

DIFFERENCES BETWEEN MEN AND WOMEN IN THE RATE OF USE OF HIP AND KNEE ARTHROPLASTY

GILLIAN A. HAWKER, M.D., JAMES G. WRIGHT, M.D., M.P.H., PETER C. COYTE, PH.D., J. IVAN WILLIAMS, PH.D., BART HARVEY, M.D., PH.D., RICHARD GLAZIER, M.D., M.P.H., AND ELIZABETH M. BADLEY, PH.D.

ABSTRACT

Background Previous studies suggest that, for some conditions, women receive fewer health care interventions than men. We estimated the potential need for arthroplasty and the willingness to undergo the procedure in both men and women and examined whether there were differences between the sexes.

Methods All 48,218 persons 55 years of age or older in two areas of Ontario, Canada, were surveyed by mail and telephone to identify those with hip or knee problems. In these subjects, we assessed the severity of arthritis and the presence of coexisting conditions by questionnaire, documented arthritis by examination and radiography, and conducted interviews to evaluate the subjects' willingness to undergo arthroplasty. The potential need for arthroplasty was defined by the presence of severe symptoms and disability, the absence of any absolute contraindications to surgery, and clinical and radiographic evidence of arthritis. The estimates of need were then adjusted for the subjects' willingness to undergo arthroplasty.

Results The overall response rates were at least 72 percent for the questionnaires and interviews. As compared with men, women had a higher prevalence of arthritis of the hip or knee (age-adjusted odds ratio, 1.76; $P < 0.001$) and had worse symptoms and greater disability, but women were less likely to have undergone arthroplasty (adjusted odds ratio, 0.78; $P < 0.001$). Despite their equal willingness to have the surgery, fewer women than men had discussed the possibility of arthroplasty with a physician (adjusted odds ratio, 0.63). The numbers of people with a potential need for hip or knee arthroplasty were 44.9 per 1000 among women and 20.8 per 1000 among men. After adjustment for willingness to undergo the procedure, the numbers were 5.3 per 1000 for women and 1.6 per 1000 for men.

Conclusions There is underuse of arthroplasty for severe arthritis in both sexes, but the degree of underuse is more than three times as great in women as in men. (N Engl J Med 2000;342:1016-22.)

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STUDIES have aroused concern that some types of surgical procedures, such as coronary revascularization and renal transplantation, are performed less often in women than they should be.¹⁻⁶ However, the interpretation of these findings is difficult because of possible differences between men and women in the prevalence of disease, contraindications to surgery, and preferences with respect to surgery. Whether there are differences between men and women in the rate of use of arthroplasty has not been previously addressed.

Osteoarthritis is the leading cause of long-term disability.⁷⁻⁹ The prevalence of osteoarthritis-related disability is greater among women than among men.¹⁰ Thus, arthritis is a major health problem for women. Joint arthroplasty is an efficacious and cost-effective treatment for advanced arthritis of the hip and knee that relieves pain and reduces functional disability.¹¹⁻¹⁴ The age-adjusted rates of hip and knee arthroplasty are higher for women than for men in both the United States and Canada.¹⁵⁻¹⁷ However, because these rates have not been adjusted for the higher incidence of arthritis¹⁰ and osteoporosis-related hip fracture¹⁷ among women than among men, they do not indicate whether there is a difference between men and women in the proportion of people in need of arthroplasty who actually undergo the procedure.

