Prevalence of Artificial Hip Implants and Use of Health Services by Recipients

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Synopsis

Data from the 1988 Medical Device Implant Supplement to the National Health Interview Survey are used to summarize information about the prevalence of artificial hips among adults in the United States. The 1988 National Health Interview Survey was a cross-sectional survey of the civilian noninstitutionalized United States population, and included 122,310 persons in 47,485 households in a multistage probability sample. The supplement supplied the first population-based estimates of prevalence and morbidity of selected medical devices.

Projected to the United States population, the survey results indicate that an estimated 674,000 adults were using 811,000 hip implants. Hip implant recipients were significantly more likely to be older, to be white, and to have lower educational, income, and activity levels than the general population of adults. After age-stratification, however, only differences in activity limitation and race remained.

Current economic outlays for hip replacement surgery are substantial. With the aging population, use of health services by patients with artificial hips will probably increase unless measures to reduce the need for replacement surgery are instituted. These measures include reducing injuries and improving biomaterials. Further investigation is needed to examine the activity limitation and racial difference in prevalence found in this study.

ACCORDING TO CENSUS BUREAU projections, the percentage of the United States population ages 65 years and older is expected to increase by 1.2 percent annually during the period 1988 to 2010. Even within that group, the proportion of the most elderly is expected to increase at a greater rate than the proportion of the least elderly. For example, those who were ages 85 years and older in 1987 represented 9.6 percent of this group, while in 2010 the projected proportion of the most elderly would increase to 14.7 percent. In contrast, those ages 65 to 74 years in 1987 represented 59.6 percent of the total, while in 2010 the projected proportion of the least elderly would decrease to 53.4 percent (*1*).

Currently, total hip arthroplasty is the most common adult orthopedic reconstructive procedure performed in the United States (*2*). Also, in the elderly, hip surgery is the most common orthopedic procedure (*3*). With the aging United States population, use of health services by patients receiving artificial hip implants will become an increasingly important issue. Health services relating to the care of patients with hip implants include hospitalization for the initial surgery and subsequent revisions, as well as rehabilitation and followup care after the operation.

This report details population-based national estimates of the prevalence of hip implants in adults in the United States, and includes demographic information about hip implant recipients. Economic issues and issues relating to the use of health services by artificial hip recipients are discussed. The terms "artificial hips" and "hip implants" are used interchangeably.

Methods

This report uses data from the Medical Device Implant (MDI) Supplement to the 1988 National Health Interview Survey (NHIS). The principal

source of health information about the United States population since 1957, the NHIS is a continuing, cross-sectional household interview survey conducted by the National Center for Health Statistics of the Public Health Service. Using a probability sample that is representative of the civilian, noninstitutionalized U.S. population, basic health and demographic information is collected in home interviews conducted by Bureau of the Census personnel. Detailed information is also gathered on selected health topics using supplemental questionnaires. The 1988 NHIS sample consisted of 47,485 households and 122,310 persons.

As part of the 1988 NHIS, the MDI Supplement was designed to generate the first population-based national estimates of the prevalence of selected general types of medical device implants. The supplement was a collaborative effort between the Food and Drug Administration's Center for Devices and Radiological Health and the National Center for Health Statistics. The questionnaire used in the supplement contained a screening section and these six device sections: artificial joints, fixation devices, artificial heart valves, pacemakers, intraocular lenses, and other types of implanted medical devices. The MDI Supplement was administered to all household respondents in the 1988 NHIS who were reported to have a medical device implant currently. If the recipient was physically or mentally unable to answer the questions or was unavailable after repeated attempts to contact him or her, information was obtained from a household member who was knowledgeable about the recipient's implant. Data were obtained by self-report. Medicalrecords were not reviewed. The response rate for the MDI Supplement was 92 percent. Moss and coworkers provided a detailed description of the design and methodology of the MDI supplement (*4*).

Our report is limited to an analysis of artificial joint recipients ages 18 and older, since the survey found that fewer than 1 percent of artificial hips were implanted in those younger than age 18. The estimates presented in this report are national projections. Approximate standard errors and 95 percent confidence intervals of the estimated rates were computed using a standard published procedure (*4*).

The demographic variables in this report are similar to those used in the NHIS, with age ascertained at the time of the survey (*5*). Body mass index is defined as weight divided by height squared, given in kilograms per square meter. A body mass index of more than 27 kilograms was used to define overweight (*6*). In the tables, per centages may not total 100 because of rounding, errors, or missing data. In addition to simple descriptive statistics, a stratified analysis by age is presented. Age stratification is used to control for the confounding effect of age in the comparison of demographic characteristics of artificial hip recipients with the general population (*7*). Age-adjustment was not performed. While this method will control more fully for the effects of age, the rates generated are fictitious. Since the major focus of our study is to present prevalence information, actual rates are more informative (*8*).

