive categories:

(1) *Joints only:* Includes only those persons who have one or more musculoskeletal disorders of the joints such as the hip, knee, shoulder, or hand. This category is composed of persons having conditions with ICD–9 codes of 711–719, 725–729, and 735–739, and impairment codes of X73–79 and X84–89.

(2) *Back only:* Includes persons who have only back or spine disorders and no other musculoskeletal problems. This category is composed of persons having a condition with one of the following codes: ICD–9 codes of 720–724 and 737, and impairment codes of X70 and X80.

(3) *Joints and back:* Includes persons having at least one musculoskeletal disorder of the joints in addition to an impairment of the back or spine. Persons included in this group must have at least one code from each of the other two categories.

Joint impairments are separated from disorders of the back or spine so as not to obscure possible differences in patterns of careseeking and disability. Back problems, for example, are responsible for considerable absenteeism in the working population and are a frequent cause of activity limitation for persons under 45 years of age. Because many impairments of the back are occupationally related, preventive strategies that are appropriate for this set of conditions may not be applicable to other musculoskeletal problems. Furthermore, persons with back problems may be more likely to seek care from chiropractors, and this pattern of utilization would remain undetected if all musculoskeletal conditions were grouped into a single category. Designating a separate category for which individuals must have both a joint and a back disorder permits investigation of whether there are cumulative effects in terms of both medical care use and disability for individuals suffering multiple musculoskeletal impairments of the back, as well as of the peripheral joints. Although an argument can be made that multiple joint disorders may also be cumulative in terms of disability and medical care use, the ICD

coding scheme does not allow such a distinction in all cases. Arthritis, for example, may involve multiple joints, but the number of joints and the site are not always recorded.

Sources and Limitations of Data

The National Medical Care Utilization and Expenditure Survey

Data for this study come from the public use files of the National Medical Care Utilization and Expenditure Survey (NMCUES), a national household survey conducted from early 1980 through early 1981. Specific details concerning the sample design and data collection are outlined in Appendix I.

From February 1980 through April 1981, data on 17,123 persons in 6,798 families were collected at approximately 3-month intervals. A total of five interviews, two personal interviews followed by two telephone interviews and a final personal interview, were conducted. At the conclusion of the first interview, survey participants were provided with a specially designed calendar-diary for recording data about medical events and costs in preparation for subsequent rounds of interviewing. Prior to each interview but the first, respondents were sent a summary sheet showing all medical events and costs reported in previous interviews.

Public Use Tapes

NMCUES public use tapes consist of six files: The person, medical visit, dental visit, hospital stay, prescribed medicines and other medical expenses, and condition files. The person file has one record for each of the 17,123 responding eligible persons with data describing the person's demographic characteristics, health care coverage, employment, income, and usual source of care; numbers of visits, hospital admissions, and other medical events reported for 1980; total charges for each category of care; and limitations and disabilities, including identification of conditions. Data from the other five files, which have more detailed information about events summarized in the person file, can be linked to records in the person file through a unique identification number assigned to each person.

The medical visit file contains one record for every visit reported by people in the person file. A total of 86,594 visits are in the file, which includes visits to providers' offices, hospital outpatient departments, and emergency rooms. Each record contains the identifying number of the person making the visit, the place of visit, type of physician or nonphysician seen, type of services provided, conditions causing or associated with the visit, procedures performed during the visit, associated charges, and sources of payment. Similar data on dental visits and hospital admissions are provided in the dental visit and hospital stay files.

The prescribed medicines and other medical expenses file contains one record for each purchase of prescribed medications or other medical expense incurred by survey participants during 1980. Data include the identifying number of the person for whom the purchase was made, date of purchase, prescribed medicine codes, codes for conditions leading to the purchase or other expense, and associated charges and sources of payment.

If a medical condition caused any limitation in a person's activities (such as staying in bed or staying home from work) or caused the person to seek medical care, then a condition record appears in the condition file. For each condition, the condition file record contains the identifying number of the person, codes from International Classification of Diseases (World Health Organization, 1977), dates of onset of illness, counts of visit types, prescribed medicines and other medical expenses, associated charges, and, if applicable, the reasons for not seeing a physician.

Limitations of Data

Estimates of prevalence—In NMCUES, a particular medical condition was noted only when it caused some type of disability or resulted in an ambulatory visit, hospital admission, purchase of a prescribed medication, or other encounter with the health care system. Hence, conditions that usually require treatment or cause some sort of disability will be better reported. In many cases the survey was administered to a household member other than the person with the musculoskeletal problem. Relying on proxy respondents for information regarding the use of medical services and the extent of disability specifically related to musculoskeletal ailments may contribute to an underestimation of these conditions.

Estimates of disability—Obtaining detailed information about the number of disability days associated with each medical condition is complicated by the manner in which the public use files were constructed. For each condition group discussed in this report, the number of associated disability days (restricted-activity days,

bed-disability days, and work-loss days) is of interest. Respondents could report more than one underlying condition for a disability day. It is possible to compute the number of disability days listed for each condition in the condition file, but duplication exists for any days reported as caused by two or more conditions. Also, the structure of the public use files does not permit linkage of a specific disability day with all the associated illnesses. The person file contains an unduplicated count of disability days for each respondent, but no information on conditions causing disability. Therefore, a procedure was devised that would allow estimation of condition-related disability days for persons reporting more than one condition.

Estimation of disability days attributable to a given condition was accomplished by a two-step process. First, for each person, the ratio of the number of disability days in the person file (an unduplicated count) to the total number of disability days in the condition file (a duplicated count) was computed. Second, this ratio was multiplied by the number of disability days listed in the condition file for each medical condition. The result is an estimate of disability days attributable to each condition. The major criticism of this method is that it uniformly reduces the proportion of duplicated days for all conditions. Therefore, variability in actual illness behavior across medical conditions is minimized.

Utilization of health services—For each medical encounter recorded in the survey, respondents could report up to four medical conditions. The public use files show that approximately 10 percent of medical visits have two or more conditions recorded; multiple conditions are listed for about 12 percent of all hospital stays; and 4 percent of the prescribed medication records have two or more conditions recorded.

On one hand, listing multiple conditions on the event record permits analysis of patterns of care-seeking behavior associated with different illnesses. Such data can reveal, for example, whether certain illnesses are generally treated by themselves or are treated along with other conditions during a medical visit or hospitalization.

On the other hand, the NMCUES survey instrument does not designate "principal diagnosis" or primary reason for each medical encounter. Therefore, when multiple diagnoses are reported, it is difficult to attribute health service use to a specific diagnosis. For this report, a condition-related medical service is defined as one for which the respondent identified a musculoskeletal diagnosis as the only or as one of several reasons for seeking medical care.

Direct costs of health services—NMCUES data contain a number of improbably low values of total charges for ambulatory visits, prescribed medications, and hospital stays. In many cases, the reported data may not correspond to the total charges for the service received, but instead may represent out-of-pocket expenses incurred by patients. To the extent that some respondents reported out-of-pocket expenses as total charges for services, estimates of total charges are biased downward.

As previously noted, people are often treated for more than one condition when they seek medical care. As a result, it is difficult to isolate those charges that are specific to a given illness. Thus, for these analyses, condition-related charges are defined as charges for health services for which musculoskeletal conditions were listed as either the only reason or as one of several reasons for seeking care. Because these charges may also reflect the treatment of other conditions, they may overestimate the economic impact of musculoskeletal problems, both for the population as a whole and for individuals suffering with these problems.

Indirect costs—The indirect cost of illness and injury is the loss of resources resulting from them. Resource loss is generally calculated as lost productive capacity: the loss of potential economic output because of morbidity and mortality. Indirect costs are usually estimated on the basis of the amount of time by which the individual's productivity is diminished or lost and the monetary value of that lost productive time.

In calculating the indirect costs of morbidity for 1980, the first necessary calculation is the number of years of productive activity lost by individuals with illness or injury. Because this measure deals with lost productivity, the convention is to count only persons 17 years of age and over who were either working or keeping house at the time of their illness, or who were unable to engage in these activities because of illness or injury. However, persons who were unable to work for health reasons for the entire year are excluded from calculations in this report because no condition was associated with such long-term disability in the NMCUES data files.

The unit for calculation of lost productive time is productive person years. Productive years lost, a nonmonetary measure of morbidity costs, is defined as the number of productive days lost because of illness in a year, divided by the number of productive days in a year. For this report, lost productive time is calculated for all employed persons and homemakers. Persons who were employed at any time in 1980 were classified as employed in the NMCUES data files. Homemakers are defined as persons who were not employed or disabled in 1980 and who claimed "keeping house" as their primary activity in 1979. For employed persons, reported work-loss days are divided by 245, the average number of workdays in a year, to determine productive time lost. In this study, calculations of lost output for homemakers were performed for both bed-disability days and restricted-activity days because the former underestimates lost productivity and the latter overestimates lost productivity. The appropriate denominator to annualize days lost for either of these calculations is 365 because homemakers can perform their work every day of the year. By performing both sets of calculations, a range of lost productivity with upper and lower bounds can be constructed for homemakers. Estimates in this report

are given for the more restrictive unit of measure, bed-disability days, and for restricted-activity days, which yield somewhat higher estimates of lost productivity. Measures of lost productive time for employed individuals and homemakers have been weighted and aggregated to produce national estimates of productive person years for these two population groups.

Estimates of the indirect costs of morbidity are calculated by multiplying an individual's reported work-loss time by his or her reported earnings, when available. Reported earnings do not include employee benefits, so earnings are adjusted by a factor of 1.172 to account for the additional value represented by fringe benefits. The adjustment factor is based on the mean percent of earnings represented by employee benefits (17.2 percent) in 1980 (*Survey of Current Business*, 1981). Lost earnings for employed persons whose earnings were not reported are estimated using U.S. Department of Labor 1980 data for mean annual earnings and are specific to the individual's age, sex, race, and employment status (full or part time). Again, figures are adjusted to include the value of employee benefits. Lost productivity for homemakers, whose labor is not reimbursed, is estimated using the market-value approach. The value of lost homemaker services is approximated by estimating the cost of replacing those services with services purchased in the market. The values employed are derived from time-use studies and relevant wage rates (Hodgson and Rice, 1984; Walker and Gauger, 1973). Details of the estimation procedures including tables of values used to estimate these costs are presented in *The Costs of Illness, United States, 1980*, Appendix V (Parsons et al., 1986).

Prevalence and Demographic Characteristics

Musculoskeletal conditions are frequently cited as among the most common and disabling of the chronic diseases. Data from NMCUES confirm these findings.

Slightly more than 44 million persons, or about 20 percent of the 1980 civilian noninstitutionalized population of the United States, reported having a musculoskeletal problem involving the joints or back, as shown in Table A. Impairment of the knee, hip, shoulder, and other joints was reported for more than 28 million persons (12.8 percent), compared with almost 10.5 million persons reporting disorders of the back (4.7 percent). Only about 2 percent of the population, or about 5 million persons, reported having musculoskeletal disorders of both the joints and back.

Comparison of interview-based prevalence rates with prevalence rates derived from clinical examinations indicates a likelihood that musculoskeletal problems are underreported in NMCUES. For example, only 25 percent of persons 19 years of age and over reported any musculoskeletal disorder in NMCUES. In contrast, data from the 1971–75 NHANES I (a medical examination survey) indicate that approximately 33 percent of civilian noninstitutionalized persons 25–74 years of age had musculoskeletal abnormalities (Cunningham and Kelsey, 1984). Had persons 75 years of age and over been included in NHANES I, this estimate would have undoubtedly been higher.

Age- and sex-specific reported prevalence rates of musculoskeletal disorders based on data from NMCUES are shown in Table 1. The overall prevalence of musculoskeletal impairments was more common among females than males, but the rates varied by site of the impairment. About 14 percent of females reported musculoskeletal problems of the joints compared with approximately 11 percent of males. Disorders of the back, on the other hand, were equally prevalent among both males and females; approximately 5 percent of both sexes reported this musculoskeletal problem. Joint-and-back musculoskeletal impairments were less common, with such combinations reported by about 2 percent of both males and females.

Table A

Number of persons, percent of population, and rate per 1,000 population with selected musculoskeletal conditions, by condition: United States, 1980

Condition	Number of persons in thousands	Percent of population	Rate per 1,000 population
All persons	222,824	100.0	...
All musculoskeletal conditions	[1]44,111	[1]19.8	198.0
Joints only	28,577	12.8	128.3
Back only	10,502	4.7	47.1
Joints and back	5,031	2.3	22.6

[1]Figures may not add to totals because of rounding.

For both males and females, the prevalence rate for musculoskeletal disorders of the joints increased significantly with age. This finding is consistent with the evidence reported elsewhere. Cunningham and Kelsey (1984) found that 16 percent of persons 25–34 years of age reported musculoskeletal symptoms, compared with about 40 percent of persons 65–74 years of age. In NMCUES, disorders of the joints were reported by about 6 percent of both males and females under 19 years of age; whereas the prevalence rates for persons 65 years of age and over rose dramatically to 26 percent for men and about 35 percent for women. The prevalence rate for joint-and-back musculoskeletal impairments increased similarly with age among women. For men, however, this rate peaked at 45–64 years of age. Interestingly, this pattern is repeated for men with only back problems. Prevalence rates peaked at 81.4 per 1,000 population for men 45–64 years of age. However, among women, the rate peaked in the 19–44 years of age category at 64.5 per 1,000 population, dropping to 57.6 among women 45–64 years of age.

It is not altogether surprising that the overall rate for back disorders among middle-age men exceeds the rate observed for women the same age, as a substantial number of back impairments are occupationally related (U.S. Department of Labor, 1978) and a higher proportion of men of this age are employed. The data from NMCUES indicate that approximately 57 percent of women and 82 percent of men 45–64 years of age were employed (Parsons et al., 1986). The rate for back disorders then declines for both men and women 65 years of age and over. The decline in the rate of back disorders among men of this age can be explained in part by

their retirement from the work force. The decline in back problems among older women is more difficult to interpret. One possibility is that a substantially larger percent of older women have joint problems in addition to back problems, thereby reducing the percent of older women with back disorders only (see Table 1).

It is important to note that the age distribution of persons with musculoskeletal disorders differs markedly from the distribution of noninstitutionalized civilian persons in the United States. The age composition of the condition groups, with the exception of back problems, is sharply skewed toward the older age categories. For example, approximately 26 percent of persons with joint impairments are 65 years of age and over compared with 11 percent of the overall population (calculated from data in Tables 1 and 2). A similar pattern is observed for the joint-and-back condition group. Moreover, about 54 percent of persons with musculoskeletal problems of any kind are 45 years of age and over compared with approximately 30 percent of the overall population. Because of the highly skewed nature of the age distribution of this population, rates of disability and utilization of health services that are not age-adjusted may obscure true differences between persons with these medical conditions and the overall population. Consequently, age-specific rates are discussed throughout the report and presented in the detailed tables.

The prevalence rates of musculoskeletal conditions for black persons as well as for white and other persons are summarized in Table 1. It appears that black persons are significantly less likely than are white and other persons to have musculoskeletal problems of all kinds. These findings are generally consistent with the results reported by Cunningham and Kelsey (1984) and the National Health Interview Survey (Wilder, 1973; Feller, 1981), which indicate that white persons were more likely than black persons to report higher rates of arthritis, rheumatism, and other musculoskeletal problems.

Health and Limitation of Activities

Unlike other medical conditions, such as cardiovascular disease and cancer, musculoskeletal conditions are rarely the cause of death. Instead, musculoskeletal diseases are noted for causing a deterioration in the quality of life. These conditions affect the quality of life through increased disability, limited activity, physical pain, and impairment. The NMCUES data permit the analysis of the magnitude of disability and impairment for persons afflicted with musculoskeletal problems. This analysis is done by the use of general indicators of health status and functioning, as well as by specific measures of lost productivity and limitation of activity.

Functional Limitation and Perceived Health Status

Functional limitation scores are presented in Table B; these scores range from 0, indicating no limitation of activity, to 8, indicating severe activity limitation, and to 9, indicating death during the survey period. The functional limitation score was developed from responses to a battery of questions designed to assess ability to perform various common activities such as walking, driving a car, and climbing stairs. In NMCUES, these questions were asked of persons 17 years of age and over.

The distribution of the perceived health status indicator, classified as "excellent," "good," "fair," and "poor," is also summarized in Table B. These data were obtained from the question: "Compared to other persons your age, how would you rate your health?" Perceived health is subjective and reflects not only limitations, pain, and other physical manifestations of disease, but also the person's emotional response to illness. Functional limitation is somewhat more objective, although an individual's level of functioning is almost certainly influenced by attitudinal and emotional factors, as well as any physical disability or disease.

Table B shows the mean functional limitation score for all persons in the United States, as well as for persons in each of the three condition groups. The mean score, or the degree of reported functional limitation, for each of the condition groups is significantly greater than the average score of 1.7 for the total U.S. population. Persons suffering both joint and back disorders have the highest mean score, followed by persons with joint impairments only; the mean score for persons with back problems only is significantly lower. It is important to keep in mind that the age structure of the condition groups, excluding back problems, differs sharply from the age distribution of the overall U.S. population. Thus, the higher mean functional limitation scores of persons with joint or joint-and-back impairments can be attributed in part to the higher percent of older persons afflicted with these conditions.

The functional limitation scores in Table B are generally consistent with respondents' perceptions of their health. More than twice as many persons reporting musculoskeletal problems rated their health as "fair" or

Table B

Mean functional limitation score and percent distribution of all persons and of persons with selected musculoskeletal conditions by perceived health status, according to condition: United States, 1980

Condition	Mean functional limitation score[1]	Perceived health status				
		Total[2]	Excellent	Good	Fair	Poor
		Percent distribution				
All persons	1.7	100.0	50.1	36.9	9.3	3.6
All musculoskeletal conditions	2.6	100.0	31.9	39.9	17.9	10.2
Joints only	2.7	100.0	32.3	38.9	18.1	10.7
Back only	2.0	100.0	37.1	43.4	13.7	5.8
Joints and back	3.0	100.0	19.3	38.3	25.6	16.9

[1]Functional limitation is computed only for persons 17 years of age and over.
[2]Figures may not add to totals because of rounding.

"poor" (about 28 percent) as did the overall U.S. population (about 13 percent). The condition group with the highest functional limitation score, joint-and-back disorders, also had the highest proportion of persons (42.5 percent) describing their health as "fair" or "poor." Approximately 17 percent of these persons rated their health as "poor," compared with about 4 percent of the total U.S. population. A greater proportion of persons with joint impairments described themselves as being in "fair" or "poor" health (28.8 percent) than did persons with back problems (19.5 percent). Because respondents were asked to compare their health to that of other persons their age for perceived health status, this health indicator is implicitly age-adjusted and should not be influenced by the age distribution of persons within each condition category.

Functional limitation scores and respondents' perceptions of health for selected age categories, for males and for females in each condition group, as well as by race, are displayed in Table 2. The data indicate that males and females were similar in their mean functional limitation scores. This pattern is observed, not only in the overall population, but in each of the condition groups as well. In those groups in which there were differences by sex, the differences were small and not significant. The findings for perceived health status are consistent with the pattern seen for functional limitation score; in each condition group, similar proportions of males and females rated their health as either "fair" or "poor."

Table 2 also shows that the mean functional limitation score increased with age for both males and females in the total U.S. population, and that this was generally true in each of the condition groups as well. For persons with disorders of the joints and with joint-and-back impairments, a significantly higher percent of both males and females in most age categories rated their health as "fair" or "poor" compared with persons of the same age and sex in the total U.S. population. The same held for males with back problems, although the differences were not so great. However, females in each age category with back problems have perceived health status ratings that closely resemble those of the total U.S. population.

Black persons in each condition group generally had slightly higher functional limitation scores than did white and other persons (Table 2), although these differences are not statistically significant. Health perceptions, on the other hand, showed a distinctly different pattern. For all musculoskeletal conditions, a significantly higher percent of the black population rated their health as "fair" or "poor" (39.7 percent) compared with white and other races (26.9 percent). The racial difference was more pronounced among those rating their health "poor," where the proportion of black persons was twice that of white and other races.

Disability Days and Condition-Related Disability

Selected measures of productivity and limitation of activity may also be used to assess the health of individuals suffering musculoskeletal problems. The mean bed-disability days measure is based on responses to: "How many days did illness or injury keep [you] in bed all or most of the day?" Mean work-loss days reflect responses to the question: "How many days did illness or injury keep [you] from work all or most of the day?" A restricted-activity day is defined as one during which, because of illness or injury, the respondent stayed home from work, spent all or most of the day in bed, or cut down on usual activities.

Persons with musculoskeletal problems of any kind tended to be less healthy than other persons in the United States (Figure 1). Persons with some form of musculoskeletal disorder represented about 20 percent of the total population; yet they accounted for nearly 43 percent of all restricted-activity days, about 35 percent of the days spent in bed because of illness, and more than 38 percent of all work-loss days for employed persons.

This same pattern held in each condition category (Table C). For example, persons with joint-and-back musculoskeletal disorders accounted for 6 percent of all bed-disability days, yet they represented only 2.3 percent of the U.S. population. Similarly, persons with joint disorders accounted for about 13 percent of the U.S. population, yet approximately 23 percent of all bed-disability days were attributed to this group. Al-

Figure 1

Total and condition-related disability days for persons with selected musculoskeletal conditions: United States, 1980

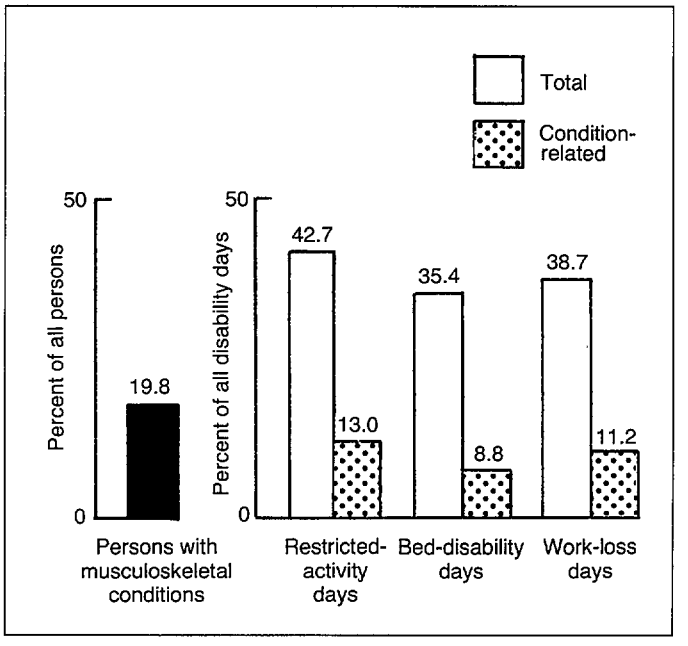


Table C

Percent distribution of total and condition-related disability days for persons with selected musculoskeletal conditions by type of disability day, according to condition: United States, 1980

Condition	Restricted-activity days	Bed-disability days	Work-loss days
		Total	
All persons	100.0	100.0	100.0
All musculoskeletal conditions	42.7	35.4	38.7
Joints only	27.4	22.7	22.8
Back only	8.3	6.7	11.0
Joints and back	7.0	6.0	4.9
		Condition-related	
All musculoskeletal conditions	13.0	8.8	11.2
Joints only	8.0	4.9	5.9
Back only	2.3	1.7	3.4
Joints and back	2.8	2.2	1.8

though these data show that persons with musculoskeletal problems tend to be less healthy and have higher levels of disability compared with other persons in the civilian noninstitutionalized U.S. population, they do not indicate the direct impact of musculoskeletal conditions on health and functional ability.