Previous studies have reported that women have worse pain and disability than men at the time of arthroplasty.^{11,18} These studies suggest that women receive treatment later in the course of their disease. We undertook this study to determine whether there are

From the Department of Medicine, Division of Rheumatology, Faculty of Medicine, University of Toronto, and Women's College Hospital Campus, Sunnybrook and Women's College Health Sciences Centre (G.A.H.); the Clinical Epidemiology and Health Care Research Program (G.A.H., J.G.W., J.I.W., R.G., E.M.B.); the Department of Surgery, Division of Orthopaedic Surgery, Hospital for Sick Children (J.G.W.); the Department of Family and Community Medicine, University of Toronto (J.I.W.); the Department of Family and Community Medicine, St. Michael's Hospital (R.G.); the Departments of Health Administration (G.A.H., P.C.C.) and Public Health Sciences (J.G.W., J.I.W., B.H., R.G., E.M.B.), University of Toronto; the Arthritis Community Research and Evaluation Unit, Wellesley Hospital Research Institute (G.A.H., P.C.C., R.G., E.M.B.); and the Institute for Clinical Evaluative Sciences (P.C.C., J.I.W.) — all in Toronto. Address reprint requests to Dr. Hawker at Women's College Hospital Campus, Sunnybrook and Women's College Health Sciences Centre, 76 Grenville St., 10th Fl., Toronto, ON M5S 1B2, Canada, or at g.hawker@utoronto.ca.

differences between men and women in the potential need for arthroplasty and in the willingness to undergo the procedure.

METHODS

Study Sample

The study was conducted in three phases. The names and addresses of persons 55 years of age or older were obtained from residential tax records provided by the Ontario Ministry of Finance. Younger people were not included because they have a low prevalence of advanced hip and knee arthritis^{9,10,19,20} and seldom undergo arthroplasty.¹⁵ Because residents of Ontario have comprehensive, universal health insurance coverage, barriers to health care based on insurance status were not an issue. In phase 1 of our study, a brief questionnaire was sent to the listed residents of two areas of the province, Oxford County and East York. Oxford County is a rural area with an ethnically homogeneous population and a high rate of arthroplasty. East York is an area in metropolitan Toronto with an ethnically diverse population and a low rate of arthroplasty. A total of 21,925 questionnaires were sent out in Oxford County and 26,293 in East York. Eligible residents who did not respond after two additional mailings were telephoned in accordance with the modified methods of the U.S. National Center for Health Statistics.²¹ To estimate the proportions of the sample that were ineligible or did not respond, extensive tracing methods²² were used for random samples of 500 nonrespondents from each of the two areas with the use of telephone and city directories from 1991 through 1998.

Collection of Data

In the phase 1 questionnaire, participants identified joints with symptoms of arthritis on a diagram, reported whether they had specific functional disabilities, and stated whether they had undergone arthroplasty. Respondents were selected for phase 2 of the study if they had at least moderately severe hip or knee arthritis, as defined by the presence of all of the following: difficulty with climbing stairs, arising from a chair, standing, and walking during the previous three months; swelling, pain, or stiffness in any joint lasting at least six weeks during the previous three months; and a symptomatic hip or knee identified on the diagram on the phase 1 questionnaire.

In phase 2, the respondents completed three questionnaires that have been demonstrated to be reliable and valid measures of the severity of hip and knee problems: the Western Ontario McMaster University Osteoarthritis Index (WOMAC),²³ the 36-item Short-Form Health Survey,^{24,25} and the disability subscale of the Health Assessment Questionnaire.²⁶ They were also given a list of 18 health problems and asked which ones they had been treated for or had seen a physician about in the past year.

Although there are no universally accepted criteria for the appropriateness of arthroplasty, the National Institutes of Health (NIH) consensus statement suggests that candidates for arthroplasty should have "radiographic evidence of joint damage and moderate to severe persistent pain or disability, or both."²⁷ For the purposes of this study, "severe" arthritis was arbitrarily defined by a WOMAC summary score of 39 or greater. The WOMAC summary score ranges from 0 (no pain or disability) to 100 (the most severe pain and disability); the cutoff score of 39 represents the 25th percentile of scores for patients undergoing arthroplasty in Ontario.²⁸ This cutoff was chosen to provide a conservative estimate of the potential need for arthroplasty. People with scores of 39 or higher were considered potential candidates for arthroplasty if they reported no absolute contraindications to arthroplasty and had both clinical and radiographic evidence of arthritis. According to more than 90 percent of orthopedic surgeons in Ontario, the absolute contraindications to arthroplasty are major mental illness, stroke with paralysis, or another major neurologic disorder.²⁹

