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Epidemiology of Primary Hip and Knee Arthroplasties in Germany: 2004 to 2008

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Abstract: The objective of this study was to describe the trend in utilization of primary joint arthroplasties in Germany. Between 2004 and 2008, the number of total knee arthroplasties (TKAs) increased faster than that of total hip arthroplasties (THAs). In 2008, 159 000 primary THAs and 146 000 primary TKAs were performed. This represented a 15% increase in THAs and a 33% increase in TKAs compared to 2004. The annual increase in number of surgeries was 4 500 for THAs and 9,000 for TKAs. Although older adults remained the main recipients of joint arthroplasties, incidence rate increased faster in non-elderly(18–64 years) compared with elderly (≥65 years) in both THAs and TKAs. Obesity, more strongly associated with TKAs than with THAs, could be a contributor to the recent steeper growth in TKAs in Germany. **Keywords:** hip arthroplasty, knee arthroplasty, epidemiology, Germany, incidence.

As the population ages and individuals experience increased body weight, arthritis has become a growing public health concern [1]. When non-surgical treatment of arthritis is unsuccessful, joint arthroplasties provide significant relief of pain and disability [2,3]. The number of primary total hip arthroplasties (THAs) and total knee arthroplasties (TKAs) continues to increase steeply in many developed countries [4-7].

Increasing life expectancy has a significant impact on the health care system because seniors have an increased demand for health care service. The number of people 65 years or older (referred hereafter as "older adults" or "elderly") represent approximately 12% to 15% of the population in most industrialized countries and 5% to 6% of the population in most developing countries. In 2008, older adults constituted 20% of Germany's population [8]. Compared to the United States, where the elderly comprised about 12.8% of the population in 2008 [9], Germany has a larger proportion of elderly population, and it is growing faster.

The increased overall incidence in THAs and TKAs is often due to the growing elderly population because arthritis affects older adults disproportionately. Recently, however, a steeper increase of joint arthroplasties rates among adults younger than 65 years (referred hereafter as "non-elderly") compared to elderly was observed in the United States [4]. By 2011 and 2016, greater than 50% of THAs and TKAs are projected to be performed on younger adult patients in the United States [10]. It is not clear if this is an isolated phenomenon in the United States or a common phenomenon in developed countries. Increasing arthroplasties in non-elderly has some important implications to both future revision needs and its economic burden. However, the growth of arthroplasties in Germany was not well understood due to the lack of registry data [11].

The objective of this study was to investigate the epidemiology of THAs and TKAs in Germany on the basis of data collected by a mandatory reporting system. We further compared the recent changes in the incidence rates of THAs and TKAs between non-elderly and elderly group. Finally, our study described changes in arthroplasty type (cemented or uncemented) over the study period.

Methods

We performed an analysis of the 2004–2008 joint arthroplasty data in Germany. The institutional review board classified this study as "exempt" for institutional review board purposes. We evaluated primary THA and TKA cases only. To date, hip resurfacing is under the code of THA. Below, we describe further the case extraction methods used by the data collection agency.

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Registry Data

Data on THA and TKA have been collected and extracted by The National Institute for Quality in Healthcare German Bundesgeschäftsstelle Qualitätssicherung (BQS). BQS was founded in late 2000 in Duesseldorf, Germany. During the study period, BQS was mandated by the Federal Joint Committee (Gemeinsamer Bundesausschuss) and the Ministry of Health. Therefore, the BQS received data from all German hospitals regardless of the type of hospital ownership. One focus of the BQS quality assurance programs was orthopedic surgery—especially primary THA and TKA. The OPS (operations) code was used to identify procedures. The OPS is a German adaptation and expansion of the international classification of procedure in medicine and the official German classification for procedures, compulsory for all hospitals. For the years 2004 through 2008, there were no coding changes for hip or knee arthroplasty.

Population Size

In 2008, the population size in Germany was approximately 82 million [12]. The number of non-elderly adults (18-64 years) decreased from 52.3 million in 2004 to 51.6 million in 2008, while the number of elderly increased from 15.4 million in 2004 to 16.7 million in 2008 [12]. To calculate the relative frequency of arthroplasties, we compared the number of arthroplasties performed to respective population size.