The direct influence of musculoskeletal problems on levels of activity and productivity can be estimated by focusing on condition-related disability. "Condition-related" disability days include days for which the respondent listed a musculoskeletal problem either as the only cause or as one of several causes for staying home from work, cutting down on usual activities, or staying in bed. The estimation process used to approximate condition-related disability is described in "Sources and Limitations of Data."

Of all restricted-activity days reported by the total U.S. population, 13 percent were directly attributable to musculoskeletal problems (Figure 1). Musculoskeletal disorders accounted directly for about 11 percent of all work-loss days, or nearly 63 million days, and approximately 9 percent of all bed-disability days.

The disabling effects of musculoskeletal problems on individuals reporting one or more of these conditions are presented in Figure 2. Data for restricted-activity days, bed-disability days, and work-loss days show the mean of the total number of such days, as well as the mean number of condition-related days experienced by individuals in each of the condition categories and for all musculoskeletal conditions combined.

The mean total restricted-activity days, work-loss days, and bed-disability days for persons suffering from any musculoskeletal disorder were significantly greater than those for the total U.S. population (Figure 2). For example, the mean number of bed-disability days per year for the U.S. population was 5.2 compared with 9.2 days for persons with any kind of musculoskeletal problem. Furthermore, the data indicate that a considerable portion of this difference is directly attributable to musculoskeletal problems. Musculoskeletal problems accounted for one-quarter to more than one-third of all restricted-activity days, bed-disability days, and work-loss days for persons having these conditions.

Impairments of both the joints and back affected productivity and activity levels more than the disorders of either one singly (Figure 2). Persons in this category stayed home in bed, on average, 5 days during the year because of their joint-and-back problems. This represented approximately 36 percent of the mean total bed-disability days for this group. In contrast, mean condition-related bed-disability days approximated 22 percent and 26 percent of mean total bed-disability days for impairments of the joints and of the back, respectively. The same pattern was seen for restricted-activity days and work-loss days as well.

If mean condition-related days (Figure 2) are subtracted from mean total days, the remaining days for persons with joint and with joint-and-back impairments presumably should not be directly related to musculoskeletal problems. However, these remaining days were still significantly greater than the mean total days for the U.S. population. This finding suggests that persons with these musculoskeletal problems have poorer health than the U.S. population as a whole, perhaps because of a variety of illnesses. Persons with back problems appeared to be only moderately worse off than the overall population.

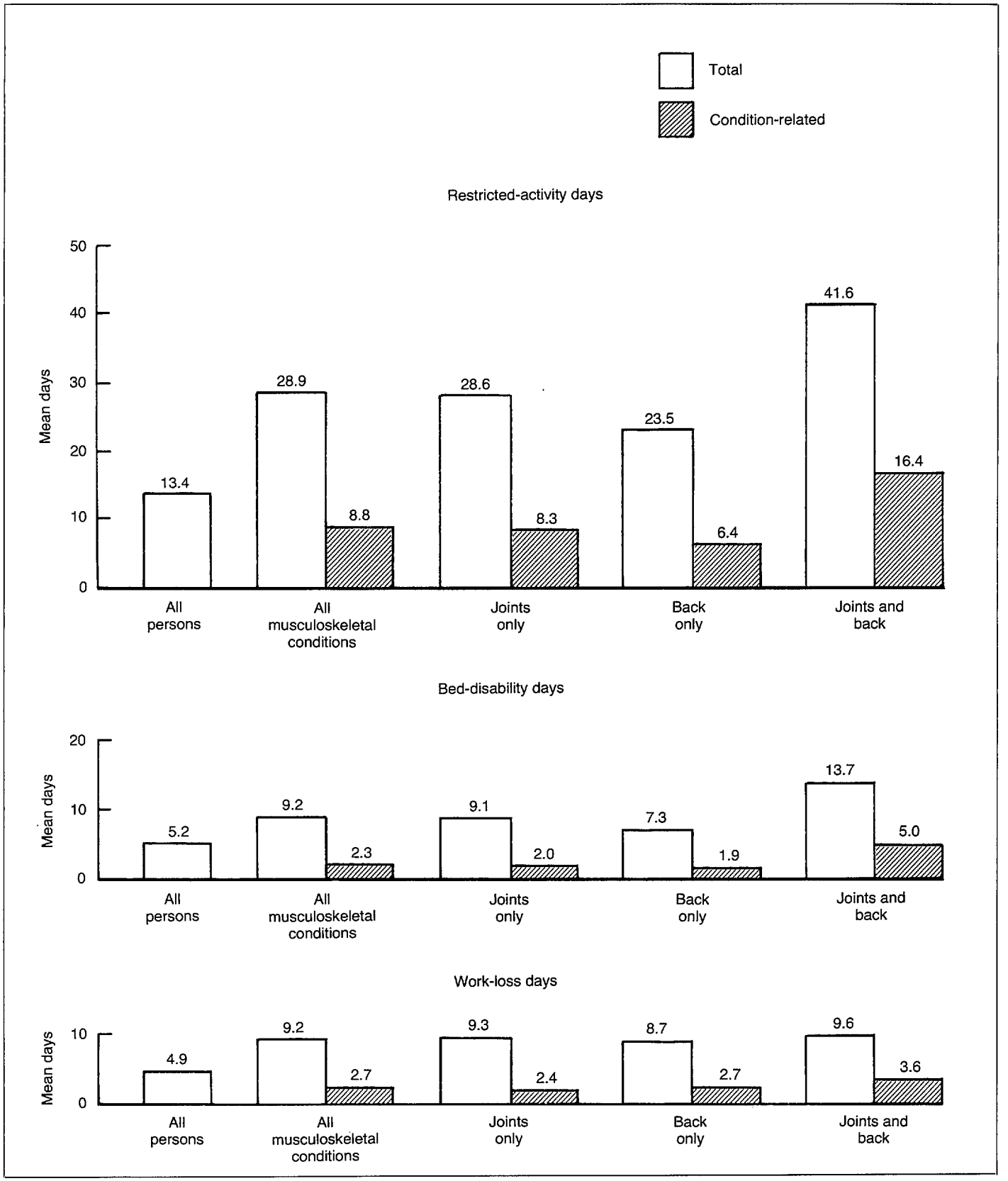
In the previous discussion on prevalence, it was shown that there are distinct age, sex, and racial patterns associated with each of the three categories of musculoskeletal problems. To analyze in greater detail the impact of these conditions on the individuals suffering with these problems, productivity and activity indicators according to selected demographic characteristics are presented in Table 3.

Mean condition-related disability days for each condition group by age for males and for females and by race are shown in Table 3. Females with musculoskeletal problems generally reported more condition-related restricted-activity days and bed-disability days than did males. Among employed persons with musculoskeletal problems, men reported a higher number of condition-related work-loss days than did women, except for back problems, for which women reported, on average, 4.1 days, compared with 1.5 for men.

It is interesting to note that not only did employed women with back problems report, on average, more condition-related work-loss days than did men, but that their condition-related work-loss days represented a higher proportion of total work-loss days (Table 3). Approximately 39 percent of all work-loss days for women in this condition group were condition-related, compared with 21 percent for men.

Figure 2

Mean disability days for all persons and for persons with selected musculoskeletal conditions: United States, 1980



Data in Table 3 show that age made a difference in the mean number of condition-related disability days reported by both males and females. Condition-related bed-disability days and restricted-activity days generally increased with age for persons with any type of musculoskeletal problem. This was not the case, however, for condition-related work-loss days. Men and women 65 years of age and over reported, on average, fewer condition-related work-loss days than did employed persons 19–64 years of age. There are several possible explanations, principally, (1) the labor force participation rates of those 65 years of age and over are lower than those for persons 19–64 years of age and only the healthiest people in the older age group are still working; and (2) employed people in the younger age categories represent a broader cross-section of health.

Productivity effects and activity level differences between the black and the white and other races are also shown in Table 3. For all three condition groups, black persons tended to have a greater number of condition-related restricted-activity days, bed-disability days, and work-loss days than did white and other persons. Musculoskeletal problems also accounted for a larger proportion of condition-related disability days among black persons than among white and other persons. This difference is most striking for condition-related work-loss days. Among black persons, 55.8 percent of all work-loss days were attributable to some type of musculoskeletal problem, compared with 23.5 percent among white and other persons. This difference probably reflects the higher proportion of black persons in occupations involving physical labor.

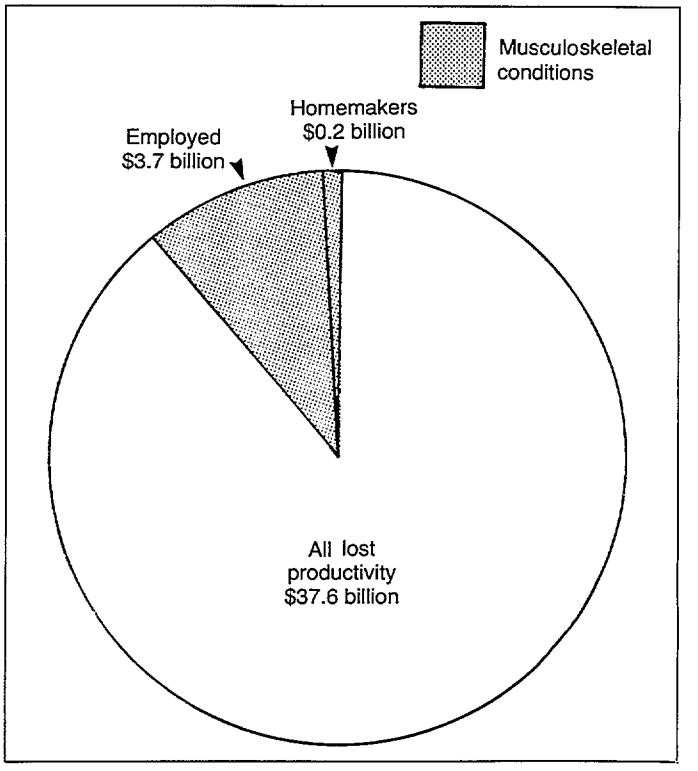
Indirect Costs of Morbidity

The results above suggest that musculoskeletal problems can seriously hamper the ability of persons to carry out their normal daily activities and to engage in work. These findings are consistent with evidence reported in the literature describing work disability and the costs of productive time lost as a result of musculoskeletal impairments (morbidity costs). Arthritis, for example, is reportedly one of the leading causes of work disability. Musculoskeletal conditions are second only to cardiovascular problems in terms of the justification for Social Security grants (Yelin, Nevitt, and Epstein, 1980); they are also second only to skin disorders in the number of applications for workers' compensation (U.S. Department of Labor, 1978).

The NMCUES data indicate that the disabling effects of musculoskeletal problems result in serious economic consequences for society. Figure 3 shows that the morbidity costs for homemakers unable to carry out their daily activities approximated $0.2 billion and the morbidity costs for employed persons with loss of work-days because of their musculoskeletal problems amounted to nearly $3.7 billion. Together, they accounted for a total of $3.9 billion in lost productivity costs during 1980

Figure 3

All lost productivity, and lost productivity attributed to selected musculoskeletal conditions, for employed persons and homemakers: United States, 1980



alone. This represents 10.5 percent of the $37.6 billion in aggregate morbidity costs associated with productive time lost as a result of illnesses of any kind among employed persons and homemakers according to data from NMCUES (Parsons et al., 1986). (The productive time lost because of musculoskeletal conditions for persons reporting their occupation as homemaker is measured using bed-disability days. For persons in the work force, lost productivity is measured using work-loss days. The methods employed in the calculation of the indirect costs of morbidity are summarized in "Sources and Limitations of Data.")

Although the morbidity costs of $3.9 billion are certainly substantial, it is important to keep in mind that this estimate does not include the monetary value of lost productive years for those totally unable to work because of their musculoskeletal impairments. NMCUES respondents were not asked to give a medical reason for not working during 1980. Given the degree of activity limitation and impairment associated with these conditions, there are probably a considerable number of persons who cannot work because of their musculoskeletal problems; their morbidity costs undoubtedly would add a substantial sum to total morbidity costs for musculoskeletal problems. By way of comparison, those unable to work for health reasons of any kind represented 5.5 percent of the total population "at risk" for lost productivity, yet they accounted for 64.2 percent of all morbidity costs ($67 billion) in the United States during 1980 (Parsons et al., 1986).

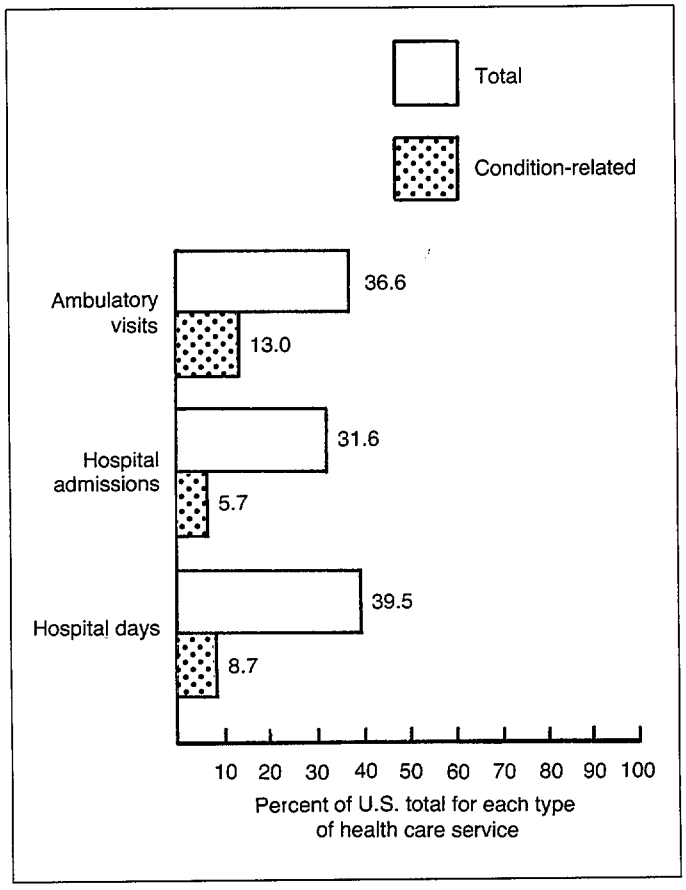
Utilization of Health Services

Utilization data from NMCUES permit the analysis of the volume of health services used in the treatment of musculoskeletal problems. NMCUES respondents identified up to four medical conditions for which medical services were received for each type of utilization (ambulatory visit, hospital admission, or medication). A condition-related medical service in these analyses is defined as one for which the respondent identified a musculoskeletal diagnosis as either the only reason or as one of several reasons for seeking medical care. Not-condition-related services are defined as those for which none of the musculoskeletal diagnoses was listed.

These data show that persons with musculoskeletal conditions consume a sizable proportion of our Nation's health care resources. Although they represent about 20 percent of the civilian noninstitutionalized U.S. population, they accounted for about 37 percent of all ambulatory visits, 32 percent of all hospital admissions, and 40 percent of all hospital days during 1980 (Figure 4). Furthermore, a considerable proportion of total resources in the U.S. health care system was devoted to the diagnosis and treatment of musculoskeletal conditions, 13 percent of all ambulatory visits, and nearly 9 percent of all acute hospital days.

Figure 4

Total and condition-related ambulatory and hospital services for persons with selected musculoskeletal conditions: United States, 1980



Ambulatory Care

Utilization data presented on a per capita basis permit assessment of the health care effects of musculoskeletal conditions from the perspective of the individual. The average number of condition- and not-condition-related ambulatory visits for persons in each of the condition groups is shown in Table D. Ambulatory visits include visits to physicians' offices, hospital outpatient departments, clinics, and the offices of other health service providers, such as podiatrists and chiropractors.

Table D shows that persons with different types of musculoskeletal problems varied considerably in the number and percent of ambulatory visits that were condition-related. For example, more than 51 percent of visits among persons with joint-and-back impairments were attributed to the treatment of these conditions compared with 28 percent for joints and 44 percent for backs. Persons with joint-and-back disorders also made a significantly greater number of condition-related visits than those in the two other condition groups, an average of 7.1 condition-related visits, which is between two and three times the mean number for the other two groups.

The mean numbers of condition-related visits and total visits by age, sex, and race for persons in each of the condition categories and in the total U.S. population are shown in Table 4. For condition-related visits, sex does not appear to be a significant source of differences in the use of ambulatory services for persons in any of the three condition categories. This is generally true for each age by sex category as well. It is important to note, however, that this pattern did not hold for total visits. For each of the three condition groups, females

Table D

Mean ambulatory visits and percent of total visits for persons with selected musculoskeletal conditions, by type of visit and condition: United States, 1980

Condition	Mean total visits	Condition related		Not condition related	
		Mean visits	Percent of total visits	Mean visits	Percent of total visits
All musculoskeletal conditions	9.5	3.4	35.6	6.1	64.4
Joints only	9.2	2.6	28.4	6.6	71.6
Back only	8.5	3.8	44.5	4.7	55.5
Joints and back	13.8	7.1	51.3	6.7	48.7

reported a significantly higher number of visits for all illnesses than did males. This latter finding is consistent with sex differences in the use of ambulatory services for the total U.S. population (Table 4), which has been well documented (Cleary, Mechanic, and Greenley, 1982; Verbrugge, 1979).

Condition-related visits for persons with musculoskeletal conditions of all kinds also did not vary by race. The overall mean number of condition-related visits for black persons was 3.8 and for white and other persons, 3.4. This same pattern held for each individual condition group as well.

Although Table D provides the mean number of condition-related visits for persons with musculoskeletal problems, it does not provide the actual distribution of these visits—that is, the percent of persons making no visits or the proportion of persons who can be considered "high users." Table E shows the cumulative percent of persons making condition-related visits for each of the condition groups.

A striking finding is that a substantial percent of persons in each condition group made no condition-related visits at all. Among persons with any musculoskeletal condition, approximately 33 percent used no ambulatory services. Among the condition categories of the joints and of the back, the percent of persons making no visits was not significantly different. However, the proportion of persons with joint-and-back problems having no visits was significantly lower than the other two groups. It is also interesting to note the proportion of persons in each group who were "high users" of ambulatory services. Among persons with joint-and-back problems, about 20 percent reported more than 10 visits for treatment of their musculoskeletal condition, compared with 4 percent and 10 percent for individuals with joint and with back conditions, respectively.

Musculoskeletal conditions are somewhat different from many other illnesses because their treatment is within the professional domain of several types of health providers. For example, back problems, as well as most joint disorders, are treated by physicians, physical therapists, and chiropractors. Another example of nonphysician providers who treat selected musculoskeletal conditions is podiatrists. The frequency with which people seek care from physicians, as well as from nonphysician providers, for the diagnosis and treatment of their musculoskeletal problems is shown in Table 5. Persons with back disorders were less likely to seek care from physicians for the treatment of their problem than were persons in the other two groups. Only 40 percent of persons with back impairments were treated by physicians, compared with 59 percent and 65 percent for persons with joint and with joint-and-back impairments, respectively. The amount of care rendered by nonphysician providers for treating musculoskeletal conditions is considerable, particularly among persons with back problems or joint-and-back impairment. Approximately 30 percent of persons with any kind of back disorder received treatment for their condition from a chiropractor, compared with 4 percent of persons with joint ailments only.

The use of physician and nonphysician providers

Table E

Mean condition-related ambulatory visits and cumulative percent of condition-related visits for persons with selected musculoskeletal conditions, by condition: United States, 1980

Condition	Mean condition-related visits	Mean condition-related visits for persons with 1 or more visits	Cumulative percent of population with condition-related visits less than or equal to—						
			0	1	2	3	4	5	6–10
All musculoskeletal conditions	3.4	5.1	32.8	58.2	70.5	77.5	82.1	85.0	92.8
Joints only	2.6	4.0	34.7	62.6	75.2	82.5	86.9	89.5	96.0
Back only	3.8	5.7	33.6	58.0	68.3	74.5	78.6	81.6	90.0
Joints and back	7.1	8.9	20.3	33.0	48.2	55.3	62.6	66.8	80.5

for the treatment of musculoskeletal problems by selected demographic characteristics is also shown in Table 5. Several of the findings warrant emphasis.

Within each condition group, there did not appear to be significant differences in the percents of males and females who seek care from each type of provider listed in Table 5. The same pattern held for most age categories for both males and females. Black persons with back problems showed a somewhat different pattern of utilization of physician and nonphysician services compared with white and other persons who had similar ailments. A significantly higher percent of black persons sought care from a physician (53.9 percent) than did white and other persons (39.1 percent). Conversely, white and other persons were significantly more likely to receive treatment from a chiropractor. This difference was not observed for joint-and-back problems, where the use of chiropractic services by both black and white and other persons was relatively high overall.

The frequent use of ambulatory services for treating musculoskeletal conditions can be attributed to the chronic pain and discomfort associated with these illnesses and the therapeutic methods that are employed by an array of providers. Therapies that are commonly used to treat the disabling symptoms of musculoskeletal problems include physical therapy, medication, and chiropractic manipulation. Implicit in some of these regimens, such as physical therapy and chiropractic manipulation, is the requirement of multiple visits.