In phase 3, to determine the sensitivity and specificity of our WOMAC summary-score cutoff in identifying persons with ar-

thritis, we visited and examined all respondents in East York who had scores of at least 39 (indicating severe arthritis) and a random sample of persons with scores of 7 to 38 (indicating mild-to-moderate arthritis). The participants underwent a standardized joint examination,³⁰ which included the assessment of range of motion, tenderness, pain on movement of the joint (stress pain), swelling, and deformity. Anteroposterior radiographs of the pelvis and anteroposterior and lateral radiographs of the knees with the participant standing were obtained by a standardized procedure. Each radiograph was reviewed blindly by one of two radiologists and graded for the presence of osteophytes, subchondral sclerosis, marginal erosions, subchondral cysts, and narrowing of the joint space. A hip or knee was classified as arthritic if there was stress pain, reduced range of motion, or deformity on examination and if the radiologist observed osteophytes, subchondral sclerosis, marginal erosions, subchondral cysts, or narrowing of the joint space.

In both study areas, respondents with severe hip or knee arthritis who had not undergone arthroplasty and were not on a waiting list for arthroplasty were interviewed to determine their willingness to undergo arthroplasty. We did not interview persons who had previously undergone joint arthroplasty or who were currently on a waiting list for arthroplasty, since these persons were deemed to have a need for arthroplasty that had been met. Furthermore, persons on a waiting list for arthroplasty were assumed to be "definitely willing" to undergo arthroplasty. Since orthopedic surgeons have varied opinions regarding the risks and benefits of arthroplasty,²⁹ a standardized interview was essential to provide identical information to the respondents. The interview, based on audiotapes of 10 patient-surgeon discussions, was designed to simulate a typical conversation between a patient and a surgeon. The interview described the consequences of not having surgery, alternative treatments, and the risks and benefits of arthroplasty, including the projected life span of the replaced joint.^{29,31} The risks of arthroplasty were discussed in greater detail than is usually done by orthopedic surgeons, biasing the study toward providing a conservative estimate of patients' willingness to undergo surgery. Participants indicated their degree of willingness to have arthroplasty on a five-point scale: "definitely not willing," "probably not willing," "unsure," "probably willing," and "definitely willing." Joint examinations and interviews were performed by trained therapists from the Arthritis Society of Canada.

In this study, persons with a potential need for arthroplasty were defined as those with severe arthritis (a WOMAC score of at least 39), no absolute contraindications to surgery, and both clinical and radiologic evidence of arthritis. The estimates of potential need were then adjusted for willingness. Only those persons who indicated "definite" willingness to have arthroplasty were considered to be willing to undergo the procedure.

Statistical Analysis

The demographic and socioeconomic characteristics of respondents to the phase 1 questionnaire were compared with 1991 census data for East York, Oxford County, and Canada overall. The potential need for and willingness to undergo arthroplasty were expressed per 1000 respondents in phase 1. Stepwise multivariate logistic-regression modeling was used to evaluate the independent determinants of having previously undergone arthroplasty (according to data from phase 1), requiring personal assistance with daily activities, being on a waiting list for arthroplasty (according to data from phase 2), and having ever spoken with a physician about arthroplasty (according to data from phase 3). The goodness of fit of the models was assessed by the Hosmer-Lemeshow test statistic.³² All analyses were first performed on the data from the two areas separately and were then performed on the combined data set. For all analyses, a two-tailed P value of 0.05 or less was considered to indicate statistical significance.

The human subjects review committee of the University of Toronto approved all phases of the study, and the subjects gave oral informed consent to participate in the study in phases 1 and 2 and written informed consent to participate in phase 3.

