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Bilateral simultaneous hip and knee replacement: an epidemiological nationwide study from 2001 to 2016

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Abstract

Background Several studies have compared the pros and cons of simultaneous bilateral versus staged bilateral hip and knee replacement but the outcomes of these two surgical options remains a matter of controversy. This study aimed to evaluate demographic features, incidence and hospitalization rates of bilateral one stage total hip and knee arthroplasty in Italy.

Methods The Italian Ministry of Health's National Hospital Discharge Reports (SDO) were used to gather data. This study referred to the adult population (+ 20 years of age) from 2001 to 2015 for hip arthroplasty and from 2001 to 2016 for knee arthroplasty.

Results Overall, 1,544 bilateral simultaneous hip replacement were carried out. The incidence rate was 0.21 cases per 100,000 adult Italian residents. Male/female ratio was 1.1. The average days of hospital stay was 11.7 ± 11.8 days. The main primary codified diagnosis was: osteoarthritis, localized, primary, pelvic region and thigh (ICD code: 715.15). 2,851 bilateral simultaneous knee replacement were carried out. The incidence rate was 0.37 cases per 100,000 adult Italian residents. Male/female ratio was 0.6. The average days of hospital stay was 7.7 ± 5.8 days. The main primary codified diagnosis was: osteoarthritis, localized, primary, lower leg (ICD code: 715.16).

Conclusions The burden of hip and knee osteoarthritis as a leading cause of bilateral joint replacement is significant in Italy. The national registers' longitudinal analysis may provide data for establishing international guidelines regarding the appropriate indications for one stage bilateral simultaneous hip or knee replacement versus two stage.

Keywords Hip, Knee, Joint, Replacement, Bilateral, Simultaneous, Epidemiology, Demographic

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Background

Patients with severe arthropathies can benefit from total joint arthroplasty (TJA), which includes total knee arthroplasty (TKA) and total hip arthroplasty (THA) such as osteoarthritis (OA), which can greatly ameliorate these patients' quality of life [1–5]. As life expectancy increases, it is expected that the prevalence of arthropathies continues to rise in parallel worldwide [6, 7]. Undoubtedly, arthroplasty procedures will put a tremendous financial strain on the public health-care system with the passing of time [6]. Bilateral THA or TKA can be performed as two staged unilateral arthroplasties under separate anesthetics and hospitalizations or as a one stage bilateral surgery under the same anesthetic and during one hospitalization. Bilateral one stage THA was firstly described by Jaffe and Charnley more than 50 years ago [8]. Historically, the most frequent causes of such extensive involvement of multiple joints have been OA and rheumatoid arthritis (RA) [1, 9, 10]. However, several studies have compared the pros and cons of simultaneous bilateral versus staged bilateral TKA and THA but the outcomes of these two surgical options remains a matter of controversy [11–15]. In general, studies have shown superior clinical results for simultaneous bilateral TKA and THA. Simultaneous TKA showed higher prosthesis survival rates in 10-year [16], shorter hospitalizations [14] and lower frequency of periprosthetic joint infections rates [17, 18] when compared to staged TKA. Similarly, simultaneous THA has been linked to lower rates of deep vein thrombosis and pulmonary embolism [15], reduced blood loss [19], with no appreciable variations in mortality or hip dislocation rates [15].

National registries constitute the most appropriate tool for evaluating epidemiological data [20]. Unfortunately, despite the fact that numerous studies have examined the postoperative outcomes, in the available literature there are few studies regarding demographic features, incidence and trends of hospitalization of patients undergoing bilateral one stage TJA in the Italian population.

The purpose of this study was to evaluate demographic features, hospitalization trends and incidence of bilateral simultaneous THA from 2001 to 2015 and TKA from 2001 to 2016 in Italy. The longitudinal examination of national registers may be helpful to obtain these data: they are crucial to provide data for establishing international guidelines regarding the appropriate indications for one stage bilateral simultaneous THA or TKA versus two stage.

Methods

Data from 2001 to 2015 for bilateral simultaneous THA and from 2001 to 2016 for bilateral simultaneous TKA were supplied by the Italian Ministry of Health in the National Hospital Discharge records (SDO) archive.