Among persons who sought ambulatory services for treating their musculoskeletal problem, the mean number of such visits was 5.1; however, the number of visits differed significantly by type of provider (Table F). Physicians consistently provided fewer services for treating musculoskeletal conditions, on average, than did the other providers. Among persons with joint disorders, for example, the mean number of condition-related physician visits for persons seeking care was 2.6, compared with 7.7 for chiropractors, 3.3 for podiatrists, and 6.1 for other nonphysician providers. Similarly, the mean numbers of physician visits for persons with back problems and with joint-and-back disorders were 2.8 and 4.0, respectively, compared with 8.2 and 10.1 chiropractic visits for persons in the other two groups.

The extent of overlap in terms of the therapy offered by physicians and other health providers for treating musculoskeletal problems raises the question of whether nonphysician care is used to supplement or to substitute for physician services. Some insight may be provided by examining the relationship of the use of nonphysician providers to the frequency of physician visits. Table G shows the percent of persons receiving services for their musculoskeletal problem from a nonphysician provider, and the mean number of visits to these providers according to the number of physician visits made for the same medical problem. The data appear to raise questions about the role of nonphysician providers in the substitution or supplementation of physician services. (For general information about the use of nonphysician providers as reported by NMCUES participants, see Mugge, 1984, and Mugge, 1986.)

The data in Table G clearly show that a substantial number of persons who did not seek care from a physician did, in fact, receive services from other providers for their musculoskeletal problems. The proportion of persons who followed this pattern ranged from about 16 percent for persons with joint problems to approximately 44 percent for persons with back problems.

Moreover, the mean number of visits to nonphysician providers according to the number of physician visits made (Table G) also suggests that people are supplementing physician care with the services of other providers. The most striking example is the category of joint disorders. The mean number of condition-related visits to nonphysician providers was 0.5 for persons making one physician visit, increasing to 1.1 visits for two to four physician visits, and to 3.4 visits for persons making five or more condition-related physician visits. In those instances where visits are made to both physicians and nonphysicians for the same musculoskeletal problem, it is not possible to determine from the data whether these visits were initiated by the patient or resulted from a physician or other professional referral. For example, physicians may provide diagnostic services and perhaps drug therapy to persons with musculoskeletal problems and also refer these patients to physical therapists for physical therapy. In other cases, patients may not only initiate visits with physicians, but with nonphysicians

Table F

Mean condition-related visits for persons with selected musculoskeletal conditions who made 1 or more condition-related ambulatory visits, by provider and condition: United States, 1980

Condition	Mean condition-related visits for users				
	Any provider[1]	Physician	Chiropractor	Podiatrist	Other nonphysician provider[2]
All musculoskeletal conditions . . .	5.1	2.8	8.5	3.4	6.0
Joints only	4.0	2.6	7.7	3.3	6.1
Back only	5.7	2.8	8.2	–	2.9
Joints and back	8.9	4.0	10.1	4.1	8.7

[1]Categories do not add to total because of multiple responses.
[2]Includes optometrists, psychologists, social workers, nurses, physical therapists, and others.

Table G

Percent of persons with selected musculoskeletal conditions who made condition-related ambulatory visits to nonphysicians, and mean condition-related visits, by number of physician visits and condition: United States, 1980

Condition	0 physician visits		1 physician visit		2–4 physician visits		5 or more physician visits	
	Percent with non-physician visit	Mean non-physician visits	Percent with non-physician visit	Mean non-physician visits	Percent with non-physician visit	Mean non-physician visits	Percent with non-physician visit	Mean non-physician visits
All musculoskeletal conditions	26.9	2.1	15.2	1.1	25.5	1.4	36.8	4.1
Joints only	15.9	1.1	11.0	0.5	21.1	1.1	30.4	3.4
Back only	43.5	3.3	17.7	1.4	33.2	1.6	41.4	3.9
Joints and back	42.1	4.7	47.0	5.4	36.5	2.7	50.5	6.0

as well. Furthermore, because the services provided by some of the nonphysician providers differ from those provided by physicians, it cannot be determined from these data whether nonphysician provider services actually supplement or substitute for a physician visit in terms of therapy.

Hospital Care

Utilization rates of hospital inpatient services are summarized for persons with musculoskeletal problems in Table H. Although the condition-related hospital admission rates of 48.1 and 31.1 admissions per 1,000 population represented about 16 and 18 percent of total admissions for persons with back and with joint problems, respectively, the percent was significantly higher for persons with joint-and-back impairments. Approximately 30 percent of all admissions for persons in this category were for treatment of their musculoskeletal ailments. Condition-related hospital days represented a significantly lower percent of total hospital days for persons with joint disorders (20.3 percent) compared with those with back problems (26.8 percent) and joint-and-back problems (26.6).

Differences in hospital utilization by sex, age, and race are displayed in Table 4. Among persons with joint impairments, males had significantly more condition-related admissions and hospital days than did females. For both males and females with joint problems, condition-related hospital days increased with age. Among persons in each of the three condition groups, there was no significant difference in condition-related admission rates for males and for females. Among both males and females with joint-and-back disorders, hospital admission rates declined with increasing age. There were too few hospital admissions for persons with back problems to detect any consistent trends in admission rates for both males and females. Although condition-related admissions increased with age among males with joint disorders, this pattern did not hold for females in this group.

The most notable difference in the use of hospital inpatient services occurs between black persons and white and other persons. For persons with musculoskeletal conditions of all kinds, the black population had almost twice the number of condition-related admissions per 1,000 population as for the white and other population, 84 compared with 47. This pattern held for all three condition groups. This magnitude of difference was not seen in the hospital admission rates for all illnesses. It should be kept in mind, however, that the relatively small numbers of black persons represented in these condition groups, particularly the number who are hospitalized, prevent the confirmation of the statistical significance of these differences. Such difficulties notwithstanding, the direction of these racial differences is consistent with the comparatively poorer health status reported by black persons in NMCUES.

Table H

Condition-related hospital utilization for persons with selected musculoskeletal conditions, by condition: United States, 1980

Condition	Condition-related hospital admissions		Condition-related hospital days	
	Rate per 1,000 population	Percent of total admissions	Rate per 1,000 population	Percent of total hospital days
All musculoskeletal conditions	50.6	18.1	536.6	22.1
Joints only	48.1	15.7	546.0	20.3
Back only	31.1	17.9	357.9	26.8
Joints and back	105.8	30.2	856.9	26.6

Health Care Charges

Persons with musculoskeletal problems accounted for a substantial proportion of the Nation's health care costs (Table J). This group represents about 20 percent of the U.S. civilian noninstitutionalized population, yet it incurred approximately 36 percent of the Nation's total estimated health care charges. Charges for persons with back problems were slightly greater than would be expected, given this group's proportion of the population. On the other hand, persons with joint disorders and with joint-and-back problems generated charges two times greater than would be expected given their population proportions.

Charges related to the treatment of musculoskeletal conditions accounted for about 8 percent of the total health care bill. This is lower than the 14 percent of charges incurred in the treatment of hypertension and cardiovascular disease (Thomas et al., to be published), yet it is more than double the 3.5 percent of total charges spent on the treatment of acute respiratory illnesses (Harlan et al., to be published). NMCUES data for 1980 show that musculoskeletal problems ranked third in terms of civilian noninstitutional health care charges, in comparison with their 1972 ranking of 10 (Cooper and Rice, 1976). This difference in ranking is attributable in large part to variability in the sources of data. The NMCUES charge data are charges reported by survey respondents as incurred during 1980; the estimates of 1972 health care expenditures are derived from provider sources.

Table J

Total charges and condition-related charges for persons with selected musculoskeletal conditions, by condition: United States, 1980

Condition	Charges in millions	Percent[1]
	Total	
All musculoskeletal conditions	$55,796	36.3
Joints only	39,060	25.4
Back only	9,022	5.9
Joints and back	7,714	5.0
	Condition-related	
All musculoskeletal conditions	12,480	8.1
Joints only	8,165	5.3
Back only	2,046	1.3
Joints and back	2,270	1.5

[1]Percent of estimated total health care charges for U.S. civilian noninstitutionalized population in 1980.

The allocation of health care resources for the civilian noninstitutionalized U.S. population, as measured by dollar charges, and the allocation of condition-related charges for persons with musculoskeletal problems are shown in Figure 5. Condition-related charges are defined as charges for health services for which musculoskeletal conditions were listed either as the only reason or as one of several reasons for seeking care. (See "Sources and Limitations of Data" for further information about estimation of total and condition-related charges.) It appears that the allocation of health care resources for treating all musculoskeletal problems differs significantly from the distribution of resources for treating all illnesses in the total population.

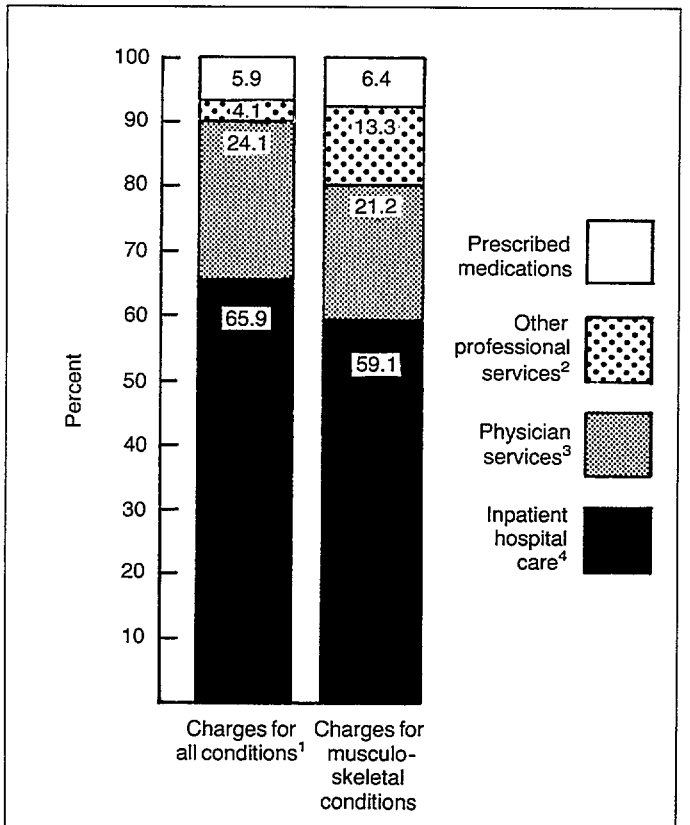
Charges for inpatient care incurred by persons with musculoskeletal problems in connection with their condition represented a significantly smaller percent of their total condition-related health care charges than did inpatient charges incurred for all conditions by the population as a whole. On the other hand, a significantly greater proportion of charges for musculoskeletal problems was generated for ambulatory services rendered by physicians, chiropractors, podiatrists, and other health care providers. Approximately 35 percent of all condition-related charges were attributable to ambulatory visits compared with 28 percent of all-conditions charges for the total U.S. population. Prescription drugs accounted for about 6 percent of total health care charges as well as 6 percent of charges incurred in the treatment of musculoskeletal problems.

Inspection of Table 6 indicates, however, that the three individual musculoskeletal groups were distinctly different from each other, as well as from the overall U.S. population, with respect to the distribution of charges. These differences are obscured when all musculoskeletal problems are combined in a single category.

Persons with back problems have a significantly lower percent of their condition-related health care charges generated by hospital inpatient care, compared with the other two condition groups and the U.S. population, about 42 percent versus 65 percent for joint conditions and approximately 52 percent for joint-and-back

Figure 5

Percent distributions of health care charges for all conditions and for selected musculoskeletal conditions, by type of health service: United States, 1980



[1]Excludes charges for dental services and other medical services (eyeglasses, orthopedic appliances, hearing aids, ambulance services, and diabetic supplies). Inclusion of charges for these types would distort the comparison between the distributions of total charges and condition-related charges because of the low percent of these charges that were condition related.
[2]Includes chiropractors, podiatrists, social workers, nurses, physical therapists, and others, as well as emergency room services.
[3]Includes physician office visits and other outpatient physician services.
[4]Includes inpatient physician services.

problems. These percents can be contrasted with the 66 percent of charges attributable to hospital care for the civilian noninstitutionalized U.S. population (Figure 5). Perhaps the most interesting financial phenomenon for the category of back disorders is the large percent of charges attributable to services rendered by providers other than physicians. Approximately 29 percent of all condition-related charges for back problems were attributable to nonphysician services, significantly higher than that for the other two condition groups and for the total U.S. population. This difference was largely accounted for by the greater use of chiropractic services for back problems than for joint disorders.

The more frequent use of hospital services, as measured by hospital admissions and hospital days per 1,000 population, among persons with joint-and-back problems compared with joint problems might lead one to expect that the proportion of charges attributable to hospital care would be highest for the joint-and-back group. This is not the case, however, because persons with joint-and-back disorders also used significantly more ambulatory care than did persons suffering joint impairments (Table 4). This caused the distribution of condition-related charges for persons with joint-and-back impairments to shift toward services other than inpatient hospital care.

The issue of who shoulders the burden of paying for the treatment of musculoskeletal problems is of considerable interest to policy-makers. Figure 6 shows the percent distribution of charges for the treatment of musculoskeletal conditions by source of payment. The data clearly indicate that private payers, which include Blue Cross, Blue Shield, and the commercial insurance companies, among others, paid the greatest share of charges associated with the diagnosis and treatment of musculoskeletal ailments, nearly 42 percent. Out-of-pocket expenditures represented the second largest proportion of total condition-related charges.

Given the age distribution of persons suffering with musculoskeletal problems of any kind, it is not surprising that about 17 percent of all charges associated with these conditions were paid for by Medicare. Inspection of Medicare expenditures during 1980, however, casts a different light on the economic importance of musculoskeletal conditions to the Medicare program. Of the $27 billion attributed to Medicare by NMCUES data during 1980, about 7 percent was generated by the treatment of musculoskeletal conditions. In contrast, hypertension and cardiovascular disease accounted for approximately 25 percent of all Medicare charges reported in NMCUES (Harlan et al., to be published).

Health care charges expressed on a per capita basis provide some indication of the economic impact of musculoskeletal conditions on the individual. For persons

Figure 6

Charges and percent distribution of charges for treatment of musculoskeletal conditions, by source of payment: United States, 1980

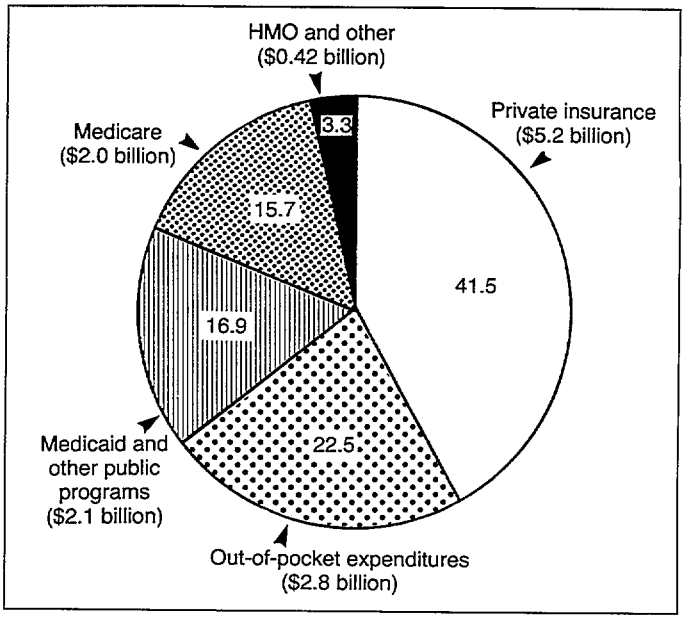


Table K

Condition-related per capita charges and percent of charges paid out of pocket for persons with selected musculoskeletal conditions, by type of health service and condition: United States, 1980

Condition	All health services		Hospital admissions		Prescribed medications		Ambulatory visits		Dental and other medical services	
	Per capita	Percent out of pocket	Per capita	Percent out of pocket	Per capita	Percent out of pocket	Per capita	Percent out of pocket	Per capita	Percent out of pocket
All musculoskeletal conditions	$283	22.7	$164	11.9	$18	58.5	$96	32.6	$6	56.7
Joints only	286	21.7	184	12.2	20	59.5	77	31.6	5	66.9
Back only	195	24.7	78	8.9	7	45.2	101	34.7	8	34.3
Joints and back	451	24.5	231	12.5	28	61.5	188	32.4	5	76.9

with any musculoskeletal disorder, per capita condition-related charges were $283 (Table K). Compared with persons having joint impairments or joint-and-back disorders, persons with back problems had, on average, significantly lower condition-related charges. These lower charges reflect the lesser likelihood of being hospitalized for a back problem. Not surprisingly, per capita condition-related charges were highest for persons with joint-and-back impairments; in fact, their per capita charge of $451 was more than twice that ($195) for persons with back problems. This finding is consistent with the higher utilization rates of health services for this group, noted previously.

It is well documented that health care charges are relatively low among the young and gradually increase with age (Donabedian, Axelrod, and Wyszewianski, 1980). The data in Table 7, which show per capita condition-related charges by age, sex, and race for each of the three condition groups, provide additional confirmation. Condition-related health service charges do not differ significantly between males and females in each of the condition groups. There do not appear to be significant differences in condition-related per capita charges between black persons and white and other races for all three condition groups.

To examine whether condition-related charges are disproportionally distributed among persons having musculoskeletal conditions, consider the data in Table L, which shows the cumulative percent distribution of condition-related charges for each condition group. The data indicate that for the majority of individuals afflicted with these disorders, the economic burden is relatively small. Approximately 69 percent of persons with any kind of musculoskeletal ailment had charges of $100 or less for care for their condition. In fact, about 24 percent had no charges specifically for the treatment of their musculoskeletal problems.

Given the high utilization rates of all health services among persons with joint-and-back disorders, it is not unexpected that persons in this condition group generated a disproportionate share of charges, compared with people in the other two groups. Only 47 percent of persons in this category had charges of $100 or less, compared with 71 percent and 73 percent of persons with joint and with back disorders, respectively. At the other end of the distribution, about 10 percent of persons with joint-and-back problems had charges of more than $1,000.

Although condition-related charges were relatively small for most persons in these condition groups, comparison of the distribution of charges in Table L with the per capita charges displayed in Table K indicates that, for some individuals, the charges associated with treating their musculoskeletal problems are nearly catastrophic. Among persons with joint disorders, for example, the median charge was less than $50, yet the per capita charge was $286. The data indicate that a relatively small number of people were responsible for the large difference between the mean and median charges. Although not shown, of the 3,344 persons reporting a

Table L

Condition-related per capita charges and cumulative percent of condition-related charges for persons with selected musculoskeletal conditions, by condition: United States, 1980

Condition	Per capita charges	Per capita condition-related charges for persons with charges	Percent of persons with charges less than or equal to—					
			$0	$50	$100	$250	$500	$1,000
All musculoskeletal conditions	$283	$373	24.1	53.3	68.9	85.3	92.3	95.2
Joints only	286	375	23.8	55.0	71.1	87.2	93.6	95.7
Back only	195	277	29.6	58.1	73.1	87.2	92.7	96.4
Joints and back	451	524	14.0	33.9	47.1	70.9	83.9	89.6

musculoskeletal problem in NMCUES, 30 persons had generated charges in excess of $5,000 for the treatment of their condition. If these 30 persons and their charges were excluded, the per capita condition-related charge would drop to about $178.

From an individual patient's perspective, affordability of care is determined less by the total amount of charges for medical services than by the proportion of those charges that must be paid out of pocket. About 23 percent of all charges incurred in the treatment of any musculoskeletal problem was paid out of pocket, with little variance among the three condition groups (Table K). This compares with approximately 28 percent of all charges paid out of pocket by the U.S. population as a whole. These data suggest that the economic burden imposed by musculoskeletal problems, as measured by the proportion of condition-related charges paid out of pocket, is no greater than the burden imposed by other kinds of illnesses.

Discussion

Musculoskeletal conditions are quite variable, ranging from self-limited disorders to recurrent long-term illness, and are often accompanied by moderate to severe levels of functional impairment. This heterogeneity persists in this study, despite the fact that two groups of musculoskeletal problems were excluded from the analysis: Traumatic conditions (such as fractures, sprains, and dislocations) and congenital defects.

Several possible approaches to the categorization of musculoskeletal conditions based on specific diagnoses were considered, but none was viable because of the lack of specificity of the medical diagnoses provided by the respondents and the small sample size for individual conditions. The three groupings finally selected represent a compromise between these two constraints. As a result, only one of the three condition categories used in this analysis approaches some degree of homogeneity—back disorders. Back pain is a common, recurrent, and often self-limited manifestation of back disorders. Moreover, diseases of the back most commonly result in mild to moderate disability.

Diseases of the joint, the second category, are much more varied than are back problems. In contradistinction to back disorders, diseases of the peripheral joints, such as rheumatoid arthritis, can be severely debilitating, resulting in systemic manifestations and even death. Of course, some joint impairments cause only mild disability. In this regard, such conditions are similar to mild transient back pain.

The third category, joint-and-back conditions, will have prognostic and functional characteristics at least as varied as peripheral joint conditions considered alone.

The reason for emphasizing the heterogeneity of the condition categories used in this report is to inject a note of caution about overly general statements or hypotheses based on the data. The relative diversity, severity, and prognoses of the various diseases under consideration should be kept in mind as the disability, utilization, and charge patterns are discussed, both here and throughout the report.

The data from NMCUES are generally consistent with those from NHANES I and the National Health Interview Survey, both of which surveys also found that musculoskeletal impairments are more prevalent among the elderly, are generally more common among females than among males, and are more frequent among white persons than among black persons (Cunningham and Kelsey, 1984; Wilder, 1973; Feller, 1981).

From the perspective of disability incurred, the broad category of musculoskeletal conditions, exclusive of traumatic injuries or congenital diseases, can be characterized from these data as both common and costly in terms of work-loss days and limitation of activity. For example, 13 percent of all restricted-activity days reported by civilian noninstitutionalized persons in the United States during 1980 were related to some type of musculoskeletal problem. Furthermore, musculoskeletal conditions were responsible for about 11 percent of all work-loss days reported by this population.

Among black persons, the mean number of disability days (including work-loss days) directly attributable to musculoskeletal conditions was greater than the average number of condition-related disability days reported by persons of white and other races. This is a rather striking finding, given that the overall prevalence of musculoskeletal conditions is higher among white persons and those of other races than among black persons. These differences may suggest a difference in the severity of musculoskeletal conditions, with black persons being more vulnerable to musculoskeletal disease either through genetic predisposition or through acquired differences such as obesity. Another possible explanation for the difference could be a lack of financial and social resources with which to deal with the disabling effects of musculoskeletal conditions.

