(CJRR) CANADIAN JOINT REPLACEMENT REGISTRY


# 2003 REPORT

# TOTAL HIP AND TOTAL KNEE REPLACEMENTS IN CANADA

Canadian Institute
for Health Information

Institut canadien
d'information sur la santé

# Canadian Joint Replacement Registry (CJRR)
# 2003 Report

# Total Hip and Total Knee Replacements in Canada

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# Canadian Joint Replacement Registry (CJRR)
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# Executive Summary

The purpose of the CJRR 2003 annual report is to characterize the basic epidemiology of total hip and total knee replacement surgeries performed in Canada according to person (patient demographics), place (provincial and national level data) and time (trends), as well as selected surgical and clinical parameters. In Canada, 42,917 total hip and total knee replacements were performed in 2000/2001 compared to 32,147 procedures in 1994/1995, representing a 33.5% increase over this 7-year period.

Hip and knee replacement can provide significant pain relief and considerable improvement in a patient's functional status and quality of life.[3,4] These benefits extend to all age groups, including patients over the age of 80 years.[4] In view of the potential for excellent outcomes associated with total joint replacement surgeries, these procedures will likely continue to increase in most developed countries as technologies advance and populations age.[5]

## Canadian Joint Replacement Registry (CJRR)

The CJRR is a national registry that collects information on total hip and total knee replacement surgeries performed in Canada and follows joint replacement recipients over time to monitor their outcomes, including revision rates. The ultimate goal of the CJRR is to improve the quality of care and clinical outcomes of joint replacement recipients through post-market surveillance of orthopaedic implants, improving the quality of surgical practices and the study of risk factors affecting outcomes.

Participation in the CJRR has been steadily increasing since orthopaedic surgeons began submitting operative data in May 2001. At the time of publication, more than 54% of eligible orthopaedic surgeons in Canada (excluding Ontario) participated in the registry. Orthopaedic surgeons in Ontario submit their data to the Ontario Joint Replacement Registry (OJRR), an Ontario Ministry of Health and Long-Term Care funded initiative based at London Health Sciences Centre. Data from the OJRR will be electronically forwarded to CJRR.

## Methodology

Joint replacement data for this report are obtained from three sources, namely orthopaedic surgeons participating in the CJRR and two hospital separation databases managed by the Canadian Institute for Health Information (CIHI), the Hospital Morbidity Database and the Discharge Abstract Database.

Surgical and orthopaedic implant data presented in this report are based on 5,799 procedures submitted by surgeons participating in the CJRR between May 2001 and September 2002.

## Results

There were 42,917 total hip and total knee replacements performed in Canada in 2000/2001, up by 34% from 32,147 procedures in 1994/1995. Among the provinces, the largest percentage increase occurred in Manitoba, where total hip replacements increased by 31% and knee replacement procedures more than doubled between 1994/1995 and 2000/2001. Manitoba also performed the highest percentage of hip replacement revisions and had the largest percent decrease in hip replacements (-10.3%) between 1999/2000 and 2000/2001.

The number of total knee replacements performed on people under the age of 55 rose by 90% (up from 938 to 1,779), while total hip replacements increased by 30% (up from 2,310 to 3,013). Persons 85 years and older experienced the highest percent increase in the number of total hip replacement procedures, showing a 59% increase among males and a 44% increase among females. Similarly, there was a 95% jump in the number of knee replacements performed on men 85 years and older and a 74% increase for women of the same age.

The majority of total hip and knee replacements are performed on individuals 65 years of age and older. The mean age of a patient who underwent a total hip replacement in Canada was 67.8 years (69.5 years for females and 65.7 years for males) in 2000/2001. The majority (66%) of Canadian hip replacement recipients were 65 years or older. In contrast, only 6% of patients who underwent a hip replacement were younger than 45 years of age.

There has been a significant decrease in length of stay for these procedures since 1994/1995. For total hip replacements, the average length of stay has decreased by 29% from 1994/1995 to 2000/2001, down from 13.6 to 9.7 days, while for total knee replacements it dropped 33% down from 12.2 to to 8.2 days.

## Provincial Comparisons

The age-standardized rates of total hip and knee replacement surgery vary across Canada. Quebec and Newfoundland had the lowest rates in Canada, while Nova Scotia and Manitoba had the highest.

With the exception of Yukon and Nunavut, the majority of patients had their surgeries done in their home province. However, a small proportion of patients have their replacements done in another province. Residents of Prince Edward Island, Nova Scotia and Saskatchewan were most likely to have their hip or knee replacements done in another province.

## Surgical and Clinical Characteristics

Degenerative osteoarthritis was the most common diagnosis for a primary total hip (76%) and a primary total knee replacement (88%). Other common diagnoses were osteonecrosis, inflammatory arthritis and post-traumatic osteoarthritis.

The most common reasons for revising a total hip replacement were aseptic loosening (60%), osteolysis (34%), poly wear (29%) and instability (17%). Among the revised knee replacements, the same group comprised the top four reasons, as follows: aseptic loosening (42%), poly wear (29%), instability (21%) and osteolysis (18%).

Post-operative in-hospital mortality is a relatively rare event among recipients of a total hip or total knee replacement. Overall, the mortality rate of total hip and knee replacement patients was 0.6% and 0.2%, respectively.

## Discussion

Although data currently available are inadequate for determining revision rates, the registry in future will be able to measure and monitor revision rates by following patients over time and conducting post-market surveillance of orthopaedic implants.

In the future, the CJRR will be exploring ways to measure wait times for these surgeries and determining what is required to report on these wait times across Canada. Data on prioritization, illness severity, and patient follow-up and satisfaction are also being explored as additional components that may be included in CJRR in the future.

*Copies of the 2003 report can be purchased through the CIHI Order Desk at www.cihi.ca. Copies of the Executive Summary, media release and recent bulletins can be downloaded free of charge from the CIHI website. Queries regarding this report may be addressed to cjrr@cihi.ca.*

# Introduction

This is the second annual report produced by the Canadian Joint Replacement Registry (CJRR). The first annual report was published in January 2002 and the supplementary report was released in October 2002.[1,2] The aim of this report is to characterize the basic epidemiology of total hip and total knee replacements performed in Canada according to person (patient demographics), place (provincial and national level data) and time (trends), as well as selected surgical and clinical parameters. Joint replacement data for this report are obtained from three sources, namely orthopaedic surgeons participating in the CJRR and two hospital separation databases managed by the Canadian Institute for Health Information (CIHI), the Hospital Morbidity Database and the Discharge Abstract Database.

The CJRR is a national registry that collects information on total hip and total knee replacement surgeries performed in Canada and follows joint replacement recipients over time to monitor their outcomes including revision rates. The ultimate goal of the CJRR is to improve the quality of care and clinical outcomes of joint replacement recipients through post-market surveillance of orthopaedic implants, improving the quality of surgical practices and the study of risk factors affecting outcomes.

The CJRR is a joint effort between CIHI and the orthopaedic surgeons of Canada. This initiative was championed by CIHI and orthopaedic surgeons from each province who were working under the auspices of the Canadian Orthopaedic Association and the Canadian Orthopaedic Foundation. A number of other key partners contributed to the successful development and implementation of the CJRR including the Federal, Provincial and Territorial Ministries of Health, the Arthritis Society, the Canadian Arthritis Network, and the Ontario Joint Replacement Registry (OJRR).

A brief history of the development of the CJRR is described in more detail in the section titled "Canadian Joint Replacement Registry".

# Background

Total joint replacement surgery has evolved substantially since 1938, when the notion of total hip arthroplasty was first introduced. Replacement of a diseased hip can provide significant pain relief and considerable improvement in a patient's functional status and quality of life.[3] Significant improvements have also been observed in all dimensions of health, including pain, mobility, well-being and emotional status following a total knee replacement.[4] These benefits extend to all age groups, including patients over the age of 80 years.[4] In view of the potential for excellent outcomes associated with total joint replacement surgeries, these procedures will likely continue to increase in most developed countries as technologies advance and populations age.[5] The number of these procedures carried out each year will also be influenced by the need for these surgeries and access to services.

In Canada, 42,917 total hip and total knee replacements were performed in 2000/2001, compared to 32,147 procedures in 1994/1995, representing a 33.5% increase over this 7-year period. This increase is similar to that observed in the United States, where the number of total hip and total knee replacements increased by 34.2% from 380,000 procedures in 1994 to 510,000 procedures in 2000.[6]

This upward trend in the absolute number of surgeries is paralleled by an increase in the age-standardized rates for total hip and total knee replacements, which increased by 5.1% and 35.6%, respectively, during the same time period. The consistent upward trend in age-adjusted rates over time indicates that an aging population is not the only factor leading to an increase in the number of procedures performed annually.

# Canadian Joint Replacement Registry

## Description

The CJRR is a national registry that collects information on patient outcomes and revisions following total hip and total knee replacement procedures performed in Canada. The registry was officially launched at the Canadian Orthopaedic Association annual meeting in June 2000 and has been receiving data since May 2001. The CJRR, which is managed by CIHI, was modelled after the Swedish hip and knee replacement registries, which have been operational since 1975 and 1979, respectively. A brief history of the development of the CJRR is outlined in Table 1.

**Table 1. History of the Development of the CJRR**

| Milestones | Date |
|---|---|
| 1. Proposal and Planning | 1995 |
| 2. Feasibility Study and Report (Phase 1) | May 1996 |
| 3. Pilot Study and Report (Phase 2) | August 1997 |
| 4. Launch of the CJRR at the COA 2000 Annual Meeting | June 2000 |
| 5. Start of Data Submission | May 2001 |
| 6. First Annual CJRR Report | January 2002 |
| 7. CJRR Surgeon Participation Rate Exceeds 50% | July 2002 |
| 8. Supplementary CJRR Report | October 2002 |
| 9. Second Annual CJRR Report | January 2003 |

Prior to surgery, patients are asked to provide consent to have their surgical information included in the CJRR. Once written patient consent is obtained, the surgeon and/or operating room staff completes a two-page data collection form that captures information on patient demographics, the type of replacement, reason for replacement, surgical approach, fixation mode, implant types, antibiotic use, deep vein thrombosis prophylaxis and operating room environment. The data collection forms are mailed directly to CIHI in a confidential and secure manner where data verification and data entry are completed. Joint replacement data are then analyzed in conjunction with administrative hospital data held at CIHI from the Hospital Morbidity and Discharge Abstract Databases.

At publication time, only the province of Ontario had an operational provincial joint replacement registry, the Ontario Joint Replacement Registry (OJRR). Orthopaedic surgeons in Ontario participate in the CJRR through the OJRR. Surgeons in all other provinces submit operative data directly to CIHI. Surgical information in Ontario is collected via hand-held computers in the operating room. Eventually, the data will be sent electronically to CIHI by the OJRR. The flow of data collection in the CJRR is shown in Figure 1.

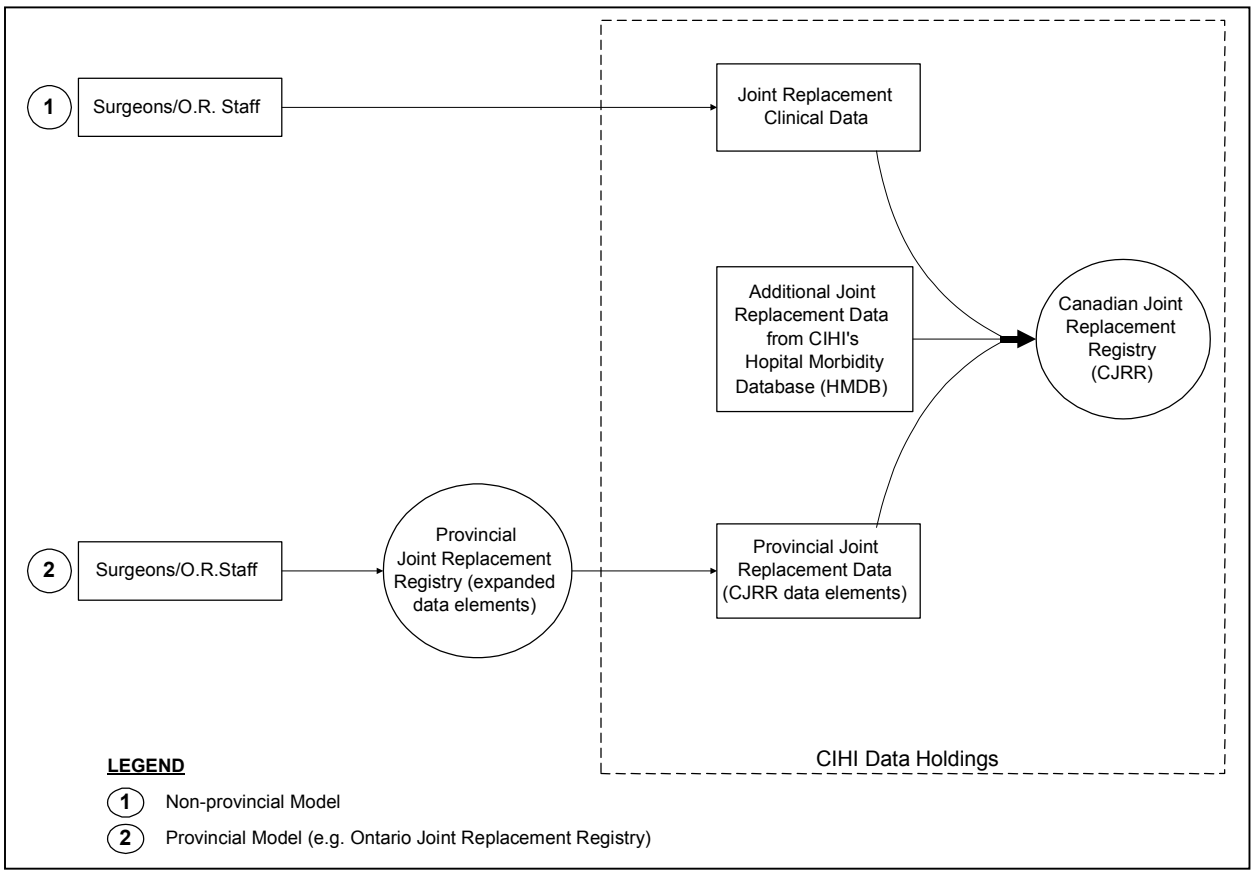



**Figure 1. Canadian Joint Replacement Registry (CJRR) Dataflow**

Privacy and confidentiality of patients and surgeons is assured. As custodian of numerous registries and databases, CIHI has stringent policies for ensuring that the privacy, confidentiality and security of its data holdings are protected. For more information on CIHI's Privacy and Confidentiality policies and procedures, visit the CIHI web site at www.cihi.ca.

## Why a National Joint Replacement Registry?

Before the CJRR, detailed surgical data on total hip and total knee replacements were not routinely collected nationally. Therefore, the relative effectiveness of various surgical techniques, operating room environments, practices around antibiotic use and prevention of deep vein thrombosis, as well as fixation methods on clinical outcomes and implant survival could not be determined. Similarly, the relative effectiveness of currently available hip and knee implants is largely unknown. Although there has been a proliferation of orthopaedic implants in the last two decades, post-market surveillance of these devices has not previously been carried out on an ongoing, systematic basis in Canada.

In the past, the coding of hip and knee replacement procedures across Canada has not distinguished between primary and revision surgeries. Consequently, the proportion of *all* replacements that are revisions and the revision rate (i.e. the proportion of *primary*

replacements that are revised within a specific time period) and the reasons for revision could not readily be determined from existing data. In early 2000, CIHI requested that hospitals submitting data to its Discharge Abstract Database code primary total hip and total knee replacements separately from revision replacements beginning April 1, 2000. As a result, it is now possible to determine the proportion of total hip and total knee replacements that were revisions in 2000/2001. It is important to recognize that Quebec hospitals do not submit to the Discharge Abstract Database, and as such, are not included in the calculation of percent revisions. In 2000/2001, 10.6% of total hip replacements and 7.9% of total knee replacements performed in Canada (excluding Quebec) were revisions.

The CJRR captures revision operations, reasons for revision and follows joint replacement recipients over time to monitor their outcomes. This information will enable CIHI to calculate revision rates and determine the most common reasons for revisions identified. Through focused analyses of revisions, reasons for revisions and other factors related to the patient, to the implant and to the surgical technique, risk factors that predict revisions can be identified, which in turn, may contribute to decreasing the number of revisions.

Although Health Canada has a process in place for the evaluation and approval of medical devices prior to their release in the field, post-market surveillance of medical implants and new technologies is largely lacking in Canada. Longitudinal follow-up of joint replacement recipients registered in the CJRR will help delineate the reasons for and variables affecting implant survival, thus providing an effective mechanism for post-market surveillance of orthopaedic implants. A 1996 editorial in the British Medical Journal called for the development of a national arthroplasty registry in the UK and identified it as the best method for assessing orthopaedic implants.[8] The author argued that a minimum follow-up of 10 years is usually required to ascertain the effectiveness of an implant. With the exception of the Charnley low friction arthroplasty, no other prosthesis has had a long-term follow-up in the UK. The UK National Joint Replacement Registry is now in the consultative stages of development. The CJRR will provide valuable information on implant performance to surgeons in Canada and internationally.

## Benefits of CJRR

With close to 43,000 total joint replacements performed annually in Canada, the CJRR will be one of the largest arthroplasty registries in the world with great potential to follow a significant number of joint replacement recipients over time. Large numbers are often needed to detect changes in trends as well as provincial variations in procedure rates and lengths of stay. Additionally, a large sample size is necessary to carry out meaningful analyses of association and prediction.

Demographic information on patients is limited in existing data holdings collected from hospital discharge abstracts in Canada. The CJRR captures detailed patient demographics allowing us to characterize the profile of joint replacement recipients and linking this to clinical outcomes.

CJRR data can be linked with other CIHI's holdings, such as the Hospital Morbidity Database and Discharge Abstract Database to determine average lengths of stay, re-admissions including reasons for re-admission, in-hospital mortality and other clinical interventions while in hospital, such as blood transfusion.

### Patient Benefits

The ultimate goal of the CJRR is to improve the quality of care and clinical outcomes of joint replacement recipients in Canada. Lowering the risk for revisions through optimal surgical techniques and effective orthopaedic implants can result in better patient care, surgical outcomes and health system efficiency. CJRR will also be measuring patient wait times, functional status following surgery, and patient satisfaction in future years.

### Surgeon Benefits

Over time, the CJRR will provide information to surgeons for evidence-based decision-making with respect to patient prioritization, surgical technique and implant selection, all of which may improve the quality of total hip and total knee replacement surgery. Surgeons and institutions participating in the registry will receive regular feedback and comparative reports and analyses. The CJRR will also provide a credible source of information for use in policy and planning decisions.

Participating surgeons can earn Continuing Professional Development (CPD) Credits by submitting operative data to the CJRR and reviewing regular CJRR feedback reports. Submission of six completed data collection forms to CIHI will earn each surgeon 1 credit under activities outlined in Section 6 (Educational Development, Teaching and Research) of the CPD Framework of the Maintenance of Certification Program. The CJRR team at CIHI provides surgeons with regular updates on the number of CPD credits earned through their participation in the CJRR.

### Benefits for the Health-care System

Information from the CJRR will aid in the development of evidence-based practice and/or guidelines for total hip and total knee replacement surgeries in Canada. The application of these evidence-based practices will improve the outcomes of these surgeries through a decrease in subsequent morbidity among joint replacement patients and will provide system-wide cost savings.

## Participation in the CJRR

Participation in the CJRR has been steadily increasing since orthopaedic surgeons began submitting operative data in May 2001. In July 2002, the CJRR surpassed the 50% participation mark. Between May 2001 and December 1, 2002, 386 surgeons had started participating in the CJRR either directly or through the Ontario Joint Replacement Registry (OJRR). The 250 surgeons from outside Ontario represent an estimated 54% of the CJRR eligible orthopaedic surgeons in Canada (excluding Ontario). Furthermore, their annual volumes represent 77% of the total hip and total knee replacements performed in Canada (excluding Ontario) annually. Orthopaedic surgeons in Ontario submit their data to the OJRR, which will eventually be electronically forwarded to CJRR. The OJRR participation rates are even higher in regions where OJRR is active. As shown in Table 2, participation in the CJRR varies by province.

**Table 2. Participation in the Canadian Joint Replacement Registry as of December 1, 2002**

| Province | Surgeons Signed up to Participate | Estimated Number of Surgeons[2] | % Surgeons Participating | 2000/2001 Procedures | Total Hip Replacements[3] | Total Knee Replacements[3] | Total | % Total Procedures |
|---|---|---|---|---|---|---|---|---|
| British Columbia | 52 | 94 | 55.3 | 5,835 | 1,901 | 1,970 | 3,871 | 66.3 |
| Alberta | 28 | 50 | 56.0 | 4,408 | 1,052 | 1,374 | 2,426 | 55.0 |
| Saskatchewan | 18 | 24 | 75.0 | 1,851 | 893 | 998 | 1,891 | N/A |
| Manitoba | 17 | 23 | 73.9 | 2,090 | 789 | 944 | 1,733 | 82.9 |
| Quebec | 75 | 202 | 37.1 | 6,209 | 1,944 | 2,030 | 3,974 | 64.0 |
| Nova Scotia | 23 | 26 | 88.5 | 1,833 | 1,390 | 1,190 | 2,580 | N/A |
| Newfoundland | 11 | 13 | 84.6 | 445 | 267 | 290 | 557 | N/A |
| Prince Edward Island | 3 | 3 | 100.0 | 193 | 75 | 75 | 150 | 77.7 |
| New Brunswick | 22 | 25 | 88.0 | 1,276 | 595 | 755 | 1,350 | N/A |
| Northwest Territories | ∫ | ∫ | ∫ | 29 | 10 | 20 | 30 | N/A |
| Nunavut | N/A | 0 | N/A | - | 0 | 0 | - | N/A |
| Yukon | N/A | 0 | N/A | - | 0 | 0 | - | N/A |
| **Subtotal[1]** | **250** | **462** | **54.1** | **24,169** | **8,916** | **9,646** | **18,562** | **76.8** |
| Ontario[1] | 136 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| **TOTAL** | 386 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

[1] Ontario surgeons participate in the CJRR through the OJRR. The OJRR is being implemented on a region by region basis across Ontario.