Patients' data about age, sex, length of hospital stay, diagnosis and procedure codes were collected. The annual adult population size was provided by the National Institute for Statistics (ISTAT). In order to group patients with bilateral one stage THA and TKA, we selected cases with the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes 81.51 or 81.54 in both primary or secondary procedures. We included data only from patients who underwent a procedure (THA or TKA) classified as bilateral according to the (ICD-9-CM). Only adult patients were involved in the study, therefore people aged at least 20 years. All methods were performed in accordance with the relevant guidelines and regulations.

Statistics

Descriptive statistical analyses were performed. For categorical variables, frequencies and percentages were calculated. For continuous variables, means and standard deviations were used. Incidence was determined as the ratio between the number of cases and the size of the adult population, referring to 100,000 inhabitants (cases/population*100,000). All statistical analyses were carried out with the IBM SPSS Statistics for Windows, Version 26.0. (Armonk, NY: IBM Corp) and Microsoft Excel (2019).

Results

Bilateral THA

Demographics

1,544 bilateral THA were performed between 2001 and 2015 in the adult population. The number of bilateral THA decreased from 2001 (122 cases) to 2003 (58 cases), while increased from 2003 to 2015 (168 cases). The cumulate period of incidence was 0.21 cases of bilateral THA for every 100,000 Italian adult residents. The incidence rate increased from 0.27 for every 100,000 residents in 2001 to 0.34 for every 100,000 residents in 2015 (Fig. 1). Male/female ratio was 1.1 (from 0.4 in 2001 to 1.4 in 2015). Overall, 48% of patients were females. Females represented the majority of patients who underwent bilateral THA only in the 2001 year (Fig. 2).

The average age of patients was 58.3 ± 12.6 (56.7 ± 11.7 years for males and 60 ± 13.4 years for females). Except in 2001, female always had a higher average age than males (Fig. 3).

Hospitalization length

The average days of hospital stay was 11.7 ± 11.8 days, from a minimum of 1 to a maximum of 157 days (males 10.7 ± 10.7 days and females 12.9 ± 12.8 days). The trend of the mean days of hospital stay from 2001 to 2015 was decreasing (Fig. 4).

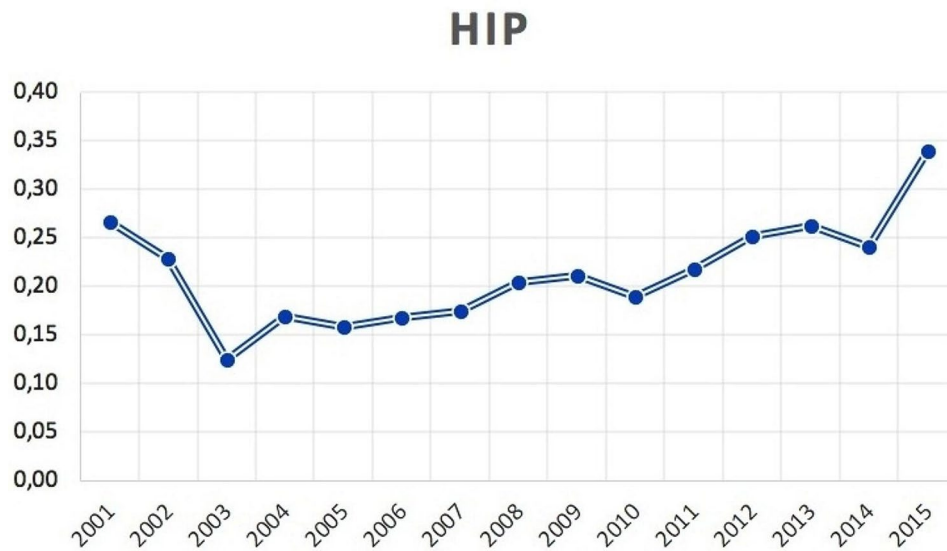


Fig. 1 Incidence of bilateral simultaneous THA per 100,000 residents by 2001 to 2015 in Italy