More than half of all work-loss days reported for black persons (55.8 percent) were related to these conditions; this rate is twice that for white and other persons. This difference is most likely linked to occupational differences. For example, the physical demands of occupations that involve strenuous work may preclude work attendance if there has been damage to the musculoskeletal system; whereas similar levels of impairment would be compatible with continued work attendance in less physically demanding jobs. The variability in work disability by race emphasizes the potentially different health and economic consequences of musculoskeletal conditions for black persons.

The costs associated with productive time lost because of musculoskeletal problems are considerable. Musculoskeletal disorders accounted for $3.9 billion in lost productivity among employed persons and home-

makers. This represents more than 10 percent of the total morbidity costs for employed persons and homemakers. Because many musculoskeletal disorders are occupationally related (Yelin, Nevitt, and Epstein, 1980), altering on-the-job conditions that are causally related to the development of musculoskeletal disorders would be a significant step in the reduction of the productivity losses attributable to these disorders.

Despite the large number of work-loss days and bed-disability days attributable to musculoskeletal disorders, people with these conditions do not necessarily perceive themselves to be suffering from serious ailments. People with back problems, for example, do not differ significantly from the overall population in the extent to which they report their health as poor, nor do they differ significantly in their level of daily functioning. One possible explanation is that people with back disorders are able to manage their daily activities within the scope of their ability to function. Such management of daily activities may not be feasible for persons with peripheral joint disorders, who therefore see themselves as more limited and in poorer health.

There are noticeable racial differences in the way people with musculoskeletal conditions perceive their health and level of functioning. Within each condition group, black persons not only reported more disability days, on average, than did white and other persons; but they were also more limited in their functional abilities and they perceived themselves to be in poorer health. It is important to keep in mind that the way in which individuals perceive their level of health and their ability to carry out daily activities is influenced not only by the existence of medical conditions, but also by a constellation of social, psychological, and economic factors.

A large proportion of the care administered to patients with musculoskeletal conditions was provided in ambulatory care settings. This reliance on ambulatory care is attributable to the fact that these conditions, with certain notable exceptions, are not generally amenable to surgical interventions. The most common types of intervention are, therefore, drug treatment, physical therapy, and manipulation. Such intervention can easily be achieved in an outpatient setting in most cases.

It is interesting to note that about 33 percent of all persons with a musculoskeletal disorder made no ambulatory visits at all for their condition during 1980, despite the fact that they reported more limitation in their activities and rated their health as poor more frequently than the overall civilian noninstitutionalized population. There are several explanations for this finding. First, many of the musculoskeletal problems included in this analysis are characterized by acute recurrent episodes that are self-limiting in nature. Individuals will generally be acquainted with the appropriate treatment during these episodes, thus eliminating the need to visit a health care provider. Second, persons suffering from these conditions may not seek medical care to alleviate the disability and discomfort that accompany many musculoskeletal problems because the health care system has been unable to provide successful treatment of their symptoms. These individuals often turn to a host of folk remedies to treat their musculoskeletal ailments (Kronenfeld and Wasner, 1982). Third, pain is the most frequent symptom reported in connection with musculoskeletal disorders; and because this symptom is often successfully treated with over-the-counter medications, the need for other health care services is thus eliminated.

At the other end of the continuum are those persons who make frequent visits to health care providers for the treatment of their musculoskeletal problems. For example, approximately 7 percent of persons with musculoskeletal conditions made more than 10 ambulatory visits during the year. The frequent use of ambulatory services for some people can be explained in part by the types of providers treating musculoskeletal conditions and the therapies they are likely to use.

Nearly 30 percent of persons with back problems sought care from chiropractors. Moreover, persons with any musculoskeletal problems were likely to make three times as many visits to chiropractors as visits to physicians. Among persons making at least one ambulatory care visit, the average number of chiropractic visits was 8.5, compared with 2.8 for physician visits. This difference is undoubtedly the result of differences in the therapeutic regimens used by each profession. Manipulation therapy, for example, is generally used by chiropractors and is performed during a series of visits. Physicians, on the other hand, are more apt to prescribe medications or to set up a treatment schedule to be carried out by a physical therapist. The physician will therefore see the patient less often than a chiropractor would because the physician's role is limited to monitoring change, if any, and any untoward reaction to drug therapy. It is interesting to note that chiropractors are used predominantly by persons of white and other races. Among persons with back disorders, for example, only about 10 percent of black persons used chiropractic services compared with 32 percent of persons of white and other races.

Although the median charge generated in the treatment of musculoskeletal conditions in 1980 was less than $50, total charges associated with these conditions amounted to more than $12 billion. This represents 7.8 percent of the total direct health care costs of the 1980 civilian noninstitutionalized U.S. population. These charges of $12 billion are high relative to the low costs for each individual in these condition groups because of the high prevalence of these disorders.

The median charge for the treatment of musculoskeletal conditions is relatively low because 24 percent of persons with these ailments had no charges at all during the year. The per capita charge of $283 for all persons with these disorders, however, is relatively high. The substantial difference between mean and median charges suggests that the charges associated with the

treatment of musculoskeletal conditions approach catastrophic levels for some individuals.

Nearly 23 percent of charges generated by the treatment of musculoskeletal problems were paid out of pocket. This figure is not dramatically different from the estimate of 28 percent for out-of-pocket expenditures of the total U.S. civilian noninstitutionalized population. Although musculoskeletal conditions tended to have the highest prevalence among the aged, only 16 percent of all charges for these conditions were paid by Medicare. Private insurance sources accounted for a much larger share—42 percent of total condition-related charges.

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List of Detailed Tables

Table 1

Number of persons with selected musculoskeletal conditions and rate per 1,000 population, by sex, age, and race: United States, 1980

Sex, age, and race	Number of persons in thousands	All musculoskeletal conditions		Joints only		Back only		Joints and back	
		Number of persons in thousands	Rate per 1,000 population	Number of persons in thousands	Rate per 1,000 population	Number of persons in thousands	Rate per 1,000 population	Number of persons in thousands	Rate per 1,000 population
Male, all ages	107,481	19,408	180.6	12,271	114.2	4,959	46.1	2,177	20.3
Under 19 years	35,451	2,416	68.2	1,938	54.7	†394	†11.1	‡84	‡2.4
19–44 years	41,709	7,381	177.0	4,067	97.5	2,424	58.1	891	21.4
45–64 years	20,828	6,448	309.6	3,796	182.3	1,696	81.4	955	45.9
65 years and over	9,491	3,162	333.2	2,470	260.3	†445	†46.9	‡248	‡26.1
Female, all ages	115,344	24,704	214.2	16,307	141.4	5,543	48.1	2,854	24.7
Under 19 years	34,233	2,810	82.1	1,918	56.0	767	22.4	‡126	‡3.7
19–44 years	44,383	7,773	175.1	4,015	90.5	2,862	64.5	896	20.2
45–64 years	22,750	7,727	339.7	5,441	239.2	1,309	57.6	976	42.9
65 years and over	13,978	6,393	457.4	4,932	352.9	†605	†43.3	856	61.3
Race:									
Black	26,046	4,216	161.9	2,880	110.6	996	38.2	†341	†13.1
White and other	196,779	39,895	202.7	25,698	130.6	9,507	48.3	4,691	23.8

NOTE: Figures may not add to totals because of rounding.

Table 2

Functional limitation score and percent distribution of all persons and for persons with selected musculoskeletal conditions by perceived health status, according to sex, age, race, and condition: United States, 1980

Sex, age, race, and condition	Number of persons in thousands	Functional limitation score[1]	Perceived health status				
			Total	Excellent	Good	Fair	Poor
All persons			Percent distribution				
Total	222,824	1.7	100.0	50.1	36.9	9.3	3.6
Male, all ages	107,481	1.7	100.0	53.2	35.1	8.4	3.4
Under 19 years	35,451	1.2	100.0	62.1	34.0	3.6	0.4
19–44 years	41,709	1.2	100.0	58.1	34.6	5.7	1.6
45–64 years	20,828	1.9	100.0	39.8	38.0	14.1	8.1
65 years and over	9,491	3.1	100.0	27.4	35.4	25.3	12.0
Female, all ages	115,344	1.8	100.0	47.3	38.6	10.3	3.8
Under 19 years	34,233	1.2	100.0	62.7	33.4	3.6	0.3
19–44 years	44,383	1.3	100.0	49.6	40.4	7.9	2.1
45–64 years	22,750	1.9	100.0	33.2	43.4	15.9	7.4
65 years and over	13,978	3.3	100.0	24.9	38.0	24.9	12.3
Race:							
Black	26,046	1.8	100.0	42.6	40.9	11.2	5.3
White and other	196,779	1.7	100.0	51.1	36.4	9.1	3.4
All musculoskeletal conditions							
Total	44,111	2.6	100.0	31.9	39.9	17.9	10.2
Male, all ages	19,408	2.4	100.0	36.2	38.2	16.6	8.9
Under 19 years	2,416	1.6	100.0	49.2	41.6	7.9	1.3
19–44 years	7,381	1.7	100.0	44.8	40.6	9.9	4.7
45–64 years	6,448	2.7	100.0	28.8	38.6	19.3	13.3
65 years and over	3,162	3.6	100.0	21.5	29.5	33.3	15.7
Female, all ages	24,704	2.7	100.0	28.5	41.2	19.0	11.2
Under 19 years	2,810	1.7	100.0	51.3	41.5	6.5	0.7
19–44 years	7,773	1.8	100.0	35.6	44.4	13.0	7.0
45–64 years	7,727	2.7	100.0	22.5	41.6	22.9	13.0
65 years and over	6,393	4.0	100.0	17.3	37.0	27.0	18.8
Race:							
Black	4,216	3.0	100.0	20.9	39.5	21.0	18.7
White and other	39,895	2.5	100.0	33.1	40.0	17.6	9.3
Joints only							
Total	28,577	2.7	100.0	32.3	38.9	18.1	10.7
Male, all ages	12,271	2.5	100.0	38.2	36.4	16.6	8.7
Under 19 years	1,938	1.3	100.0	49.9	41.5	6.9	1.7
19–44 years	4,067	1.6	100.0	48.4	38.1	9.2	4.2
45–64 years	3,796	2.7	100.0	33.4	37.0	17.6	12.0
65 years and over	2,470	3.8	100.0	19.6	28.9	35.0	16.5
Female, all ages	16,307	2.9	100.0	27.8	40.8	19.3	12.1
Under 19 years	1,918	1.8	100.0	50.4	42.4	6.7	0.5
19–44 years	4,015	1.7	100.0	38.3	44.0	12.9	4.8
45–64 years	5,441	2.7	100.0	22.6	40.9	21.4	15.1
65 years and over	4,932	4.1	100.0	16.2	37.5	26.9	19.3
Race:							
Black	2,880	3.1	100.0	22.3	34.2	22.5	21.1
White and other	25,698	2.6	100.0	33.4	39.5	17.7	9.5

Table 2 – continued

Functional limitation score and percent distribution of all persons and for persons with selected musculoskeletal conditions by perceived health status, according to sex, age, race, and condition: United States, 1980

Sex, age, race, and condition	Number of persons in thousands	Functional limitation score[1]	Perceived health status				
			Total	Excellent	Good	Fair	Poor
Back only			Percent distribution				
Total	10,502	2.0	100.0	37.1	43.4	13.7	5.8
Male, all ages	4,959	2.0	100.0	37.4	43.0	12.9	6.8
Under 19 years	†394	†1.9	†100.0	†42.2	†47.5	†10.3	†–
19–44 years	2,424	1.6	100.0	43.9	44.7	7.6	3.8
45–64 years	1,696	2.4	100.0	28.1	42.6	18.0	11.2
65 years and over	†445	†2.8	†100.0	†32.6	†30.8	†24.3	†12.2
Female, all ages	5,543	2.1	100.0	36.8	43.7	14.5	4.9
Under 19 years	767	1.3	100.0	55.3	37.7	7.0	–
19–44 years	2,862	1.8	100.0	36.0	47.3	10.9	5.8
45–64 years	1,309	2.3	100.0	28.7	47.5	19.2	4.7
65 years and over	†605	†3.0	†100.0	†35.0	†26.2	†30.8	†8.0
Race:							
Black	996	2.4	100.0	22.0	58.4	11.7	7.9
White and other	9,507	2.0	100.0	38.7	41.8	13.9	5.6
Joints and back							
Total	5,031	3.0	100.0	19.3	38.3	25.6	16.9
Male, all ages	2,177	2.7	100.0	22.5	37.5	24.9	15.1
Under 19 years	‡84	‡4.0	‡100.0	‡64.6	‡16.9	‡18.6	‡–
19–44 years	891	2.2	100.0	30.7	40.4	19.4	9.5
45–64 years	955	3.1	100.0	11.7	37.7	28.6	21.9
65 years and over	‡248	‡2.7	‡100.0	‡19.8	‡33.3	‡32.5	‡14.4
Female, all ages	2,854	3.2	100.0	16.8	38.9	26.1	18.3
Under 19 years	‡126	‡2.6	‡100.0	‡41.0	‡50.2	‡–	‡8.8
19–44 years	896	2.3	100.0	22.3	36.9	19.9	20.9
45–64 years	976	3.1	100.0	13.5	37.3	36.3	12.9
65 years and over	856	4.2	100.0	11.2	41.1	24.7	23.0
Race:							
Black	†341	†3.0	†100.0	†6.2	†28.8	†35.4	†29.6
White and other	4,691	3.0	100.0	20.2	39.0	24.8	16.0

[1]Functional limitation is computed only for persons 17 years of age and over.

NOTE: Figures may not add to totals because of rounding.

Table 3

Mean condition-related disability days and percent of total disability days reported by persons with selected musculoskeletal conditions, by sex, age, race, and condition: United States, 1980

Sex, age, race, and condition	Restricted-activity days		Bed-disability days		Work-loss days	
	Mean	Percent of total days	Mean	Percent of total days	Mean	Percent of total days
All musculoskeletal conditions						
Total	8.8	30.4	2.3	25.0	2.7	29.3
Male, all ages	8.1	30.8	2.0	27.8	2.8	30.1
Under 19 years	3.2	28.1	0.5	10.4	...	...
19–44 years	5.4	26.1	1.4	24.1	3.2	32.0
45–64 years	11.2	35.9	3.0	37.5	2.6	30.0
65 years and over	11.9	28.7	2.2	23.2	1.3	14.3
Female, all ages	9.3	30.1	2.5	23.1	2.5	27.8
Under 19 years	7.2	40.9	1.0	15.6	...	...
19–44 years	7.5	28.7	2.2	23.2	2.5	29.8
45–64 years	10.0	32.1	2.4	24.2	3.1	26.7
65 years and over	11.7	27.8	3.8	24.7	0.2	10.0
Race:						
Black	14.4	35.7	5.6	38.1	9.2	55.8
White and other	8.2	29.7	1.9	22.1	2.0	23.5
Joints only						
Total	8.3	29.0	2.0	22.0	2.4	25.8
Male, all ages	7.9	30.4	1.5	21.1	3.1	30.7
Under 19 years	2.5	22.9	0.5	10.2	...	...
19–44 years	6.1	31.1	1.0	19.2	3.9	35.1
45–64 years	8.9	30.4	1.9	26.8	2.4	26.7
65 years and over	13.3	30.6	2.5	20.5	1.5	13.4
Female, all ages	8.7	28.5	2.3	21.7	1.7	20.5
Under 19 years	8.2	43.8	1.3	20.6	...	...
19–44 years	5.4	24.3	1.6	20.6	2.0	26.3
45–64 years	9.7	30.5	1.9	18.8	1.8	16.5
65 years and over	10.5	25.9	3.6	23.8	0.1	4.4
Race:						
Black	13.2	33.8	5.4	35.1	7.5	59.6
White and other	7.8	28.5	1.6	19.0	1.9	21.1
Back only						
Total	6.4	27.2	1.9	26.0	2.7	31.0
Male, all ages	5.1	24.3	1.7	34.0	1.5	20.8
Under 19 years	†7.1	†48.3	†0.1	†2.8	...	...
19–44 years	2.0	12.0	1.5	31.3	1.1	15.5
45–64 years	8.7	35.1	2.5	45.5	2.3	28.4
65 years and over	†6.1	†17.0	†0.6	†11.3	†1.5	†34.9
Female, all ages	7.7	30.0	2.1	22.3	4.1	39.0
Under 19 years	4.8	37.2	0.2	4.2	...	...
19–44 years	7.1	27.5	1.9	20.0	3.0	32.6
45–64 years	11.0	38.2	4.0	42.1	8.7	55.8
65 years and over	†6.6	†19.2	†1.3	†8.7	†0.9	†90.0
Race:						
Black	17.7	42.1	5.8	44.6	11.7	46.4
White and other	5.3	24.7	1.5	22.4	1.8	25.4

Table 3 – continued

Mean condition-related disability days and percent of total disability days reported by persons with selected musculoskeletal conditions, by sex, age, race, and condition: United States, 1980

Sex, age, race, and condition	Restricted-activity days		Bed-disability days		Work-loss days	
	Mean	Percent of total days	Mean	Percent of total days	Mean	Percent of total days
Joints and back						
Total	16.4	39.4	5.0	36.5	3.6	37.5
Male, all ages	16.4	41.0	5.1	39.5	4.9	46.2
Under 19 years	‡–	‡–	‡–	‡–	...	...
19–44 years	11.7	32.1	3.2	28.6	6.1	47.7
45–64 years	24.5	49.0	8.4	50.9	4.1	47.6
65 years and over	‡7.9	‡32.1	‡1.3	‡18.1	‡–	‡–
Female, all ages	16.3	38.1	4.9	34.3	2.1	24.7
Under 19 years	‡6.2	‡21.1	‡.9	‡5.0	...	...
19–44 years	18.5	42.0	6.0	37.0	2.8	29.4
45–64 years	10.5	33.4	3.1	32.6	1.7	18.7
65 years and over	22.2	39.4	6.2	35.6	0.4	22.2
Race:						
Black	†15.6	†33.3	†5.9	†41.8	†11.3	†94.2
White and other	16.4	39.8	4.9	35.8	3.0	31.7

Table 4

Ambulatory care and hospital utilization for all persons and for persons with selected musculoskeletal conditions, by sex, age, race, and condition: United States, 1980

Sex, age, race, and condition	Ambulatory visits		Hospital admissions		Hospital days	
	Condition-related	Total	Condition-related	Total	Condition-related	Total
All persons	Number per person		Number per 1,000 population			
Total	...	5.2	...	175	...	1,218
Male, all ages	...	4.4	...	157	...	1,161
Under 19 years	...	3.9	...	133	...	506
19–44 years	...	3.6	...	98	...	635
45–64 years	...	5.2	...	188	...	1,725
65 years and over	...	7.5	...	435	...	4,688
Female, all ages	...	5.9	...	192	...	1,271
Under 19 years	...	3.8	...	122	...	429
19–44 years	...	5.9	...	200	...	1,036
45–64 years	...	6.9	...	184	...	1,516
65 years and over	...	9.3	...	352	...	3,683
Race:						
Black	...	4.3	...	174	...	1,408
White and other	...	5.3	...	175	...	1,193
All musculoskeletal conditions						
Total	3.4	9.5	51	280	537	2,430
Male, all ages	3.1	8.1	58	252	665	2,366
Under 19 years	1.8	5.9	20	167	180	737
19–44 years	3.1	7.4	58	144	352	868
45–64 years	3.3	8.5	67	271	924	2,880
65 years and over	3.4	10.7	68	529	1,240	6,060
Female, all ages	3.7	10.7	45	302	436	2,481
Under 19 years	3.0	8.0	34	154	447	813
19–44 years	3.6	10.3	43	256	261	1,639
45–64 years	3.8	10.8	45	261	335	1,973
65 years and over	3.9	12.1	53	472	764	4,851
Race:						
Black	3.8	10.9	84	336	796	3,036
White and other	3.4	9.4	47	274	509	2,366
Joints only						
Total	2.6	9.2	48	306	546	2,694
Male, all ages	2.5	8.1	59	283	776	2,800
Under 19 years	1.5	5.8	25	194	223	837
19–44 years	2.6	7.4	54	159	264	1,040
45–64 years	2.4	8.4	69	284	1,124	3,119
65 years and over	3.1	10.4	77	553	1,518	6,750
Female, all ages	2.7	10.0	40	324	373	2,614
Under 19 years	2.1	7.3	38	167	635	994
19–44 years	2.2	9.1	36	244	125	1,371
45–64 years	2.9	10.4	31	283	193	1,975
65 years and over	3.1	11.3	55	494	672	4,962
Race:						
Black	3.5	11.3	87	371	779	3,562
White and other	2.5	8.9	44	299	520	2,597

Table 4 – continued

Ambulatory care and hospital utilization for all persons and for persons with selected musculoskeletal conditions, by sex, age, race, and condition: United States, 1980

Sex, age, race, and condition	Ambulatory visits		Hospital admissions		Hospital days	
	Condition-related	Total	Condition-related	Total	Condition-related	Total
Back only	Number per person		Number per 1,000 population			
Total	3.8	8.5	31	174	357	1,334
Male, all ages	3.2	6.8	33	156	258	1,161
Under 19 years	†2.9	†6.3	†–	†67	†–	†397
19–44 years	2.5	5.7	41	82	276	426
45–64 years	4.0	7.2	38	194	360	1,958
65 years and over	†4.2	†12.5	†–	†493	†–	†2,797
Female, all ages	4.4	10.1	29	190	446	1,490
Under 19 years	5.1	8.8	–	100	–	443
19–44 years	4.3	10.5	28	211	339	1,355
45–64 years	3.9	9.1	56	147	502	1,183
65 years and over	†4.8	†11.8	†18	†301	†1,400	†4,124
Race:						
Black	3.4	8.0	42	240	658	1,939
White and other	3.8	8.6	30	167	326	1,271
Joints and back						
Total	7.1	13.8	106	351	857	3,219
Male, all ages	6.1	11.1	112	294	968	2,666
Under 19 years	‡3.9	‡7.6	‡–	‡–	‡–	‡–
19–44 years	6.7	11.8	123	241	963	1,290
45–64 years	5.9	11.1	115	356	1,128	3,570
65 years and over	‡5.1	‡10.3	‡98	‡347	‡699	‡5,032
Female, all ages	7.8	15.7	101	394	772	3,641
Under 19 years	‡4.9	‡12.7	‡187	‡275	‡317	‡317
19–44 years	7.4	15.4	120	452	620	3,746
45–64 years	8.6	15.6	106	293	901	3,020
65 years and over	7.8	16.6	64	466	851	4,726
Race:						
Black	†7.4	†16.1	†184	†320	†1,345	†1,795
White and other	7.0	13.6	100	353	821	3,322