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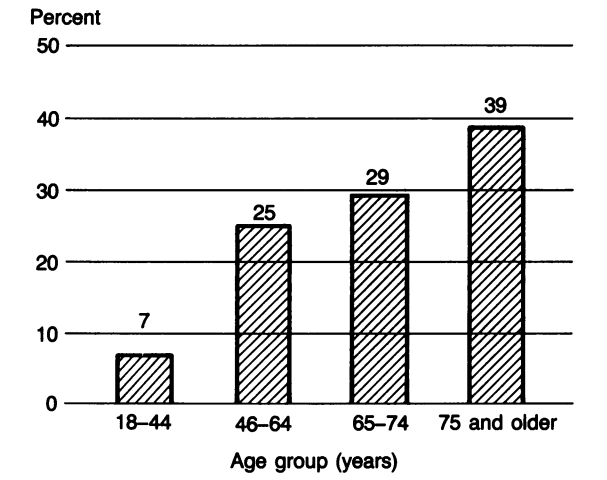
Results

Information was reported on a total of 7,600 devices, among which there were 417 hip implants in 347 adults. The age distribution of total-hip patients is shown in the chart. The median age was 70 years, with a range of 22 to 97 years. As expected, prevalence increased with age. Almost 40 percent of recipients were at least age 75, while 25 percent were ages 45 to 64 years. Only 7 percent were younger than age 45 years.

Projected to the United States population, in 1988 the estimated prevalence of noninstitutionalized adults in the United States with artificial hips was 674,000 (95 percent confidence interval [CI], 577,000, 771,000). Per 1,000 population, the prevalence rate was 3.8 (95 percent CI, 3.2, 4.4). The prevalence of hip implants was 811,000 (95 percent CI, 704,000, 918,000).

Demographic characteristics of artificial hip recipients are compared with the general population in table 1. Those with artificial hips were significantly more likely than the general population to be older, to be white, to have less than a high school education, and to have a lower family income. Furthermore, artificial hip recipients were significantly more likely than the general popula-

Age distribution of hip implant recipients by percentages



NOTE: Percentages may not total 100 because of rounding.

tion to be limited in activity. As expected, prevalence rates increased with age. In the youngest age group, the prevalence rate was 0.4 per 1,000, while in the oldest age group, the rate was 23.9 per 1,000. The prevalence rates for hip implants were greater in those whose income was below the poverty level, in women, in those with a body mass index of 27 kilograms or more, in those who lived in the Midwest, and in those who did not live in a metropolitan statistical area, that is, those who lived in more rural areas.

Age-stratified Analysis

The significant differences in prevalence rates for the demographic characteristics of race, educational level, family income, and activity level may be due to the differing age distributions of recipients of artificial hips compared with the population at large. Age-stratification was performed to account for this confounding effect of age, that is, so that the characteristic of interest independent of the effect of age could be examined.

After age-stratification, the significant differences in prevalence for higher family income compared with lower and educational level were no longer present. As seen in table 2, prevalence rates were higher for whites compared with nonwhites. This difference was significant, however, only in the oldest age stratum. For those older than age 74, whites had a more than three-fold higher prevalence rate than nonwhites. Per 1,000 population, the prevalence rate for whites was 30.6, while for nonwhites the rate was 10.1. Prevalence rates for recipients with activity limitation were significantly greater than for those who were not limited in activity in all age strata. The differences in prevalence, however, were more marked for those in the younger age groups. For those younger than age 65, there was a 20-fold higher prevalence for those limited in activity compared with those without limitation, 10.8 versus 0.5 per 1,000 population.

Discussion

Prevalence estimates. The majority of artificial hip recipients were elderly; 69 percent were older than age 64 in this survey. The increasing prevalence of hip implants with age most likely reflects the greater incidence of hip fractures (*9*) and the greater frequency of degenerative arthritis (*3*) with advancing age. The prevalence of artificial hips among persons older than age 74 was twice that among those ages 65 to 74. Given the observed distribution of hip implants by age, it is likely that the number of hip implants will increase over the next few decades because of the expected increase in the proportion of the most elderly Americans in the population.

The recipients of hip implants were more limited in activity than the general population, a difference that persisted after controlling for age differences. Although concurrent health problems may account for this finding, the data indicate that limitation in mobility persists after hip implantation in a minority of recipients. With a median age of 70 years, the predominance of recipients with low educational achievement and low income reflects the disproportionate number of the elderly in the low education and income categories (*4*).