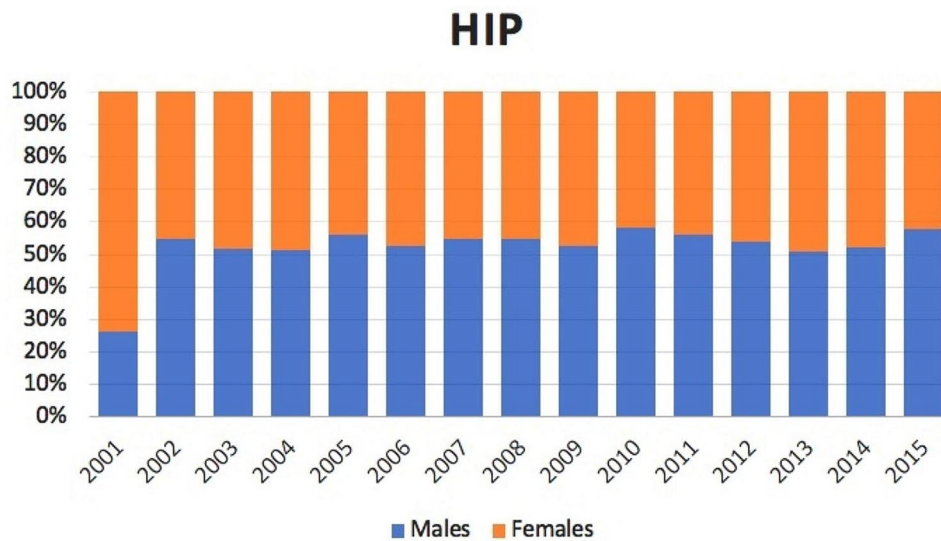


Fig. 2 Bilateral simultaneous THA in the study period stratified for gender

Main primary diagnoses

The main primary diagnoses most frequently made over the 15-year study period were: Osteoarthritis, localized, primary, pelvic region and thigh (ICD code: 715.15, 66.5%); Osteoarthritis, localized, secondary, pelvic region and thigh (ICD code: 715.25, 11.1%); Osteoarthritis, localized, not specified whether primary or secondary, pelvic region and thigh (ICD code: 715.35, 4.3%); Aseptic necrosis of head and neck of femur (ICD code: 733.42, 4.0%); Closed fracture of epiphysis (separation) (upper) of neck of femur (ICD code: 820.01, 2.5%); Osteoarthritis involving, or with mention of more than one site, but not specified as generalized, site unspecified

(ICD code: 71,580, 1.5%); Closed fracture of midcervical section of neck of femur (ICD code: 82,002, 1.4%) (Fig. 5).

Bilateral TKA

Demographics

2,851 bilateral TKA were performed from 2001 to 2016 in the adult population. The number of bilateral TKA increased from 85 cases in 2001 to 425 cases in 2016. The cumulate period of incidence was 0.37 cases of bilateral TKA for every 100,000 Italian adult residents. The incidence rate increased from 0.19 for every 100,000 residents in 2001 to 0.86 for every 100,000 residents in 2016 (Fig. 6). Male/female ratio was 0.6 (from 0.2 in 2001 to 0.6 in 2016). Overall, 64.3% of patients were females. Females

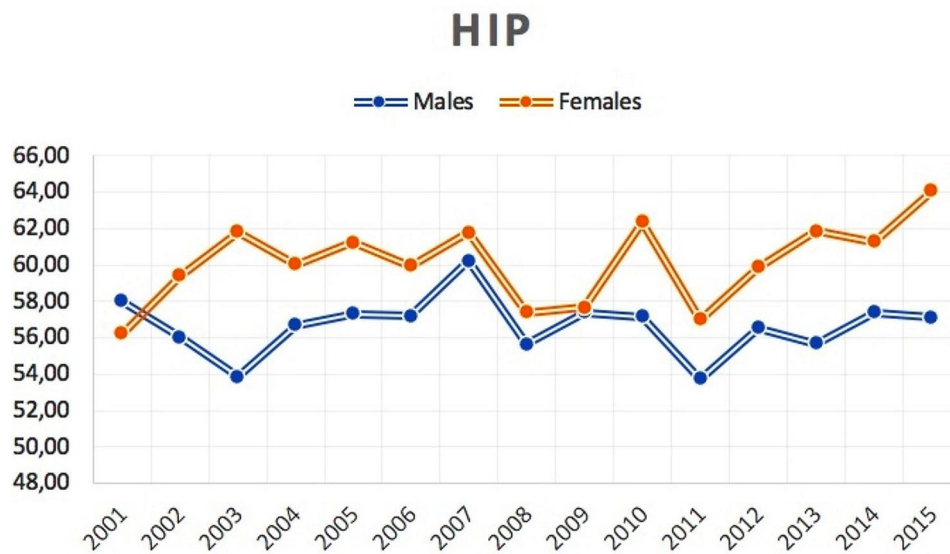


Fig. 3 Average age of male and female patients undergoing bilateral simultaneous THA over the study period