[2] Number of surgeons who perform total hip and total knee replacements is not known. This list will be updated as new information becomes available.

[3] Estimated number of total hip and knee replacements performed each year by surgeons who have agreed to participate in the CJRR.

∫ Numbers are too small.

CJRR provincial representatives and numerous site leaders have been instrumental in promoting the benefits of the registry and, by extension, increasing surgeon participation and commitment for submitting operative data to the CJRR in their respective provinces.

# Methodology and Limitations

## Data Sources

Surgical and implant data presented in this report are submitted to the CJRR by orthopaedic surgeons participating in the CJRR. National and provincial numbers and rates of total hip and total knee replacements presented in this report are extracted from CIHI's Hospital Morbidity Database and Discharge Abstract Database.

### Orthopaedic Surgeons

Surgical and orthopaedic implant data presented in this report are based on 5,799 procedures submitted by the orthopaedic surgeons participating in the CJRR between May 1, 2001 and September 30, 2002 (Figure 3). It is possible that surgeons participating in the CJRR differ from non-participating surgeons and, thus results should not be generalized to all joint replacements performed in Canada.

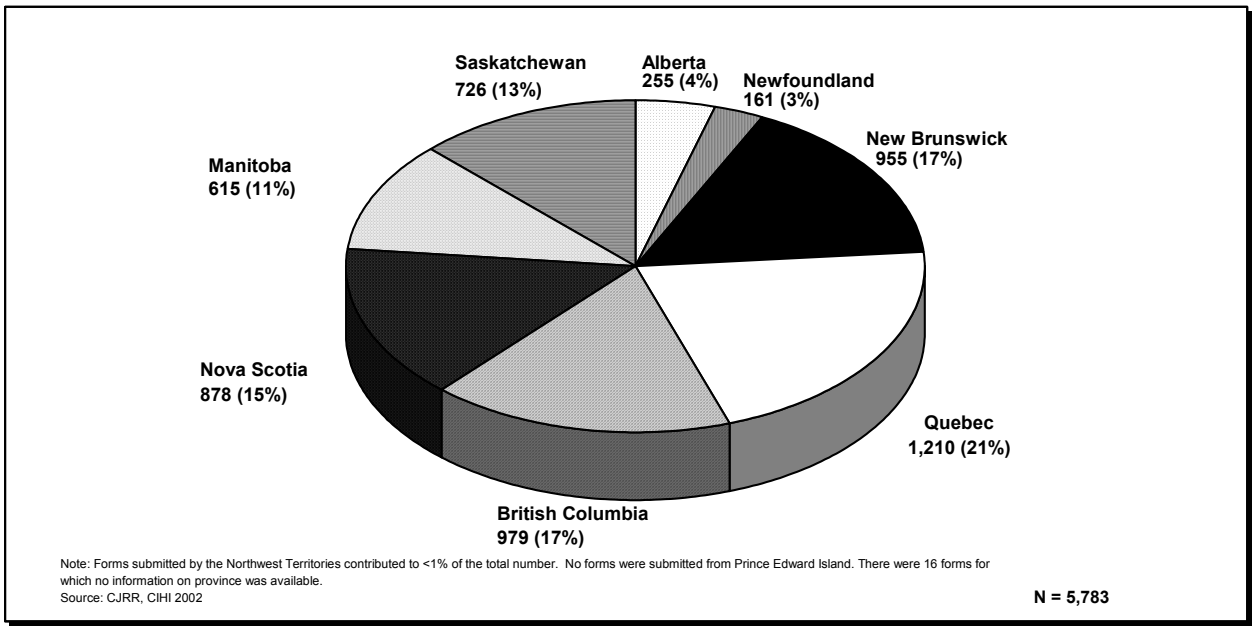



**Figure 2. Number of Total Hip and Total Knee Replacement Forms by Province**

### Hospital Morbidity Database

The Hospital Morbidity Database provides the number of discharges (including deaths) from a hospital by primary diagnosis and contains all acute care discharges in Canada. This database contains a number of different clinical and demographic data, such as, primary diagnosis, operation, admission date, discharge condition, total days stay, and age and sex of the patient.

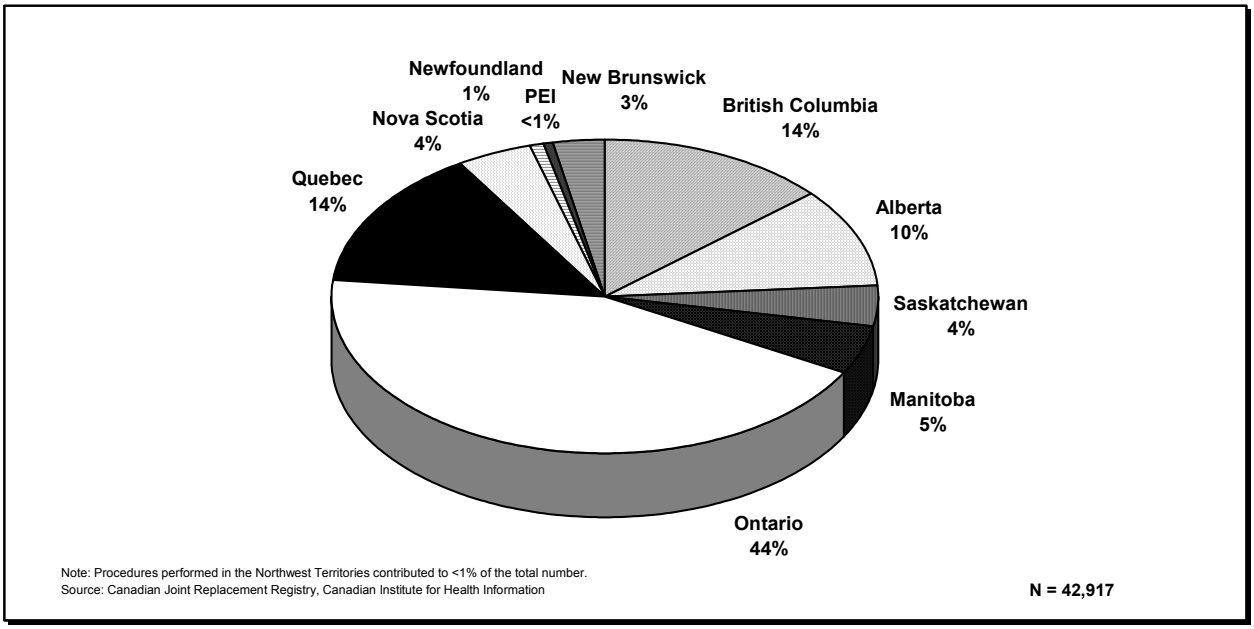



**Figure 3. Number of Total Hip and Total Knee Replacement Procedures Performed in Canada, by Province, 2000/2001**

Data are received from general and allied special hospitals, including acute care, convalescence and chronic facilities (with the exception of Ontario) and are downloaded from the Discharge Abstract Database (DAD) for those provinces participating in DAD. Data for the remaining hospitals are submitted separately by the corresponding provinces and territories. The Hospital Morbidity Database captures 100% of acute care discharges in Canada.

**Table 3. Number of Total Hip and Total Knee Replacements Submitted to CJRR Relative to the Total Number of these Procedures Performed in Canada in 2000/2001**

| Province | Total number of replacements submitted to CJRR[1] (% of total) | Total number of replacements performed in 2000/2001 (% of total) |
|---|---|---|
| British Columbia | 979 (16.9%) | 5,835 (13.6%) |
| Alberta | 255 (4.4%) | 4,408 (10.3%) |
| Saskatchewan | 726 (12.6%) | 1,851 (4.3%) |
| Manitoba | 615 (10.6%) | 2,090 (4.9%) |
| Ontario[2] | N/A | 18,748 (43.7%) |
| Quebec | 1,210 (20.9%) | 6,209 (14.5%) |
| Nova Scotia | 878 (15.2%) | 1,833 (4.3%) |
| Newfoundland | 161 (2.8%) | 445 (1.0%) |
| Prince Edward Island | 0 (0.0%) | 193 (0.4%) |
| New Brunswick | 955 (16.5%) | 1,276 (3.0%) |
| Northwest Territories | 4 (0.1%) | 29 (0.1%) |
| **TOTAL** | **5,783 (100.0%)** | **42,917 (100.0%)** |

[1]There were 16 forms for which no information on province was available.
[2]Ontario surgeons participate in CJRR via OJRR.

## Discharge Abstract Database

This database contains demographic, administrative and clinical data for hospital discharges, including inpatient acute, chronic, rehabilitation as well as day surgeries. CIHI receives data directly from participating hospitals, which represent about 85% of all hospital inpatient discharges in Canada. The DAD is used to determine the number and percentage of hip and knee replacement surgeries that are revisions. Quebec and some Manitoba facilities do not submit to the DAD, thus the percentage of revisions cannot be calculated for these sites.

### Statistics Canada

For the calculation of rates, national, provincial and regional fiscal estimates (October 1) are used. These are special order tabulations provided by the Demography Division of Statistics Canada. Regional rates are reported for fiscal year 1999/2000 as the regional fiscal estimates were not available at the publication of this report.

## Data Elements

### Hospital Morbidity and Discharge Abstract Databases

Total hip replacements include *total hip replacement with methyl methacrylate* and *other total hip replacement*, which correspond to ICD-9-CCP[†] codes 93.51 and 93.59, respectively. Total knee replacements include *geomedic total knee replacement* and *polycentric total knee replacement* and correspond to ICD-9-CCP code 93.41. Until April 2000, these codes captured both primary and revision procedures. After April 2000, health care facilities submitting data to CIHI's Discharge Abstract Database were asked to use a separate CCP code for revisions. Therefore, since April 2000, revision of a total hip replacement *cemented with methyl methacrylate* is assigned the ICD-9-CCP code of 93.52, revision of a total hip replacement *uncemented* is coded 93.53 and revision of a total knee replacement (*cemented or uncemented*) is captured by ICD-9-CCP code 93.40.

To permit comparisons over time, primary and revision surgeries as well as elective and emergency surgeries are included in the analyses for all years of data. In 2000/2001, the proportion of total hip replacements and total knee replacements that were revisions is 10.6% and 7.9%, respectively (excluding Quebec). The estimated proportion of total hip replacements and total knee replacements that are performed on an emergency basis is 6% and 1%, respectively.

Previous surgeries are excluded from the Hospital Morbidity Database as of 1998/1999 only. The proportion of total hip replacements and total knee replacements that constitute previous surgeries on an annual basis is estimated at 2.3% and 2.4%, respectively. Cancelled surgeries are excluded from the Hospital Morbidity Database for all years reported (i.e. 1994/1995 to 2000/2001).

### Surgical and Implant Data

Orthopaedic surgeons participating in the CJRR complete a two-page data collection form following a total hip or a total knee replacement surgery. Data collection forms and a list of data elements are available for download on the CIHI web site at www.cihi.ca.

[†] International Classification of Diseases, 9th Revision—Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedures

## Data Analysis

In calculating the rates of total hip and total knee replacements, the numerator is based on the number of procedures according to where the patient lives and not where the procedure was performed. Patients with unknown or invalid residence codes were excluded from rate calculations. Unless otherwise indicated, rates are adjusted for age and reported separately for males and females. Age-standardization is a statistical method employed to control for the effect of the age structure of the population, thereby permitting comparisons over time or between populations. Therefore, changes or differences in age-standardized rates of total hip and total knee replacements are caused or explained by factors other than changes or differences in the age structure of the population. Sex-specific rates are reported because there are considerable differences in rates of total hip and total knee replacements between males and females.

It is generally recommended that age-standardized rates be used for examining trends over time and for comparing rates across populations. The purpose of adjusting for age is to eliminate the effect of differing age compositions between populations. These age structures may be different in the case of interprovincial comparisons or may have changed over time, in the case of longitudinal comparisons within the same population. Differences in age-adjusted rates are due to factors other than age.

Univariate analyses of surgical and implant data were calculated using SAS (version 8) statistical package. National data from the Hospital Morbidity and Discharge Abstract Databases were analyzed using CIHI's Oracle-based Query and Analysis analytical tool.

## Data Quality

The quality of total hip and total knee replacement data obtained from CIHI's Hospital Morbidity and Discharge Abstract Databases is judged to be accurate and reliable. The accuracy of hospital health record coding is greatest for major surgery and diminishes with the complexity of the information.[5]

In regards to surgical and implant information, data collection forms are completed by orthopaedic surgeons and forwarded directly to CIHI in a confidential and secure manner. A data entry clerk examines the data collection forms to ensure that patient consent is obtained and the form is adequately completed. If patient consent is not indicated, the data collection form is returned to the orthopaedic surgeon for confirmation of patient consent. Once the data collection forms have been checked for patient consent and deemed complete, they are entered into the CJRR system (Oracle database).

The CJRR team is also in the process of conducting a comprehensive data quality evaluation of the CJRR specifically related to surgical and implant data, based on CIHI's Data Quality Framework[9]. The framework considers data quality from a user's perspective whereby "quality" is defined as "fitness-for-use". Data quality is assessed based on 24 characteristics rolled up into five dimensions, namely timeliness, usability, relevance, accuracy and comparability. In order to identify and rank aspects of data quality needing improvement, each characteristic must be carefully evaluated.

## Limitations

The results pertaining to surgical and implant information presented in this report are preliminary and have not been validated through an extensive data quality study. The 5,799 procedures that constitute the sample size from which the surgical and implant analyses are derived, represent approximately 10% of total hip and total knee replacement procedures performed in Canada and do not include Ontario data. Thus, these results are not considered generalizable to all total hip and total knee arthroplasties performed in Canada. In addition, the operative and implant information on these procedures was submitted to the CJRR by a subset of all orthopaedic surgeons who have signed up to participate in the registry. It is possible that those surgeons who have submitted data to the registry differ from surgeons who have signed up but are not yet submitting data to the registry as well as from those who have not yet signed up with the CJRR. Therefore the surgical data should be reviewed as preliminary. Age-standardized rates for 2000/2001 for total hip and total knee replacements differ than those published in previous reports because of updates to population estimates provided by Statistics Canada. The data on number of procedures, rates, lengths of stay are drawn from the Morbidity database and the DAD. These sources of data are considered reliable and valid.

# Results

***Important Note:*** *Analyses on trends, patient demographics and provincial variations are based on total hip and total knee replacement data extracted from the Hospital Morbidity database. Surgical and clinical characteristics, as well as utilization and outcome analyses (with the exception of those related to in-hospital deaths) are presented using surgical and orthopaedic data submitted by orthopaedic surgeons participating in the CJRR between May 1, 2001 and September 30, 2002.*

## Trends in Total Hip and Total Knee Replacements in Canada

There were 42,917 total hip and total knee replacements performed in Canada in 2000/2001, up by 34% from 32,147 procedures in 1994/1995 (Figure 4). There has been a shift in the proportion of total knee arthroplasties compared to total hip arthroplasties in the last 7 years. In 1994/1995, the majority of procedures were for hip replacements (52%), compared to 48% knee replacements. By 2000/2001, these proportions changed to 54% for total knee replacements and 46% for total hip replacements. This change is the result of a larger increase in knee arthroplasties, as evidenced by a 51% increase in knee replacements compared with a 18% rise in hip replacements from 1994/1995 to 2000/2001.

Figures 4 and 5 show that the number and rate respectively of hip replacements actually decreased between 1999/2000 and 2000/2001 for both males and females. Figure 6 shows that the rate of increase in knee replacements declined between 1999/2000 and 2000/2001.

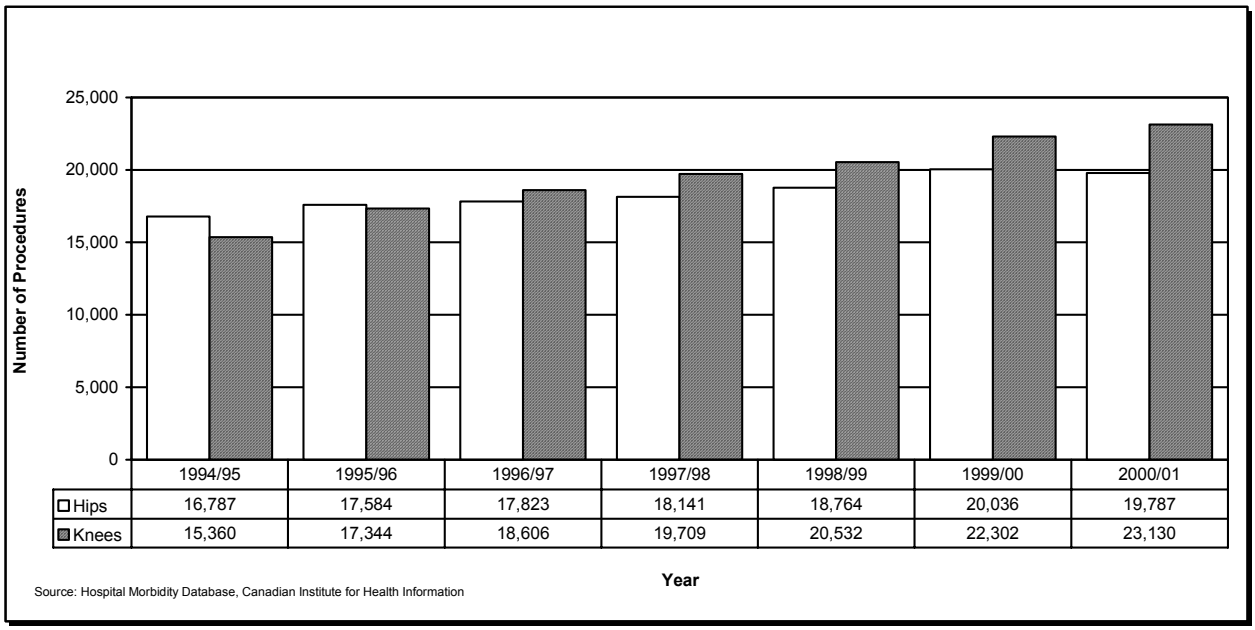



**Figure 4. Number of Total Hip and Total Knee Replacement Procedures Performed in Canada, 1994/1995 to 2000/2001**

The increase in the number of procedures has not been uniform in each province as shown in Tables 4 and 5. Although variations exist, an increase in the number of procedures is generally observed in each province. Among the provinces, the largest percentage increase is observed in Manitoba where total hip replacements increased by 31% and knee replacement procedures more than doubled between 1994/1995 and 2000/2001. However, Manitoba also had the largest percentage decline in total hip replacements between 1999/2000 and 2000/2001 (Table B.1).

**Table 4. Number of Total Hip Replacement Procedures Performed in Canada Based on Patient Residence, 1994/1995 and 2000/2001**

| Province | Total Hip Replacement 1994/1995 | Total Hip Replacement 2000/2001 | Percentage Change |
|---|---|---|---|
| Newfoundland[1] | 203 | 218 | + 7.4% |
| Prince Edward Island | 104 | 110 | + 5.8% |
| Nova Scotia | 734 | 781 | + 6.4% |
| New Brunswick | 429 | 514 | + 19.8% |
| Quebec | 2,527 | 3,188 | + 26.2% |
| Ontario | 6,988 | 8,078 | + 15.6% |
| Manitoba | 664 | 867 | + 30.6% |
| Saskatchewan | 821 | 885 | + 7.8% |
| Alberta | 1,786 | 2,036 | + 14.0% |
| British Columbia | 2,383 | 2,892 | + 21.4% |
| Territories[2] | 9 | 29 | + 222.2%[5] |
| Unknown[1,3] | 199 | 189 | --- |
| **CANADA[4]** | **16,787** | **19,787** | **+ 17.9%** |

[1] For Newfoundland and patients with unknown residence, 1995/1996 numbers are used; 1994/1995 data are incomplete.
[2] Includes Northwest Territories, Yukon and Nunavut.
[3] Includes both Canadian and non-Canadian residents.
[4] Total does not add up because 1995/1996 numbers used for Newfoundland and patients with unknown residents.
[5] Percentage change should be interpreted with caution as it is based on small numbers.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

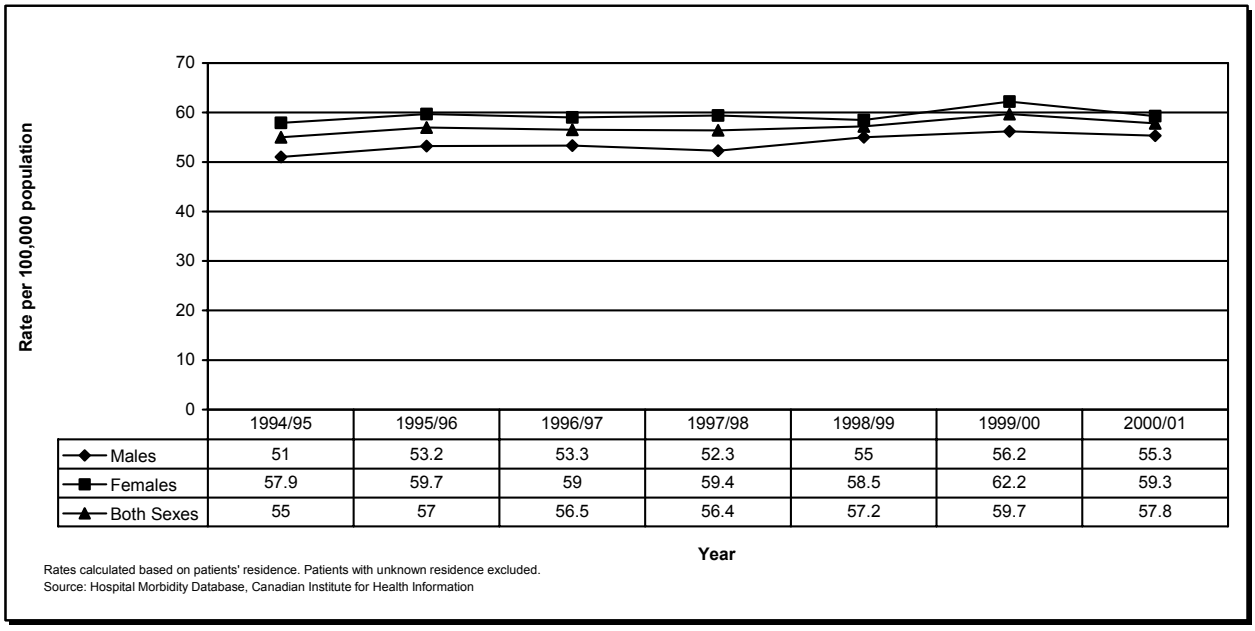
**Table 5. Number of Total Knee Replacement Procedures Performed in Canada Based on Patient Residence, 1994/1995 and 2000/2001**

| Province | Total Knee Replacement 1994/1995 | Total Knee Replacement 2000/2001 | Percentage Change |
|---|---|---|---|
| Newfoundland[1] | 175 | 226 | + 29.1% |
| Prince Edward Island | 88 | 101 | + 14.8% |
| Nova Scotia | 679 | 1,077 | + 58.6% |
| New Brunswick | 402 | 685 | +70.4% |
| Quebec | 2,146 | 3,069 | + 43.0% |
| Ontario | 6,839 | 10,426 | + 52.4% |
| Manitoba | 578 | 1,178 | + 103.8% |
| Saskatchewan | 840 | 975 | + 16.1% |
| Alberta | 1,587 | 2,223 | + 40.1% |
| British Columbia | 1,875 | 2,946 | + 57.1% |
| Territories[2] | 6 | 35 | + 483.3%[5] |
| Unknown[1,3] | 176 | 189 | -- |
| **CANADA[4]** | **15,360** | **23,130** | **+ 50.6%** |