The lower prevalence of hip implants among nonwhites than whites may be related to differences in the incidence of hip problems requiring surgery. For example, blacks are slightly less likely than whites to report arthritis (*5*), and blacks are less likely than whites to sustain hip fractures (*9*), which are two common indications for hip implantation.

Another explanation for the racial difference in prevalence of hip implants is different patterns in the use of health services among racial subgroups. For example, blacks are less likely than whites to receive kidney or liver transplants (*10,11*) or to undergo angiography and coronary artery bypass grafting (*12*). In a recently reported study that examined income, race, and surgery in Maryland, blacks were 27 percent less likely than whites to have undergone total hip replacement surgery. Furthermore, the more discretionary the procedure,

Table 1. Estimated prevalence of adults with hip implants compared with all adults by demographic characteristics,[1] United States, 1988

Demographic characteristic	Adults with implants[2]	All adults[2]	Prevalence rate[3]	95 perent confidence interval
Age (years):[1,4]				
Total	674	177,321	3.8	3.2, 4.4
18–44	45	103,065	0.4	0.2, 0.6
45–64	166	45,573	3.6	2.6, 4.6
65–74	198	17,565	11.3	8.4,14.2
75 or older	266	11,118	23.9	18.4,29.4
Race:[2,4]				
White	631	151,929	4.2	3.6, 4.8
Nonwhite	44	25,392	1.7	0.7, 2.7
Sex:				
Women	416	93,190	4.5	3.7, 5.3
Men	258	84,131	3.1	2.3, 3.9
Education (years):[4]				
Fewer than 12	271	39,502	6.9	5.3, 8.5
12 or more	400	136,172	2.9	2.3, 3.5
Family income:[4]				
Less than $20,000 per year	375	61,421	6.1	4.9, 7.3
$20,000 or more	288	110,440	2.6	2.0, 3.2
Poverty level:[5]				
In poverty	71	15,786	4.5	2.3, 6.7
Not in poverty	536	146,513	3.7	3.1, 4.3
Activity level:[4,6]				
Limited	427	29,663	14.4	11.9,16.9
Not limited	247	147,658	1.7	1.3, 2.1
Body mass index:[7]				
Less than 27 kilograms	457	128,247	3.6	3.0, 4.2
27 kilograms or more	217	49,073	4.4	3.2, 5.6
Geographic region:				
Midwest	193	43,224	4.5	3.3, 5.7
Northeast	149	37,647	4.0	2.8, 5.2
West	126	36,264	3.5	2.3, 4.7
South	207	60,185	3.4	2.4, 4.4
Residence:				
Nonmetropolitan Statistical Area	214	39,653	5.4	4.0, 6.8
Not central city	281	81,918	3.4	2.6, 4.2
Central city	179	55,750	3.2	2.2, 4.2

[1] Percents may not total 100 due to missing values or rounding; ages 18 and older included.
[2] In thousands.
[3] Per thousand.
[4] Stratum-specific prevalence rates are statistically significantly different from each other.
[5] Poverty level is based on family size, number of children younger than age 18, and family income according to the 1987 poverty levels obtained from the August 1988 Current Population Survey.
[6] Limited activity level includes inability to perform major activity, limited in kind or amount of major activity, or limited in other activities. Not limited includes unknown.
[7] Body mass index is defined as weight divided by height squared, given in kilograms per square meter.

the lower the relative incidence among blacks. The authors stated, "Discretionary aspects of common vascular, orthopedic, and laryngologic procedures suggest that lower rates for blacks were related to referral and access rather than morbidity" (*13*).

Information about the incidence or prevalence of artificial hips has been scanty. The incidence of total hip arthroplasty in Olmsted County, MN, was reported by Melton in 1982. Because of insufficient sample size, however, nonwhites could not be included in the estimates (*14*). Although the National Hospital Discharge Survey yields estimates of total hip joint replacements, these figures count admissions, not persons, in a given survey period (*15*). Moore and coauthors recently published a report of the prevalence of orthopedic implants based on data from the MDI Supplement to the 1988 NHIS. Moore's report deals with the broad categories of artificial joints and fixation devices (*16*). The prevalence rates in this report represent population-based data on hip implants in adults with reliable estimates for demographic subgroups, such as racial subgroups.