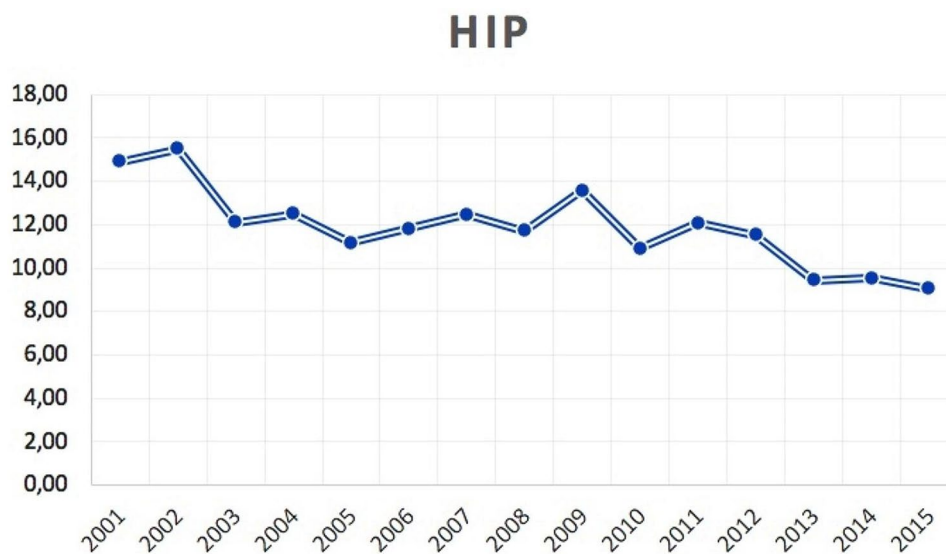


Fig. 4 Mean days of hospital stay for patients undergone bilateral simultaneous THA from 2001 to 2015

represented at each year the majority of patients who underwent bilateral TKA (Fig. 7). The patients' average age was 68 ± 8.3 (67.6 ± 8.7 years males and 68.2 ± 8.1 years females) (Fig. 8).

Length of hospital stay

The average days of hospital stay was 7.7 ± 5.8 days, from a minimum of 1 to a maximum of 93 days (males 7.7 ± 5.9 days and females 7.7 ± 5.8 days). The trend of the mean days of hospital stays from 2001 to 2015 was decreasing (Fig. 9).

Main primary diagnoses

Over the study period, main primary diagnoses were: Osteoarthritis, localized, primary, lower leg (ICD code: 715.16, 86.2%); Osteoarthritis, localized, not specified whether primary or secondary, lower leg (ICD code: 715.36, 6.0%); Osteoarthritis, localized, secondary, lower leg (ICD code: 715.26, 4.0%); Genu varum (acquired) (ICD code: 736.42, 1.9%) (Fig. 10).

Discussion

Relieving pain and regaining function are two of total joint arthroplasty's primary objectives. In the present study, bilateral one stage THA showed an incidence of 0.21 cases for every 100,000 Italian adult residents,