[1] For Newfoundland and patients with unknown residence, 1995/1996 numbers are used; 1994/1995 data are incomplete.
[2] Includes Northwest Territories, Yukon and Nunavut.
[3] Includes both Canadian and non-Canadian residents.
[4] Total does not add up because 1995/1996 numbers used for Newfoundland and patients with unknown residents.
[5] Percentage change should be interpreted with caution as it is based on small numbers.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

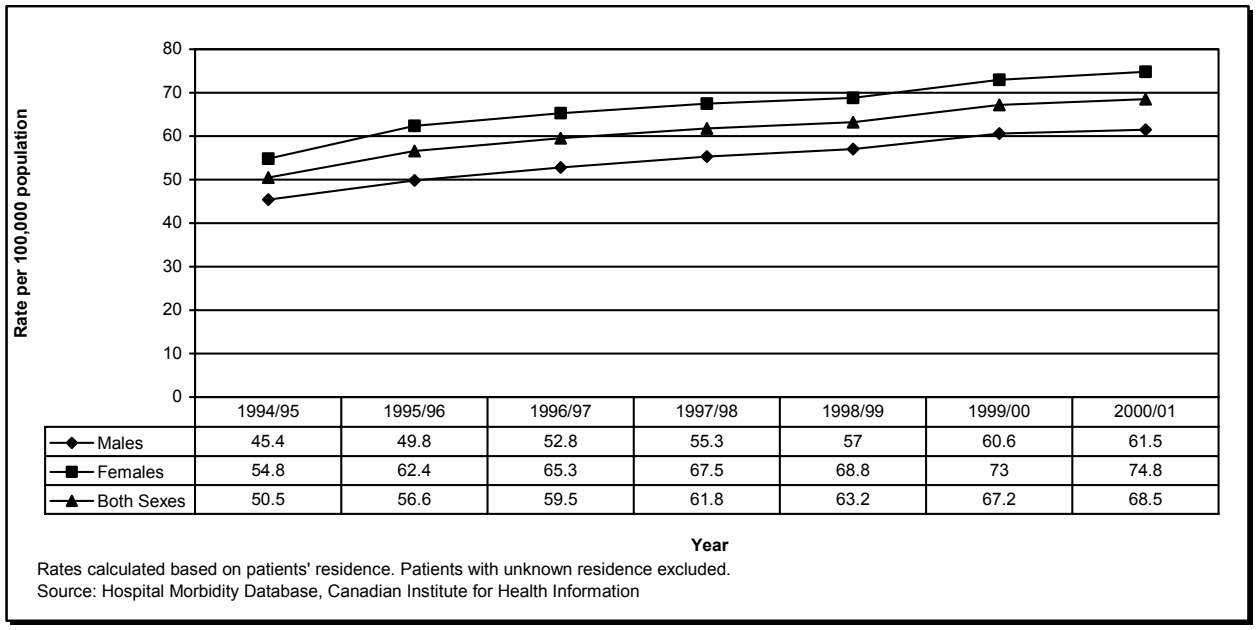
The age-standardized rates for total hip and total knee replacements also increased from 1994/1995 to 2000/2001. Figure 5 shows the age-standardized rate for total hip replacement procedures in Canada increased by 5.1%, from 55.0 per 100,000 population in 1994/1995 to 57.8 per 100,000 in 2000/2001. A steady rise is evident for men, women and both sexes combined. The increase is more marked in the case of total knee replacements (35.6% increase), as seen in Figure 6. Women are more likely to undergo both types of procedures than men.




| | 1994/95 | 1995/96 | 1996/97 | 1997/98 | 1998/99 | 1999/00 | 2000/01 |
|---|---|---|---|---|---|---|---|
| Males | 51 | 53.2 | 53.3 | 52.3 | 55 | 56.2 | 55.3 |
| Females | 57.9 | 59.7 | 59 | 59.4 | 58.5 | 62.2 | 59.3 |
| Both Sexes | 55 | 57 | 56.5 | 56.4 | 57.2 | 59.7 | 57.8 |

Rates calculated based on patients' residence. Patients with unknown residence excluded.
Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Figure 5. Age-Standardized Rates (per 100,000 population) by Sex for Total Hip Replacement Procedures, Canada, 1994/1995 to 2000/2001**




| | 1994/95 | 1995/96 | 1996/97 | 1997/98 | 1998/99 | 1999/00 | 2000/01 |
|---|---|---|---|---|---|---|---|
| Males | 45.4 | 49.8 | 52.8 | 55.3 | 57 | 60.6 | 61.5 |
| Females | 54.8 | 62.4 | 65.3 | 67.5 | 68.8 | 73 | 74.8 |
| Both Sexes | 50.5 | 56.6 | 59.5 | 61.8 | 63.2 | 67.2 | 68.5 |

Rates calculated based on patients' residence. Patients with unknown residence excluded.
Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Figure 6. Age-Standardized Rates (per 100,000 population) by Sex for Total Knee Replacement Procedures, Canada, 1994/1995 to 2000/2001**

Tables 6 and 7 show the percent changes in age-standardized rates between 1994/1995 and 2000/2001 by province. When reviewing these changes it is also important to consider what impact the percent change has had on the relative rank of a province or territory. It is also important to understand the level of need in the population and the burden of revisions. Variations in the age-standardized rates are summarized in the section on provincial/territorial variations.

Similar to increases in absolute numbers of total hip and total knee replacement surgeries, Manitoba experienced the greatest increase in the age-standardized rates for these procedures during the same time period (Tables 6 and 7). Age-standardized rates for total hip replacement procedures decreased in Alberta by 5.2% and Prince Edward Island had the smallest increase in total knee replacements (6.4%).

**Table 6. Age-Standardized Rates of Total Hip Replacement Procedures Performed in Canada Based on Patient Residence, 1994/1995 and 2000/2001**

| Province | Total Hip Replacement 1994/1995 | Total Hip Replacement 2000/2001 | Percentage Change |
|---|---|---|---|
| Newfoundland[1] | 38.5[1] | 37.6 | - 2.3% |
| Prince Edward Island | 70.9 | 70.5 | - 0.6% |
| Nova Scotia | 72.9 | 71.7 | - 1.6% |
| New Brunswick | 53.7 | 59.1 | + 10.1% |
| Quebec | 34.0 | 38.1 | + 12.1% |
| Ontario | 62.1 | 62.8 | + 1.1% |
| Manitoba | 53.7 | 66.7 | + 24.2% |
| Saskatchewan | 69.6 | 72.8 | + 4.6% |
| Alberta | 77.5 | 73.5 | - 5.2% |
| British Columbia | 59.7 | 62.1 | + 4.0% |
| **CANADA[2]** | **55.0** | **57.8** | **+ 5.1%** |

[1] For Newfoundland, 1995/1996 numbers are used as 1994/1995 data are incomplete.
[2] Patients with unknown residence are excluded. Yukon, Northwest Territories and Nunavut rates are suppressed due to small numbers but included in national average.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Table 7. Age-Standardized Rates of Total Knee Replacement Procedures Performed in Canada Based on Patient Residence, 1994/1995 and 2000/2001**

| Province | Total Knee Replacement 1994/1995 | Total Knee Replacement 2000/2001 | Percentage Change |
|---|---|---|---|
| Newfoundland[1] | 33.6[1] | 39.6 | + 17.9% |
| Prince Edward Island | 61.2 | 65.1 | + 6.4% |
| Nova Scotia | 67.6 | 100.6 | + 48.8% |
| New Brunswick | 50.8 | 80.8 | + 59.1% |
| Quebec | 29.0 | 37.0 | + 27.6% |
| Ontario | 60.9 | 81.8 | + 34.3% |
| Manitoba | 46.3 | 91.4 | + 97.4% |
| Saskatchewan | 70.0 | 81.2 | + 16.0% |
| Alberta | 70.0 | 82.2 | + 17.4% |
| British Columbia | 46.9 | 64.4 | + 37.3% |
| **CANADA[2]** | **50.5** | **68.5** | **+ 35.6%** |

[1] For Newfoundland, 1995/1996 numbers are used as 1994/1995 data are incomplete.
[2] Patients with unknown residence are excluded. Yukon, Northwest Territories and Nunavut rates are suppressed due to small numbers but included in national average.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

Persons 85 years and older experienced the highest percent increase in the number of total hip replacement procedures, showing a 59% increase among males and a 44% increase among females (Table 8). This partly reflects the greater number of people over the age of 85 in 2000/2001 compared to 1994/1995. Similarly, there was a 95% jump in the number of knee replacements performed on men 85 years and older and a 74% increase for women of the same age (Table 9). In considering the change in age-specific rates for total hip replacements over the same period, a consistent but more modest increase is observed for men (20.6%) and women (11.5%) 85 years of age or older (Table 10). A similar upward trend is also evident for the age-specific rates for total knee replacement procedures, which showed a 48.1% increase for men and a 35.1% increase for women in this age group between 1994/1995 and 2000/2001 (Table 11).

**Table 8. Number of Total Hip Replacement Procedures by Age Group and Sex, Canada, 1994/1995 and 2000/2001**

| Age Groups | Males | | | Females | | |
|---|---|---|---|---|---|---|
| | 1994/1995 | 2000/2001 | % Change | 1994/1995 | 2000/2001 | % Change |
| <45 years | 489 | 612 | + 25.1% | 475 | 477 | + 0.4% |
| 45–54 years | 716 | 1,025 | + 43.2% | 630 | 899 | + 42.7% |
| 55–64 years | 1,609 | 1,806 | + 12.2% | 1,659 | 1,815 | + 9.4% |
| 65–74 years | 2,475 | 2,951 | + 19.2% | 3,746 | 3,690 | - 1.5% |
| 75–84 years | 1,470 | 1,843 | + 25.4% | 2,798 | 3,604 | + 28.8% |
| 85+ years | 194 | 308 | + 58.8% | 526 | 757 | + 43.9% |
| **TOTAL** | **6,953** | **8,545** | **+ 22.9%** | **9,834** | **11,242** | **+ 14.3%** |

Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Table 9. Number of Total Knee Replacement Procedures by Age Group and Sex, Canada, 1994/1995 and 2000/2001**

| Age Groups | Males | | | Females | | |
|---|---|---|---|---|---|---|
| | 1994/1995 | 2000/2001 | % Change | 1994/1995 | 2000/2001 | % Change |
| <45 years | 104 | 137 | + 31.7% | 155 | 198 | + 27.7% |
| 45–54 years | 282 | 535 | + 89.7% | 397 | 909 | +129% |
| 55-64 years | 1,292 | 1,890 | + 46.3% | 1,684 | 2,768 | + 64.4% |
| 65–74 years | 2,754 | 4,022 | + 46.0% | 4,170 | 5,358 | + 28.5% |
| 75–84 years | 1,564 | 2,496 | + 59.6% | 2,597 | 4,164 | + 60.3% |
| 85+ years | 117 | 228 | + 94.9% | 244 | 425 | + 74.2% |
| **TOTAL** | **6,113** | **9,308** | **+ 52.3%** | **9,247** | **13,822** | **+ 49.5%** |

Source: Hospital Morbidity Database, Canadian Institute for Health Information

The number of total hip replacement procedures performed on younger Canadians also increased as seen by a 43% jump in the 45–54 year age group for both men and women (Table 8). This trend is more evident in the case of knee replacements where procedures performed on individuals aged 45–54 years showed a 129% increase for females and a 90% increase for males (Table 9). Similar to the older age groups, the increase in the age-specific rates for total hip and total knee replacements among 45–54 year old individuals is consistent with but less pronounced than the increase in the absolute number of these procedures (Tables 10 and 11).

**Table 10. Age-Specific Rates (per 100,000 population) of Total Hip Replacement Procedures by Sex, Canada 1994/1995 and 2000/2001**

| Age Groups | Males | | | Females | | |
|---|---|---|---|---|---|---|
| | 1994/1995 | 2000/2001 | % Change | 1994/1995 | 2000/2001 | %Change |
| <45 years | 4.9 | 6.1 | + 24.5% | 4.9 | 4.9 | 0.0% |
| 45–54 years | 40.8 | 47.1 | + 15.4% | 35.9 | 41.0 | + 14.2% |
| 55–64 years | 131.1 | 130.4 | - 0.5% | 131.8 | 126.8 | - 3.8% |
| 65–74 years | 267.5 | 295.6 | + 10.5% | 335.8 | 325.4 | - 3.1% |
| 75–84 years | 353.2 | 360.8 | + 2.1% | 434.0 | 464.1 | + 6.9% |
| 85+ years | 205.0 | 247.3 | + 20.6% | 236.6 | 263.9 | + 11.5% |
| **TOTAL** | **48.2** | **55.9** | **+ 16.0%** | **66.9** | **72.1** | **+ 7.8%** |

Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Table 11. Age-Specific Rates (per 100,000 population) of Total Knee Replacement Procedures by Sex, Canada, 1994/1995 and 2000/2001**

| Age Groups | Males | | | Females | | |
|---|---|---|---|---|---|---|
| | 1994/1995 | 2000/2001 | % Change | 1994/1995 | 2000/2001 | %Change |
| <45 years | 1.0 | 1.4 | + 40.0%[1] | 1.6 | 2.0 | + 25.0%[1] |
| 45–54 years | 16.1 | 24.6 | + 52.8% | 22.6 | 41.5 | + 83.6% |
| 55–64 years | 105.3 | 136.5 | + 29.6% | 133.8 | 193.4 | + 44.5% |
| 65–74 years | 297.0 | 402.9 | + 35.7% | 373.8 | 472.5 | + 26.4% |
| 75–84 years | 375.8 | 488.6 | + 30.0% | 402.9 | 536.2 | + 33.1% |
| 85+ years | 123.6 | 183.1 | + 48.1% | 109.7 | 148.2 | + 35.1% |
| **TOTAL** | **42.4** | **60.9** | **+ 43.6%** | **62.9** | **88.7** | **+ 41.0%** |

[1]Percent change should be interpreted with caution as it is based on small numbers.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

Crude rates of total hip and knee replacement procedures for several countries are presented in Tables 12 and 13. While Canada has one of the lowest rates of total hip replacements, the rate of total knee replacements falls within the average range. Comparisons of these national crude rates should be done with caution, since the rates are not adjusted for differences in the age and sex structures of each country's population. In addition, with the exception of Sweden, the optimal rates of total hip and total knee replacements have not been determined for most of these countries, which makes comparisons even more difficult. A group of Swedish researchers have recommended a hip replacement rate of 130 per 100,000 population to meet the needs for these procedures and eliminate wait times in Sweden.[7] However, this 'optimal' rate cannot be assumed to be applicable to other countries, as there are many factors that influence the population-based need for total hip replacements. The CJRR will contribute key information that will be useful in determining appropriate rate ranges for regions and sub-groups (i.e. age groups) within Canada. Determining the optimal rate for hip and knee replacement rates in Canada will require a better understanding of the impact of waiting for surgery on outcomes and quality of life.

**Table 12. International Comparison of Crude Rates (per 100,000 population) of Primary Total Hip Replacements**

| Country | Crude Rate per 100,000 | Year | Reference |
|---|---|---|---|
| Australia | 74 | 1999/2000 | 2001 Annual Report |
| Finland | 93 | 1999 | Acta Orthop Scand 2001;72(5):433-41 |
| New Zealand | 119 | 2000 | Personal communication, Toni Hobbs, New Zealand Joint Replacement Register Co-Ordinator, November 2001. |
| Norway | 114 | 1990 | Bulletin Hospital Joint Diseases 1999;58(3):139-47 |
| | 124 | 2000 | Personal communication, Birgitte Espehaug, Statistician, The Norwegian Arthroplasty Register, December 2001. |
| Sweden | 100 | N/A | Acta Orthop Scand 2000;71(2):111-21 |
| United States[1] | 52 | 1996 | American Academy of Orthopaedic Surgeons, Musculoskeletal Conditions in the United States. Arthroplasty and Total Joint Procedures, 1999. |
| **Canada**[2] | 64 | 2000/2001 | Canadian Institute for Health Information |

[1]U.S. data is not representative of full population.
[2]Canadian rate includes both primary and revision total hip replacements.

**Table 13. International Comparison of Crude Rates (per 100,000 population) of Primary Total Knee Replacements**

| Country | Crude Rate per 100,000 | Year | Reference |
|---|---|---|---|
| Australia | 81 | 1999/2000 | 2001 Annual Report |
| New Zealand | 75 | 2000 | Personal communication, Toni Hobbs, New Zealand Joint Replacement Register Co-Ordinator, November 2001. |
| Norway | 35 | 2000 | Personal communication, Birgitte Espehaug, Statistician, The Norwegian Arthroplasty Register, December 2001. |
| Sweden | 63 | 1996/1997 | Acta Orthop Scand 2000;71(4):378-80 |
| United States[1] | 92 | 1996 | American Academy of Orthopaedic Surgeons, Musculoskeletal Conditions in the United States. Arthroplasty and Total Joint Procedures, 1999. |
| **Canada[2]** | 75 | 2000/2001 | Canadian Institute for Health Information |

[1] U.S. data is not representative of full population.
[2] Canadian rate includes both primary and revision total knee replacements. The Swedish rate includes all endoprosthetic knee replacements, not just total knee replacements.

## Patient Demographics

The majority of total hip and knee replacements are performed on individuals 65 years of age and older. The mean age of a patient who underwent a total hip replacement in Canada was 67.8 years (69.5 years for females and 65.7 years for males) in 2000/2001. The majority (66%) of Canadian hip replacement recipients were 65 years or older (Figure 7). In contrast, only 6% of patients who underwent a hip replacement were younger than 45 years of age.

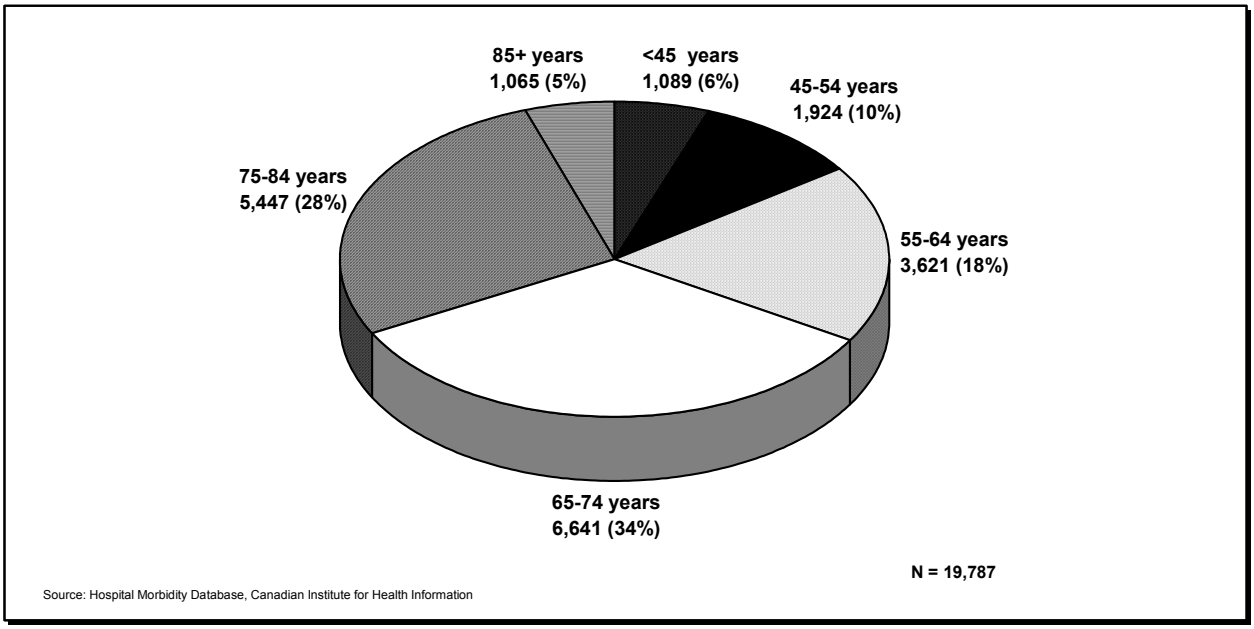



**Figure 7. Distribution of Total Hip Replacement Procedures by Patient Age, Canada, 2000/2001**

Overall, 57% of total hip replacement recipients were female. The age group of patients over the age of 65 accounted for 72% of the total hip replacement among women and 60% among men. Conversely, the proportion of total hip replacements less than 55 years of age was higher among men (19%) than among women (12%) (Figures 8 and 9).