Statistical Analysis

We projected the number of future TKAs and THAs using the trends in recent years. To reflect linear growth, a linear regression was used in projecting the number of primary procedures in Germany. To compare the incidence rates of increase between 2 age groups, we calculated the number of younger and older adults who underwent joint arthroplasties for every 100,000 people in the respective age groups. Because our study is on the basis of comprehensive mandatory data as opposed to sample data, the sampling variation (SD or SE) was not calculated.

Results

Increase of THAs and TKAs

In 2008, approximately 159,000 primary THAs and 146,000 TKAs were performed. This represented a 15% increase in THAs and a 33% increase in TKAs compared to 2004. As shown in Fig. 1, the recent trend follows a linear pattern with a high coefficient of determination (also known as R^2). The annual increase in number of surgeries was 4500 for THAs (R^2=98%) and 9000 for TKAs(R^2=99%). Because of the steeper increase in TKAs than THAs, a larger number of TKAs than THAs is expected in the near future in Germany (Fig. 1). If current trends continue over the next decades, by the year 2020, the annual numbers of primary THAs and TKAs will be greater than 217 000 and 253 000, respectively.

Annual Number of THAs and TKAs per 100 000 People

We calculated the annual rate of joint arthroplasties for every 100 000 people based on the population in the respective years and countries. In Germany, 109 035 THAs and 111 470 TKAs were performed on 16.7 million elderly in 2008. That is, for every 100 000 elderly, there were approximately 653 THAs and 667 TKAs (Table 1). During the same period, the rate of THAs and TKAs on non-elderly was 93 and 67 for every 100,000, respectively. Although elderly remained the main recipients of joint arthroplasties, we noted a steeper rate increase

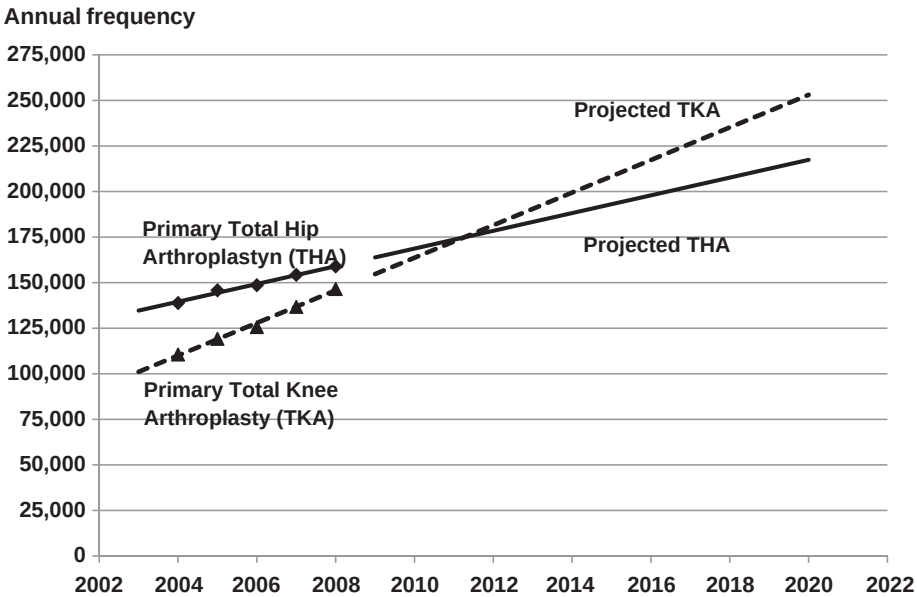

Fig. 1. Recent trend and projected number of primary THAs and TKAs in Germany.

Table Change in the Rate (Per 100 000 Person Year) for Primary THAs and TKAs in Germany

	Non-Elderly (18-64 Years Old)			Elderly (65 Years and Older)		
Germany	Year 2004	Year 2008	Change	Year 2004	Year 2008	Change
THA	84	93	+11%	610	653	+7%
TKA	48	67	+40%	554	667	+20%

Data source: The German Bundesgeschäftsstelle für Qualitätssicherung.

among non-elderly. Compared with 2004, the rate of THAs increased 11% and 7% for non-elderly, respectively (Table). For TKAs, the increase in rate was much steeper for non-elderly compared to elderly (40% vs. 20%). Among non-elderly, although the rate of THAs was still higher than TKAs, TKAs was increasing faster.