RESULTS

The results of the analyses according to sex were similar in the two areas, and therefore all reported results are for the combined data set. The numbers of people eligible for the study and their response rates are summarized in Table 1. The overall response rates for all questionnaires and interviews were 72 percent or higher. Higher response rates were associated with higher income and lower frequency of moving to a new residence in the prior year, but not with sex or age. Sociodemographically, phase 1 respondents were highly representative of the Canadian population as a whole.³³

Fifty-eight percent of phase 1 respondents were female. Women were older than men (mean age, 69.4 vs. 67.7 years; $P < 0.001$) and were more likely to report that a physician had given them a diagnosis of arthritis (52.6 percent vs. 38.0 percent; age-adjusted odds ratio, 1.76; $P < 0.001$). After adjustment for age and the prevalence of self-reported arthritis, women were more likely than men to report chronic hip or knee problems (adjusted odds ratio, 1.16; 95 percent confidence interval, 1.11 to 1.21) and to have seen their family physician in the past year for this reason

(adjusted odds ratio, 1.15; 95 percent confidence interval, 1.04 to 1.24).

Among the phase 1 respondents, 5.1 percent had undergone joint arthroplasty. After adjustment for age and the self-reported presence of osteoporosis and arthritis, women were less likely than men to have undergone arthroplasty of either the hip or the knee (adjusted odds ratio, 0.78; 95 percent confidence interval, 0.72 to 0.90), of the hip alone (adjusted odds ratio, 0.62; 95 percent confidence interval, 0.34 to 0.84), and of the knee alone (adjusted odds ratio, 0.54; 95 percent confidence interval, 0.21 to 0.80).

Among the phase 1 respondents, 14.3 percent of women and 8.0 percent of men ($P < 0.001$) had at least moderately severe hip or knee problems and thus met the criteria for phase 2. As compared with men, women in phase 2 were older ($P < 0.001$), were more likely to live alone ($P = 0.001$), had worse (higher) WOMAC scores ($P < 0.001$), had worse (lower) scores on physical functioning ($P < 0.001$) and vitality ($P < 0.001$) subscales of the Short-Form Health Survey, and were more likely to require regular personal assistance in performing daily activities because of their arthritis ($P = 0.001$) (Table 2).

Among the phase 2 respondents, 5.5 percent of the women and 5.8 percent of the men were on a waiting list for arthroplasty ($P = 0.73$). After adjustment for age, general health, and measures of the severity of arthritis, women were less likely than men to be on a waiting list for arthroplasty (adjusted odds ratio, 0.71; 95 percent confidence interval, 0.44 to 1.15). However, this difference did not reach statistical significance. Among those on a waiting list for arthroplasty, men and women did not differ in age or in disease severity according to WOMAC scores.

Of the 1325 phase 2 respondents with severe arthritis (a WOMAC score of at least 39), 74.9 percent were women. After the exclusion of 220 respondents with self-reported absolute contraindications to arthroplasty and adjustment for the 115 respondents (10.4 percent) with WOMAC scores of at least 39 who did not have both clinical and radiographic evidence of arthritis in at least one hip or knee, there were 990 persons with a potential need for arthroplasty. Among these, there were no significant differences between men and women in the severity of arthritis according to clinical examination or radiographic assessment or in the incidence of coexisting conditions (Table 2). The numbers of phase 1 responders with a potential need for arthroplasty were 44.9 per 1000 for women and 20.8 per 1000 for men (Table 3).