Table 5

Percent of persons with selected musculoskeletal conditions who made 1 or more condition-related ambulatory visits, by provider, sex, age, race, and condition: United States, 1980

Sex, age, race, and condition	Any provider[1]	Physician	Chiropractor	Podiatrist	Other nonphysician provider[2]
All musculoskeletal conditions			Percent		
Total	67.2	55.1	13.1	2.5	10.8
Male, all ages	64.2	52.5	13.1	2.0	10.1
Under 19 years	80.8	70.7	5.2	2.7	10.3
19–44 years	64.4	51.3	15.3	2.7	10.2
45–64 years	60.7	48.2	15.1	0.9	10.9
65 years and over	58.4	50.2	10.2	1.7	8.0
Female, all ages	69.6	57.2	13.1	2.9	11.4
Under 19 years	79.6	68.5	8.8	2.0	12.9
19–44 years	72.9	53.7	19.5	2.3	11.3
45–64 years	67.7	58.9	11.4	3.2	11.6
65 years and over	63.4	54.3	9.5	3.8	10.5
Race:					
Black	68.0	62.4	4.0	1.2	10.0
White and other	67.1	54.4	14.1	2.6	10.9
Joints only					
Total	65.3	58.8	4.3	3.3	10.7
Male, all ages	62.8	57.4	3.6	2.7	11.0
Under 19 years	80.0	73.9	0.5	3.4	6.8
19–44 years	61.7	55.8	3.8	4.1	13.2
45–64 years	58.7	53.0	5.7	1.3	12.7
65 years and over	57.6	54.1	2.7	2.2	8.2
Female, all ages	67.2	59.8	4.8	3.7	10.5
Under 19 years	79.5	72.9	1.2	2.9	13.4
19–44 years	70.2	58.9	7.9	3.9	8.7
45–64 years	66.9	60.4	4.7	3.8	12.3
65 years and over	60.4	54.8	3.7	3.8	8.8
Race:					
Black	68.8	64.2	–	1.0	9.6
White and other	64.9	58.2	4.8	3.5	10.9
Back only					
Total	66.4	40.5	29.9	–	8.2
Male, all ages	63.2	36.4	30.3	–	5.9
Under 19 years	†84.1	†52.6	†25.9	†–	†22.6
19–44 years	64.9	39.0	29.3	–	4.9
45–64 years	57.2	31.3	30.4	–	3.9
65 years and over	†58.3	†27.2	†39.4	†–	†3.9
Female, all ages	69.3	44.2	29.5	–	10.2
Under 19 years	80.0	57.4	25.8	–	11.7
19–44 years	71.2	41.6	30.5	–	12.4
45–64 years	62.6	44.7	28.9	–	7.3
65 years and over	†60.9	†38.5	†31.1	†–	†4.4
Race:					
Black	61.1	53.9	9.6	–	9.6
White and other	67.0	39.1	32.0	–	8.0

Table 5 – continued

Percent of persons with selected musculoskeletal conditions who made 1 or more condition-related ambulatory visits, by provider, sex, age, race, and condition: United States, 1980

Sex, age, race, and condition	Any provider[1]	Physician	Chiropractor	Podiatrist	Other nonphysician provider[2]
Joints and back			Percent		
Total	79.7	64.9	28.5	3.4	16.7
Male, all ages	74.6	61.6	27.8	2.2	14.3
Under 19 years	‡82.6	‡82.6	‡16.9	‡–	‡33.8
19–44 years	75.9	64.4	29.7	3.9	10.7
45–64 years	74.8	59.5	25.6	1.3	15.9
65 years and over	‡66.8	‡52.8	‡32.9	‡–	‡14.0
Female, all ages	83.6	67.5	29.1	4.3	18.5
Under 19 years	‡80.0	‡68.8	‡19.3	‡–	‡11.6
19–44 years	90.0	69.5	36.2	3.0	19.3
45–64 years	79.0	69.6	25.3	4.1	13.4
65 years and over	82.7	62.7	27.5	6.4	24.7
Race:					
Black	†81.8	†71.6	†21.5	†6.2	†14.1
White and other	79.6	64.5	29.0	3.1	16.9

[1]Categories do not add to total because of multiple responses.
[2]Includes optometrists, psychologists, social workers, nurses, physical therapists, and others.

Table 6

Charges related to musculoskeletal conditions and percent distribution by type of health service, according to condition: United States, 1980

Condition	Total condition-related charges[1]	Inpatient hospital services[2]	Ambulatory care		Prescribed medications
			Physician services[3]	Other professional services[4]	
	Amount in millions				
All musculoskeletal conditions ...	$12,234	$7,232	$2,598	$1,624	$780
Joints only	8,026	5,248	1,591	624	564
Back only	1,962	822	498	566	76
Joints and back	2,247	1,162	510	435	140
	Percent distribution				
All musculoskeletal conditions ...	100.0	59.1	21.2	13.3	6.4
Joints only	100.0	65.4	19.8	7.8	7.0
Back only	100.0	41.9	25.4	28.8	3.9
Joints and back	100.0	51.5	22.7	19.6	6.2

[1]Does not include $246 million for dental services and other medical service charges incurred in the treatment of musculoskeletal conditions.
[2]Includes inpatient physician services.
[3]Includes physician office visits and outpatient physician services.
[4]Includes chiropractors, podiatrists, social workers, nurses, physical therapists, and others, as well as emergency room services.

NOTE: Figures may not add to totals because of rounding.

Table 7

Condition-related per capita charges and percent of charges paid out of pocket for persons with selected musculoskeletal conditions, by type of health service, age, sex, race, and condition: United States, 1980

Age, sex, race, and condition	Number of persons in thousands[1]	All health services		Hospital admissions		Prescribed medications		Ambulatory visits		Dental and other medical services	
		Per capita charge	Percent out of pocket	Per capita charge	Percent out of pocket	Per capita charge	Percent out of pocket	Per capita charge	Percent out of pocket	Per capita charge	Percent out of pocket
All musculoskeletal conditions											
Total	44,111	$283	22.7	$164	11.9	$18	58.5	$96	32.6	$6	56.7
Age:											
Under 19 years	5,226	178	18.1	91	3.4	2	77.4	69	30.3	17	43.5
19-44 years	15,154	232	27.6	122	21.4	9	54.8	98	31.5	3	69.0
45-64 years	14,175	312	19.1	180	5.6	25	54.4	103	32.1	4	74.1
65 years and over	9,556	378	23.4	246	12.9	30	64.7	96	36.0	6	50.7
Sex:											
Male	19,408	316	22.6	207	14.9	15	60.9	89	31.7	5	64.5
Female	24,704	257	22.8	130	8.1	20	57.0	101	33.2	6	51.3
Race:											
Black	4,216	318	18.3	161	16.4	17	46.2	135	16.6	5	27.6
White and other	39,895	279	23.2	164	11.4	18	59.7	92	35.0	6	59.8
Joints only											
Total	28,577	286	21.7	184	12.2	20	59.5	77	31.6	5	66.9
Age:											
Under 19 years	3,856	184	16.1	119	3.5	2	83.1	56	33.9	7	72.0
19-44 years	8,082	216	30.4	129	26.6	9	59.0	74	31.0	4	78.6
45-64 years	9,237	299	17.9	188	4.2	27	54.8	81	34.1	4	88.2
65 years and over	7,402	398	21.4	272	13.6	33	63.8	87	28.5	6	39.1
Sex:											
Male	12,271	365	22.1	263	16.1	16	61.9	80	30.2	6	74.3
Female	16,307	226	21.1	124	6.1	23	58.3	76	32.7	4	57.7
Race:											
Black	2,880	298	13.6	158	9.8	20	38.4	116	13.4	4	45.9
White and other	25,698	284	22.6	186	12.4	20	61.9	73	34.8	5	68.7

Table 7 -- continued

Condition-related per capita charges and percent of charges paid out of pocket for persons with selected musculoskeletal conditions, by type of health service, age, sex, race, and condition: United States, 1980

Age, sex, race, and condition	Number of persons in thousands[1]	All health services		Hospital admissions		Prescribed medications		Ambulatory visits		Dental and other medical services	
		Per capita charge	Percent out of pocket	Per capita charge	Percent out of pocket	Per capita charge	Percent out of pocket	Per capita charge	Percent out of pocket	Per capita charge	Percent out of pocket
Back only											
Total	10,502	$195	24.7	$78	8.9	$7	45.2	$101	34.7	$8	34.3
Age:											
Under 19 years	1,161	159	25.3	–	–	1	41.4	106	22.8	52	30.1
19–44 years	5,286	186	21.4	75	6.0	7	40.7	103	30.6	2	64.1
45–64 years	3,006	210	30.1	93	17.3	9	47.3	103	40.2	4	26.4
65 years and over	1,049	236	23.8	141	0.8	8	58.9	84	57.1	3	74.9
Sex:											
Male	4,959	165	26.7	74	12.1	9	40.8	79	38.7	3	27.8
Female	5,543	222	23.4	82	6.3	6	51.7	122	32.4	12	35.9
Race:											
Black	996	322	21.4	125	29.9	8	56.9	177	14.6	12	8.3
White and other	9,507	181	25.4	73	5.2	7	43.8	93	38.7	8	38.6
Joints and back											
Total	5,031	451	24.5	231	12.5	28	61.5	188	32.4	5	76.9
Age:											
Under 19 years	‡210	‡196	‡21.3	‡90	‡–	‡1	†42.1	‡102	‡37.3	‡3	‡100.0
19–44 years	1,786	442	29.0	234	22.9	12	66.4	192	33.9	5	37.3
45–64 years	1,932	531	15.8	277	4.2	43	55.5	209	22.0	3	100.0
65 years and over	1,104	374	37.8	173	14.4	32	72.5	161	52.8	8	100.0
Sex:											
Male	2,177	389	21.1	200	8.2	26	73.5	160	28.1	4	43.7
Female	2,854	498	26.5	255	15.1	29	53.4	209	35.0	5	94.0
Race:											
Black	†341	†478	†37.2	†287	†30.0	†24	†88.9	†166	†41.8	†1	†100.0
White and other	4,691	449	23.5	227	10.9	28	59.8	189	31.8	5	76.6

[1]Figures may not add to totals because of rounding.

Appendixes

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Appendix I. Sample Design, Data Collection, and Processing

Introduction

The National Medical Care Utilization and Expenditure Survey (NMCUES) was designed to collect data about the U.S. civilian noninstitutionalized population during 1980. Because of the complexity of the survey, the analyst must be familiar with a range of design features, both to determine appropriate analytic methods and to investigate the impact that the design may have on a particular analysis. Several topics are addressed in this appendix: The overall design of NMCUES, the survey background, sampling methods, data collection methods, weighting, and compensation procedures for missing data. In these descriptions, the NMCUES data are presented essentially as they are available to the user of the public use data tape. This appendix draws heavily from a paper in the Proceedings of the 19th National Meeting of the Public Health Conference on Records and Statistics (Casady, 1983).

Survey Background

During the course of NMCUES, information was obtained on health, access to and use of medical services, associated charges and sources of payment, and health care coverage. The survey was cosponsored by the National Center for Health Statistics (NCHS) and the Health Care Financing Administration (HCFA). Data collection was provided under contract by the Research Triangle Institute (RTI) and its subcontractors, National Opinion Research Center (NORC) and SysteMetrics, Inc.

The basic survey plan for NMCUES drew heavily on two previous national surveys: The National Health Interview Survey (NHIS), which is conducted by NCHS, and the National Medical Care Expenditure Survey (NMCES), which was cosponsored by the National Center for Health Services Research and NCHS.

NHIS is a continuing multipurpose health survey first conducted in 1957. The primary purpose of NHIS is to collect information on illness, disability, and the use of medical care. Although some information on medical charges and insurance payments has been collected in NHIS, the cross-sectional nature of the NHIS survey design is not well suited for providing annual data on charges and payments.

NMCES was a panel survey in which sample households were interviewed six times over an 18-month period in 1977 and 1978. NMCES was designed specifically to provide comprehensive data on how health services were used and paid for in the United States in 1977.

NMCUES is similar to NMCES in survey design and question wording, so that analysis of change during the years between 1977 and 1980 is possible. Both NMCUES and NMCES are similar to NHIS in terms of question wording in areas common to the three surveys. Together they provide extensive information on illness, disability, use of medical care, costs of medical care, sources of payment for medical care, and health care coverage at two points in time.

Sample Design

General plan—The NMCUES sample of housing units and group quarters, hereafter jointly referred to as dwelling units, is a concatenation of two independently selected national samples, one provided by RTI and the other by NORC. The sample designs used by RTI and NORC are quite similar with respect to principal design features: Both can be characterized as stratified, multistage area probability designs. The principal differences between the two designs are the type of stratification variables and the specific definitions of sampling units at each stage.

Target population—All persons living in a sample dwelling unit at the time of the first interview became part of the national sample. Unmarried students 17–22 years of age who lived away from home were included in the sample if their parent or guardian was included in the sample. In addition, persons who died or were institutionalized between January 1 and the date of first interview were included in the sample if they were related to persons living in the sampled dwelling units and were living in the sample dwelling before their death or institutionalization. All of these persons were considered "key" persons, and data were collected for them for the full 12 months of 1980 or for the portion of time that they were part of the U.S. civilian noninstitutionalized population. In addition, children born to key persons during 1980 were considered key persons, and data were collected for them from the time of birth.

Relatives from outside the original population (i.e., institutionalized, in the Armed Forces, or outside the United States from January 1 up to the first interview) who moved in with key persons after the first interview were also considered key persons, and data were collected for them from the time they joined the key person. Relatives who moved in with key persons after the first interview but were part of the civilian noninstitutionalized population on January 1, 1980, were classified as "nonkey" persons. Data were collected for nonkey persons for the time that they lived with a key person; but because they had a chance of selection in the initial sample, their data are not used for general analysis of persons. However, data for nonkey persons are used in an analysis of families because they contribute to the family's utilization of and charges for health care during the time they are part of the family. Family analysis is not part of this investigation, though, and will not be discussed further.

Persons included in the sample were grouped into "reporting units" for data collection purposes. Reporting units were defined as all persons related to each other by blood, marriage, adoption, or foster care status who lived in the same dwelling unit. The combined NMCUES sample consisted of approximately 7,200 reporting units, of which nearly 6,600 agreed to participate in the survey. In total, complete data were obtained on 17,123 key persons. The RTI sample yielded approximately 8,300 respondents and the NORC sample 8,800.

Research Triangle Institute Sample Design

Primary sampling units (PSU's)—A PSU was defined as a county, a group of contiguous counties, or parts of counties with a combined minimum 1970 population size of 20,000. A total of 1,686 nonoverlapping RTI PSU's cover the entire land area of the 50 States and Washington, D.C. The PSU's were classified as one of two types. The 16 largest standard metropolitan statistical areas (SMSA's) were designated as self-representing PSU's, and the remaining 1,670 PSU's in the primary sampling frame were designated as non-self-representing PSU's.

Stratification of PSU's—PSU's were grouped into strata whose members tend to be relatively alike within strata and relatively unlike between strata. PSU's derived from the 16 largest SMSA's were of sufficient 1970 population size to be treated as primary strata. The 1,659 non-self-representing PSU's from the continental United States were stratified into 42 approximately equal-sized primary strata. Each primary stratum had a 1970 population size of about 3.3 million. One supplementary primary stratum of 11 PSU's, with a 1970 population size of about 1 million, was added to the RTI primary frame to include Alaska and Hawaii.

First-stage selection of PSU's—The total RTI primary sample consisted of 59 PSU's, of which 16 were self-representing. The non-self-representing PSU's were obtained by selecting 1 PSU from each of the 43 non-self-representing primary strata. These PSU's were selected with probability proportional to 1970 population size.

Secondary stratification—In each of 59 sample PSU's, the entire PSU was divided into nonoverlapping smaller area units called secondary sampling units (SSU's). Each SSU consisted of one or more 1970 census-defined enumeration districts (ED's) or block groups (BG's). Within each PSU the SSU's were ordered and then partitioned to form approximately equal-sized secondary strata. Two secondary strata were formed in the non-self-representing PSU drawn from Alaska and Hawaii, and four secondary strata were formed in each of the remaining 42 non-self-representing PSU's. Thus, the non-self-representing PSU's were partitioned into a total of 170 secondary strata. In a similar manner the 16 self-representing PSU's were partitioned into 144 secondary strata.

Second-stage selection of SSU's—One SSU was selected from each of the 144 secondary strata covering the self-representing PSU's, and two SSU's were selected from each of the remaining secondary strata. All second-stage sampling was with replacement and with probability proportional to the SSU's total noninstitutionalized population in 1970. The total number of sample SSU's was $2 \times 170 + 144 = 484$.

Third-stage selection of areas and segments—Each SSU was divided into smaller nonoverlapping geographic areas, and one area within the SSU was selected with probability proportional to the 1970 total number of housing units. Next, one or more nonoverlapping segments of at least 60 housing units (HU's) were formed in the selected area. One segment was selected from each SSU with probability proportional to the segment HU count. In response to the sponsoring agencies' request that the expected household sample size be reduced, a systematic sample of one-sixth of the segments was deleted from the household sample. Thus, the total third-stage sample was reduced to 404 segments.

Fourth-stage selection of housing units—All dwelling units within the segment were listed, and a systematic sample of dwelling units was selected. The procedures used to determine the sampling rate for segments guaranteed that all dwelling units had an approximately equal probability of selection. All reporting units within the selected dwelling units were included in the sample.

National Opinion Research Center Sample Design

Primary sampling units (PSU's)—The land area of the 50 States and Washington, D.C., was divided into nonoverlapping PSU's. A PSU consisted of SMSA's, parts of SMSA's, counties, parts of counties, or independent cities. Grouping of counties into a single PSU occurred when individual counties had a 1970 population of less than 10,000.

Zoning of PSU's—The PSU's were classified into two groups according to metropolitan status (SMSA or not SMSA). These two groups were individually ordered and then partitioned into zones with a 1970 census population size of 1 million persons.

First-stage zone selection of PSU's—A single PSU was selected within each zone with a probability proportional to its 1970 population. It should be noted that this procedure allows a PSU to be selected more than one time. For instance, an SMSA PSU with a population of 3 million may be selected at least twice and possibly as many as four times. The full general-purpose sample contained 204 PSU's, which were systematically allocated to 4 subsamples of 51 PSU's. The final set of 76 sample PSU's was chosen by randomly selecting 2 complete subsamples of 51 PSU's; 1 subsample was included in its entirety, and 25 PSU's in the other subsample were selected systematically for inclusion in NMCUES.

Second-stage zone selection of SSU's—Each PSU selected in the first stage was partitioned into a nonoverlapping set of SSU's defined by BG's, ED's, or a combination of the two types of census units. SSU's were selected from the ordered list of these SSU's. The cumulative number of households in the second-stage frame for each PSU was divided into 18 zones of equal width. An SSU could be selected more than once, as was the case in the PSU selection. If a PSU had been hit more than once in the first stage, then the second-stage selection process was repeated as many times as there were first-stage hits. Some 405 SSU's were identified by selecting 5 SSU's from each of the 51 PSU's in the subsample that was included in its entirety and 6 SSU's from each of the 25 PSU's in the subsample for which one-half of the PSU's were included.

Third-stage selection of segments—The selected SSU's were subdivided into area segments with a minimum size of 100 housing units. One segment was then selected with probability proportional to the estimated number of housing units.

Fourth-stage selection of housing units—Sample selection at this level was essentially the same as for the RTI design.

Data Collection

Field operations for NMCUES were performed by RTI and NORC under specifications established by the cosponsoring agencies. Persons in the sample dwelling units were interviewed at approximately 3-month intervals beginning in February 1980 and ending in March 1981. The core questionnaire was administered during each of the five interview rounds to collect data on health, health care, health care charges, sources of payment, and health care coverage. A summary of responses was used to update information reported in previous rounds. Supplements to the core questionnaire were used during the first, third, and fifth interview rounds to collect data that did not change during the year or that were needed only once. Approximately 80 percent of the third- and fourth-round interviews were conducted by telephone; all remaining interviews were conducted in person. The respondent for the interview was required to be a household member 17 years of age and over. A nonhousehold proxy respondent was permitted only if all eligible household members were unable to respond because of health, language, or mental condition.

Weighting

For the analysis of NMCUES data, sample weights are required to compensate for unequal probabilities of selection, to adjust for the potentially biasing effects of failure to obtain data from some persons or reporting units (RU's) (i.e., nonresponse), and failure to cover some portions of the population because the sampling frame did not include them (i.e., undercoverage).

Basic sample design weights—Development of weights reflecting the sample design of NMCUES was the first step in the development of weights for each person in the survey. The basic sample design weight for a dwelling unit is the product of four components that correspond to the four stages of sample selection. Each of the four weight components is the inverse of the probability of selection at that stage when sampling was without replacement, or the inverse of the expected number of selections when sampling was with replacement, and multiple selection of the sample unit was possible.

Two-sample adjustment factor—As previously discussed, the NMCUES sample is composed of two independently selected samples. Each sample, together with its basic sample design weights, yields independent unbiased estimates of population parameters. Because the two NMCUES samples were of approximately equal size, a simple average of the two independent estimators was used for the combined sample estimator. This is equivalent to computing an adjusted basic sample design weight by dividing each basic sample design weight by 2. In the subsequent discussion, only the combined sample design weights are considered.

Total nonresponse and undercoverage adjustment—A weight adjustment factor was computed at the RU level to compensate for RU-level nonresponse and undercoverage. Because every RU within a dwelling unit is included in the sample, the adjusted basic sample design weight assigned to an RU is simply the adjusted basic sample design weight for the dwelling unit in which the RU is located. An RU was classified as responding if members of the RU initially agreed to participate in NMCUES and as nonresponding otherwise.

Initially, 96 RU weight-adjustment cells were formed by cross-classifying the following variables: Race of RU head (white or all other), type of RU head (female,

male, or husband-wife), age of RU head (four levels), and size of RU (four levels). These cells were then collapsed to 63 cells so that each cell contained at least 20 responding RU's. Within each cell an adjustment factor was computed so that the sum of adjusted basic sample design weights would equal the March 1980 Current Population Survey estimate for the same population. The weight for nonresponse and undercoverage was computed for each RU as the product of the adjusted basic sample design weight and the nonresponse-undercoverage adjustment factor for the cell containing the RU.