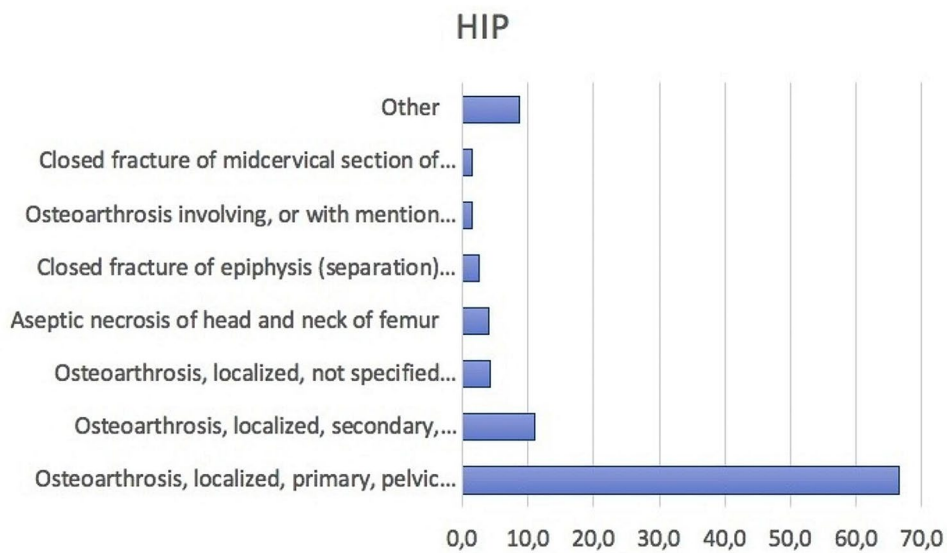


Fig. 5 Main primary diagnoses (according to the ICD-9-CM) requiring bilateral simultaneous THA from 2001 to 2015



Fig. 6 Incidence of bilateral simultaneous TKA per 100,000 residents by 2001 to 2016 in Italy

whereas bilateral one stage TKA showed an incidence of 0.37 cases for every 100,000 Italian adult residents. Except for the 2001–2003 period, the present study highlighted an increasing incidence rate of one stage bilateral THA and TKA in Italy. Several studies have tried to investigate the pros and cons of simultaneous bilateral versus staged bilateral TKA and THA. Literature shows that performing one stage bilateral TKA provides a number of benefits, including a single anesthetic exposure [12], a single postoperative course of pain and rehabilitation period [13], decreased overall hospitalization, more effective resource use, and higher patient satisfaction [14]. A systematic review and meta-analysis comparing simultaneous bilateral THA versus staged bilateral THA revealed significantly lower rates of deep

vein thrombosis, pulmonary embolism and respiratory problems in the first group, with no appreciable variations in mortality or hip dislocation rates [15]. However, when performing a TKA, surgical procedures including tourniquet inflation and deflation, cementing, and bone preparation may increase the risk of vascular, respiratory, hematological and neurological alterations that could be doubled performing one stage bilateral TKA [21, 22].

Results showed an average age under 60 years for THA and under 70 years for TKA. Taking into account the physiologic demands of patients undergoing simultaneous bilateral arthroplasty, previous studies have pointed out that they are generally younger, have lower BMI and less comorbidities than patients undergoing unilateral or staged bilateral arthroplasty [23–26].