Among those with a potential need for arthroplasty, 32.5 percent of women and 41.8 percent of men reported having ever discussed arthroplasty with a physician (Table 2). Of these, 19.0 percent and 25.6 percent, respectively, had ever discussed arthroplasty with an orthopedic surgeon. After adjustment for age and disease severity, women were less likely ever to

TABLE 1. OVERVIEW OF STUDY PARTICIPANTS.

| VARIABLE | WOMEN | MEN |
|--|------------------|---------------|
| | number (percent) | |
| Total* | 27,745 | 20,473 |
| Eligible subjects† | 21,337 (76.9) | 15,819 (77.3) |
| Eligible subjects who responded to phase 1 questionnaire‡ | 16,521 (77.4) | 11,930 (75.4) |
| Phase 1 respondents with self-reported diagnosis of arthritis | 8,687 (52.6) | 4,528 (38.0) |
| Phase 1 respondents who met criteria for phase 2 | 2,358 (14.3) | 949 (8.0) |
| Subjects meeting criteria for phase 2 who responded to phase 2 questionnaire | 1,751 (74.3) | 660 (69.5) |
| Phase 1 respondents who were potential candidates for arthroplasty§ | | |
| Unadjusted¶ | 828 (5.0) | 277 (2.3) |
| Adjusted¶ | 742 (4.5) | 248 (2.1) |
| Potential candidates who were "definitely" willing to have arthroplasty | 42/331 (12.7) | 11/125 (8.8) |

*The totals are the numbers of men and women 55 years of age or older listed in the residential tax records of the Ontario Ministry of Finance.

†Eligible subjects were confirmed to be living, at least 55 years of age, residing in the area, and able to complete the phase 1 survey.

‡The numbers have been adjusted to account for deceased and ineligible subjects.

§Potential candidates were those with severe arthritis and no absolute contraindications to arthroplasty on the basis of phase 2 responses.

¶The numbers have been adjusted to account for those without both clinical and radiographic evidence of arthritis.

||The denominators represent the number of participants who completed the willingness interview in phase 3.

TABLE 2. COMPARISON OF MALE AND FEMALE PHASE 2 RESPONDENTS.*

| CHARACTERISTIC | WOMEN (N=1751) | MEN (N=660) | P VALUE |
|--|-------------------|----------------|---------|
| Age — yr | 70.9±9.6 | 69.4±8.7 | <0.001 |
| Education beyond high school — no./total no. (%) | 323/1691 (19.1) | 121/631 (19.2) | 0.14 |
| White race — no./total no. (%) | 1608/1680 (95.7) | 615/638 (96.4) | 0.91 |
| Married — no./total no. (%) | 824/1697 (48.6) | 525/642 (81.8) | <0.001 |
| Living alone — no. (%) | 658 (37.6) | 92 (13.9) | 0.001 |
| Yearly income ≤\$20,000 Canadian — no./total no. (%) | 1247/1423 (87.6) | 288/546 (52.7) | 0.001 |
| Currently seeing physician for joint problem — no./total no. (%) | 1014/1358 (74.7) | 353/499 (70.7) | 0.1 |
| On waiting list for arthroplasty — no./total no. (%) | 74/1358 (5.4) | 29/499 (5.8) | 0.73 |
| Summary WOMAC score† | 41.9±19.7 | 38.7±19.7 | <0.001 |
| SF-36 | | | |
| Physical Functioning Subscale score‡ | 16.3±4.6 | 17.6±4.9 | <0.001 |
| Vitality Subscale score§ | 11.9±4.1 | 12.9±4.9 | <0.001 |
| Activity restrictions because of joints — no. (%) | | | |
| Staying in bed all or most of the time | 212 (12.1) | 59 (8.9) | 0.03 |
| Cutting down on usual activities | 890 (50.8) | 286 (43.3) | 0.001 |
| Limited at work | 259 (14.8) | 160 (24.2) | <0.001 |
| Subjects with WOMAC summary score ≥39 — no. (%) | 993 (56.7) | 332 (50.3) | 0.005 |
| With self-reported absolute contraindications to surgery — no./total no. (%) | 165/993 (16.6) | 55/332 (16.6) | 0.98 |
| Potential candidates for arthroplasty — no. (%)¶ | 742 (42.4) | 248 (37.6) | 0.02 |
| No. of self-reported coexisting conditions | 1.38±1.32 | 1.45±1.48 | 0.29 |
| With self-reported cardiovascular disease — no./total no. (%) | 210/742 (28.3) | 88/248 (35.5) | 0.025 |
| With self-reported lung disease — no./total no. (%) | 124/742 (16.7) | 38/248 (15.3) | 0.62 |
| Spoke with physician about having arthroplasty — no. (%) | | | |
| All phase 2 respondents | 144/520 (27.7) | 69/187 (36.9) | 0.02 |
| Potential candidates for arthroplasty | 105/323 (32.5) | 51/122 (41.8) | 0.08 |