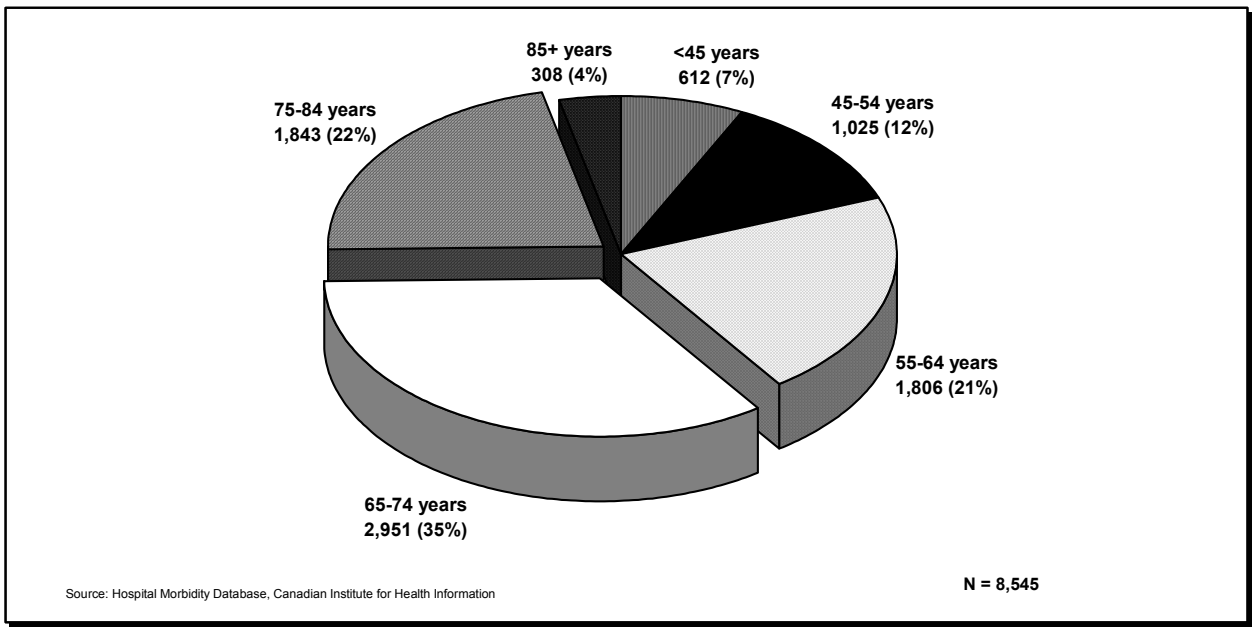



**Figure 8. Distribution of Total Hip Replacement Procedures by Patient Age for Males, Canada, 2000/2001**

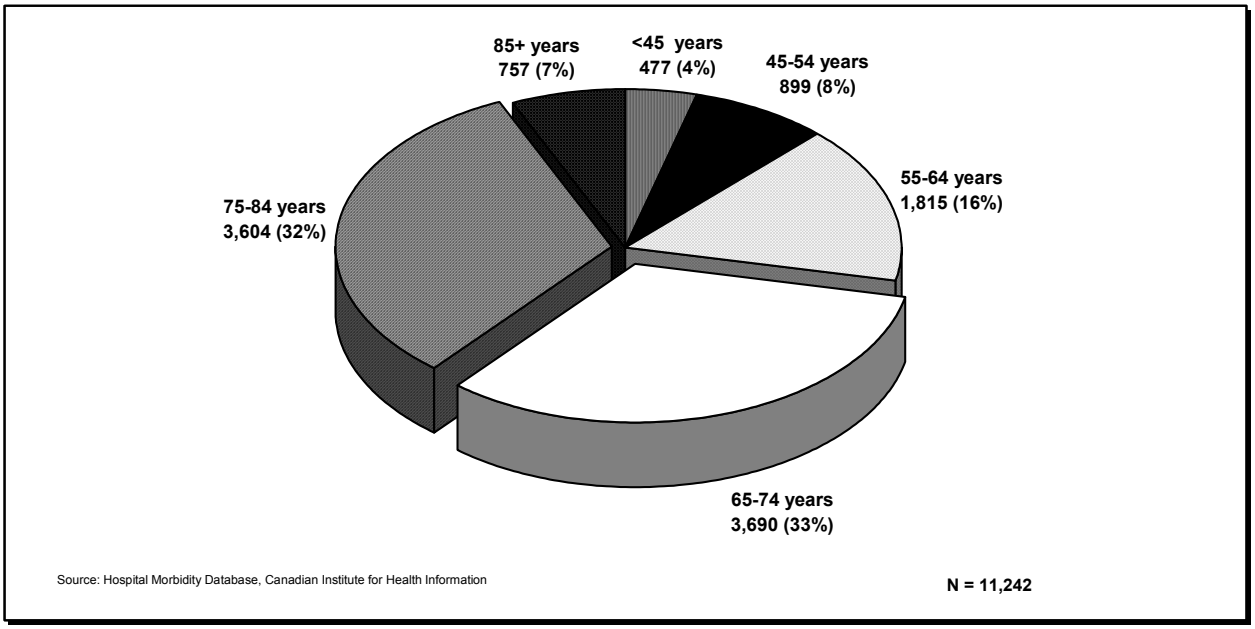



**Figure 9. Distribution of Total Hip Replacement Procedures by Patient Age for Females, Canada, 2000/2001**

Patients receiving a total knee replacement in 2000/2001 were slightly older, on average, than hip replacement recipients. The average age of a Canadian total knee replacement recipient was 69.2 years (69.4 years for females and 69.0 years for males) in 2000/2001.

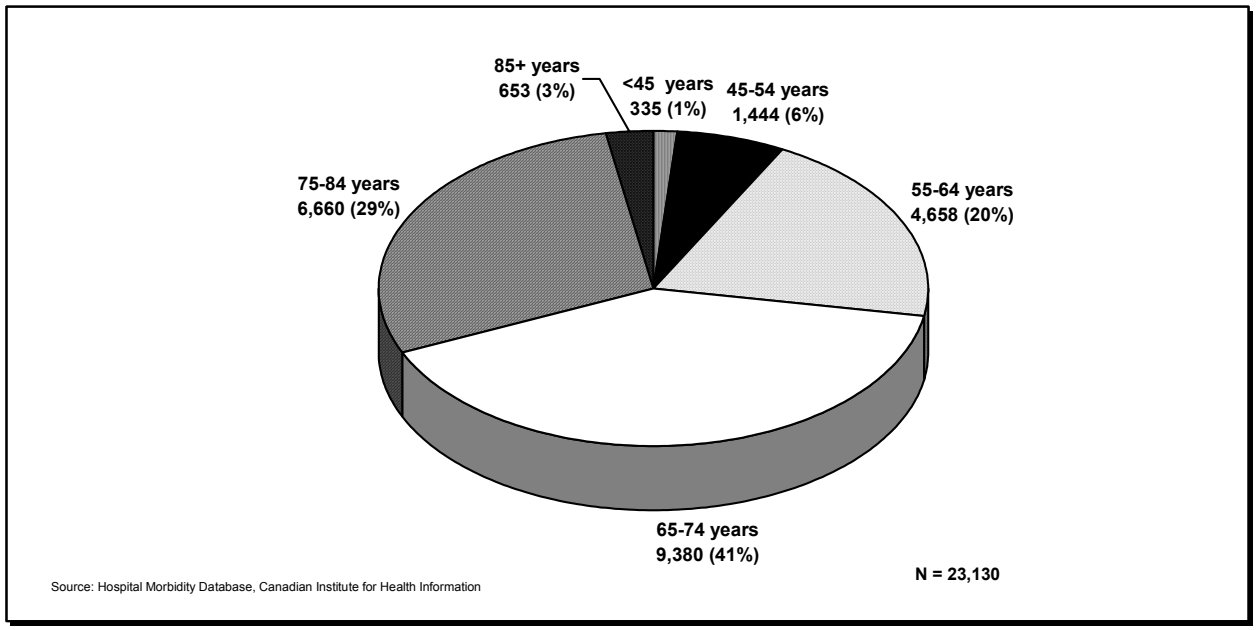



**Figure 10. Distribution of Total Knee Replacement Procedures by Patient Age, Canada, 2000/2001**

Patients aged ≥65 years accounted for 72% of the patients receiving a total knee replacement (Figure 10). These procedures were less commonly performed on younger individuals than hip replacements, with just over 1% of knee replacement recipients being under the age of 45 years, compared to 6% for a hip replacement.

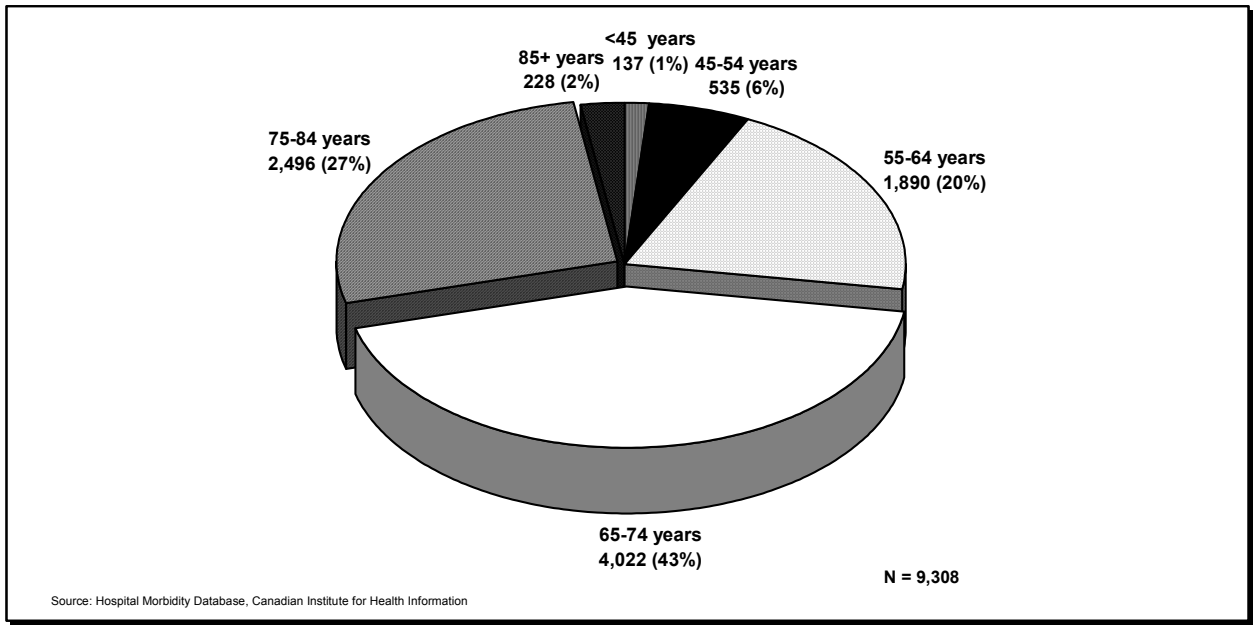



**Figure 11. Distribution of Total Knee Replacement Procedures by Patient Age for Males, Canada, 2000/2001**

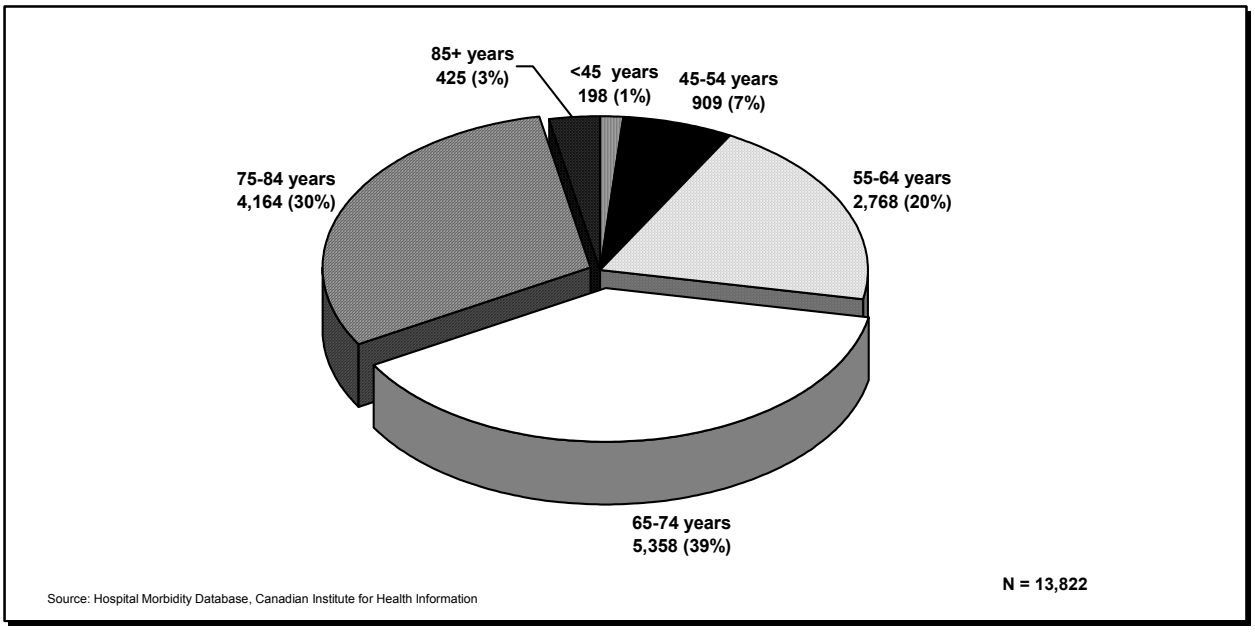
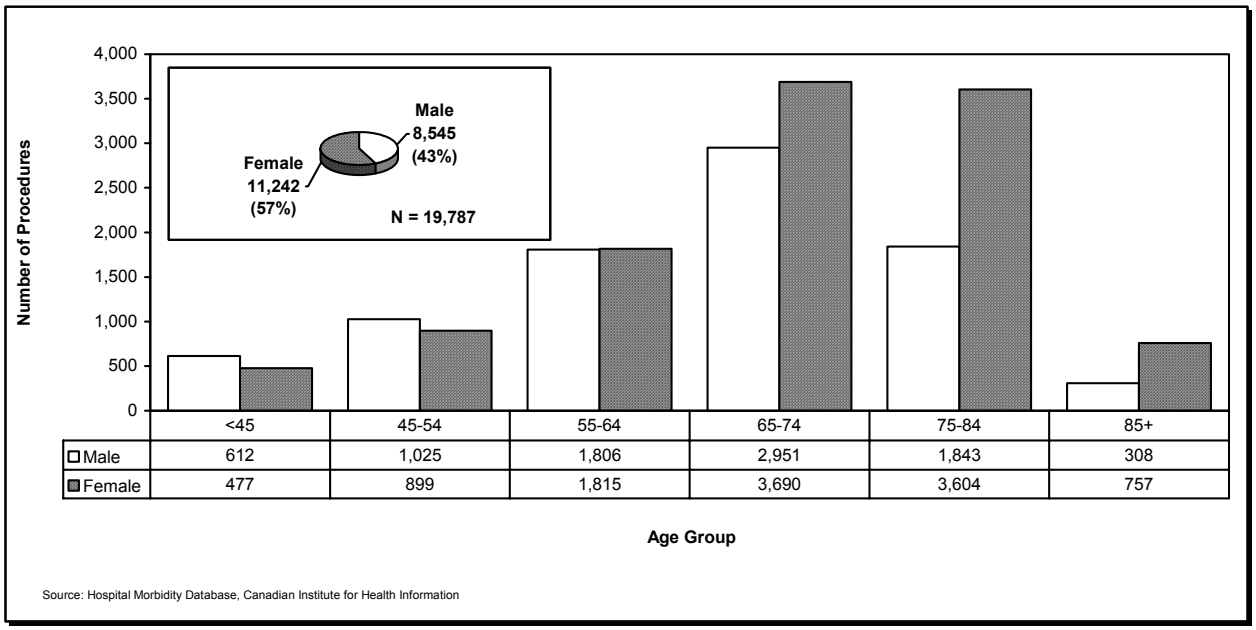



**Figure 12. Distribution of Total Knee Replacement Procedures by Patient Age for Females, Canada, 2000/2001**

As in the case for hip replacements, women were more likely to have a total knee replacement than men with 60% of knee replacement procedures being performed on females. In contrast to hip replacements, however, the age distribution for knee replacement procedures is very similar for males and females (Figures 11 and 12).

When the absolute number of total hip and total knee replacements are examined by age group and sex, the number of procedures performed on women outnumber men in all age groups except for total hip replacements performed on men less than 55 years of age (Figures 13 and 14).




| | <45 | 45-54 | 55-64 | 65-74 | 75-84 | 85+ |
|---|---|---|---|---|---|---|
| Male | 612 | 1,025 | 1,806 | 2,951 | 1,843 | 308 |
| Female | 477 | 899 | 1,815 | 3,690 | 3,604 | 757 |

**Figure 13. Number of Total Hip Replacement Procedures by Age Group and Sex, Canada, 2000/2001**

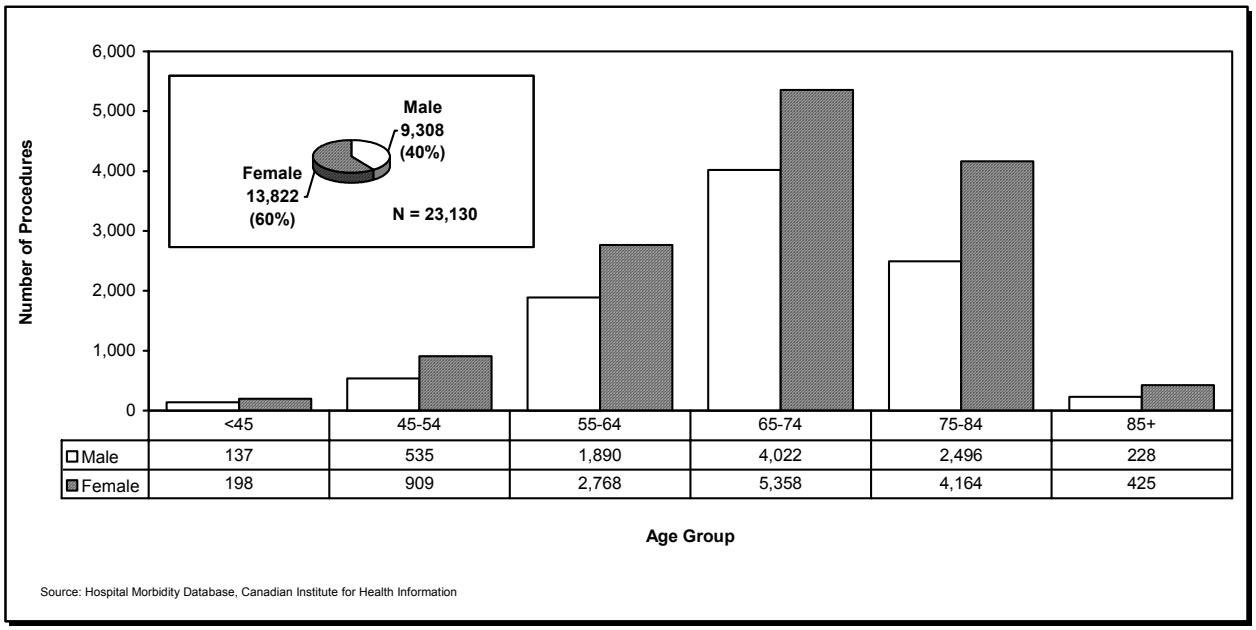
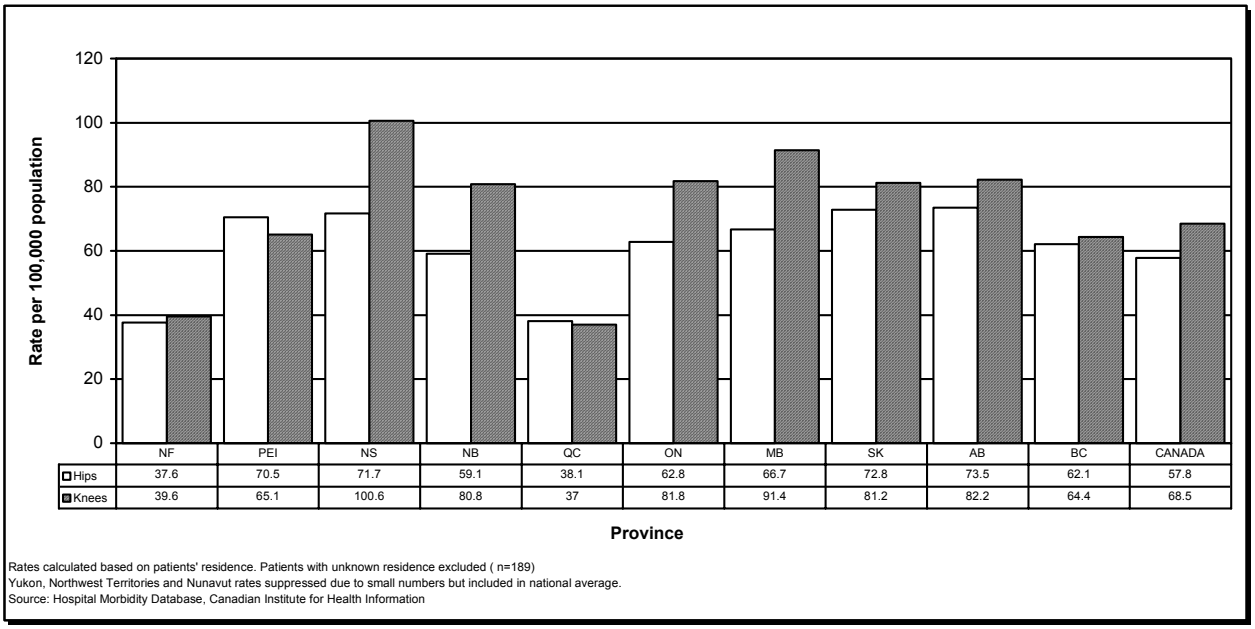