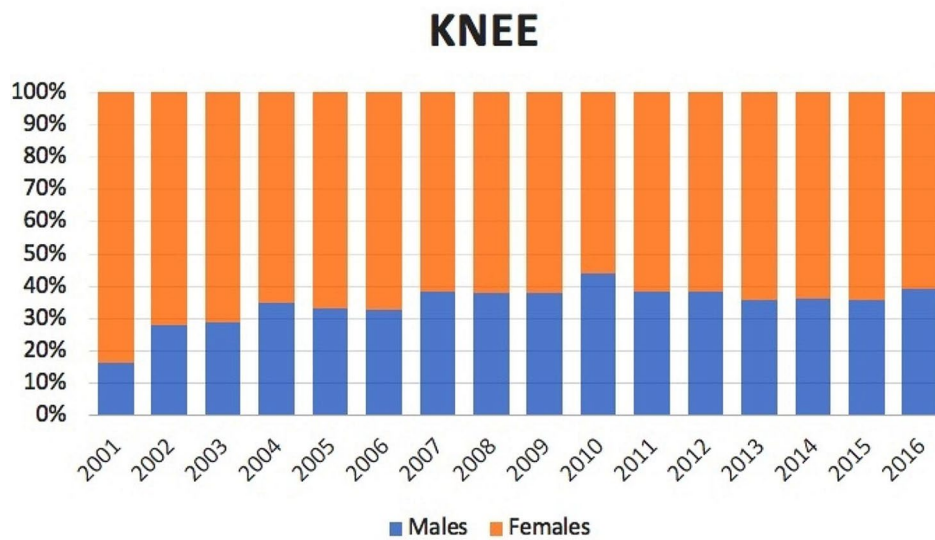


Fig. 7 Bilateral simultaneous TKA in the study period stratified for gender

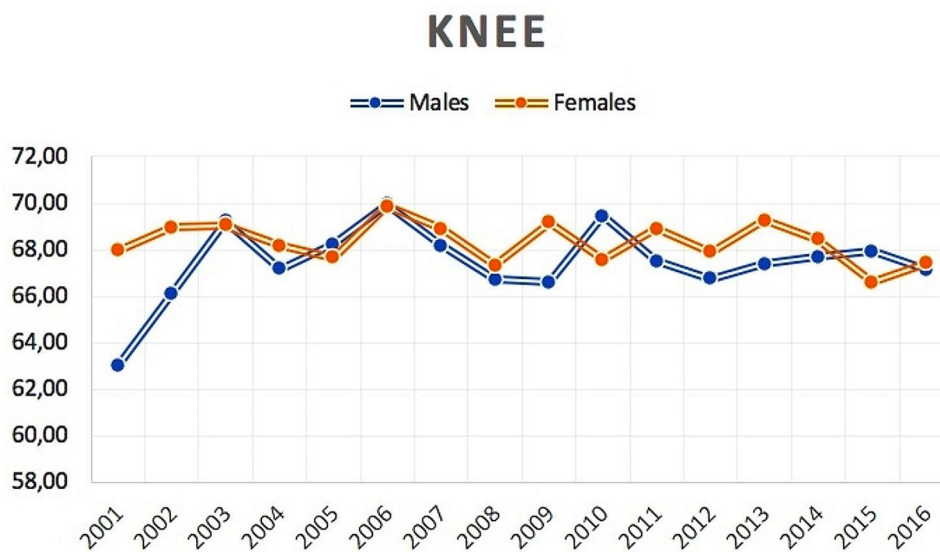


Fig. 8 Average age of male and female patients undergoing bilateral simultaneous TKA over the study period

Our results showed that the overall male/female ratio was almost equal for THA over the study period. It is known that after the age of 40, both sexes have an increasing risk of developing knee and hip OA, peaking at ages around 75–80 years [10, 27, 28]. The early and late peaks of arthroplasty female predominance from our results could be attributable to some common causes of secondary hip involvement that mainly affect women in these two different age groups. RA affects at least twice as many women as men [29], “pincer type” femoroacetabular impingement is seen more frequently in young adult women [30], and female sex is a well-known risk factor for developmental dysplasia of the hip [31, 32]. These are among the leading causes of secondary early hip OA

requiring surgical treatment, often bilaterally. In contrast, the female predominance in the elderly could be linked to the longer women’s life expectancy and better general conditions to undergo a simultaneous bilateral THA. The present study showed that a minor part of bilateral one stage THA are performed to treat hip fractures: polytraumatized patients may require joint replacement for fracture treatment (sometimes bilaterally), partly justifying our results.

Over the study period, females represented at each year the majority of patients who underwent bilateral TKA in Italy. This is in line with data from other studies, indicating that nearly two thirds of knee arthroplasties are performed on women in the United States [33]. Many



Fig. 9 Mean days of hospital stay for patients undergone bilateral simultaneous TKA from 2001 to 2016

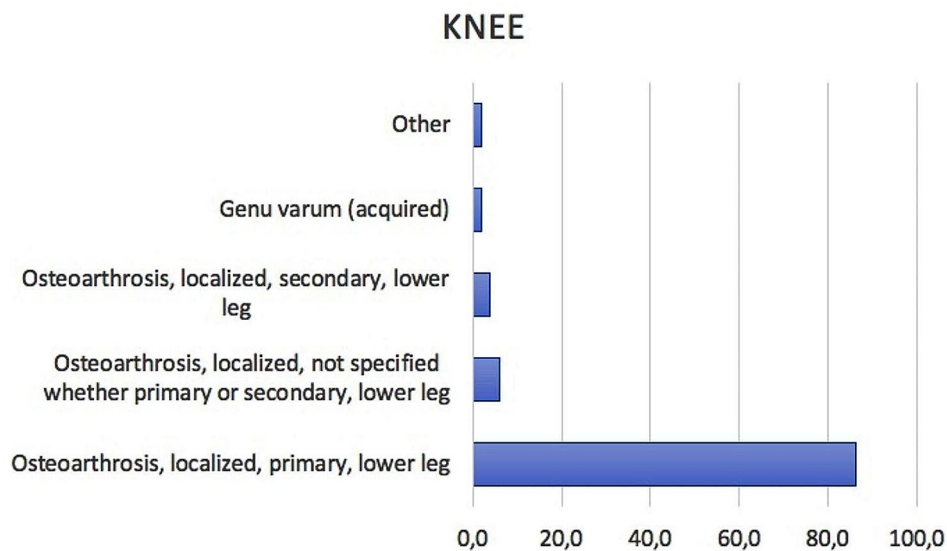


Fig. 10 Main primary diagnoses (according to the ICD-9-CM) requiring bilateral simultaneous TKA from 2001 to 2016

authors have investigated gender differences in the knee anatomy [34, 35]: women typically have a larger quadriceps angle (Q-angle) [36], a less pronounced anterior condyle [34], and a smaller mediolateral to anteroposterior aspect ratio [37]. It has led to the idea of gender-specific knee prostheses with controversial results [38].