*Denominators are given when response rates were less than 100 percent. WOMAC denotes the Western Ontario McMaster University Osteoarthritis Index, and SF-36 the Short-Form Health Survey. Plus-minus values are means ±SD.

†The WOMAC summary score, as normalized, ranges from 0 (no pain or disability) to 100 (most pain and disability).

‡The Physical Functioning Subscale score ranges from 0 (poorest status) to 30 (best status).

§The Vitality Subscale score ranges from 4 (tired and worn out) to 24 (full of energy).

¶Potential candidates had WOMAC scores ≥39, no absolute contraindications to arthroplasty, and both clinical and radiographic evidence of arthritis.

||From a list of 18 conditions, respondents indicated those for which they had seen a physician or received treatment in the previous year.

have discussed arthroplasty with any physician (adjusted odds ratio, 0.63; $P=0.01$) (Table 4), and specifically with an orthopedic surgeon (adjusted odds ratio, 0.65; $P=0.04$). However, among those who had discussed arthroplasty with an orthopedic surgeon, women and men were equally likely to have had surgery recommended (42 percent for both sexes). Among those for whom arthroplasty had been recommended, no differences in age or WOMAC scores were found between the sexes. The cited reasons for having not yet had arthroplasty when it had been recommended were similar for women and men, except that women were less risk averse ($P<0.001$) and were

more likely to be still waiting to see the orthopedic surgeon ($P=0.18$) (Table 5). Among those for whom arthroplasty had not been recommended, the reasons reported were similar for both sexes (Table 5).

Among persons with a potential need for arthroplasty, 12.7 percent of women and 8.8 percent of men were “definitely willing” to have arthroplasty; the adjusted estimates of need per 1000 phase 1 respondents were 5.3 in women and 1.6 in men (Table 3).

DISCUSSION

In this population-based study, we found that arthroplasty was underused in both men and women,

TABLE 3. ESTIMATED NUMBERS OF PHASE 1 RESPONDENTS WITH POTENTIAL NEED FOR ARTHROPLASTY.

| SEX AND AGE CATEGORY | NO. WITH POTENTIAL NEED FOR ARTHROPLASTY (PER 1000 RESPONDENTS)* | |
|----------------------|--|---|
| | UNADJUSTED | ADJUSTED FOR WILLINGNESS TO UNDERGO ARTHROPLASTY† |
| Female | | |
| 55–64 yr | 36.5 | 6.4 |
| 65–74 yr | 38.6 | 4.1 |
| ≥75 yr | 62.3 | 5.3 |
| Total | 44.9 | 5.3 |
| Male | | |
| 55–64 yr | 16.1 | 2.9 |
| 65–74 yr | 21.9 | 0.5 |
| ≥75 yr | 27.8 | 1.1 |
| Total | 20.8 | 1.6 |

*Respondents with the potential need for arthroplasty had severe arthritis (Western Ontario McMaster University Osteoarthritis Index summary score of at least 39), radiographic and clinical evidence of arthritis of the hip or knee, and no absolute contraindications to arthroplasty.

†Respondents who said on a questionnaire that they were “definitely willing” to undergo arthroplasty were classified as being willing to have the procedure.