**Figure 14. Number of Total Knee Replacement Procedures by Age Group and Sex, Canada, 2000/2001**

## Provincial/Territorial Variations

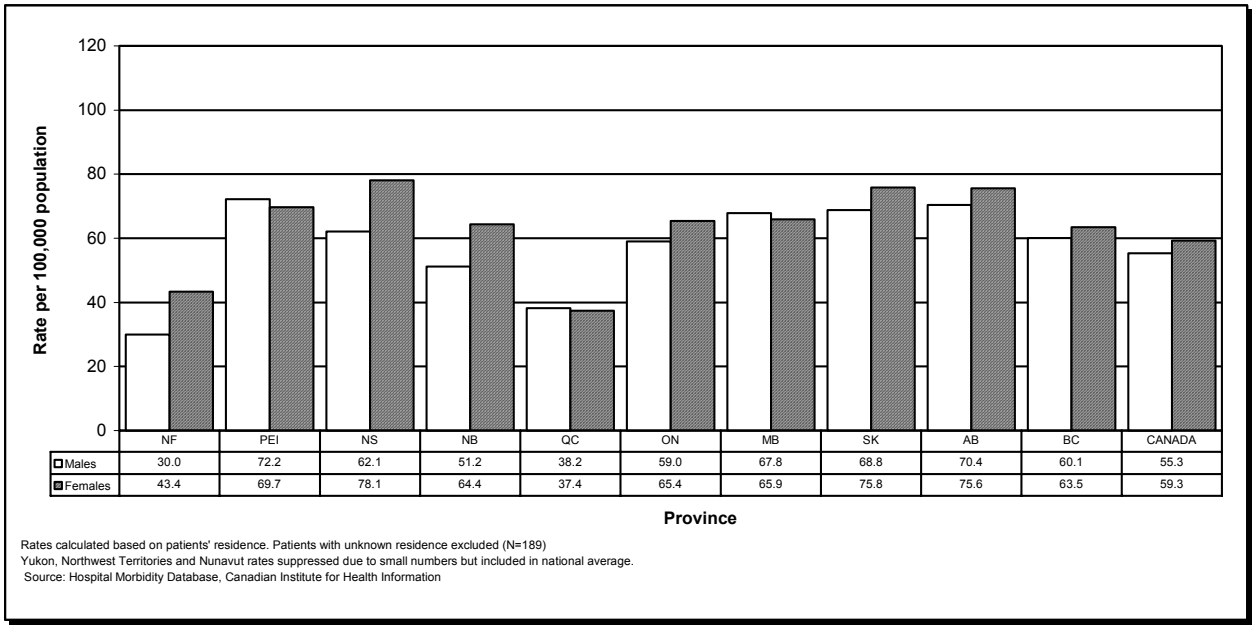
The age-standardized rates of total hip and knee replacement surgery vary across Canada (Figure 15). Provincial and national age-standardized rates are reported separately for males and females to illustrate gender differences (Figures 16 and 17). Quebec and Newfoundland have the lowest rates in Canada, while Nova Scotia and Manitoba have the highest. This pattern extends to both males and females as well as both sexes combined. The procedure rates in the more populated provinces/territories have a larger influence on the national average than do rates in the less populated regions.




| | NF | PEI | NS | NB | QC | ON | MB | SK | AB | BC | CANADA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hips | 37.6 | 70.5 | 71.7 | 59.1 | 38.1 | 62.8 | 66.7 | 72.8 | 73.5 | 62.1 | 57.8 |
| Knees | 39.6 | 65.1 | 100.6 | 80.8 | 37 | 81.8 | 91.4 | 81.2 | 82.2 | 64.4 | 68.5 |

Rates calculated based on patients' residence. Patients with unknown residence excluded ( n=189)
Yukon, Northwest Territories and Nunavut rates suppressed due to small numbers but included in national average.
Source: Hospital Morbidity Database, Canadian Institute for Health Information

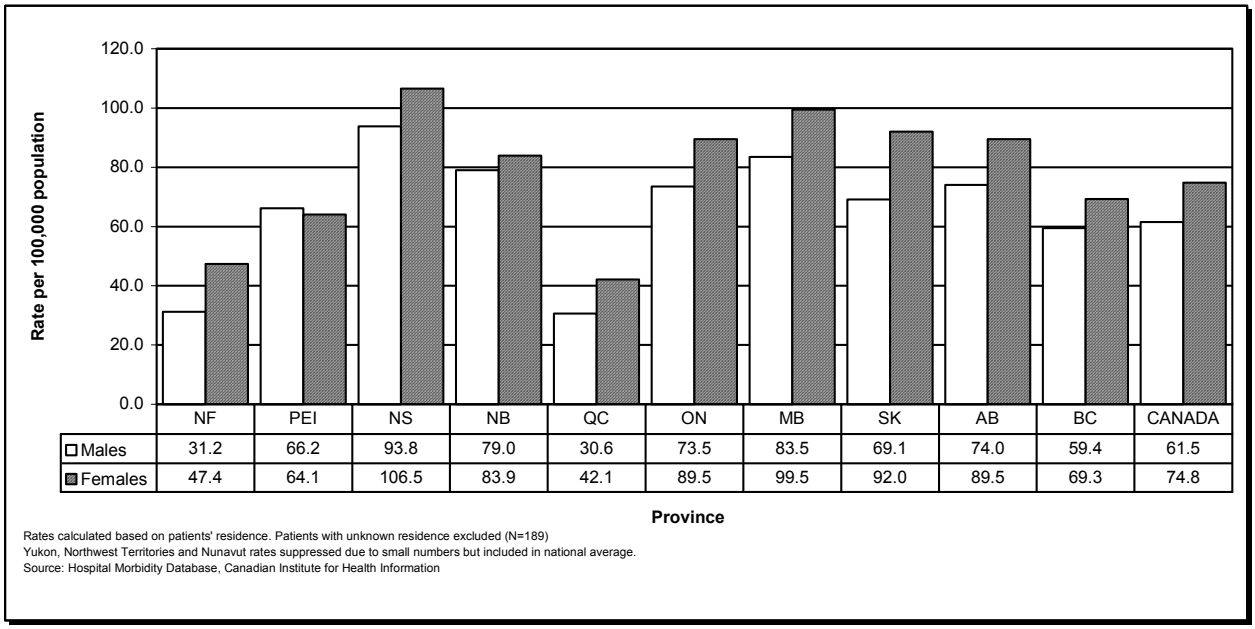
**Figure 15. Age-Standardized Rates (per 100,000 population) of Total Hip and Total Knee Replacement Procedures by Province, 2000/2001**




| | NF | PEI | NS | NB | QC | ON | MB | SK | AB | BC | CANADA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Males | 30.0 | 72.2 | 62.1 | 51.2 | 38.2 | 59.0 | 67.8 | 68.8 | 70.4 | 60.1 | 55.3 |
| Females | 43.4 | 69.7 | 78.1 | 64.4 | 37.4 | 65.4 | 65.9 | 75.8 | 75.6 | 63.5 | 59.3 |

Rates calculated based on patients' residence. Patients with unknown residence excluded (N=189)
Yukon, Northwest Territories and Nunavut rates suppressed due to small numbers but included in national average.
Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Figure 16. Age-Standardized Rates (per 100,000 population) of Total Hip Replacement Procedures for Males and Females, 2000/2001**




| | NF | PEI | NS | NB | QC | ON | MB | SK | AB | BC | CANADA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Males | 31.2 | 66.2 | 93.8 | 79.0 | 30.6 | 73.5 | 83.5 | 69.1 | 74.0 | 59.4 | 61.5 |
| Females | 47.4 | 64.1 | 106.5 | 83.9 | 42.1 | 89.5 | 99.5 | 92.0 | 89.5 | 69.3 | 74.8 |

**Figure 17. Age-Standardized Rates (per 100,000 population) of Total Knee Replacement Procedures for Males and Females, 2000/2001**

The absolute number of total hip and knee replacement procedures performed in 1994/1995 through 2000/2001 is presented in Tables B.3 and B.4 (Appendix B) for each province, territory and Canada as a whole. The counts are based on where the patient lives rather than where the surgery took place. For example, in 2000/2001, 975 total knee replacements were performed on residents of Saskatchewan.

With the exception of Yukon and Nunavut, the majority of patients have their surgeries done in their home province. However, a small proportion of patients have their replacements done in another province. Because no total joint replacements are performed in the Yukon and Nunavut, residents of these two territories need to travel to neighboring provinces of Alberta or British Columbia to have their hip and knee replacements done.

**Table 14. Movement of Total Hip Replacement Patients Across Provinces, 2000/2001**

| Province | Number of patients who had their total hip replacement done in another province | Number out of province total hip replacement patients performed in this province |
|---|---|---|
| Newfoundland | 2 (0.9%) | 6 (2.7%) |
| Prince Edward Island | 19 (17.3%) | 1 (1.1%) |
| Nova Scotia | 27 (3.5%) | 31 (4.0%) |
| New Brunswick | 8 (1.6%) | 37 (6.9%) |
| Quebec | 41 (1.3%) | 18 (0.6%) |
| Ontario | 1 (<0.1%) | 130 (1.6%) |
| Manitoba | 16 (1.8%) | 38 (4.3%) |
| Saskatchewan | 21 (2.4%) | 24 (2.7%) |
| Alberta | 18 (0.9%) | 82 (3.9%) |
| British Columbia | 43 (1.5%) | 36 (1.2%) |
| Northwest Territories | 2 (20.0%) | ** |
| Yukon | 15 (100%)* | * |
| Nunavut | 4 (100%)* | * |

*No joint replacements performed in Nunavut and the Yukon.

**Note:** Columns two and three have different totals because Northwest Territories numbers are suppressed and patients with unknown geography codes are not accounted for in the second column.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

In the case of total hip replacements, the provincial movement of patients is depicted in Table 14. Residents of Prince Edward Island were more likely to have their total hip replacement surgery in another province than residents of any other province in Canada. Just over 17% of PEI patients who had a hip replacement travelled to another province to have their operation. In contrast, Ontarians (less than 0.1%) and Albertans (0.9%) were the least likely to go to another province for their surgery. When considering the number of patients, more residents of British Columbia (N = 43) and Quebec (N = 41) travelled to another province to have their hip replaced than residents of any other province. The majority of patients from British Columbia travelled to Alberta while those from Quebec went to Ontario.

**Table 15. Movement of Total Knee Replacement Patients Across Provinces, 2000/2001**

| Province | Number of patients who had their total knee replacement done in another province | Number out of province total knee replacement patients performed in this province |
|---|---|---|
| Newfoundland | 5 (2.2%) | 2 (0.9%) |
| Prince Edward Island | 2 (2.0%) | 2 (2.0%) |
| Nova Scotia | 37 (3.5%) | 15 (1.4%) |
| New Brunswick | 8 (1.2%) | 49 (6.9%) |
| Quebec | 36 (1.2%) | 11 (0.4%) |
| Ontario | 1 (<0.1%) | 109 (1.1%) |
| Manitoba | 22 (1.9%) | 46 (3.8%) |
| Saskatchewan | 32 (3.4%) | 20 (2.1%) |
| Alberta | 5 (0.2%) | 90 (3.9%) |
| British Columbia | 40 (1.4%) | 43 (1.5%) |
| Northwest Territory | 4 (26.7%) | ** |
| Yukon | 10 (100%)* | * |
| Nunavut | 8 (100%)* | * |

*No joint replacements performed in Nunavut and the Yukon.

**Note:** Columns two and three have different totals because Northwest Territories numbers are suppressed and patients with unknown geography codes are not accounted for in the second column.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

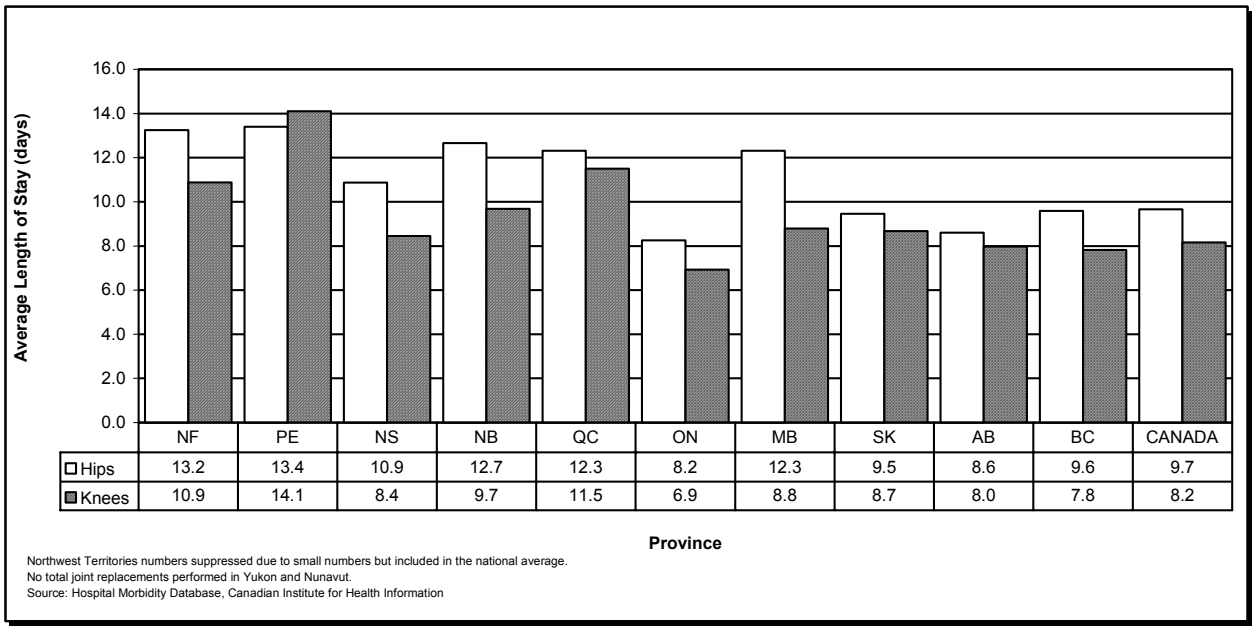
When considering the flow of patients into provinces for hip replacement surgery, New Brunswick (6.9%), Manitoba (4.3%) and Nova Scotia (4.0%) received the highest proportion of out-of-province patients. In absolute numbers, however, Ontario (N = 130) and Alberta (N = 82) received the most out-of-province patients for a total hip replacement.

Table 15 shows the movement of patients who underwent a total knee replacement in Canada in 2000/2001. Nova Scotia (3.5%) and Saskatchewan (3.4%) had the highest proportion of their residents travel to another province to have their knees replaced. As with hip replacement recipients, only a small proportion of residents of Alberta (0.2%) and Ontario (<0.1%) had their operation out-of-province. A higher number of British Columbia (N = 40), Nova Scotia (N = 37) and Quebec (N = 36) residents had their knee replacements done in another province compared to patients residing in other provinces. The majority of out-of-province knee replacement surgeries for Quebec residents were carried out in Ontario and almost all out-of-province patients from British Columbia and Saskatchewan

went to neighboring Alberta to have their knee replacement surgery. Accordingly, Ontario (N = 109) and Alberta (N = 90) received the highest number of out-of-province patients for a total knee replacement.

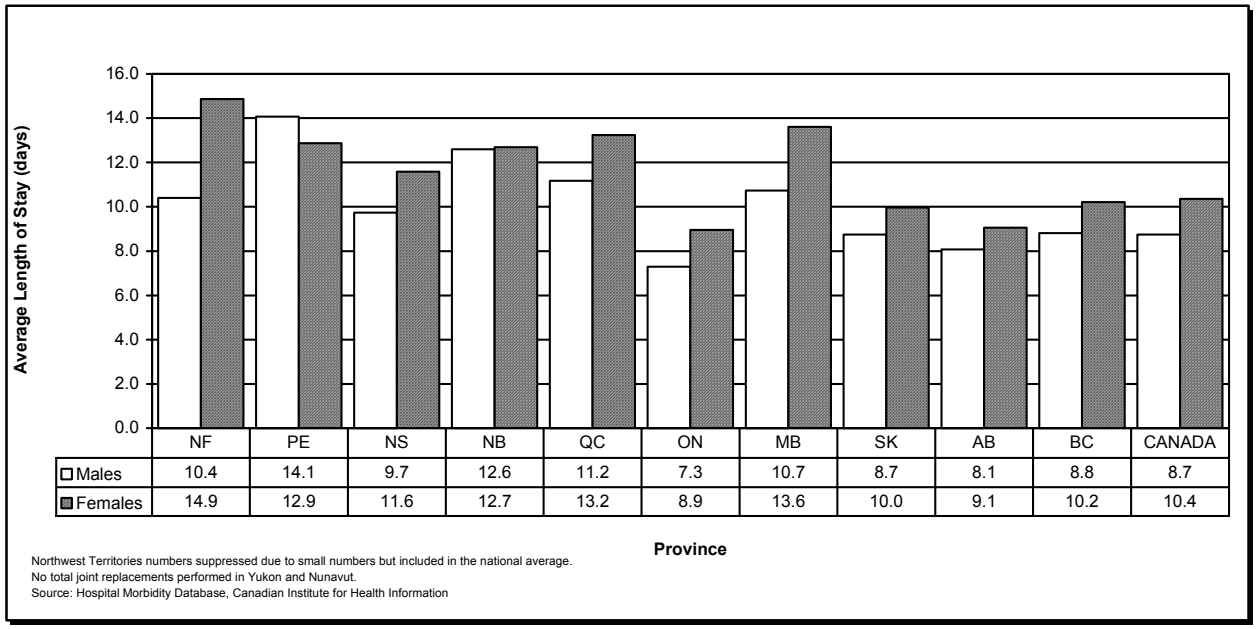
Provincial average lengths of stay for total hip and knee replacement patients are shown in Figure 18. Total hip replacement recipients have higher lengths of stay than patients undergoing a total knee replacement in all provinces except Prince Edward Island. On average, patients with a total hip replacement remain in hospital for 9.7 days compared to 8.2 days for those receiving a total knee replacement. Ontario and the western provinces of British Columbia, Alberta and Saskatchewan have lower average lengths of stay than the national average. In contrast, Prince Edward Island, Newfoundland and Quebec have higher than national average lengths of stay for these procedures.

On average, women undergoing a total hip or total knee replacement procedure remain in hospital longer than men undergoing the same procedures in all provinces except in Prince Edward Island (Figures 19 and 20).



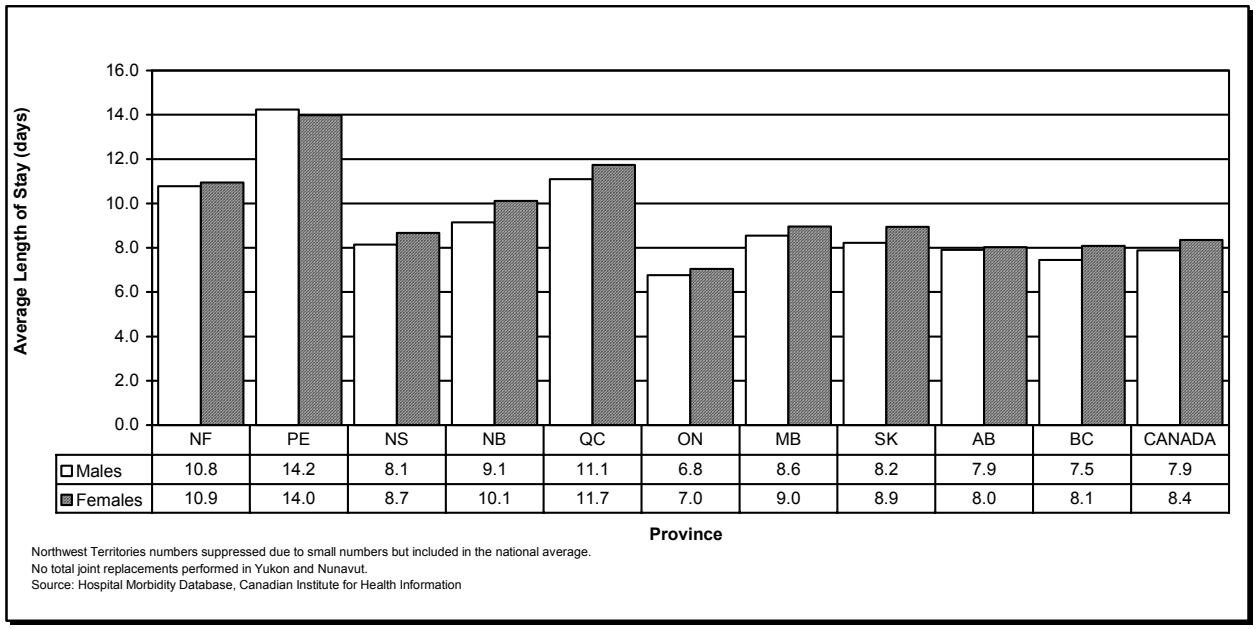

| | NF | PE | NS | NB | QC | ON | MB | SK | AB | BC | CANADA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hips | 13.2 | 13.4 | 10.9 | 12.7 | 12.3 | 8.2 | 12.3 | 9.5 | 8.6 | 9.6 | 9.7 |
| Knees | 10.9 | 14.1 | 8.4 | 9.7 | 11.5 | 6.9 | 8.8 | 8.7 | 8.0 | 7.8 | 8.2 |

**Figure 18. Average Length of Stay for Total Hip and Total Knee Replacement Patients by Province, 2000/2001**




| | NF | PE | NS | NB | QC | ON | MB | SK | AB | BC | CANADA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Males | 10.4 | 14.1 | 9.7 | 12.6 | 11.2 | 7.3 | 10.7 | 8.7 | 8.1 | 8.8 | 8.7 |
| Females | 14.9 | 12.9 | 11.6 | 12.7 | 13.2 | 8.9 | 13.6 | 10.0 | 9.1 | 10.2 | 10.4 |

**Figure 19. Average Length of Stay for Total Hip Replacement Patients by Sex and Province, 2000/2001**




| | NF | PE | NS | NB | QC | ON | MB | SK | AB | BC | CANADA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Males | 10.8 | 14.2 | 8.1 | 9.1 | 11.1 | 6.8 | 8.6 | 8.2 | 7.9 | 7.5 | 7.9 |
| Females | 10.9 | 14.0 | 8.7 | 10.1 | 11.7 | 7.0 | 9.0 | 8.9 | 8.0 | 8.1 | 8.4 |

**Figure 20. Average Length of Stay for Total Knee Replacement Patients by Sex and Province, 2000/2001**

There has been a noticeable decrease in the length of stay for total hip and knee replacements in all provinces since 1994/1995. Nationally, the average length of stay for patients undergoing a total hip replacement decreased by 29% from 13.6 days in 1994/1995 to 9.7 days in 2000/2001. Similarly, total knee replacement recipients now spend on average 8.2 days in hospital compared to 12.2 days in 1994/1995, a decrease of 33%.