The use of artificial hips is increasing. In 1979 the rate (per 100,000 population) of hip arthroplasty and replacement was 60.4 (*17*), while in 1987 the rate was 87.8 (*15*). Several factors have contributed to the use of this procedure. First, the costs of the surgery are reimbursed by Medicare for those who are eligible. Second, salutary clinical effects occur as a result of the surgery. In addition to pain relief, benefits include improved mobility of most

Table 2. Age-stratification of selected sociodemographic characteristics of artificial hip recipients, United States, 1988

Characteristic	Younger than age 65		Ages 65–74		Ages 75 or older	
	Prevalence rate[1]	95 percent CI	Prevalence rate[1]	95 percent CI	Prevalence rate[1]	95 percent CI
Race						
Whites	1.8	1.4,2.2	13.5	10.0,17.0	30.6	24.1,37.1
Nonwhites	1.3	0.3,2.3	6.7	0.0,14.0	10.1	0.0,21.7
Activity level						
Limited	10.8	8.1,13.5	22.4	15.2,29.7	39.9	29.1,50.7
Not limited	0.5	0.3,0.7	7.9	4.8,11.0	20.6	13.9,27.3

[1] Per 1,000 population. NOTE: CI = Confidence interval.

patients, improved performance in activities of daily living, and a reduction in use of community medical resources (for example, home visits from physicians and nurses) (*18*). Additionally, implantation of an artificial hip may allow some recipients to resume working. Although the majority of hip implant recipients are of retirement age, a sizeable minority are not. In a study done by Nevitt and coworkers among working aged persons, about one-third of those totally work disabled prior to hip implantation were working 1 or 4 years after surgery (*19*).

Use of Health Services

Use of health services for artificial hip recipients include

1. hospital inpatient services for the initial surgery, revisions, re-operations, and medical and surgical complications of the surgery;
2. nursing home services;
3. outpatient institutional diagnostic and therapeutic services, including emergency room services, rehabilitation services, radiologic tests and procedures;
4. physician inpatient, emergency room, and outpatient services;
5. other practitioner services;
6. drugs; and
7. assistive devices (*20*).

Felts and Yelin evaluated the economic aspects of rheumatic diseases in the United States. Using 1985 data, they reported hospital reimbursement to be about $10,000 and physician's charges to be about $3,200 per total hip replacement procedure. A total of 222,000 total hip replacement procedures were performed in 1985. Therefore, the approximate cost of hip replacement surgery was almost $3 billion, a substantial proportion of the $20 billion in direct costs of medical care for all musculoskeletal conditions (*21*).

Health care costs arising from artificial hip implantation may increase in the future. For the period 1986 to 1988, considering only Medicare patients, total hip procedures increased 22.5 percent in volume and 25 percent in payments (*22*). Using Census Bureau middle series projections, the total cost of Medicare is expected to nearly double by the year 2020. The greatest proportional increases will occur in the ages 75–84 and the older than age 85 groups (*23*). Since recipients of artificial hips tend to be older, and it is this age group that is expected to increase in size over the next few decades, one would expect an even higher rate of hip implant surgery in the coming years. Furthermore, since hip replacement surgery is costly and the majority of recipients are in the Medicare age group, this procedure may make an even greater impact on health care resources in the future.

No discussion of the costs of medical procedures would be complete without a discussion of benefits. Although somewhat dated, a 1976 study by Taylor in Great Britain evaluated the cost:benefit ratio of total hip replacement for arthritis. The cost:benefit ratio differed by age, that is, the lower the age, the greater the benefit. Among those younger than age 60, the cost:benefit ratio was 1:10, while among those ages 60 to 70, the cost:benefit ratio was 1:2 (*24*).

The use of health services relating to the care of hip implant recipients is likely to increase in the future unless primary preventive measures are successful and technical improvements in the device and the surgical implantation procedure are realized. Specifically, the following suggestions should be considered to reduce the need for artificial hip implantation:

1. Reduce injury and other preventable causes of hip joint pathology.
2. Develop improved treatments for arthritis that will reduce or prevent joint damage.
3. Increase the longevity of the implant and reduce mechanical failure by improvements in biomaterials and implant designs (*25*).

4. Reduce the morbidity associated with hip replacement surgery by refinements in surgical techniques.

Conclusions

Two caveats should be considered in interpreting the findings of this study. First, since the survey was limited to the noninstitutionalized United States population, an underestimate of the prevalence occurs. For example, those living in nursing homes were not enumerated and they, because of age alone, would be expected to have hip implants. A survey of the institutionalized would need to be performed to obtain a more precise estimate of the population prevalence of those with artificial hips.

The second caveat is that the information obtained in the survey is by self-report. Although self-reporting of problems may yield higher estimates than those obtained from other data sources (*4*), numerous studies have verified the accuracy of long-term recall of life events such as major surgery (*19*).

The major contribution of the MDI Supplement is the population-based prevalence estimates provided. These benchmark data are important for workers in the public and private sector who deal with issues surrounding medical devices. As enumerated in this paper, health services use, and hence costs, are substantial for the care of patients with artificial hips. A focus for future study would be to explore the reasons for prevalence differences relating to race and activity limitations in artificial hip recipients.

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