A significant decrease in hospitalization days for both THA and TKA was noticed in Italy. Variations over time of the length of stay is likely to be the consequence of hospitals generally shortening hospitalization for economic reasons. Moreover, it could be due to the widespread adoption of fast-track arthroplasty protocols in developed countries. Fast-track hip and knee replacement aims to provide patients the best care possible

creating a shortened approach from admission till discharge by combining evidence-based clinical and therapeutic procedures with organizational optimization [39]. The goal is to decrease morbidity and mortality, to quicken the achievement of early postoperative functional milestones, resulting in a shorter length of stay and a higher patient satisfaction [39]. As expected for the worse general clinical conditions, older patients needed on average more days of hospital stay.

Over the study period, primary bilateral hip and knee OA were the most common causes requiring one stage bilateral THA or TKA in Italy. These data underline the burden of OA, one of the most common chronic diseases

today, that due to longer life expectancies is predicted to increase both its frequency and incidence [1].

Our study has some limitations. All of the reported diagnoses and procedures in this study were recorded using the ICD-9-CM, which is based on administrative data from different hospitals and Italian regions. Due to the numerous hospitals involved, it is difficult to identify diagnosis, procedure or coding errors. The ICD-9-CM allows for using multiple codes for the same surgical procedure. This heterogeneity in coding could lead to overestimate or underestimate our results. Because the ICD-9 coding was performed by surgeons, individual inter-observer variations are possible. A potential limitation is the lack of outcome scores. Moreover, the present study does not compare data from patients undergoing unilateral and bilateral procedures.

Conclusions

The purpose of this study was to estimate demographic features, hospitalization trends and incidence of bilateral simultaneous THA and TKA in Italy by using hospitalization records as official information sources. Except for the 2001–2003 period, there was an increasing incidence trend of one stage bilateral THA and TKA in Italy. Although it still represents a matter of controversy, many studies have shown the potential advantages of one stage bilateral arthroplasty versus two stage. Results of the present study also highlighted the demographic features of patients undergoing bilateral one stage hip and knee arthroplasty (average age under 60 years for THA and under 70 years for TKA). This study also confirmed in the Italian population the role of primary hip and knee OA as a leading cause of bilateral joint replacement. Therefore, epidemiological studies may contribute to gather data for establishing international guidelines about the appropriate indications for one stage bilateral simultaneous THA or TKA versus two stage.

Abbreviations

TJA	total joint arthroplasty
TKA	total knee arthroplasty
THA	total hip arthroplasty
OA	osteoarthritis
RA	rheumatoid arthritis
SDO	the National Hospital Discharge records
ISTAT	the National Institute for Statistics
ICD-9-CM	the International Classification of Diseases, Ninth Revision, Clinical Modification

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Author contributions

UGL, AM: manuscript preparation, study design, database interpretation and manuscript revision. UGL, AM: manuscript preparation, database interpretation and statistical analysis. AM, SDS: manuscript preparation, figures and tables preparation, study design. UGL, AM: Manuscript preparation and database

interpretation. UGL, VD, AV: Study design, manuscript revision. All authors read and approved the final manuscript.

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Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request. The access to the database is on request. All data were obtained by the Direzione Generale della Programmazione Sanitaria—Banca Dati SDO of the Italian Ministry of Health.

Declarations

Ethics approval and consent to participate

The Institutional Review Board of Campus Bio-Medico University of Rome ruled that no formal ethics approval was required in this particular case and the need to obtain informed consent was waived based on the retrospective design and anonymization of patient identifiers. All methods were performed in accordance with the relevant guidelines and regulations. All data were obtained by the Direzione Generale della Programmazione Sanitaria—Banca Dati SDO of the Italian Ministry of Health.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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