Poststratification adjustment—Once the nonresponse–undercoverage adjusted RU weights were computed, a poststratification adjusted weight was computed at the person level. Because each person within an RU is included in the sample, the nonresponse and undercoverage adjusted weight for a sample person is the nonresponse–undercoverage adjusted weight for the RU in which the person resides. Each person was classified as responding or nonresponding, as discussed subsequently in the section on attrition imputation.

Sixty poststrata were formed by cross-classifying age (15 levels), race (2 levels), and sex (2 levels). One poststratum (black males 75 years of age and over) had fewer than 20 respondents, so it was combined with an adjacent poststratum (black males 65–74 years of age), resulting in 59 poststrata.

Estimates based on population projections from the 1980 census were obtained from the Bureau of the Census for the U.S. civilian noninstitutionalized population by age, race, and sex poststrata for February 1, May 1, August 1, and November 1, 1980. The mean of these midquarter population estimates for each of the poststrata was computed and used as the 1980 average target population for calculating the poststrata adjustment factors.

Survey-based estimates of the average poststrata population were developed using the nonresponse and undercoverage adjusted weights. First, a survey-based estimate of the target population of each poststratum for each quarter was computed by summing the nonresponse and undercoverage adjusted weights for respondents eligible for the survey on the midquarter date. Then the survey-based estimate of the 1980 average population was computed as the mean of the four midquarter estimates. Finally, the poststratification adjustment factor in each poststratum was computed as the ratio of the 1980 average target population (obtained from Bureau of the Census data) to the NMCUES 1980 average population. The poststratified weight for each respondent was then computed as the product of the nonresponse and undercoverage adjusted weight and the poststratification adjustment factor for the poststratum containing the respondent.

Thus, the weighting procedure is composed of three steps: Development of base sample design weights for each RU, adjustment for RU-level nonresponse and undercoverage, and adjustment for person-level nonresponse and undercoverage. A further adjustment for the number of days a person was an eligible member of the U.S. civilian noninstitutionalized population was made, but this adjustment affects only certain types of estimates from NMCUES and is discussed in Appendix III.

Survey Nonresponse

Nonresponse in panel surveys such as NMCUES occurs when sample individuals refuse to participate in the survey (total nonresponse), when initially participating individuals drop out of the survey (attrition nonresponse), or when data for specific items on the questionnaire are not collected (item nonresponse). Response rates for RU's and persons in NMCUES were high, with approximately 90 percent of the sample RU's agreeing to participate in the survey and approximately 94 percent of the individuals in the participating RU's supplying complete information. Even though the overall response rates are high, survey-based estimates of means and proportions may be biased if nonrespondents tend to have different health care experiences than respondents or if there is a substantial response rate differential across subgroups of the target population. Furthermore, annual totals tend to be underestimated unless allowance is made for the loss of data attributable to nonresponse.

Two methods commonly used to compensate for survey nonresponse are data imputation and adjustment of sampling weights. For NMCUES, data imputation was used to compensate for attrition and item nonresponse, and weight adjustment was used to compensate for total nonresponse. The calculation of the weight adjustment factors was discussed in the previous section.

Attrition Imputation

A special form of the sequential hot-deck imputation method (Cox, 1980) was used for attrition imputation. First, each sample person with incomplete annual data (referred to as a "recipient") was linked to a sample person with similar demographic and socioeconomic characteristics who had complete annual data (referred to as a "donor"). Second, the time periods for which the recipient had missing data were divided into two categories: Imputed eligible days and imputed ineligible days. Imputed eligible days were those days for which the donor was eligible (i.e., in scope), and imputed ineligible days were those days for which the donor was ineligible (i.e., out of scope). The donor's medical care experiences, such as medical provider visits, dental visits, and hospital stays, during the imputed eligible days were imputed into the recipient's record for eligible days. Finally, the results of the attrition imputation were used to make the final determination of a person's respondent status. If more than two-thirds of the person's total

eligible days (both reported and imputed) were imputed eligible days, then the person was considered a total nonrespondent, and the data for the person were removed from the data file.

Item Nonresponse and Imputation

Persons classified as respondents may fail to provide information for some or many items in the questionnaire. In NMCUES, item nonresponse was particularly a problem for health care charges, income, and other sensitive topics. The extent of missing data varied by question, and imputation for all items in the data file would have been expensive. Imputations were made for missing data on key demographic, economic, and charge items across five of the six data files in the public use data tape (all except the condition file). Table I illustrates the extent of the item nonresponse problem for selected survey measures that received imputations in four data files used in this report.

Demographic items tend to require the least amount of imputation. Some, such as age, sex, and education, had insignificant levels of imputation. Income items had higher levels of nonresponse. Nearly one-third of the persons required imputation for at least one component of total personal income, which is a cumulation of earned income and 11 sources of unearned income. The bed-disability days, work-loss days, and cut-down days have levels of imputation between those for the demographic and income items.

Table I

Percent of data imputed for selected survey items in 4 of the NMCUES public use data files: United States, 1980

Tape location	Description	Percent imputed
	Person file (n = 17,123)	
P54	Age	0.1
P57	Race	[1]20.0
P59	Sex	0.1
P62	Highest grade attended	0.1
P67	Perceived health status	0.8
P592	Functional limitation score	3.2
P125	Number of bed-disability days	7.9
P128	Number of work-loss days	8.9
P135	Number of cut-down days	8.2
P399	Wages, salary, business income	9.7
P434	Pension income	3.5
P445	Interest income	21.6
P462	Total personal income	[2]30.4
	Medical visit file (n = 86,594)	
M117	Total charge	25.9
M123	First source of payment	1.8
M125	First source of payment amount	11.6
	Hospital stay file (n = 2,946)	
H252	Nights hospitalized	3.1
H124	Total charge	36.3
H130	First source of payment	2.2
H132	First source of payment amount	17.6
	Medical expenses file (n = 58,544)	
E117	Total charge	19.4
E123	First source of payment	2.8
E125	First source of payment amount	10.0

[1]Race for children under 17 years of age imputed from race of head of reporting unit.
[2]Cumulative across 12 types of income.

The highest levels of imputation occurred for the important charge items on the various visit, hospital stay, and medical expenses files. Total charges for medical visits, hospital stays, and prescribed medicines and other medical expenses were imputed for 25.9 percent, 36.3 percent, and 19.4 percent of the events, respectively. Among the source-of-payment data, the imputation rates for the source of payment were small, but the rates for the amount paid by the first source of payment were generally subject to high rates of imputation. The number of nights hospitalized on the hospital stay file was imputed at a rate comparable to that for first source of payment.

The methods used to impute for missing items were diverse and tailored to the measure requiring imputation. Three types of imputation predominate: Edit or logical imputations, a sequential hot deck, and a weighted sequential hot deck. The edit or logical imputations were used to eliminate missing data that could reasonably be determined from other data items that provided overlapping information for the given item. The sequential hot deck was used primarily for small numbers of imputations for the demographic items; the weighted sequential hot deck was used more extensively and for virtually all other items for which imputations were made.

The edit or logical imputation is a process in which the value of a missing item is deduced from other available information in the data file. For example, race was not recorded for children under 17 years of age during the survey. Instead, a logical imputation was made during data processing that assigned the race of the head of the reporting unit to the child. Similarly, extensive editing was performed for the charge data before any imputations were made. If first source of payment was available, only one source of payment was given; and if total charge was missing, the value of the first source of payment amount was assigned to the total charge item.

In the sequential hot-deck procedure, the data are grouped within imputation classes formed by variables thought to be correlated with the item to be imputed. An additional sorting within imputation classes by variables also thought to be correlated with the imputed item is typically used. An initial value, such as the mean of the nonmissing cases for the item, is assigned as a "cold-deck" value. The first record in the file is then examined. If it is missing, the "cold-deck" value replaces the missing data code; if it is real (not missing), the real value replaces the "cold-deck" value and becomes a "hot-deck" value. Then the next record is examined. Again, the "hot-deck" value is used to replace missing

data; if the value is real, it becomes the "hot-deck" value. The process continues sequentially through the sorted file. The weighted hot deck, a modification of the sequential hot deck, uses weights to determine which real values are used to impute for a particular record needing imputation.

The imputation process will be described for two items to illustrate the nature of imputation for NMCUES. For Hispanic origin, two different imputation procedures were used: Logical and sequential hot deck. Because Hispanic origin was not recorded during the interview for children under 17 years of age, a logical imputation was made by assigning to the child the Hispanic origin of the wife of the head of the reporting unit, if present, and the origin of the head of the reporting unit otherwise. For the remaining cases that were not assigned a value by this procedure, the data were grouped into classes by observed race of the head of the reporting unit; within classes, the data were sorted by reporting unit identification number, primary sampling unit, and segment. An unweighted sequential hot deck was used to impute values of Hispanic origin for the remaining cases with missing values.

The imputations for medical visit total charge were made after extensive editing had been done to eliminate as many inconsistencies as possible between sources of payment and total charges. The medical visit records were then separated into three types: Emergency room, hospital outpatient department, and doctor visits. Within each type, the records were classed and sorted by several measures, which differed across visit types, prior to a weighted hot-deck imputation. For example, the records for doctor visits were classified by reason for visit, type of doctor seen, whether work was done by a physician, and age of the individual. Within the groups formed by these classification variables, the records were then sorted by type of health care coverage and month of visit. Finally, the weighted hot-deck procedure was used to impute for missing total charge, sources of payment, and source-of-payment amounts for the classified and sorted data file.

Because imputations were made for missing items for a large number of the important items in NMCUES, they can be expected to influence the results of the survey in several ways. In general, the weighted hot deck is expected to preserve the means of the nonmissing observations when those means are for the total sample or classes within which imputations were made. However, means for other subgroups, particularly small subgroups, may be changed substantially by imputation. In addition, sampling variances can be substantially underestimated when imputed values are used in the estimation process. For a variable with one-quarter of its values imputed, for instance, sampling variances based on all cases will be based on one-third more values than were actually collected in the survey for the given item. That is, the variance would be too small by a factor of at least one-third. Finally, the strength of relationships between measures that received imputations can be substantially attenuated by the imputation. A more complete discussion of these issues can be found in Lepkowski, Stehouwer, and Landis (1984).

Appendix II. Data Modifications to Public Use Files

During the preparation of this report, a number of problems were discovered in the NMCUES public use files that required modification of the data. Eight sets of problems were identified:

(1) Sampling weights for 68 newborns (i.e., persons born in 1980) were in error.

(2) Six respondents had extremely high hospital stay charges.

(3) Forty-seven respondents had health care coverage categories inconsistent with source of payment for some medical events.

(4) For 173 respondents, fewer bed-disability days than hospital nights were reported. (Length-of-stay data were recorded in terms of the number of nights—as opposed to days—spent in the hospital.)

(5) Four respondents had extremely long lengths of stay in the hospital as a result of incorrect hospital admission dates.

(6) Four respondents had poverty status categories that were inconsistent with their poverty status level.

(7) Nine respondents were coded as deliveries in the hospital file but had inconsistent values for other hospital stay data.

(8) One respondent had duplicate hospital stay records.

Details of the changes made to correct these problems may be obtained from NCHS. Detailed descriptions of the specific changes are provided in the NMCUES series report by Lepkowski et al. (to be published). General information on the problems and changes is outlined below.

(1) Records for 68 newborns were incorrectly coded as eligible for the entire survey period (all 366 days) although born after January 1, 1980. These errors were corrected by changing the eligible time-adjustment factor and the person time-adjusted weight for each of the 68 records.

(2) After careful examination, the University of Michigan and NCHS determined that six hospital stay records, each with charges of at least $90,000, were incorrect and should be changed. These six records and related information in the person file (e.g., hospital stay charges, total charges) were changed to conform with records in the Medicare best estimate file or with other information about each of the six respondents' hospitalizations contained in the hospital stay file.

(3) Discrepancies between source of payment and health care coverage were noted in the course of analysis. All of the discrepancies involved Medicare coverage. Forty-seven respondents reporting Medicare as a source of payment in the medical visit, hospital stay, or prescribed medicine file were not properly coded as covered by Medicare. Health care coverage for these respondents was reclassified strictly according to source-of-payment data. Respondents originally coded as covered by private insurance but whose records did not show private insurance as a source of payment for any services were coded as having Medicare and private insurance coverage. When reassignment based on imputed data for source of payment would conflict with real data for health care coverage, the real data were used in preference to the imputed data.

(4) For 173 cases, the value for hospital nights was greater than the value for bed-disability days. According to interviewer instructions for the NMCUES questionnaire, hospital nights should be included in bed-disability days, except for newborns. Therefore, the value of bed-disability days was adjusted to equal hospital nights for these 173 cases, a procedure used in Health Interview Survey processing. However, this adjustment does not fully compensate for the errors in recording or computing bed-disability days. It is likely that bed-disability days are still underestimated for these 173 cases after the edit. The edit was performed without regard to the imputation status of either bed-disability days or hospital nights.

(5) Four cases with discrepancies between bed-disability days and hospital nights also had improperly coded hospital admission dates, which led to the recording of excessively long lengths of stay. In these cases, the admission dates and hospital nights were corrected, and the bed-disability days edit was not necessary.

(6) Comparison of the continuous and the categorical poverty status variables on the public use file identified four respondents whose categorical poverty status was inconsistent with their continuous poverty status value. The categorical variable was changed to correspond to their poverty status on the continuous variable.

(7) A variety of problems were discovered on nine records coded as deliveries in the hospital stay file.

(a) Two deliveries were attributed to male respondents. Examination of the data files suggested that the sex variable was incorrectly coded in these two cases; the sex was therefore recoded to female. A third delivery attributed to a male was actually that of the respondent's spouse. In this case, the hospital record was reassigned and appropriate changes made in the person file for both respondents.

(b) Four hospitalizations for newborns were incorrectly coded as deliveries. These were recoded in the hospital stay file. A fifth newborn's hospital record was attributed to its mother. In this case, the hospital record was transferred to the newborn, and appropriate changes were made in the person file for both respondents.

(c) One delivery was attributed to a 74-year-old woman. Following an NCHS recommendation, the response was recoded to reflect signs, symptoms, and ill-defined conditions as the admitting condition.

(8) Two sets of duplicate records (four records in total) in the hospital stay file were discovered for one respondent. The two duplicates were deleted in the hospital stay file, and necessary changes were made in the person file. Three of the four records had been imputed to another respondent for reasons of attrition. No changes were made in the records for the respondent receiving the attrition-imputed records.

Appendix III.
Analytical Strategies

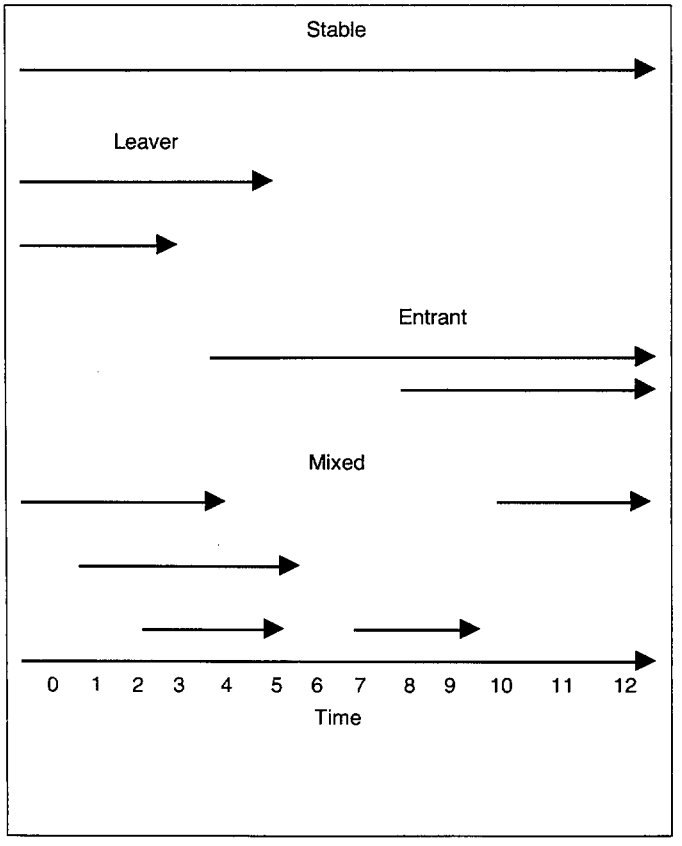
Notion of an Average Population

NMCUES was a panel survey in which members of the population were followed during the panel period (calendar year 1980). The nature of a dynamic population over time influences the rules used to determine who should be followed and for how long. It also has significant implications for the form of estimators for characteristics of the population during the panel period. Before discussing estimation strategies for NMCUES data, it is useful to review the nature of a dynamic population over time.

The nature of a longitudinal population as members move in and out of eligibility is illustrated in Figure I. Stable members of the population appear at the beginning and at every time point during the life of the longitudinal time period. Even though these persons are termed "stable," they may, of course, change residence during the panel period and may be quite difficult to trace. Leavers are persons who are eligible at the beginning of a time period but become ineligible at some later time. Leaving may occur through events such as death, institutionalization, or moving outside the geographic boundary of the population. At the same time, new members (entrants) may enter the population through births or through returns from institutions or from outside the geographic boundary of the population. Finally, there also will be mixed population elements that are both entrants and leavers from the population during different time periods. The majority of the population typically will be stable in nature, but it is the entrants and leavers, persons who may be experiencing major changes in their lives, who are often of particular interest to analysts of panel survey data. In order to assure adequate coverage of all elements in the dynamic population considered over the entire time period, NMCUES followup rules were carefully specified to include entrants, leavers, and mixed population elements properly.

Figure I

Dynamic population for 12 time period panel survey



As an illustration, consider a person who was in the Armed Forces on January 1, 1980, and was discharged on June 1, 1980, thus becoming a key person (i.e., one to be followed for the rest of the year while eligible) in the NMCUES panel. Because NMCUES was designed to provide information about the civilian population, medical care use and charges during the first 5 months of 1980 for this person are outside the scope of the survey. Data about health care use and charges were not collected unless they occurred after June 1. At the same time, this person was eligible for only 7 months of the year, and he was also "at risk" of incurring health care use or charges for only 7 of the 12 months. This person thus contributes only 7/12 or 0.58 of a year of eligibility (person year) to the study. This quantity is referred to as the "time-adjustment factor" in the documentation and throughout these appendixes.

For readers not familiar with the concept of "person years of risk," it may be useful to consider briefly the rules that were used to determine eligibility for a given person at a given moment during 1980. There were essentially two ways of becoming eligible for or entering

the NMCUES eligible population. One way was to be a member of the U.S. civilian noninstitutionalized population on January 1, 1980, and hence a member of the original or base cohort about which inferences were to be made. The second way was to enter after January 1 through birth or through rejoining the civilian noninstitutionalized population during the year by returning from an institution, from the Armed Forces, or from outside the United States. There were also several ways by which persons who were eligible members of the population could become ineligible. Death obviously removes a person from further followup, as does institutionalization, joining the Armed Forces, or moving to a residence outside the United States. Information was collected to monitor the exact number of days that each person selected for NMCUES was eligible during the year. These eligibility periods are summarized by the time-adjustment factor on each record.

The use of "person years" to form sample estimates requires careful assessment of the characteristic to be estimated. Estimates that use only data collected from persons during periods of eligibility (e.g., total number of doctor visits, total charges for health care) do not need to account for time adjustments. Estimates for person characteristics (e.g., total population, proportion of the population in a given subgroup) must be based on person years to obtain estimates that correspond to those for health care estimates. Some estimates require the use of the time-adjustment factor in the denominator but not in the numerator. For example, an estimate of the mean total charge for health care during 1980 must use the total charges for health care as a numerator without time adjustment, but the denominator must be the number of person years that the U.S. population was exposed to the risk of such charges during 1980, a time-adjusted measure. The mean in this case is actually a rate of health care charges per person year of exposure for the eligible population in 1980.

When making estimates in which person years are important, the effect of the time-adjustment factor will vary depending on the subpopulation of interest (Table II). A cross-sectional cohort of N persons selected from the U.S. population on January 1, 1980, and followed for the entire year will contribute a total number of person years for 1980 that is smaller than N because of removals (i.e., deaths, institutionalization, and so on). If entrants are added to the initial cohort during the year, the person years contributed by the initial cohort and the entrants may well exceed N, but it will still be less than the number of original cohort members plus the number of entrants.

The difference between persons and person years will vary by subgroups as well. Females 25–29 years of age on January 1 constitute a cohort for which few additions are expected because of entrants from institutions, the Armed Forces, or living abroad. Few removals are expected because of death, institutionalization, joining the Armed Forces, or moving abroad. On the other hand, males 80 years of age and over on January 1 will contribute a much smaller number of person years to the population than the total number of persons in the cohort at the beginning of the year, because a large number of the cohort will die during the year.

Role of Weights and Imputation

Estimated means and sampling errors from NMCUES for bed-disability days, work-loss days, work-loss days in bed, cut-down days, and restricted-activity days are presented in Table III. For each survey measure, separate estimates were computed using all data (i.e., both real and imputed) and using only the real data. The unweighted and weighted mean, unweighted and weighted simple random sampling standard error of the mean, and the weighted complex standard error, which accounts for the stratified, multistage nature of the design, are presented.

For each measure, the weighted means computed using all the data and using only the real data are quite similar. This similarity is not unexpected given that the weighted hot deck imputation procedure is designed to preserve the weighted mean for overall sample estimates. The simple random sampling standard errors, however, are smaller when all data are used simply because the simple random sampling variance is inversely related to the sample size. For the complex standard error, three of the five measures have smaller standard errors when all data are used, and the other two measures show the opposite relationship. Weighting and imputation for the disability measures have little or no effect on estimated means or their standard errors for the total

Table II

Effect of person-year adjustment on counts and sampling weights, by 4 population groups: United States, 1980

Population group	Sample size	Person years	Sum of sampling weights	
			Basic weight in thousands	Adjusted weight in thousands
Total population	17,123	16,862.84	226,368	222,824
Females, 25–29 years of age	702	699.39	9,529	9,494
Males, 80 years of age and over	113	104.05	1,384	1,274
All persons born during 1980	251	121.02	3,560	1,713

Table III

Sample size, means, and standard errors for 5 disability measures, by all and real data subgroups: United States, 1980

Estimates in this table are presented for illustrative purposes. Calculations were made prior to data modifications described in Appendix II.