## Surgical and Clinical Characteristics

Total knee replacements comprised 55% (N = 3,209) of the 5,799 procedures submitted to the CJRR between May 2001 and September 2002, with total hip replacements accounting for the remaining 45% (N = 2,590). The majority (92.1%) of total hip and total knee replacement procedures captured for this report were primary surgeries (N = 5,335). Revision surgeries made up 7.8% (N = 450) of the 5,790 procedures where the type of replacement is known. In the case of total hip replacements, 89.0% were primary surgeries (N = 2,301) and 10.9% were revisions (N = 283). Primary total knee replacements (N = 3,034) accounted for 94.7% of all knee surgeries, with revision surgeries (N = 167) accounting for 5.2% of knee replacements. Tables 16 and 17 depict primary and revision surgeries for total hip and total knee replacements respectively.

**Table 16. Type of Total Hip Replacement Procedures**

| Type of Replacement[1] | Number of Replacements | Percent of Total |
|---|---|---|
| Primary | 2,301 | 89.0% |
| First Revision | 222 | 8.6% |
| Second Revision | 48 | 1.9% |
| Third or greater revision | 13 | 0.5% |
| ***Subtotal-Revisions*** | ***283*** | ***10.9%*** |
| Excision (not a revision) | 2 | 0.1% |
| **TOTAL** | **2,586** | **100.0%** |

[1]Type of replacement information is missing for 4 surgeries.

Source: Canadian Institute for Health Information

**Table 17. Type of Total Knee Replacement Procedures[1]**

| Type of Replacement[2] | Number of Replacements | Percent of Total |
|---|---|---|
| Primary | 3,034 | 94.7% |
| First Revision | 140 | 4.4% |
| Second Revision | 17 | 0.5% |
| Third or greater revision | 10 | 0.3% |
| ***Subtotal-Revisions*** | ***167*** | ***5.2%*** |
| Excision (not a revision) | 3 | 0.1% |
| **TOTAL** | **3,204** | **100.0%** |

[1] Figures shown are based on an estimated distribution of the total number of total knee replacements (3,204) among replacement types.
[2] Type of replacement information is missing for 5 surgeries.

Source: Canadian Institute for Health Information

## Indications for Surgery

Degenerative osteoarthritis is the most common diagnosis grouping for a primary total hip (76%) and a primary total knee replacement (88%). The second and third most common indications for a total hip replacement are osteonecrosis (7%) and inflammatory arthritis (5%), respectively. In the case of a total knee replacement, inflammatory arthritis (8%) and post-traumatic osteoarthritis (2%) make up the second and third most common indication for surgery, respectively. It is noted that diagnosis groupings are not mutually exclusive. Figures 21 and 22 provide a breakdown of the most common diagnosis groupings for a primary total hip and primary total knee replacement respectively.

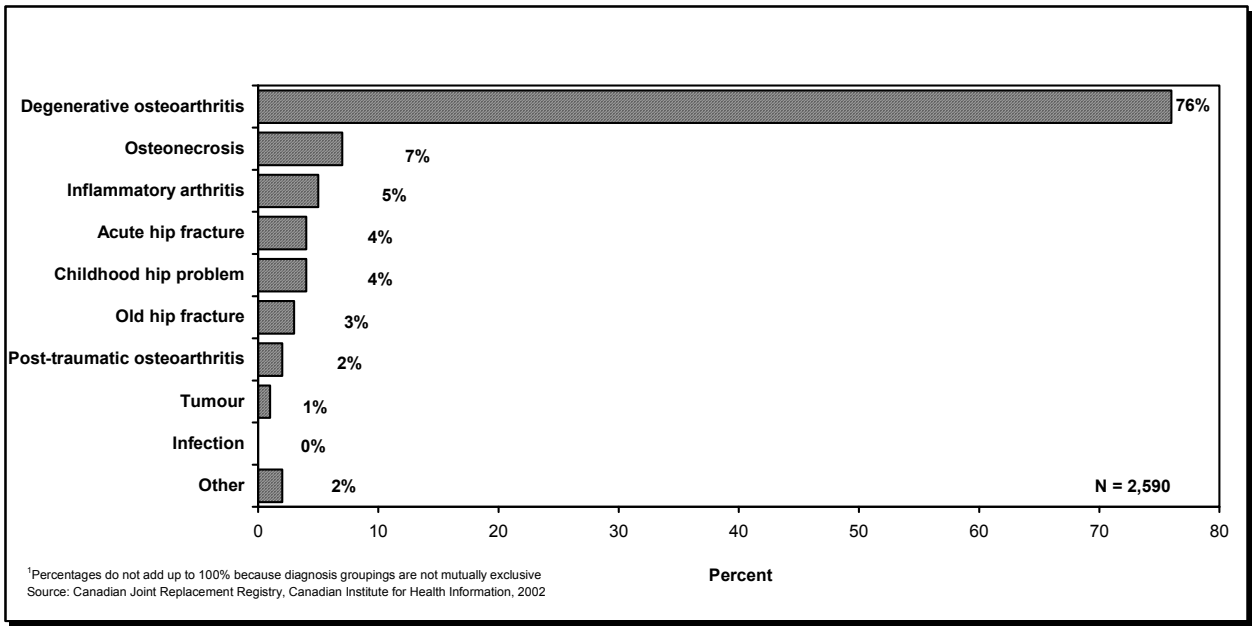



**Figure 21. Primary Total Hip Replacement Procedures by Diagnosis Grouping[1]**

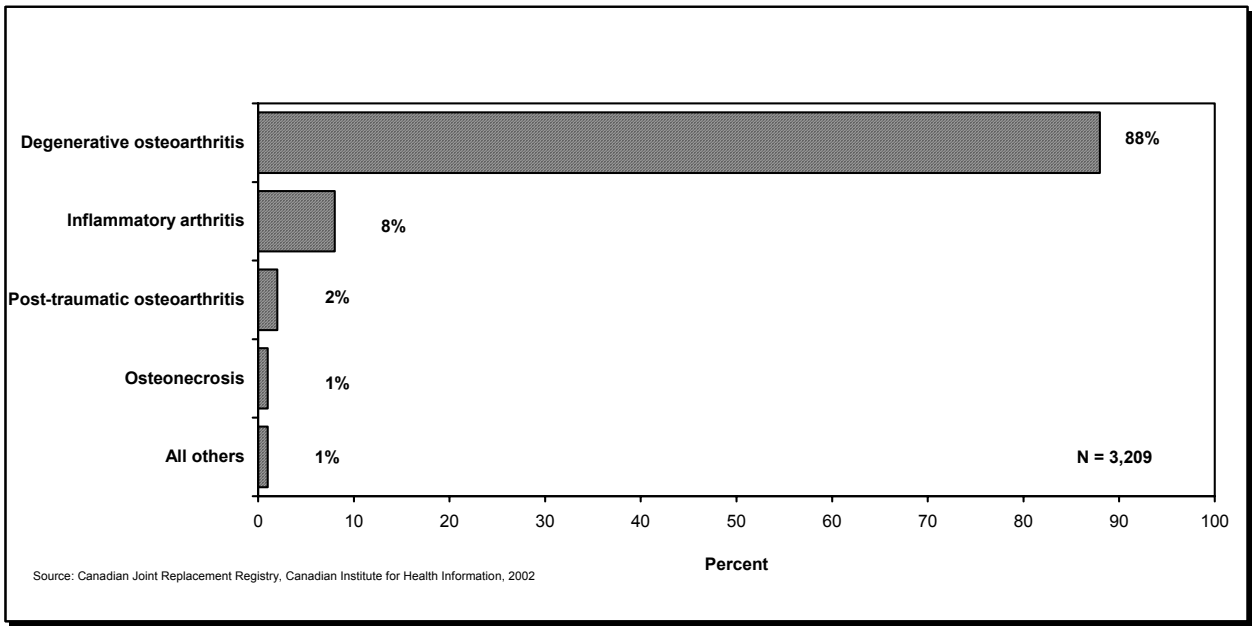
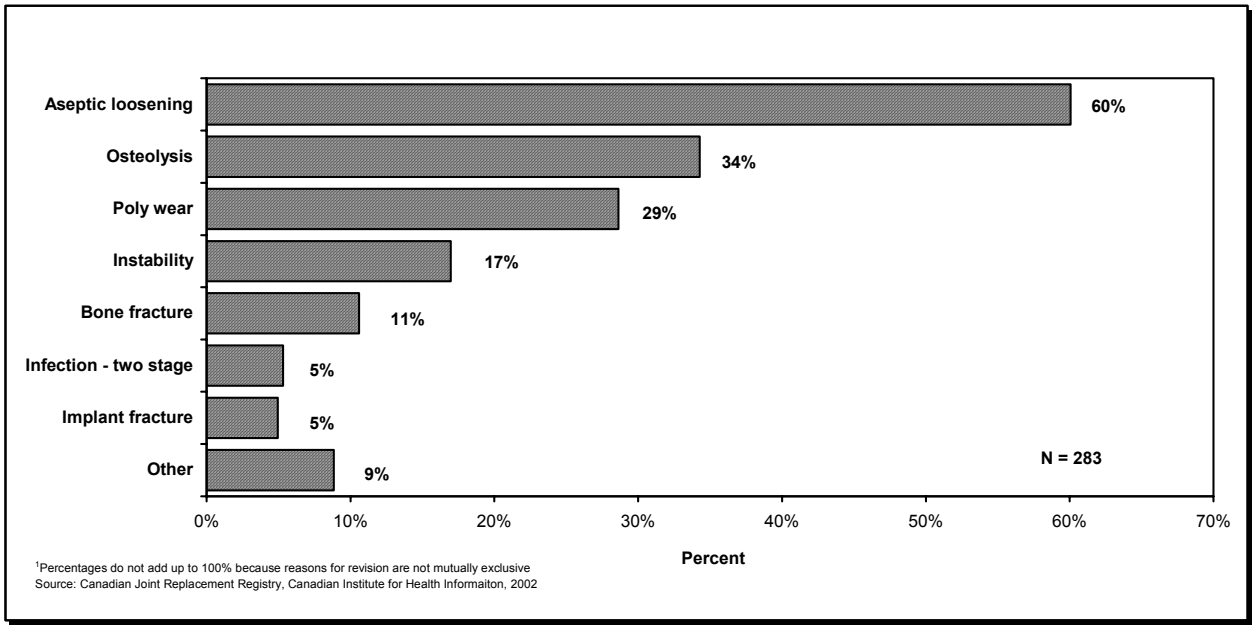



**Figure 22. Primary Total Knee Replacement Procedures by Diagnosis Grouping**

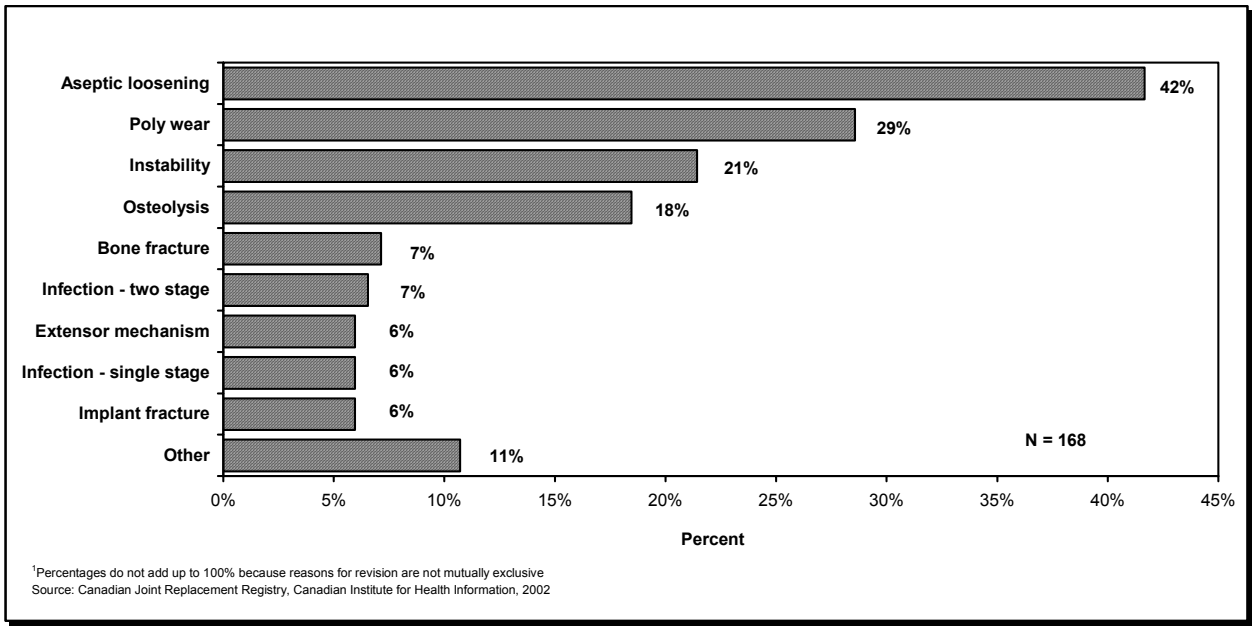
## Reasons for Revision

The most common reasons for revising a total hip replacement are shown in Figure 23. The top four indications for revising a total hip replacement (N = 283) are aseptic loosening (60%), osteolysis (34%), poly wear (29%) and instability (17%). The same 4 reasons for revisions are observed in the case of total knee replacements as seen in Figure 24. Among the 168 revised knee replacements, the 4 most common reasons for the revision are aseptic loosening (42%), poly wear (29%), instability (21%) and osteolysis (18%). Percentages do not add up to 100% because diagnosis groupings are not mutually exclusive.




[1]Percentages do not add up to 100% because reasons for revision are not mutually exclusive
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Informaiton, 2002

**Figure 23. Revised Total Hip Replacement Procedures by Reason for Revision[1]**




[1]Percentages do not add up to 100% because reasons for revision are not mutually exclusive
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

**Figure 24. Revised Total Knee Replacement Procedures by Reason for Revision[1]**

## Surgical Approach

The distribution of total hip replacement procedures by surgical approach is shown in Figure 25. The direct lateral approach (39%) and the anterolateral (33%) approach are the most commonly used techniques in total hip replacement surgeries. While the posterolateral approach was used in 28% of procedures in this sample, the Smith/Peterson approach was used in less than 1% of surgeries.

The medial approach was used in the majority (79%) of total knee replacement procedures, followed by the intravastus (15%) and subvastus (3%) approaches. The lateral approach is the least common surgical approach (1%) used in this sample (Figure 26).

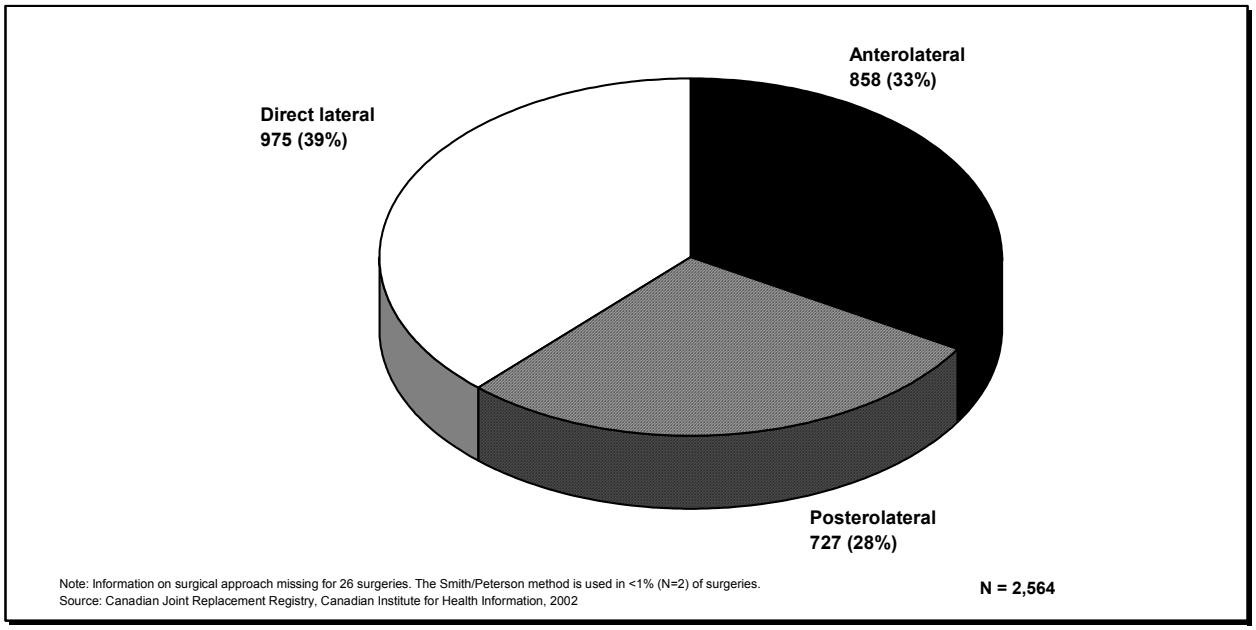



**Figure 25. Distribution of Total Hip Replacement Procedures by Surgical Approach**

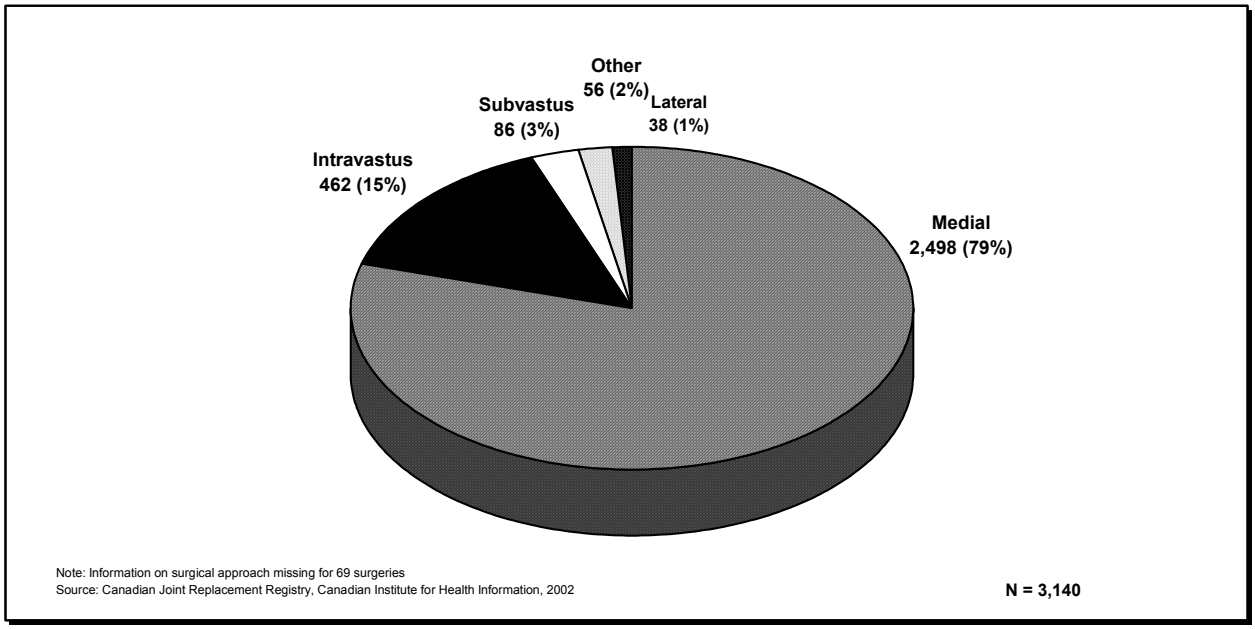



**Figure 26. Distribution of Total Knee Replacement Procedures by Surgical Approach**

## Operating Room (OR) Environment

The types of OR environments where total hip and total knee replacement procedures are performed are depicted in Figures 27 and 28. The standard OR environment is the most widespread OR environment (82%) followed by laminar air flow (16%) Less than 2% of surgeries were performed in a body exhaust environment or a combination of laminar air flow and body exhaust.