TABLE 4. ODDS RATIOS FOR EVER HAVING DISCUSSED ARTHROPLASTY WITH A PHYSICIAN AMONG SUBJECTS WITH A POTENTIAL NEED FOR ARTHROPLASTY.*

| INDEPENDENT VARIABLE | ODDS RATIO (95% CI) | P VALUE |
|---|---------------------|---------|
| Age category (65–74 or ≥75 yr vs. 55–64 yr) | 1.21 (0.98–1.49) | 0.075 |
| WOMAC score (highest three quartiles vs. lowest quartile) | 1.55 (1.31–1.83) | <0.001 |
| Sex (female vs. male) | 0.63 (0.44–0.90) | 0.01 |

*The odds ratios were derived by logistic-regression analysis. CI denotes confidence interval, and WOMAC the Western Ontario McMaster University Osteoarthritis Index. The Hosmer–Lemeshow goodness-of-fit statistic was 4.00, with 8 df; P=0.86.

and that the degree of underuse was significantly greater for women. The estimated potential need for arthroplasty was more than twice as great among women as among men because of the higher prevalence of severe hip and knee arthritis in women. Women and men were equally likely to be excluded as candidates for arthroplasty. In comparison with men, women had greater arthritis pain, were more likely to be disabled, and were more likely to require personal assistance in performing daily activities, largely because they were more likely to live alone. These findings sug-

gest that underuse of arthroplasty may have substantial direct costs to the health care system and indirect costs to society, and that more of these costs are due to underuse in women than in men. The observed disparity between men and women in the rate of arthroplasty may be even greater in countries other than Canada, such as the United States, where insurance status may pose a further barrier to access to health care, and where the barriers are greater for women than for men because of socioeconomic factors.

A prior study suggested that women and men differ in their preferences with respect to arthroplasty. Karlsson et al.³⁴ conducted focus-group discussions among patients with moderately severe osteoarthritis of the hip or knee who had either undergone arthroplasty or were on a waiting list for arthroplasty. As compared with men, women declined to a lower functional level before considering arthroplasty, were more averse to surgical risk and more concerned about being a burden on the family, and wanted more information before making a decision. The primary limitation of the study was that it evaluated only patients who had undergone or were about to undergo arthroplasty. In our study, which recruited subjects from the community independently of their interaction with the health care system, we found no difference between men and women in their willingness to undergo arthroplasty, after adjustment for the severity of disease and for coexisting conditions. Furthermore, the reported reasons for refusing arthroplasty when it had been offered were similar for men and women, except that men were more likely to refuse arthroplasty because they considered it “too risky.”

Although women were more likely than men to seek treatment for arthritis and had similar levels of self-reported coexisting conditions, women with a potential need for arthroplasty were less likely than men to report having ever discussed arthroplasty with a physician. These findings are provocative and suggest that a possible explanation for the observed sex differences in the potential need for arthroplasty may be that women are less likely to be referred, or perhaps are referred after a longer interval, to orthopedic surgeons for consideration for arthroplasty. Such a delay might occur because women are less likely to initiate discussions about their arthritis or its treatment, or are less demanding of surgery when it is discussed. These differences could be due to differences in personality between the sexes, but they could also reflect interactions at the level of family, friends, and colleagues. Alternatively, primary care providers may have attitudes regarding the risks of, indications for, and expected outcomes of arthroplasty that make them consider women less appropriate candidates for surgery than men. Studies of differences in the provision of coronary arteriography and cardiac bypass surgery to women and men have suggested there may be sexually based biases in the choice of patients for these