Disability measure and data type	Sample size	Unweighted estimates		Weighted estimates		
		Mean	Simple random sampling standard error	Mean	Simple random sampling standard error	Complex standard error
Bed-disability days						
All data	17,123	5.303	0.1279	5.268	0.1269	0.1540
Real data	15,777	5.253	0.1326	5.228	0.1319	0.1599
Work-loss days						
All data	13,069	3.614	0.1221	3.696	0.1220	0.1629
Real data	11,537	3.510	0.1284	3.574	0.1277	0.1716
Work-loss days in bed						
All data	13,069	1.516	0.0508	1.568	0.0518	0.0592
Real data	10,970	1.530	0.0556	1.578	0.0568	0.0652
Cut-down days						
All data	17,123	6.831	0.1681	6.881	0.1697	0.3343
Real data	15,724	6.609	0.1721	6.639	0.1735	0.3322
Restricted-activity days						
All data	17,123	13.746	0.2559	13.805	0.2573	0.4716
Real data	14,049	13.036	0.2732	13.064	0.2742	0.4658

Table IV

Sample size, means, standard errors, and element variance for total charge for a hospital outpatient department visit, by data type: United States, 1980

Estimates in this table are presented for illustrative purposes. Calculations were made prior to data modifications described in Appendix II.

Data type	Sample size	Unweighted estimates		Weighted estimates			Element variance ($\times 10^{-3}$)
		Mean	Simple random sampling standard error	Mean	Simple random sampling standard error	Complex standard error	
All data	9,529	51.86	1.030	51.61	1.018	1.914	9.87
Real data only	4,688	52.28	1.436	52.27	1.430	2.936	9.59
Imputed data	4,841	51.45	1.476	50.98	1.447	1.600	10.14
Real data							
Not donor	929	47.83	2.108	48.53	2.117	3.935	4.17
Donor once	2,789	55.85	2.016	55.76	1.982	3.386	11.00
Donor twice	841	48.61	3.525	49.37	3.579	4.879	10.78
Donor 3–5 times	120	29.45	7.340	28.97	7.987	11.64	7.66

population because the amount of missing data for these measures is small (approximately 7 or 8 percent).

For other measures that have larger amounts of missing data, imputation has larger effects. Consider the means and standard errors for total charge for a hospital outpatient department visit shown in Table IV. Of 9,529 hospital outpatient department visits (real visit records plus those generated from the attrition imputation process), 4,841 have a total charge that was imputed from one of the other hospital outpatient department visit records. Thus, more than one-half of the total charges were missing for this particular medical event. Despite the large amount of missing data, the weighted means using all the data and using only real values are quite similar; weighting does not affect the estimated means. However, sampling errors are changed substantially when imputed values are added to real values to form an estimate. The weighted and unweighted simple random sampling standard errors are markedly smaller for all data than for the real data.

To investigate whether this decrease in sampling error is caused by changes in sample size, changes in the element variance, or both, the element or total variances were estimated by multiplying the weighted simple random sampling variances by the sample sizes. Inspection of Table IV suggests that the element variances are quite similar using all data and real data; the differences in standard error when all data and only real

data are used can be attributed mostly to the loss in sample size when going from all data to real data.

Not all of the real data were used as donors for imputation, and some of the real data were used as donors several times. Table IV also suggests that those real values not used as donors have a lower mean total charge than those used as donors, but values used as donors more than twice tend to have even smaller mean total charges. The means for donors used once, twice, or more frequently are a function of the use of imputation classes, within which the mean total charge and the amount of missing data varied.

The difference in complex standard errors between all data and the real data in Table IV illustrates the large effects of imputation. However, neither the complex standard error computed using all the data nor that computed using only the real data is the correct standard error for the weighted mean estimated using all the data. The mean computed using all data includes 4,841 values that were actually subsampled with replacement from the 4,688 real values. In addition, imputations were made across the primary sampling units and strata used in both the sample selection process and the variance estimation procedure. It is assumed in the variance estimation procedure that the observations were selected independently from primary sampling units and strata. That assumption is incorrect in this case. Hence, the complex standard error for all data shown in Table IV fails to account for two sources of variability: The double sampling used to select values for imputation and the correlation between primary sampling units and strata induced by imputation. At the same time, the complex standard error for the weighted mean computed using only the real data is an incorrect estimate of the standard error of the mean based on all the data. The actual sampling

Figure II

Estimated mean charges per hospital outpatient department visit, by 4 family income classes for all and real data: United States, 1980

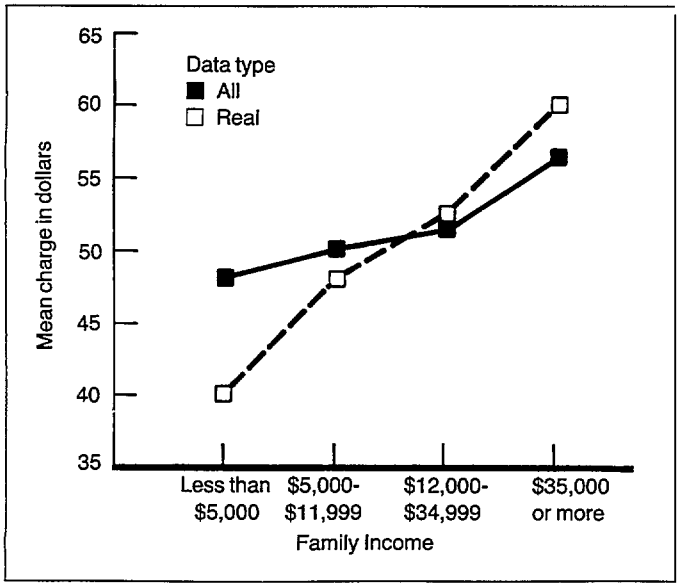
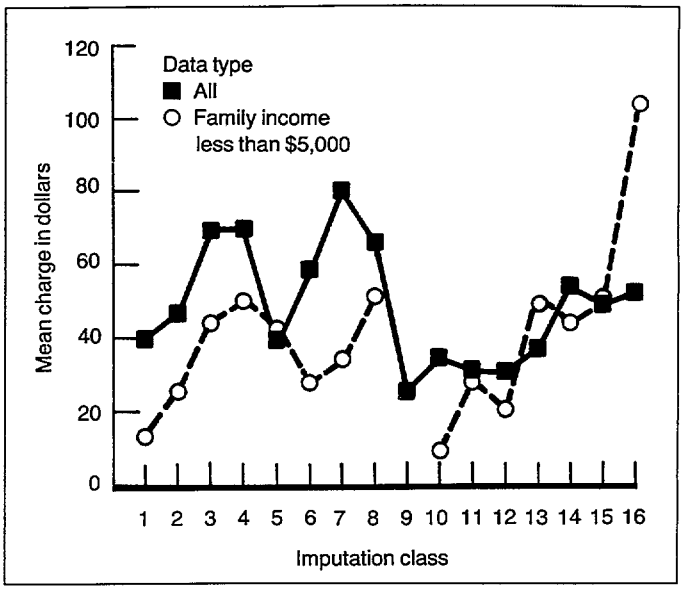


Figure III

Estimated mean charges per hospital outpatient department visit, by 16 imputation classes for all persons and for persons in families with income less than $5,000: United States, 1980



error of the weighted mean for all the data is probably larger than that shown for the mean estimated using all the data; it may even be larger than the sampling error computed using only the real data.

As a final illustration of the effects that imputation can have on survey results, Figure II presents estimated mean charges per hospital outpatient department visit for four family income groups computed using all the data and using only the real data. For the real data, the mean charge per visit increases in a linear fashion as the family income increases. However, when all the data are used to estimate the mean charge per visit, the mean charge does not increase as rapidly with increasing family income. The strong relationship between family income and mean charge per hospital outpatient department visit in the real data has been attenuated by the imputed values.

The reason for this attenuation is shown in Figure III. Sixteen imputation classes were formed for the imputation of total charges for hospital outpatient department visits. Figure III shows mean charge by imputation class for real data for the total sample and for the subgroup with family incomes less than $5,000 in 1980. The low income group has lower mean charges than the total sample. Because family income was not one of the variables used to form imputation classes, low family income persons within an imputation class with missing hospital outpatient department visit total charges were imputed a charge that was, on average, higher than the mean charge for low income persons with real data. This occurs in almost every imputation class. When the real and imputed data are combined for persons with family incomes less than $5,000, the effect of imputation is to increase the mean charge for this

subgroup. Conversely, for persons with family incomes of $35,000 or more, total hospital outpatient department visit charges for persons with real data tend to be larger than values imputed to persons with missing charges. The overall impact of the imputation process on the relationship between charges for hospital outpatient department visits and family income is a regression toward the mean charge for real data for low- and high-income subgroups.

The results in Tables III and IV and Figure II demonstrate the effect that imputation can have on estimated means, on estimated sampling errors, and on relationships between variables. Several strategies for handling imputation in estimation are suggested by these findings. It is beyond the scope of this discussion to evaluate various strategies and indicate the reasons why one was chosen for this report. The strategy used in preparing estimates for this report was to use all the data in all estimates despite the sizable effects caused by imputation. This strategy means that estimated means and totals presented in the report have been adjusted for item nonresponse, but sampling errors and relationships among some variables may be adversely affected by the imputation process. The reader should keep in mind that sampling errors for estimates that are subject to large amounts of item nonresponse may be underestimated, and the strength of relationships between a variable receiving imputed values and a variable that was not used to form imputation classes may be attenuated by the imputation process.

Estimation Procedures

Sample estimators from the NMCUES data, regardless of whether they are totals, means, medians, proportions, or standard errors, must account for the complexity of the sample survey design. Totals, means, and other estimates must include sampling weights to compensate for unequal probabilities of selection, nonresponse, and undercoverage. Stratification, clustering, and weighting must also be accounted for in the estimation of sampling errors. In addition, consideration must be given to time-adjustment factors to account for persons not eligible for the entire year and to imputations that were made to compensate for missing items.

A variety of estimators were used for the descriptive analyses. To illustrate the role of time adjustments, consider the following six specific estimates that were used in the analysis:

- Estimated total charges for a selected subgroup (e.g., persons with musculoskeletal conditions).
- Estimated total population.
- Mean charge per visit.
- Mean charge per person.
- Proportion of charges that fall in a certain range of charges.
- Proportion of persons whose charges are less than or equal to a fixed level.

To define these estimators, the following notation for these quantities for the ith person is used:

y_i = total charges for health care in 1980;

x_i = total number of medical visits for 1980;

w_i = nonresponse and undercoverage adjusted person weight;

t_i = time-adjustment factor (i.e., the proportion of days in 1980 that the person was an eligible member of the population);

$$d_i = \begin{cases} 1, \text{ if total charges are less than or equal to a fixed value,} \\ 0, \text{ otherwise;} \end{cases}$$

$$e_i = \begin{cases} 1, \text{ if the total charge is between two fixed values,} \\ 0, \text{ otherwise; and} \end{cases}$$

$$\delta_i = \begin{cases} 1, \text{ if the } i\text{th person is a member of a designated subgroup of the population,} \\ 0, \text{ otherwise.} \end{cases}$$

Estimating total charges, or any quantity from NMCUES that was recorded only during periods when the person was a noninstitutionalized civilian in the United States, is a relatively straightforward task requiring only a weighted sum of charge values. In particular,

$$\hat{y} = \sum w_i y_i \delta_i$$

is the estimated total charge for a particular service for a selected subgroup. On the other hand, for estimates of total population, a time-adjusted estimator is required such as

$$\hat{y}' = \sum w_i t_i \delta_i .$$

Thus, $\hat{y}'$ denotes an estimate of the 1980 average subgroup population, and $\hat{y}$ denotes the 1980 charges for a subgroup of the noninstitutionalized civilian population.

Estimated means may or may not need to include a time-adjustment factor in the denominator. For example, to estimate the mean charge *per visit* during 1980, no time adjustment is needed. Hence,

$$\bar{y} = \sum w_i y_i / \sum w_i x_i$$

can be used to estimate mean charge per visit. However, to estimate mean charge *per person,* a time adjustment

is required in the denominator because the denominator is actually an estimate of the total average population in 1980. In particular, the estimator has the form

$$\bar{y}' = \sum w_i y_i / \sum w_i t_i .$$

Estimates of mean charges for subgroups have a similar form, with the indicator variable δ_i included in the numerator and denominator for the appropriate subgroup of interest.

Estimated proportions are means that have an indicator variable in the numerator and a count variable in the denominator. Proportions may have time adjustments not only in the denominator but also in the numerator. For example, to estimate the proportion of persons who had charges less than or equal to a fixed value, an estimate of the form

$$p' = \sum w_i d_i t_i / \sum w_i t_i$$

was used. Appropriate indicator variables were added to the numerator and denominator to make estimates for selected subgroups.

On the other hand, the estimated proportion of total charges between two fixed levels of charges does not require time adjustments in the numerator or the denominator. In particular,

$$p = \sum w_i y_i e_i / \sum w_i y_i$$

is the estimated proportion of all charges for persons that occurred between two levels of charges.

Appendix IV. Sampling Errors

The NMCUES sample was one of a large number of samples that could have been selected from the U.S. civilian noninstitutionalized population using the same sampling procedures. Each possible sample could provide an estimate that might differ from the same estimate from another sample. The variability among the estimates from all possible samples that could have been selected is defined as the standard error of the estimate, or the sampling error. The standard error can be used to assess the precision of the estimate itself by creating a confidence interval. For each interval, there is a specified probability that the average estimate over all possible samples selected from the population using the same sampling procedures will be in the interval.

Preparation of sampling errors for every estimate in this report would be a sizable task, as would be presentation of sampling error estimates for every estimate. Rather than compute and display standard errors for every estimate in this report, standard errors were computed for a subset of estimates. A set of functions was fit to these estimated standard errors to identify a model that would allow computation of a standard error that would be reasonably close to the estimated standard error.

This appendix provides summary formulas derived from the estimated standard errors that can be used to approximate the standard error for any given estimate in the report. The formulas have been designed to allow computation of an estimated standard error using an electronic calculator with basic arithmetic operators and a square root function. The computed estimate will be an average or smoothed estimate of the actual standard error of the estimate.

The formulas for standard error estimates are presented for three types of estimates found in the report:

- Totals or aggregates (e.g., total charges for all health services used in 1980; total person years for males).
- Means (e.g., per capita condition-related charges for ambulatory visits; mean number of ambulatory visits).
- Proportions, percents, and prevalence rates (e.g., proportion of ambulatory visit charges paid out of pocket; percent of persons with hospital charges less than $1,000; prevalence rate of musculoskeletal conditions for males 45–64 years of age).

Comparisons can also be made between point estimates from two different subgroups of the population. Formulas are given for computing standard errors for two types of comparisons:

- Comparisons of two mutually exclusive subgroups (e.g., comparing mean number of ambulatory visits for males and females, male and female subgroups having no members in common).
- Comparisons between a subgroup and a larger group in which the subgroup is contained (e.g., comparing proportion of hospital stay charges paid out of pocket for the joints only condition group with those for all persons with musculoskeletal conditions).

The standard error of a difference is based on the standard error of the totals, means, proportions, percents, or prevalence rates of interest. Certain covariances between estimates, which typically are small relative to the standard errors of the estimates themselves, are ignored.

The standard errors calculated from the formulas in this appendix can be used to form intervals about which confidence statements can be made for estimates from all possible samples drawn in exactly the same way as NMCUES was. The confidence level is determined by multiplying the estimated standard error by a constant derived from the standardized normal probability distribution. In particular, for the estimate $\hat{\theta}$ with estimated standard error $S_{\hat{\theta}}$, the upper limit for a $(1-\alpha) \times 100$ percent confidence interval can be formed by adding $z_{\alpha/2}$ times S_{θ} to θ. The lower limit is formed by subtracting $z_{\alpha/2}$ times $S_{\hat{\theta}}$ from $\hat{\theta}$. The value of $z_{\alpha/2}$ is obtained from the standard normal probability distribution. For example, a 95-percent confidence interval corresponding to $\alpha = 0.05$ can be formed with $z_{0.025} = 1.96$; a 99-percent confidence interval ($\alpha = 0.01$) uses $z_{0.005} = 2.346$. Illustrations of these calculations are provided in the discussion section for each formula.

Confidence intervals for comparisons of estimates between two subgroups allow inferences to be made about whether the difference is statistically significant. If a $(1-\alpha) \times 100$-percent confidence interval does not include the value zero, the difference is significantly different from zero.

Totals

Let $\hat{y}$ denote the estimated total or aggregate for which a standard error is desired. The standard error for the estimate can be calculated by the expression

$$S_{\hat{y}} = [a\hat{y} + b\hat{y}^2]^{1/2},$$

where a and b are constants chosen from Table V for the particular estimate of interest. This formula was derived from a study of the relationship between the estimated total $\hat{y}$ and its standard error $S_{\hat{y}}^2$ in which a parabolic or quadratic relationship was observed.

As an illustration of the use of this formula, suppose that the standard error of the estimated number of persons with joint problems is needed. From Table A, $\hat{y} = \$28,577,000$, the estimated total number of person years accumulated in 1980 by persons with joint disorders. Table V contains the coefficients for person years, $a = 3.0476 \times 10^4$ and $b = 4.7081 \times 10^{-4}$. The estimated standard error is then computed as

$$\begin{aligned} S_{\hat{y}} &= [(3.0476 \times 10^4)(2.8577 \times 10^7) + \\ &\quad (4.7081 \times 10^{-4})(2.8577 \times 10^7)^2]^{1/2} \\ &= [(8.7091 \times 10^{11}) + (3.8448 \times 10^{11})]^{1/2} \\ &= 1,120,445,000. \end{aligned}$$

This estimated standard error for the total $\hat{y}$ can be used to create confidence intervals for the number of persons with joint problems. For example, a 68-percent confidence interval is obtained by adding and subtracting the standard error from the estimate. In this case, in 68 out of 100 samples drawn exactly in the same way as in NMCUES, the estimated number of persons with joint problems will range from 27,456,555 to 29,697,445. Similarly, a 95-percent confidence interval can be obtained by adding and subtracting from the estimate 1.96 times the standard error. Thus, for 95 of 100 samples drawn in the same way as in NMCUES, the estimated number of persons with joint disorders would be from 26,380,928 to 30,773,072.

Table V

Coefficients for standard error formula for estimated aggregates or totals, by estimator

Estimator	Coefficient	
	a	*b*
Person years	3.0476×10^4	4.7081×10^{-4}
Charges	1.0986×10^8	4.5524×10^{-4}
Lost productivity and value of lost productivity	1.1593×10^1	9.1757×10^{-4}
Visits, prescription acquisitions, or disability days	4.6408×10^2	5.7634×10^{-1}

Means

A large number of means for different types of measures are presented in this report. Despite the variety of measures presented, a single formula is recommended for calculating an estimated standard error for a mean. The formula given here is based on the assumption that the standard error of the mean is determined by two quantities, the population variance and the effect of the sample design on the variances. The population variance for weighted survey data with weights w_i is estimated as

$$\hat{s}^2 = \frac{\sum w_i (y_i - \bar{y})^2}{\sum w_i - 1},$$

where y_i denotes the value of the characteristic Y for the ith sample person, and $\bar{y}$ is the weighted sample mean. The effect of the sample design on the variance of a sample mean is called the design effect, or "deff" (Kish, 1965), and is often expressed as

$$\text{deff} = [1 + [(n/a) - 1]\, roh],$$

where a is the number of clusters in the sample design and *roh* is a measure of within-cluster similarity among observations from the same cluster.

The estimated standard error for a mean $\bar{y}$ can be calculated as

$$S_{\bar{y}} = \left[\text{deff} \cdot \frac{\hat{s}^2}{\hat{n}}\right]^{1/2}$$

$$= \left[\left[1 + \left[\frac{\hat{n}}{1,795,637} - 1\right] roh\right] \cdot \frac{\hat{s}^2}{\hat{n}}\right]^{1/2}$$

where $\hat{n}$ is the estimated population total for the subgroup under consideration and 1,795,637 represents the number of clusters ($a = 138$) times the average basic person weight. Consequently, $\hat{n}/1,795,637$ is an estimator for n/a in the expression for deff. The values of *roh* and $\hat{s}^2$ for a variety of means appearing in this report can be obtained from Table VI. The table provides, for example, values of *roh* and $\hat{s}^2$ for mean charges and mean utilization measures of various types.