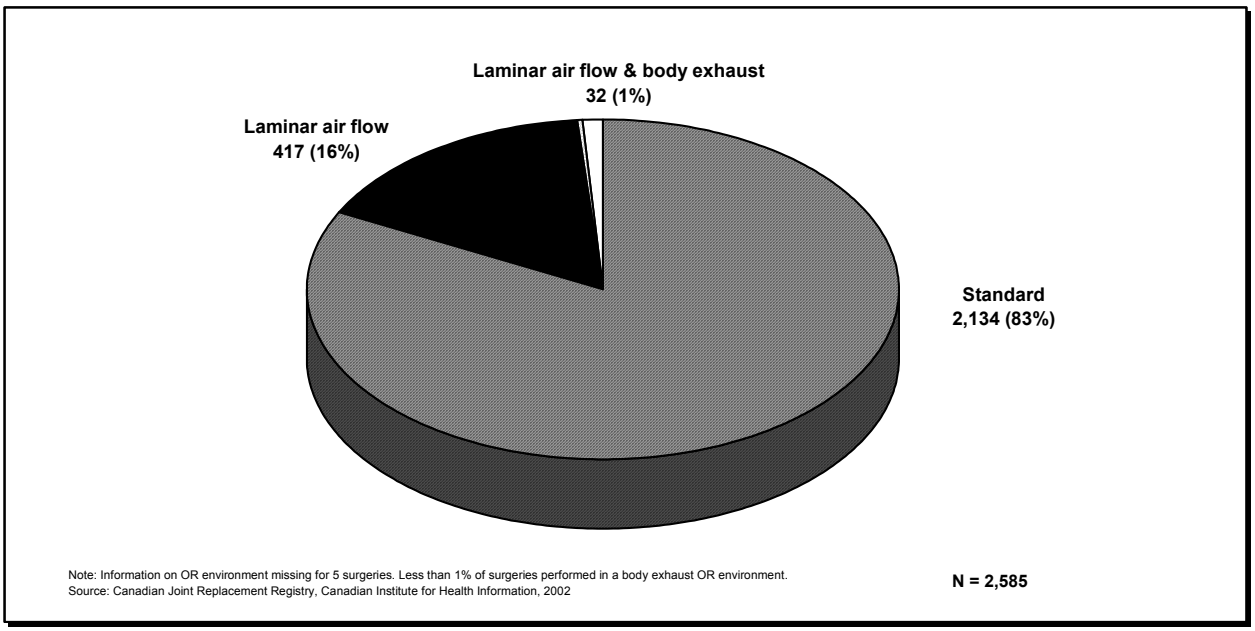



**Figure 27. Total Hip Replacement Surgeries by Operating Room Environment**

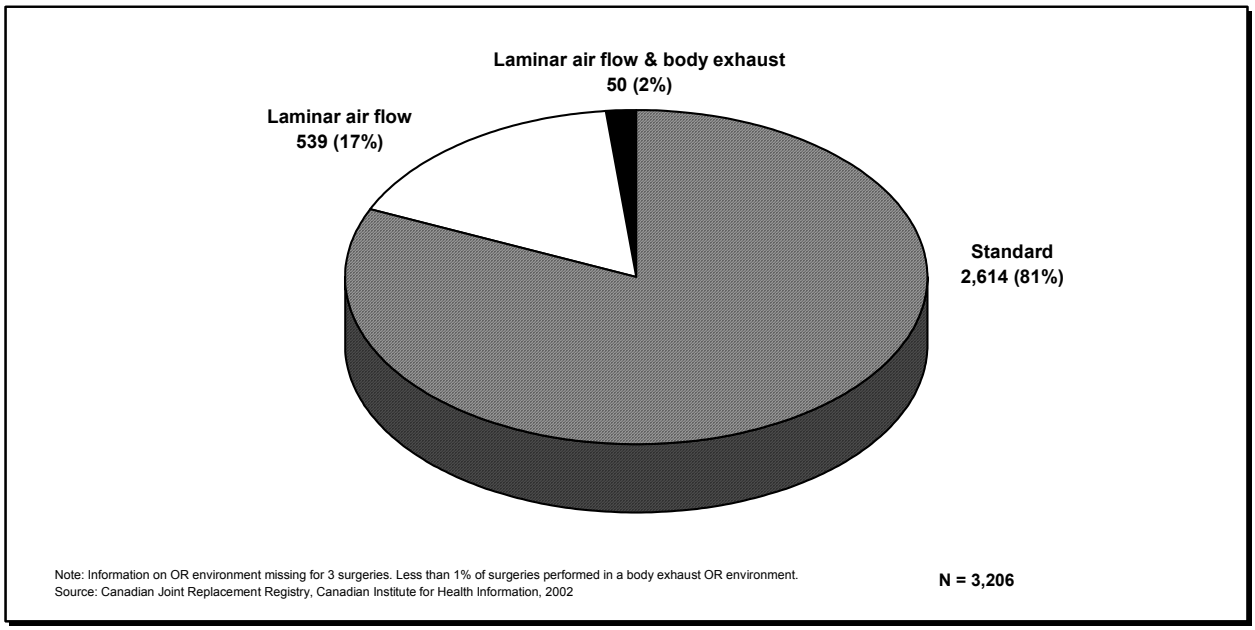



**Figure 28. Total Knee Replacement Surgeries by Operating Room Environment**

## Utilization and Outcomes

Post-operative in-hospital mortality is a relatively rare event among recipients of a total hip or total knee replacement (Table 18). Overall, the mortality rate of total hip and knee replacement patients was 0.6% and 0.2%, respectively.

**Table 18. Number of In-Hospital Deaths Among Total Hip and Total Knee Replacement Patients by Age Group, Canada, 2000/2001**

| Age Group | Total Hip Replacement Patients | | Total Knee Replacement Patients | |
|---|---|---|---|---|
| | Number of Recipients | Number of Deaths[1] (%) | Number of Recipients | Number of Deaths[2] (%) |
| <75 | 13,167 | 25 (0.2%) | 15,332 | 10 (0.1%) |
| 75-84 | 5,418 | 59 (1.1%) | 6,519 | 30 (0.5%) |
| 85+ | 1,063 | 42 (3.9%) | 644 | 7 (1.1%) |
| **TOTAL** | **19,648** | **126 (0.6%)** | **22,495** | **47 (0.2%)** |

[1]No deaths occurred in THR patients under the age of 35.
[2]No deaths occurred in TKR patients under the age of 60.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

The risk of post-operative death increases with age. For example, the mortality rate of hip replacement patients under 75 years old was 0.2%, 3.9% of patients 85 years and older died in hospital following a total hip replacement.

The most common cement types for fixation of the femoral stem (Figure 29) in total hip replacements were Simplex (90%), followed by Palacos (3%) and CMW (2%). If cementless, porous in-growth (65%) and h.a.coated (40%) were the most common femoral components used in total hip replacement (Figure 30).

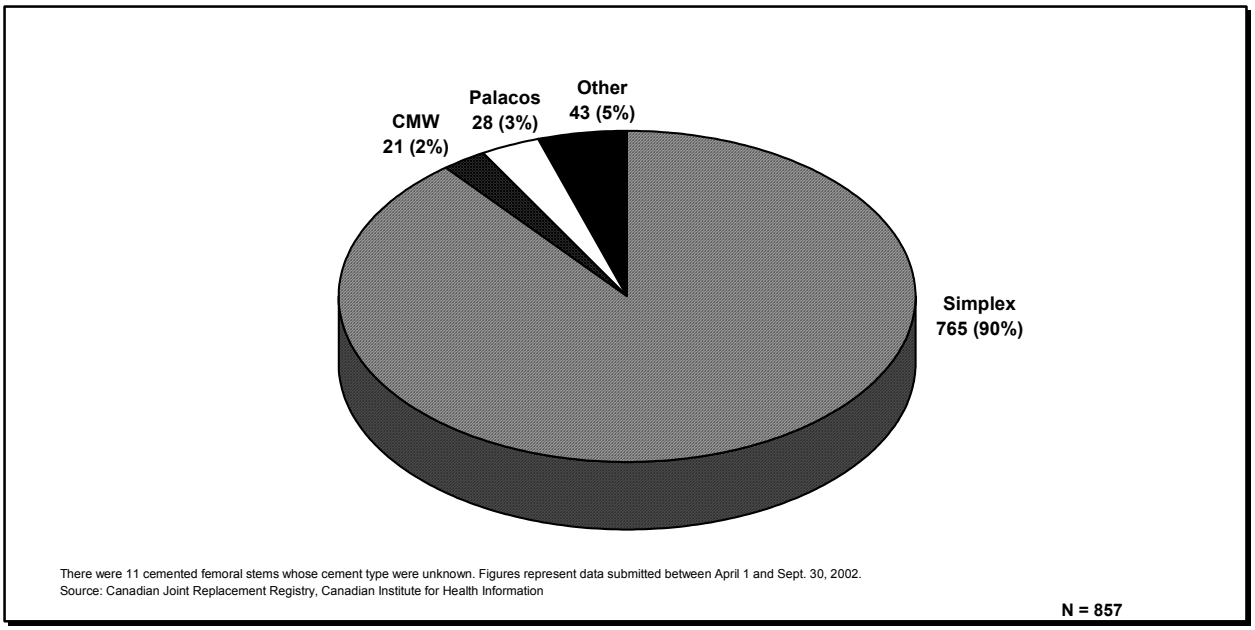
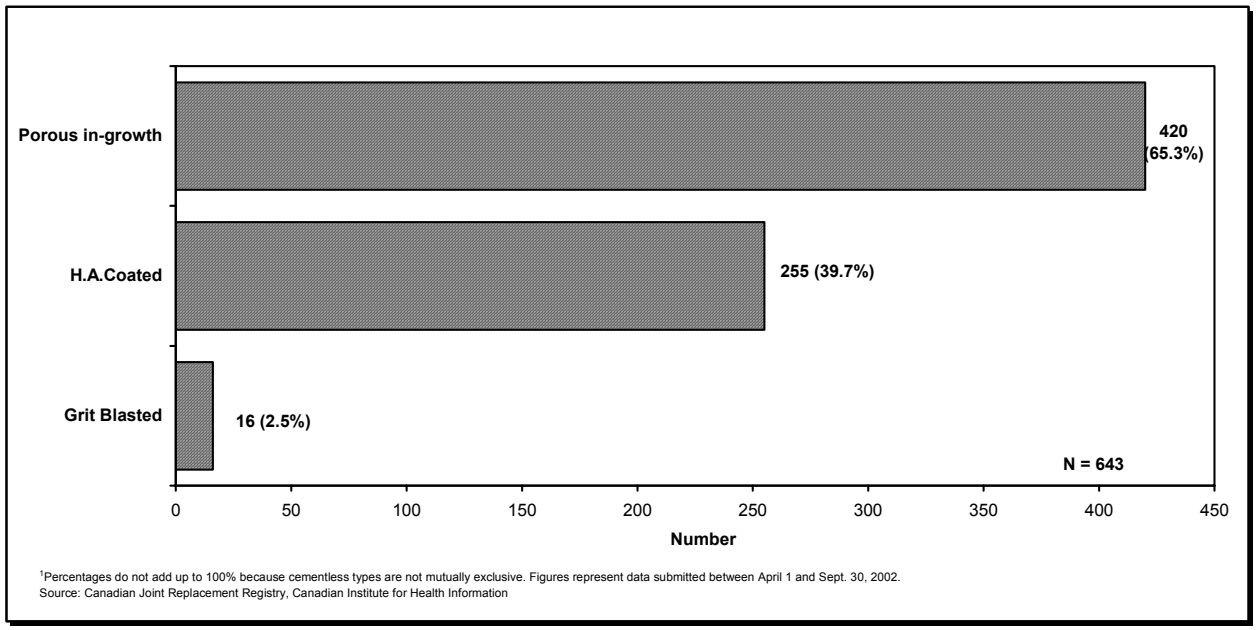


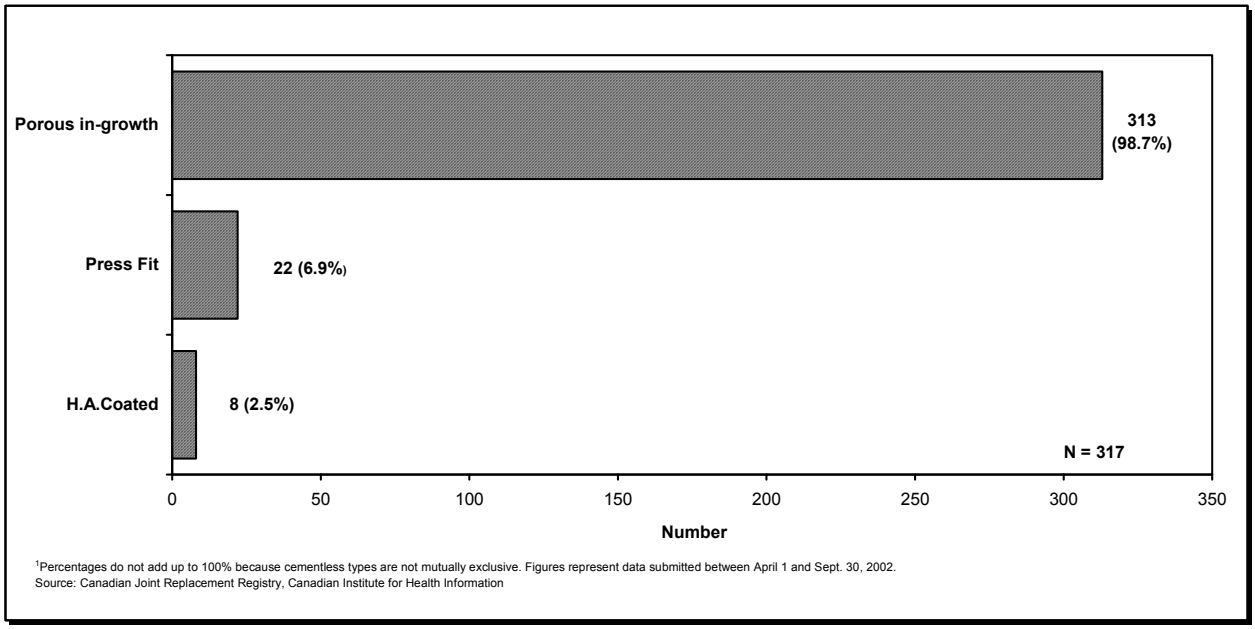

**Figure 29. Distribution of Cemented Femoral Stems of Total Hip Replacement Patients by Type of Cement Used**




[1]Percentages do not add up to 100% because cementless types are not mutually exclusive. Figures represent data submitted between April 1 and Sept. 30, 2002.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information

**Figure 30. Distribution of Cementless Femoral Stems of Total Hip Replacement Patients by Type[1]**

Similarly, the most common cement types for fixation of the femoral component (Figure 32) in total knee replacements were Simplex (93%), followed by Palacos (5%) and CMW (1%). If cementless, porous in-growth (99%) and press-fit (7%) were the most common femoral components used in total knee replacement (Figure 31).




[1]Percentages do not add up to 100% because cementless types are not mutually exclusive. Figures represent data submitted between April 1 and Sept. 30, 2002.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information

**Figure 31. Distribution of Cementless Femoral Components of Total Knee Replacement Patients by Type[1]**

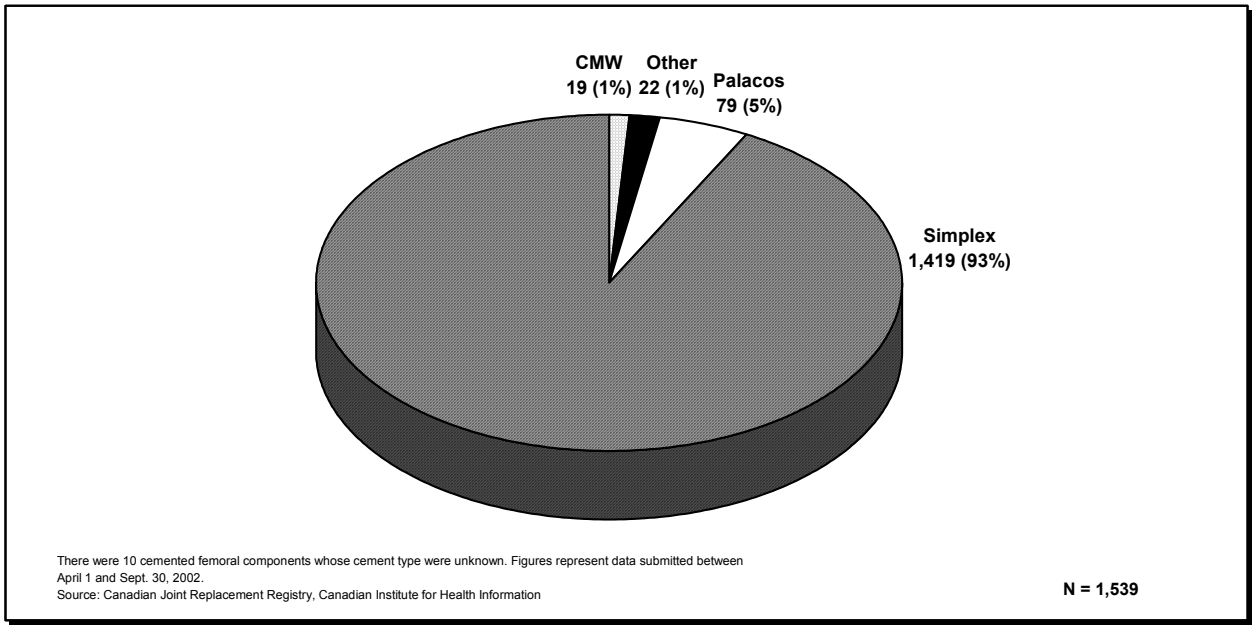



**Figure 32. Distribution of Cemented Femoral Components of Total Knee Replacement Patients by Type of Cement Used**

# Discussion

The reasons for variations in provincial rates of hip and knee replacements have not been clearly identified. A number of explanations have been put forward, including variations in clinical practices regarding indications for medical management and surgical treatment of these conditions.[3] A number of additional factors may play a role in the utilization of total joint replacement procedures, such as access to care which may be determined by the number of hospital beds dedicated to orthopaedic patients, operating room time and health human resources (e.g. population density of orthopaedic surgeons and referring physicians). A 1999 Canadian study examined reasons for regional variation in the use of knee replacement surgery in Ontario. After controlling for age, sex and access to care, opinions or enthusiasms of orthopaedic surgeons for the procedure was found to be the primary determinant of geographical variation.[8] Lastly, prevalence of predisposing clinical conditions (e.g. osteoarthritis) would also drive the demand for total joint replacements.

In considering provincial variations in average lengths of stay, it is important to remember that primary and revision surgeries as well as emergency and elective operations are included in the counts of total hip and knee replacements. It is likely that a portion of this variation is due to differences in the case mix of patients (e.g. primary to revision as well as emergency to elective surgeries) across the provinces.

Although the current data cannot be used for determining revision rates, over time CJRR will be able to measure and monitor revisions rates for these surgeries. By tracking individual patients who have had a primary total hip and total knee replacement and subsequently undergo a revision operation, the registry will be able to determine a true revision rate.

Following hip and knee replacement recipients over time will also enable the registry to determine which implants are least likely to be replaced. Providing a mechanism for post-market surveillance of orthopaedic implants is one of the goals of CJRR. Although implant-specific analysis was not included in this report, the registry will release such information in the near future.

It is also noteworthy that the age distribution of total hip and total knee replacement recipients in the CJRR sample is very similar to the age distribution of all patients who had undergone these surgeries in Canada in 2000/2001 (Figures 7 and 10 and Figures B.1 and B.2 in Appendix B). These similarities suggest that the data in the CJRR sample are representative of all total hip and total knee replacements performed in Canada, despite some differences in proportion of revisions. As participation in the CJRR increases and more data are submitted, it is expected that such differences will be minimized.

# Conclusion

Although a significant amount of information related to total joint replacement surgery is already available, there is a great deal of information that is unknown and was not presented in this report. This section focuses on what is not known and what efforts are underway that aim to capture the missing information.

## What We Don't Know

The relative contribution of an aging population to some of the other factors ( e.g. trends in the prevalence of osteoarthritis) that are driving the increase in the utilization of total hip and knee replacement procedures is not known.

Similarly, the reasons for variations in provincial rates of hip and knee replacements have not been clearly identified. A lack of consensus in clinical practice guidelines regarding indications for medical management and surgical treatment of these conditions is one potential explanation.[3] Referral patterns and access to care, including number of hospital beds dedicated to orthopaedic patients, operating room time, health human resources, and provincial funding of these procedures may also play a role.

The optimal rate of total hip and knee replacements to meet the needs of Canadians is not known. CJRR will be able to take a leadership role in providing the information needed to determine an appropriate rate range for these procedures for various regions and sub-populations. This information can then be used by policy-makers and providers to plan current and future delivery of services.

With the exception of Nunavut and the Yukon, where total joint replacements are not performed, we do not know why patients relocate to another province to have their total joint replacement done. CJRR has the capacity to provide detailed intra-provincial analyses of the proportion of patients who go outside their home region for these procedures.

The relative effectiveness of currently available hip and knee implants is largely unknown. Although there has been a proliferation of orthopaedic prostheses in the last two decades, post-market surveillance of these devices is not carried out on an ongoing, systematic basis in Canada. CJRR will be able to address this issue in future reports.

With few exceptions, we know little about how many patients are waiting for a total joint replacement in Canada and how long they wait to have their operation once a decision to proceed with surgery is made to have the surgery. The impact of wait times on the pre-operative physical function and post-operative clinical outcomes of joint replacement candidates is also not known. CJRR will be able to address this question in the near future.

The cost of total joint replacement surgery in Canada and whether there are variations in costs across provinces or hospitals is not known.

The length and impact of rehabilitation care following surgery on the recovery process is not known.

Information on the relationship between injury (i.e. hip fracture) and total hip replacement is lacking.

# Future Directions

Data captured by the Canadian Joint Replacement Registry will fill many of the information gaps outlined above. One of the unique functions of the CJRR is providing a mechanism for post-market surveillance of orthopaedic implants. As echoed by many, a national registry provides the most effective and pragmatic approach for assessing the quality of orthopaedic prostheses.

The CJRR captures revision operations and reasons for revision separately from primary surgeries. Revision rates will thus be known and the most common reasons for revisions identified.

Detailed surgical information related to operative techniques, fixation method, antibiotic and deep vein thrombosis prophylaxis is also collected by CJRR, all of which may influence implant failure rates.

A comprehensive data quality evaluation, based on CIHI's Data Quality Framework, will be carried out on CJRR data and is expected to be completed by the end of 2003.

In the coming fiscal year, the CJRR will be exploring ways to include data on wait times to enable CJRR to quantify the patient population on wait lists for a total hip or knee replacement in Canada. Data on prioritization, illness severity, and patient follow-up and satisfaction are also being explored as additional components to be included in CJRR in the near future.