TABLE 5. REASONS PATIENTS WHO HAD DISCUSSED ARTHROPLASTY WITH A PHYSICIAN DID NOT UNDERGO THE PROCEDURE.*

| REASON | ARTHROPLASTY RECOMMENDED | | ARTHROPLASTY NOT RECOMMENDED | |
|--|-----------------------------|---------------|---------------------------------|---------------|
| | WOMEN (N=53) | MEN (N=21) | WOMEN (N=91) | MEN (N=47) |
| | number (percent) | | | |
| Too risky | 10 (19) | 11 (52)† | 7 (8) | 5 (11) |
| Arthritis not severe enough | 18 (34) | 10 (48) | 52 (57) | 23 (49) |
| Other medical problems | 13 (25) | 9 (43) | 22 (24) | 14 (30) |
| Obesity | 7 (13) | 1 (5) | 2 (2) | 2 (4) |
| Not convinced the surgery is effective | 6 (11) | 3 (14) | 4 (4) | 3 (6) |
| Another procedure (e.g., osteotomy) was recommended | 4 (8) | 1 (5) | 7 (8) | 2 (4) |
| Family physician recommended joint replacement; patient waiting to see surgeon | 6 (11) | 0 | NA | NA |
| Could not leave family | 1 (2) | 0 | NA | NA |
| Had not tried all nonsurgical alternatives | 10 (19) | 2 (10) | 12 (13) | 8 (17) |
| Other reasons‡ | 22 (42) | 7 (33) | 17 (19) | 9 (19) |

*The subjects were allowed to check as many responses as applied. NA denotes not applicable.

† $P < 0.05$ for the comparison with women for whom arthroplasty was recommended.

‡Reasons included "other treatment helpful," "just don't want surgery," "decision is up to the patient," "too old," and "too young."

procedures.³⁵ Although we have previously shown that Ontario family physicians overestimate the risks and underestimate the benefits of arthroplasty,³⁶ these same physicians reported in a survey that the sex of the patient did not affect their decision whether to refer the patient to an orthopedic surgeon for arthroplasty. Further research is warranted.

There are several potential limitations to our study. First, in an effort to factor into our estimates of potential need for arthroplasty the important influence of patients' preferences, we adjusted our estimates of potential need by the patient's degree of willingness to have arthroplasty. The latter was evaluated by means of a standardized interview rather than through conversations with an orthopedic surgeon. We used this approach to provide a standard and comprehensive list of the potential risks and benefits associated with arthroplasty in the light of our prior research, which documented substantial variation among orthopedic surgeons in their opinions regarding the indications for and outcomes of arthroplasty.²⁹ We believe that because we listed all possible risks associated with arthroplasty, we obtained conservative estimates of willingness to undergo arthroplasty. Furthermore, our approach is unlikely to have had different effects on the estimates of willingness in men and in women.

Second, since there are no standardized guidelines regarding when and in whom arthroplasty should be performed, our criteria for potential need were based on self-reported symptoms and disability and obtained with use of a reliable and valid instrument (the WOMAC) that is widely used in North America to

evaluate the outcomes of arthroplasty. Since studies indicate that the primary reasons reported by patients for undergoing arthroplasty are joint pain and functional limitation,¹¹ these criteria seem reasonable. Furthermore, the estimates of need were adjusted both for the likelihood that persons with high scores had both radiographic and clinical evidence of arthritis and for contraindications to surgery.

Third, although there were no differences in the severity of arthritis between men and women who were on waiting lists for arthroplasty, we did not ask subjects how long they had been on the waiting list. Thus, we do not know whether there are differences between men and women in the waiting period once the decision has been made to go ahead with surgery. However, we previously found no association between the sex of the patient and the waiting time for knee arthroplasty,³⁷ and we have no reason to believe, on the basis of our current findings, that prolonged waiting times for arthroplasty explain either the unmet need for arthroplasty or the differences between men and women in the rate of use of arthroplasty. Finally, we did not obtain information on employment status and therefore do not know whether sex differences in employment status account in part for our findings.

In conclusion, after adjustment for the degree of willingness to undergo arthroplasty, the potential need for arthroplasty was more than three times as great among women as among men. Furthermore, women were more likely than men to be disabled by arthritis, since they were more likely to live alone.

Nevertheless, as compared with men, women were less likely to have undergone arthroplasty, and those with potential need were less likely to have discussed arthroplasty with a physician. On the basis of these findings, we propose that the most likely explanation is that barriers, perceived or actual, that are unique to women exist at the level of the interaction between the primary care provider and the patient in the process of referral to orthopedic surgery.

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