As an illustration, consider the standard error of the per capita charges generated in the treatment of all musculoskeletal conditions for males during 1980. From Table 7, for all musculoskeletal conditions; male $\bar{y} = \$316$, and from Table VI, under the entry "Mean charges per person, All charges, Total," the values $roh = 0.029644$ and $\hat{s}^2 = 7.2407 \times 10^{10}$ are obtained. There were an estimated $\hat{n} = 19,408,000$ males with mus-

Table VI

Values for *roh* and $\hat{s}^2$ for standard error formula for estimated means, by estimator

Estimator	*roh*	$\hat{s}^2$
Mean charges per person		
All charges:		
Ambulatory visits	0.029644	2.4952×10^9
Hospital stays	0.029644	6.1652×10^{10}
Physician visits	0.029644	6.1914×10^8
Total	0.029644	7.2407×10^{10}
Emergency room visits	0.029644	9.9816×10^7
Prescribed medications	0.029644	9.6458×10^7
Hospital outpatient visits	0.031367	7.6646×10^8
Independent provider visits	0.031367	2.6559×10^7
Hospital outpatient visits (nonphysician provider)	0.031367	4.2419×10^8
Physician visits (nonphysician provider)	0.031367	5.3375×10^7
Dental and other medical expenses	0.031367	8.8305×10^7
Charges paid out of pocket:		
Ambulatory visits	0.029644	2.4323×10^8
Hospital stays	0.029644	2.4068×10^9
Physician visits	0.029644	1.0745×10^8
Total	0.029644	3.5873×10^9
Emergency room visits	0.029644	1.0038×10^7
Prescribed medications	0.029644	4.5416×10^7
Hospital outpatient visits	0.031367	8.6571×10^6
Independent provider visits	0.031367	2.4996×10^8
Hospital outpatient visits (nonphysician provider)	0.031367	2.5341×10^7
Physician visits (nonphysician provider)	0.031367	6.7847×10^8
Dental and other medical expenses	0.031367	3.8943×10^8
Mean charges per user		
All charges:		
Ambulatory visits	0.043633	3.0423×10^9
Hospital stays	0.043633	3.0044×10^{11}
Physician visits	0.043633	1.1955×10^9
Total	0.043633	8.7587×10^{10}
Emergency room visits	0.043633	3.3067×10^8
Prescribed medications	0.043633	1.2535×10^8
Charges paid out of pocket:		
Ambulatory visits	0.043633	2.9046×10^8
Hospital stays	0.043633	1.6296×10^{10}
Physician visits	0.043633	1.5871×10^8
Total	0.043633	5.3877×10^9
Emergency room visits	0.043633	7.5825×10^7
Prescribed medications	0.043633	6.2806×10^7
Mean charges per visit		
All charges:		
Ambulatory visits	0.018777	3.7690×10^7
Hospital stays	0.018777	8.4926×10^{11}
Physician visits	0.018777	2.4686×10^7
Emergency room visits	0.018777	9.7896×10^8
Prescribed medications	0.018777	6.7348×10^5
Charges paid out of pocket:		
Ambulatory visits	0.018777	8.8152×10^6
Hospital stays	0.018777	9.4998×10^{10}
Physician visits	0.018777	9.2576×10^6
Emergency room visits	0.018777	1.1109×10^8
Prescribed medications	0.018777	7.8309×10^5
Mean visits per user		
Ambulatory visits	0.048246	1.4117×10^6
Hospital stays	0.048246	4.3009×10^3
Physician visits	0.048246	4.4788×10^5
Emergency room visits	0.048246	7.9937×10^3
Prescribed medications	0.048246	1.3402×10^6
Mean visits per person		
Ambulatory visits	0.048246	1.6398×10^6
Hospital stays	0.048246	1.0029×10^4
Physician visits	0.048246	5.5650×10^5
Emergency room visits	0.048246	1.6024×10^4
Prescribed medications	0.048246	1.6651×10^6
Mean percent paid out of pocket		
Ambulatory visits	0.051674	2.3071×10^3
Hospital stays	0.011724	1.7959×10^2
Prescribed medications	0.056569	2.7935×10^3
Dental and other medical expenses	0.053301	2.6150×10^3
Mean length of hospital stay	0.013098	8.5018×10^5
Mean bed-disability days	0.023772	7.6885×10^6
Mean work-loss days	0.026868	5.2013×10^6
Mean restricted-activity days	0.058349	3.4354×10^7
Mean functional limitation score	0.050066	4.9489×10^4
Mean number of surgical procedures	0.0	1.4628×10^8

culoskeletal problems. Substituting these values into the expression for $S_{\bar{y}}$,

$$S_{\bar{y}} = \left[\left[1 + \left(\frac{19{,}408{,}000}{1{,}795{,}637} - 1\right)(0.029644)\right] \cdot \frac{7.2407 \times 10^{10}}{19{,}408{,}000}\right]^{1/2}$$

$$= \left[\left[1 + (10.8084 - 1)(0.029644)\right](3{,}730.78)\right]^{1/2}$$

$$= [(1.2908)(3{,}730.78)]^{1/2}$$

$$= 69.39.$$

The standard error of per capita total charges generated in the treatment of musculoskeletal conditions among men is $69.39.

Approximate confidence intervals may be constructed for the population mean by adding to and subtracting from the estimated mean a constant times the estimated standard error. For example, to form a 95-percent confidence interval for the estimated per capita charges for men with musculoskeletal problems, 1.96 times the estimated standard error ($136) is added to and subtracted from the estimated mean $\bar{y}$=$316. In this case, the 95-percent interval ranges from $180 to $452.

When the estimated sample size is about the same size as or smaller than the constant 1,795,637 in the standard error formula, the design effect effectively becomes equal to 1. Thus, when $\hat{n} \leq 1{,}795{,}000$, the design effect portion of the standard error formula is not necessary, and the estimated standard error can be calculated simply as

$$S_{\bar{y}} = [\hat{s}^2/\hat{n}]^{1/2},$$

where $\hat{s}^2$ is again chosen from Table VI.

For example, there are an estimated $\hat{n}$=996,000 black persons with back problems. To estimate the standard error of the per capita charges for all health care for these persons in 1980 ($\bar{y}$=$322 from Table 7), the value $\hat{s}^2 = 7.2407 \times 10^{10}$ is obtained from Table VI as before and

$$S_{\bar{y}} = \left[\frac{7.2407 \times 10^{10}}{996{,}000}\right]^{1/2}$$

$$= 269.63.$$

To form an approximate 95-percent confidence interval for the per capita charges, 1.96 times the standard error ($528) is added to and subtracted from the estimated mean, $\bar{y}$=$322. The 95-percent interval thus ranges from −$206 to $850.

Proportions, Percents, and Prevalence Rates

The standard error of a proportion is computed using a formula similar to that recommended for the standard error of a mean. Let $\hat{p}$ denote the estimated proportion for which a standard error is needed. The standard error for $\hat{p}$ is calculated as

$$S_{\hat{p}} = \left[\left[1 + \left[\frac{\hat{n}}{1{,}795{,}637} - 1\right] roh\right] \frac{13{,}012\,\hat{p}(1-\hat{p})}{\hat{n}}\right]^{1/2},$$

where $\hat{n}$ is the estimated sample size on which the proportion is based, *roh* is a value selected from Table VII, and the constant 13,012 is the average time-adjusted weight for all persons in the sample. For proportions, the population variance can be estimated simply as

$$\hat{s}^2 = \hat{p}(1-\hat{p}),$$

and hence can be estimated directly from the sample proportions themselves (i.e., no value of $\hat{s}^2$ is needed in Table VII). The design effect, the ratio of the actual sampling variance for the estimated proportion to the variance that would be achieved for a simple random sample of the same size, is calculated for proportions in the same way as it was calculated for means.

As an illustration of the use of the formula for $S_{\hat{p}}$, consider obtaining the standard error for the proportion of persons ($\hat{p}$=0.107) who have joint problems and rate their health as poor (Table B). To calculate the standard error for percents, the same formula can be used as for proportions after the percent has been divided by 100. There are an estimated $\hat{n}$=3,057,739 persons in the group (0.107 × 28,577,000), and *roh*=0.069992 is obtained from Table VII. Substituting these values into the formula for $S_{\hat{p}}$,

$$S_{\hat{p}} = \left[\left[1 + \left(\frac{3{,}057{,}739}{1{,}795{,}637} - 1\right)(0.069992)\right] \cdot \frac{13{,}012\,(0.107)(1-0.107)}{3{,}057{,}739}\right]^{1/2}$$

$$= \left[\left[1 + (0.7028)(0.069992)\right] \frac{1{,}243.3}{3{,}057{,}739}\right]^{1/2}$$

$$= \left[(1.4920)(4.0661 \times 10^{-4})\right]^{1/2}$$

$$= 0.024630.$$

Because $S_{\hat{p}}$=0.024630 is the estimated standard error for the proportion $\hat{p}$=0.107, simply multiply $S_{\hat{p}}$ by 100 for a standard error of 2.4630 for the percent 10.7.

Table VII

Values of *roh* for standard error formula for estimated proportions, by estimator

Estimator	*roh*
Person years	0.069992
Charges	0.041917
Charges paid out of pocket	0.019816
Visits	0.084014

An approximate 95-percent confidence interval for the percent can now be calculated by adding to and subtracting from the estimated percent 1.96 times the estimated standard error. In this case, the 95-percent interval ranges from 5.9 to 15.5 percent of those persons with joint problems rating their health as poor.

When the estimated sample size is less than or equal to 1,795,637, the design effect is close to 1 and the formula can be simplified to

$$S_{\hat{p}} = \left[\frac{13{,}012\,\hat{p}(1-\hat{p})}{\hat{n}}\right]^{1/2},$$

as described for the standard error of a mean in the previous section. For example, 16.9 percent of persons with both joint and back disorders rate their health as poor (Table B). For the $\hat{n} = 850{,}239$ estimated persons in this subcategory ($0.169 \times 5{,}031{,}000$), the standard error of the proportion associated with this percent is estimated as

$$\left[\frac{13{,}012 \cdot (0.169)(1 - 0.169)}{850{,}239}\right]^{1/2} = 0.046360.$$

A 95-percent confidence interval for the estimated percent is calculated by multiplying this estimated standard error by $100 \cdot (1.96) = 196$ and adding the result to and subtracting the result from the percent. Thus, the 95-percent interval ranges from 7.8 to 26.0 percent.

The same procedure can be used to calculate standard errors for prevalence rates. Prevalence rates are handled in the same way as percents except that the rate is divided by 1,000 rather than 100 to obtain a proportion to use in the formula. For example, to obtain the estimated standard error for the prevalence rate for all musculoskeletal problems among males in Table 1 (a rate of 180.6 per 1,000 person years), divide the rate by 1,000 ($180.6/1{,}000 = 0.1806$) and calculate the estimated standard error as

$$S_{\hat{p}} = \left[[1 + (\frac{19{,}408{,}000}{1{,}795{,}637} - 1)(0.069992)] \cdot \frac{13{,}012 \cdot (0.1806)(1 - 0.1806)}{19{,}408{,}000}\right]^{1/2}$$

$$= \left[[1 + (9.8084)(0.069992)]\frac{1{,}925.563}{19{,}408{,}000}\right]^{1/2}$$

$$= [(1.6865)(9.921 \times 10^{-5})]^{1/2}$$

$$= 0.012935.$$

Multiplying this standard error by 1,000, a 95-percent confidence interval for the estimated prevalence rate ranges from 155.2 to 206.0 per 1,000.

Mutually Exclusive Subgroup Differences

Many comparisons between the same estimate for two different subgroups in the population are made in this report. Let $\hat{d} = \hat{\theta}_1 - \hat{\theta}_2$ denote the difference between two subgroup estimates, where $\hat{\theta}_1$ and $\hat{\theta}_2$ are the estimates for the two subgroups. For example, suppose that the condition-related per capita charge for males with any musculoskeletal problem is to be compared with the condition-related per capita charge for females with the same disorders (Table 7). Then, $\hat{\theta}_1 = \bar{y}_1 = \$316$ for males, $\hat{\theta}_2 = \bar{y}_2 = \$257$ for females, and $\hat{d} = \bar{y}_1 - \bar{y}_2 = \$59$. The standard error of this difference is computed as

$$S_{\hat{d}} = [S^2_{\hat{\theta}_1} + S^2_{\hat{\theta}_2}]^{1/2},$$

where $S^2_{\hat{\theta}_1}$ and $S^2_{\hat{\theta}_2}$ are the estimated sampling variances for $\hat{\theta}_1$ and $\hat{\theta}_2$, respectively. (This formula ignores the nonzero covariance between $\hat{\theta}_1$ and $\hat{\theta}_2$ that arises in complex samples such as NMCUES. This covariance is typically positive and small relative to the variances themselves. Ignoring the covariance will result in standard errors for differences that are on average somewhat larger than the actual standard errors.)

From Table 7, $\hat{n}_1 = 19{,}408{,}000$ and $\hat{n}_2 = 24{,}704{,}000$; from Table VI, $roh = 0.029644$ and $\hat{s}^2 = 7.2407 \times 10^{10}$. Hence,

$$S_{\bar{y}_1} = \left[[1 + (\frac{19{,}408{,}000}{1{,}795{,}637} - 1)(0.029644)] \cdot \frac{7.2407 \times 10^{10}}{19{,}408{,}000}\right]^{1/2}$$

$$= 4840.002$$

and

$$S_{\bar{y}_2} = \left[[1 + (\frac{24{,}704{,}000}{1{,}795{,}637} - 1)(0.029644)] \cdot \frac{7.2407 \times 10^{10}}{24{,}704{,}000}\right]^{1/2}$$

$$= 4063.913.$$

Therefore, the standard error of the difference is computed as

$$S_{\hat{d}} = [(4840.002)^2 + (4063.913)^2]^{1/2} = 94.36.$$

This standard error can be used to form an approximate confidence interval for the difference in the same manner as described previously for estimates of totals, means, proportions, percents, and prevalence rates. In this instance, the 95-percent confidence interval is from $-\$125.44$ to $\$243.95$. Since this interval includes the value zero, it can be concluded that per capita charges do not differ significantly for the two categories.

Subgroup to Total Group Differences

Another type of comparison made in this report is between an estimate for a subgroup and the same estimate for a group that contains the subgroup. Let $\hat{d} = \hat{\theta}_1 - \hat{\theta}_T$ denote the difference between a subgroup estimate and the estimate for a group in which the subgroup is contained, where $\hat{\theta}_1$ is the subgroup estimate and $\hat{\theta}_T$ is the estimate for the larger group. The standard error of this difference is computed as

$$S_{\hat{d}} = S_{\hat{\theta}_1}\left[1 - (\hat{n}_1/\hat{n}_T)\right]^{1/2},$$

where $S_{\hat{\theta}_1}$ denotes the standard error of the estimator $\hat{\theta}_1$ and $\hat{n}_1$ and $\hat{n}_T$ denote the estimated sample sizes for the subgroup and for the larger group, respectively. (This formula is based on an assumption that the covariance tween θ_1 and θ_T is the same as the variance of θ_1, i.e., $S^2_{\hat{\theta}_1}$. This assumption results in an estimated standard error for the difference that is on average somewhat larger than the actual standard error.)

For example, suppose that the standard error of the difference between per capita charges for black persons with any musculoskeletal problem and per capita charges for all persons with any musculoskeletal problem is needed. From Table 7, $\hat{\theta}_1 = \bar{y}_1 = \$318$, $\hat{\theta}_T = \bar{y}_T = \$283$, $\hat{n}_1 = 4{,}216{,}000$, and $\hat{n}_T = 44{,}111{,}000$. Using the formula for estimating the standard error of the mean and values from Table VI (i.e., $s^2 = 7.2407 \times 10^{10}$ and $roh = 0.029644$),

$$S_{\bar{y}_1} = \left[\left[1 + \left(\frac{4{,}216{,}000}{1{,}795{,}637} - 1\right)(0.029644)\right] \frac{7.2407 \times 10^{10}}{4{,}216{,}000}\right]^{1/2}$$

$$= 133.64.$$

Hence, the standard error of the difference, $\hat{d} = \$318 - \$283 = \$35$, is computed as

$$S_{\hat{d}} = 133.64\,[1 - (4{,}216{,}000/44{,}111{,}000)]^{1/2} = 127.09.$$

A 95-percent confidence interval can be constructed for the difference by adding to and subtracting from the estimated difference 1.96 times the estimated standard error of the difference. In this instance, the 95-percent confidence interval is from $-\$214.10$ to $\$284.10$. Thus, per capita charges do not differ significantly between black persons with musculoskeletal problems and all persons with these disorders because this confidence interval includes zero.

Appendix V.
Definition of Terms

Age—This is the age of the person as of January 1, 1980. Babies born during the survey period were included in the youngest age category.

Ambulatory care visit—A direct personal exchange between an ambulatory patient and a health care provider is an ambulatory care visit. The visit may take place in the provider's office, hospital outpatient department, emergency room, clinic, health center, or the patient's home. Services may be rendered by a physician, chiropractor, podiatrist, optometrist, psychologist, social worker, nurse, or other ancillary personnel.

Bed-disability day—A bed-disability day is one on which a person stays in bed more than half of the daylight hours because of a specific illness or injury. All hospital days for inpatients are considered to be bed-disability days even if the patient was not actually in bed at the hospital.

Condition—Any entry on the questionnaire that describes a departure from a state of physical or mental well-being is included. A condition is any illness, injury, complaint, impairment, or problem perceived by the respondent as inhibiting usual activities or requiring medical treatment. Pregnancy, vasectomy, and tubal ligation were not considered to be conditions; however, related medical care was recorded as if they were conditions. Neoplasms were classified without regard to site. Conditions, except impairments, were classified by type according to the Ninth Revision of the International Classification of Diseases (World Health Organization, 1977) as modified by the National Health Interview Survey Medical Coding Manual; these modifications make the code more suitable for a household interview survey. Impairments are chronic or permanent defects, usually static in nature, that result from disease, injury, or congenital malformation. They represent decrease or loss of ability to perform various functions, particularly those of the musculoskeletal system and the sense organs. Impairments are classified by using a supplementary code specified in the coding manual. In the supplementary code, impairments are grouped according to type of functional impairment and etiology.

Condition-related disability day—A condition-related disability day includes work-loss days, restricted-activity days, and bed-disability days for which the respondent listed the indexed condition as an underlying cause for staying home from work, cutting down on usual activities, or staying in bed.

Condition-related visit or hospital admission—An ambulatory visit or hospital admission for which the respondent listed the indexed condition as an underlying reason for seeking medical services.

Disability—Disability is the general term used to describe any temporary or long-term reduction of a person's activity as a result of an acute or chronic condition.

Disability day—Short-term disability days are classified according to whether they are days of restricted activity, bed-disability days, hospital days, or work-loss days. All hospital days are by definition days of bed disability; all days of bed disability are by definition days of restricted activity. The converse form of these statements is, of course, not true. Days lost from work apply only to the working population. Work-loss days are also days of restricted activity. Hence, the restricted-activity day is the most inclusive term used to describe disability days.

Employed—An individual is classified as employed if he or she worked at any time in 1980.

Family—A group of people living together and related to each other by blood, marriage, adoption, or foster care status is considered a family. An unmarried student 17–22 years of age living away from home was also considered part of the family even though his or her residence was in a different location during the school year.

Health care coverage—Twelve mutually exclusive categories of health care coverage were developed. Because of the importance and extent of Medicare coverage for persons 65 years of age and over, the population was first divided into those under 65 years of age and those 65 years of age and over. For persons under 65 years, coverage is divided into four mutually exclusive categories: Coverage all year from a single source, coverage all year from a mixture of sources, coverage only part of the year, and no health care coverage. For those under 65 years and covered all year from a single source, three subcategories of coverage were designated: Private insurance only, such as a commercial carrier or Blue Cross, Medicaid only, and other government programs including Medicare, CHAMPUS/CHAMPVA, Indian Health Service, and other programs covering the cost of health care. Persons in the part-year-coverage category had health care coverage under either a private insurance

policy or a public program, but the coverage did not extend throughout the year.

People 65 years of age and over are partitioned into two major coverage categories: Covered by Medicare and not covered by Medicare. The former group is subdivided into persons having only Medicare coverage, those who have supplemented their Medicare with private policies, and those who are covered not only by Medicare but also by Medicaid, the Indian Health Service, or other government program. The second subgroup, those not having Medicare, is divided into persons who have some other type of health care coverage, whether private or public, and those who have no coverage at all.

Homemaker—An individual is classified as a homemaker if he or she did not work at all in 1980 (unemployed or not in the labor force) and claimed housekeeping as his or her main activity in 1979. Disabled homemakers are not included.

Hospital admission—This is the formal acceptance by a hospital of a patient who is provided room, board, and regular nursing care in a unit of the hospital. A patient admitted to the hospital and discharged on the same day is considered to have had a hospital admission. Also included is a hospital stay resulting from an emergency department visit.

Hospital days—The total number of inpatient days accumulated at time of discharge by patients discharged from short-stay hospitals during a year constitute hospital days. A stay of less than 1 day (patient admission and discharge on the same day) is counted as zero days in the summation of hospital days. For patients admitted and discharged on different days, the number of days of care is computed by counting all days from (and including) the date of admission to (but not including) the date of discharge.

Household—Occupants of group quarters or of a housing unit that was included in the sample constitute a household. A household can comprise one person, a family of related people, a number of unrelated people, or a combination of related and unrelated people.

Housing unit—A group of rooms or a single room occupied or intended for occupancy as separate living quarters is a housing unit if the occupants do not live and eat with any other persons in the structure and if there was either direct access from the outside or through a common hall or there were complete kitchen facilities for the use of the occupants only.

Key person—A key person was (1) an occupant of a national household sample housing unit or group quarters at the time of the first interview; (2) a person related to and living with a State Medicaid household case member at the time of the first interview; (3) an unmarried student 17–22 years of age living away from home and related to a person in one of the first two groups; (4) a related person who had lived with a person in the first two groups between January 1, 1980, and the round 1 interview, but was deceased or had been institutionalized; (5) a baby born to a key person during 1980; or (6) a person who was living outside the United States, was in the Armed Forces, or was in an institution at the time of the round 1 interview but who had joined a related key person.

Limitation of activity—A functional limitation score was developed for classifying limitation of activity. It ranges from 0, indicating no limitation of activity, to 8, meaning severe activity limitation, and to 9, indicating death during the survey period. The functional limitation score was developed from responses to a battery of questions designed to assess ability to perform various common functions such as walking, driving a car, and climbing stairs. For NMCUES, these questions were asked of persons 17 years of age and over.

Median charge per person—The amount at which half the reference population had lower charges and half had higher charges.

Nonkey person—A person related to a key person who joined him or her after the round 1 interview but was part of the civilian noninstitutionalized population of the United States at the date of the first interview is considered nonkey.

Patient—A person who is formally admitted to the inpatient service of a short-stay hospital for observation, care, diagnosis, or treatment is considered a patient. In this report, the number of patients refers to the number of discharges during the year, including any multiple discharges of the same individual from one or more short-stay hospitals. The terms "patient" and "inpatient" are used synonymously.

Per capita charges—These charges were calculated by dividing the total charges by the number of people in the reference population.

Perceived health status—The family respondent's judgment of the health of the person compared to others the same age, as reported at the time of the first interview. The categories were excellent, good, fair, or poor.

Prevalence of conditions—In general, prevalence of conditions is the estimated number of conditions of a specified type existing at a specified time or the average number existing during a specified interval of time (1980 in this survey).

Race—The race of people 17 years of age and over was reported by the family respondent; the race of those under 17 was derived from the race of other family members. If the head of the family was male and had a wife who was living in the household, her race was assigned to any children under 17 years of age. In all other cases, the race of the head of the family (male or female) was assigned to any children under 17 years of age. Race is classified as "white," "black," or "other." The "other" race category includes American Indian, Alaskan Native, Asian, and Pacific Islander. The category "white and other" includes the categories "white" and "other."

Region—NORTHEAST: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania; NORTH CENTRAL: Michigan, Wisconsin, Ohio, Indiana, Illinois, Minnesota, Iowa, Missouri, North Dakota, South

Dakota, Nebraska, Kansas; SOUTH: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas; WEST: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, Hawaii.

Reporting unit—This is the basic unit for reporting data in the household component of NMCUES. A reporting unit consists of all related people residing in the same housing unit or group quarters. One person could give information for all members of the reporting unit.

Restricted-activity day—A restricted-activity day is one on which a person cuts down on his or her usual activities for the whole of that day because of an illness or an injury. The term "usual activities" for any day means the things that the person would ordinarily do on that day. A day spent in bed or a day home from work because of illness or injury is, of course, a restricted-activity day.

Round—A round was the administrative term used to designate all interviews that occurred within a given period of time and that used the same instruments and procedures.

Work-loss day—A work-loss day is a day on which a person did not work at his or her job or business because of a specific illness or injury. The number of days lost from work is determined only for persons 17 years of age and over who reported that at any time during the survey period they either worked at or had a job or business.

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