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# Appendix A

# Glossary

# Glossary

**Age-Standardized Rate**
A rate that is statistically modified to eliminate the effect of different age distributions in the population over time, or between different populations.

**Percent Revisions**
The number of revisions relative to the total number of replacements.

**Revision**
Exchange or removal of one or both components. Exchange of liner or head component is not considered a revision (Swedish National Hip Arthroplasty Registry).

**Revision Rate**
The revision rate is the percentage of primary replacements that have had a subsequent removal or exchange of one or more components.

**Total Hip Replacement**
Total hip replacement (THR) or total hip arthroplasty (THA) involves the replacement of both the upper femur and the acetabulum. The two parts of the hip joint are removed and replaced with smooth artificial surfaces. This hip is composed of the hip socket (acetabulum, a cup-shaped bone in the pelvis) and the "ball" or head of the femur. The artificial socket is made of high-density plastic, while the artificial ball with its stem is made of a strong stainless steel metal. These artificial pieces are implanted into healthy portions of the pelvis and femur and affixed with a bone cement (methyl methacrylate) or through a cementless procedure in which the implant has a rough surface that the bone grows into over time (WCWL Project, Literature Review on Hip and Knee Joint Replacement, 2000).

**Total Knee Replacement**
Total knee replacement (TKR) or total knee arthroplasty (TKA), involves the replacement of injured or damaged parts of the knee joint with artificial components. The procedure is performed by separating the muscles and ligaments around the knee to expose the knee capsule. The capsule is opened, exposing the inside of the joint. The ends of the thighbone (femur) and the shinbone (tibia) are removed, and often the underside of the kneecap (patella) is removed. The artificial parts are then cemented into place. The new knee consists of a metal shell on the end of the femur, a metal and plastic trough on the tibia, and if needed, a plastic button on the kneecap (WCWL Project, Literature Review on Hip and Knee Joint Replacement, 2000).

# Appendix B

# Additional Tables and Figures

# Appendix B—Additional Tables and Figures

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### Tables



### Figures

**Table B.1. Number of Total Hip Replacement Procedures Performed in Canada Based on Patient Residence, 1999/2000 and 2000/2001**

| Province | Total Hip Replacement 1999/2000 | Total Hip Replacement 2000/2001 | Percentage Change |
|---|---|---|---|
| Newfoundland | 201 | 218 | + 8.5% |
| Prince Edward Island | 104 | 110 | + 5.8% |
| Nova Scotia | 825 | 781 | - 5.3% |
| New Brunswick | 511 | 514 | + 0.6% |
| Quebec | 2,979 | 3,188 | + 7.0% |
| Ontario | 8,433 | 8,078 | - 4.2% |
| Manitoba | 967 | 867 | - 10.3% |
| Saskatchewan | 861 | 885 | + 2.8% |
| Alberta | 1,992 | 2,036 | + 2.2% |
| British Columbia | 2,931 | 2,892 | - 1.3% |
| Territories[1] | 27 | 29 | 7.4%[3] |
| Unknown[2] | 205 | 189 | -- |
| **CANADA** | **20,036** | **19,787** | **- 1.2%** |

[1]Includes Northwest Territories, Yukon and Nunavut.
[2]Includes both Canadian and non-Canadian residents.
[3]Percent change should be interpreted with caution as it is based on small numbers.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Table B.2. Number of Total Knee Replacement Procedures Performed in Canada Based on Patient Residence, 1999/2000 and 2000/2001**

| Province | Total Knee Replacement 1999/2000 | Total Knee Replacement 2000/2001 | Percentage Change |
|---|---|---|---|
| Newfoundland | 198 | 226 | + 14.1% |
| Prince Edward Island | 104 | 101 | - 2.9% |
| Nova Scotia | 1,039 | 1,077 | + 3.7% |
| New Brunswick | 643 | 685 | + 6.5% |
| Quebec | 2,796 | 3,069 | + 9.8% |
| Ontario | 10,220 | 10,426 | + 2.0% |
| Manitoba | 1,217 | 1,178 | - 3.2% |
| Saskatchewan | 870 | 975 | + 12.1% |
| Alberta | 1,984 | 2,223 | + 12.0% |
| British Columbia | 2,970 | 2,946 | - 0.8% |
| Territories[1] | 47 | 35 | - 25.5%[3] |
| Unknown[2] | 214 | 189 | -- |
| **CANADA** | **22,302** | **23,130** | + **3.7%** |

[1]Includes Northwest Territories, Yukon and Nunavut.
[2]Includes both Canadian and non-Canadian residents.
[3]Percent change should be interpreted with caution as it is based on small numbers.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Table B.3. Number of Total Hip Replacement Procedures Performed in Canada Based on Patient Residence, 1994/1995 to 2000/2001**

| Province | 1994/ 1995 | 1995/ 1996 | 1996/ 1997 | 1997/ 1998 | 1998/ 1999 | 1999/ 2000 | 2000/ 2001 |
|---|---|---|---|---|---|---|---|
| Newfoundland | * | 203 | 205 | 187 | 182 | 201 | 218 |
| Prince Edward Island | 104 | 95 | 109 | 106 | 111 | 104 | 110 |
| Nova Scotia | 734 | 749 | 730 | 772 | 841 | 825 | 781 |
| New Brunswick | 429 | 466 | 488 | 510 | 451 | 511 | 514 |
| Quebec | 2,527 | 2,617 | 2,447 | 2,611 | 2,964 | 2,979 | 3,188 |
| Ontario | 6,988 | 7,110 | 7,306 | 7,646 | 7,916 | 8,433 | 8,078 |
| Manitoba | 664 | 689 | 745 | 828 | 921 | 967 | 867 |
| Saskatchewan | 821 | 851 | 922 | 849 | 825 | 861 | 885 |
| Alberta | 1,786 | 1,868 | 1,944 | 1,741 | 1,802 | 1,992 | 2,036 |
| British Columbia | 2,383 | 2,713 | 2,706 | 2,659 | 2,543 | 2,931 | 2,892 |
| Northwest Territories[1] | 1 | 11 | 8 | 9 | 9 | 14 | 10 |
| Yukon | 8 | 13 | 7 | 20 | 15 | 12 | 15 |
| Nunavut[1] | N/A | N/A | N/A | N/A | N/A | 1 | 4 |
| Unknown[2] | * | 199 | 206 | 203 | 184 | 205 | 189 |
| **CANADA** | **16,787** | **17,584** | **17,823** | **18,141** | **18,764** | **20,036** | **19,787** |

[1]Includes Nunavut until 1999.
[2]Includes Canadian and non-Canadian residents.
*1994/1995 data is incomplete for Newfoundland and for patients with unknown residence.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Table B.4. Number of Total Knee Replacement Procedures Performed in Canada Based on Patient Residence, 1994/1995 to 2000/2001**

| Province | 1994/ 1995 | 1995/ 1996 | 1996/ 1997 | 1997/ 1998 | 1998/ 1999 | 1999/ 2000 | 2000/ 2001 |
|---|---|---|---|---|---|---|---|
| Newfoundland | * | 175 | 220 | 186 | 194 | 198 | 226 |
| Prince Edward Island | 88 | 75 | 73 | 81 | 101 | 104 | 101 |
| Nova Scotia | 679 | 894 | 906 | 933 | 981 | 1,039 | 1,077 |
| New Brunswick | 402 | 504 | 565 | 611 | 653 | 643 | 685 |
| Quebec | 2,146 | 2,264 | 2,287 | 2,427 | 2,696 | 2,796 | 3,069 |
| Ontario | 6,839 | 7,693 | 8,303 | 9,054 | 9,580 | 10,220 | 10,426 |
| Manitoba | 578 | 661 | 725 | 911 | 989 | 1,217 | 1,178 |
| Saskatchewan | 840 | 778 | 904 | 952 | 931 | 870 | 975 |
| Alberta | 1,587 | 1,782 | 2,000 | 1,857 | 1,729 | 1,984 | 2,223 |
| British Columbia | 1,875 | 2,329 | 2,401 | 2,492 | 2,499 | 2,970 | 2,946 |
| Northwest Territories[1] | 2 | 2 | 15 | 19 | 27 | 17 | 15 |
| Yukon | 4 | 11 | 13 | 14 | 8 | 22 | 10 |
| Nunavut[1] | N/A | N/A | N/A | N/A | N/A | 8 | 10 |
| Unknown[2] | * | 176 | 194 | 172 | 144 | 214 | 189 |
| **CANADA** | **15,360** | **17,344** | **18,606** | **19,709** | **20,532** | **22,302** | **23,130** |

[1]Includes Nunavut until 1999.
[2]Includes Canadian and non-Canadian residents.
*1994/1995 data is incomplete for Newfoundland and for patients with unknown residence.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Table B.5. Number of Primary and Revision Total Hip Replacements Performed in Canada by Province, 2000/2001**

| Province | Number of Primary Replacements | Number of Revision Replacements | Total Number of Replacements | Percent Revisions |
|---|---|---|---|---|
| Alberta | 1,873 | 227 | 2,100 | 10.8 |
| British Columbia | 2,507 | 378 | 2,885 | 13.1 |
| Manitoba | 754 | 135 | 889 | 15.2 |
| New Brunswick | 463 | 82 | 545 | 15.0 |
| Newfoundland | 197 | 25 | 222 | 11.3 |
| Northwest Territories | ** | ** | ** | ** |
| Nova Scotia | 671 | 112 | 783 | 14.3 |
| Ontario | 7,474 | 733 | 8,207 | 8.9 |
| Prince Edward Island | 85 | 7 | 92 | 7.6 |
| Quebec* | 3,165 | N/A | 3,165 | N/A |
| Saskatchewan | 818 | 70 | 888 | 7.9 |
| **CANADA** | **18,017** | **1,770** | **19,787** | **10.6*** ** |

* Revision procedures are not coded separately from primary procedures in Quebec.
** Numbers from Northwest Territories suppressed due to small cell sizes.
*** Based on primaries and revisions excluding Quebec and Northwest Territories.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Table B.6. Number of Primary and Revision Total Knee Replacements Performed in Canada by Province, 2000/2001**

| Province | Number of Primary Replacements | Number of Revision Replacements | Total Number of Replacements | Percent Revisions |
|---|---|---|---|---|
| Alberta | 2,132 | 176 | 2,308 | 7.6 |
| British Columbia | 2,748 | 202 | 2,950 | 6.8 |
| Manitoba | 1,099 | 102 | 1,201 | 8.5 |
| New Brunswick | 636 | 95 | 731 | 13.0 |
| Newfoundland | 201 | 22 | 223 | 9.9 |
| Northwest Territories | ** | ** | ** | ** |
| Nova Scotia | 949 | 101 | 1,050 | 9.6 |
| Ontario | 9,741 | 800 | 10,541 | 7.6 |
| Prince Edward Island | 95 | 6 | 101 | 5.9 |
| Quebec* | 3,044* | N/A | 3,044 | N/A |
| Saskatchewan | 890 | 73 | 963 | 7.6 |
| **CANADA** | **21,551** | **1,579** | **23,130** | **7.9*** ** |

* Revision procedures are not coded separately from primary procedures in Quebec.
** Numbers from Northwest Territories suppressed due to small cell sizes.
*** Based on primaries and revisions excluding Quebec and Northwest Territories.

Source: Hospital Morbidity Database, Canadian Institute for Health Information

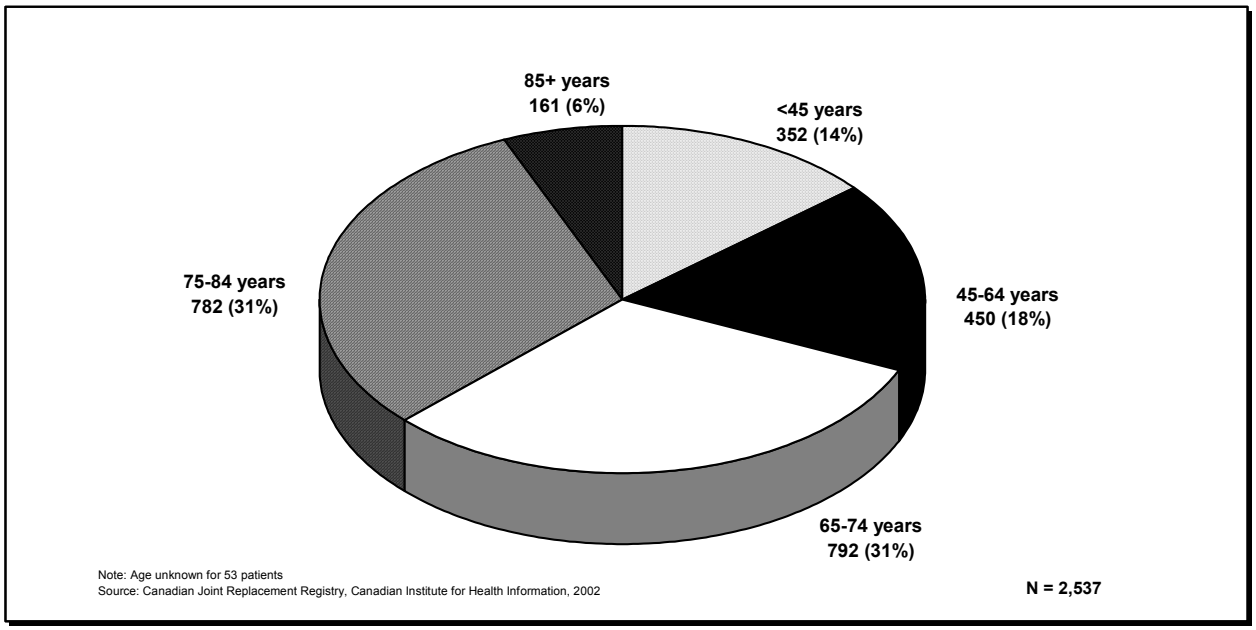



**Figure B.1. Distribution of Total Hip Replacement Procedures Submitted by Participating Surgeons, by Patient Age**

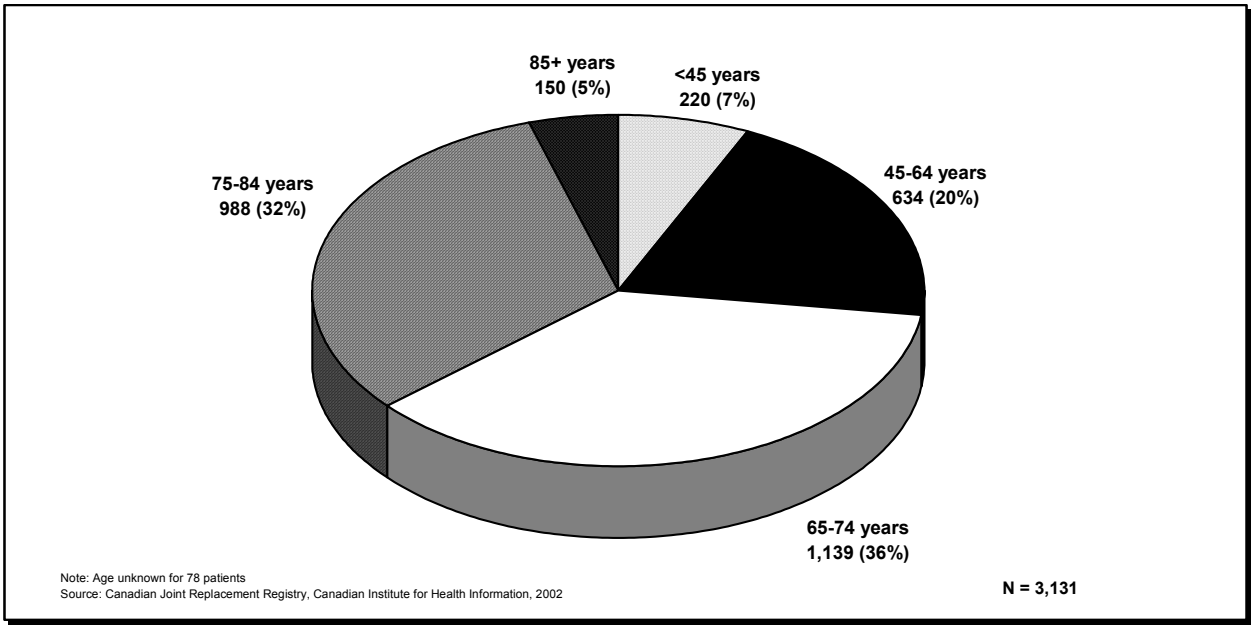
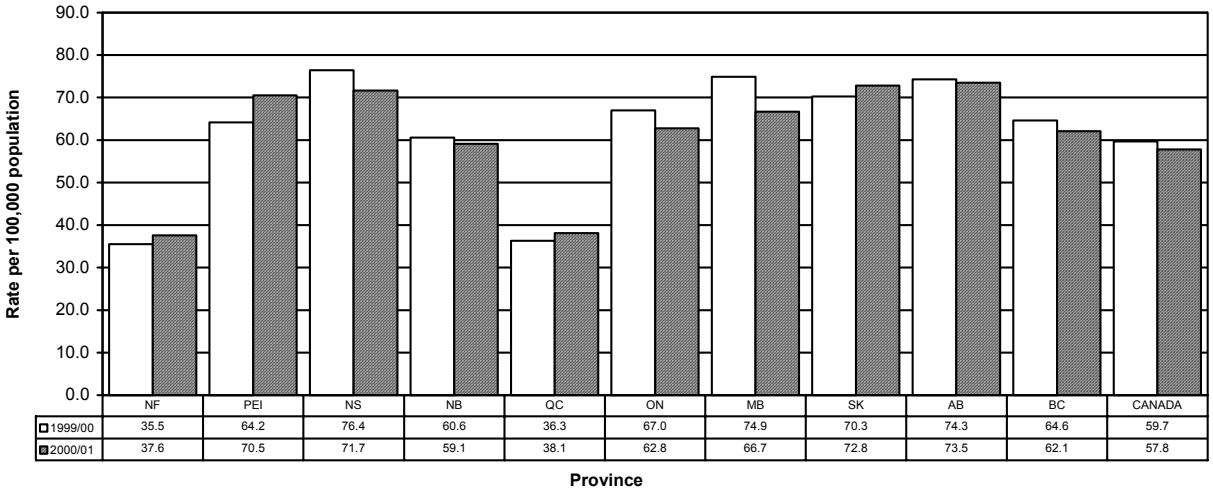



**Figure B.2. Distribution of Total Knee Replacement Procedures Submitted by Participating Surgeons, by Patient Age**

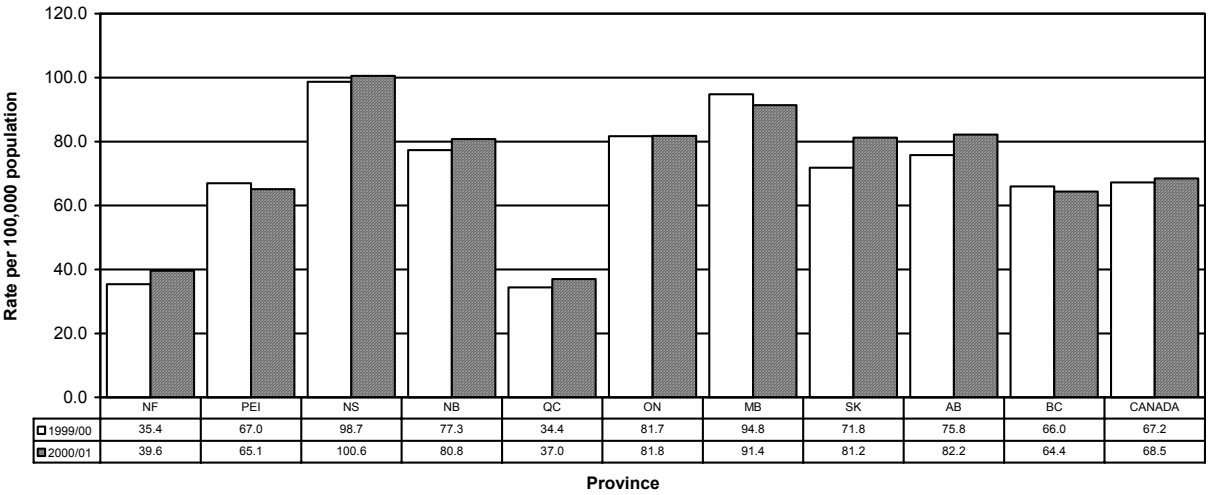



| | NF | PEI | NS | NB | QC | ON | MB | SK | AB | BC | CANADA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999/00 | 35.5 | 64.2 | 76.4 | 60.6 | 36.3 | 67.0 | 74.9 | 70.3 | 74.3 | 64.6 | 59.7 |
| 2000/01 | 37.6 | 70.5 | 71.7 | 59.1 | 38.1 | 62.8 | 66.7 | 72.8 | 73.5 | 62.1 | 57.8 |

**Province**

Rates calculated based on patients' residence. Patients with unknown residence excluded (1999/00, N=205. 2000/01, N=189)
Yukon, Northwest Territories and Nunavut rates suppressed due to small numbers but included in national average.
Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Figure B.3. Comparison of Age-Standardized Rates (per 100,000 population) of Total Hip Procedures by Province, 1999/2000 and 2000/2001**




| | NF | PEI | NS | NB | QC | ON | MB | SK | AB | BC | CANADA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999/00 | 35.4 | 67.0 | 98.7 | 77.3 | 34.4 | 81.7 | 94.8 | 71.8 | 75.8 | 66.0 | 67.2 |
| 2000/01 | 39.6 | 65.1 | 100.6 | 80.8 | 37.0 | 81.8 | 91.4 | 81.2 | 82.2 | 64.4 | 68.5 |

**Province**

Rates calculated based on patients' residence. Patients with unknown residence excluded (1999/00, N=205. 2000/01, N=189)
Yukon, Northwest Territories and Nunavut rates suppressed due to small numbers but included in national average.
Source: Hospital Morbidity Database, Canadian Institute for Health Information

**Figure B.4. Comparison of Age-Standardized Rates (per 100,000 population) of Total Knee Procedures by Province, 1999/2000 and 2000/2001**