Proportion of Younger Adults Who Underwent THAs and TKAs

Compared with TKAs, the THAs were significantly more common in non-elderly ($P < .001$). Nearly 31% of THAs and 24% of TKAs were performed on younger adults in 2008, and these proportions remained approximately the same over time (Fig. 2). Despite the increased older adult population size and decreased younger adult population size, the proportion of non-elderly remained the same over time due to the steeper increase of surgery rates among younger adults.

Type of Arthroplasties

The proportion of uncemented THAs has increased gradually (59% in 2004 vs 67% in 2008), whereas cemented THAs decreased gradually (19% in 2004 vs. 13% in 2008). Unlike the relative frequency, the actual number of cemented types remained approximately the same due to the increase in the total number of THAs (Fig. 3). Uncemented THA was performed five times more frequently than cemented THA in 2008. For TKAs, the proportion of the cemented type has increased rapidly. The cemented type constituted 71% of TKAs in 2004 and increased to 81% in 2008. The share of uncemented TKAs slowly decreased between 2004 and 2008 (from 11% to 5%), yet the actual number of cemented TKAs remained approximately the same due to the increase in total number of TKAs (Fig. 4). In 2008, cemented TKAs were performed 18 times more frequently than uncemented TKAs.

Discussion

This epidemiologic study investigated the incidence and incidence rate of total joint arthroplasties in Germany. Although the joint arthroplasty procedures has exponentially increased in the United States lately [4], the growth in Germany follows linear patterns for both THA and TKA. Based on the current trends, Germany could show a continuous, steady, and steep increase in surgical loads of joint arthroplasty.

Between 2004 and 2008, the number of TKAs increased faster than that of THAs, and this trend is consistent with a previous study in United Kingdom [5], other European countries [13], and in the United States [4]. The steeper rise in TKAs is more striking when it compared with historic data in Germany. A study published in 1996 estimated up to 180 000 hip arthroplasties and 50 000 knee arthroplasties were performed in Germany every year (as cited in Pitto study [11]). However, in 2008, the numbers of TKAs and THAs performed were close to each other (159,000 THAs vs. 146,000 TKAs). If current trends continue, a larger number of TKAs than THAs is expected in the near future due to a steeper increase in TKAs in Germany. Although there is considerable variation across European countries, the growth rate of TKAs was higher than

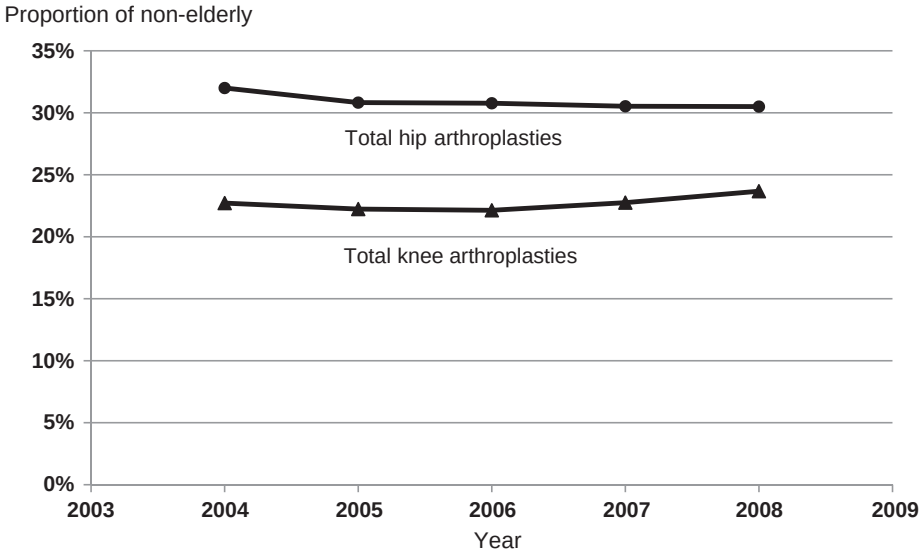

Fig. 2. Proportion of non-elderly (<65 years) among who underwent THAs and TKAs.

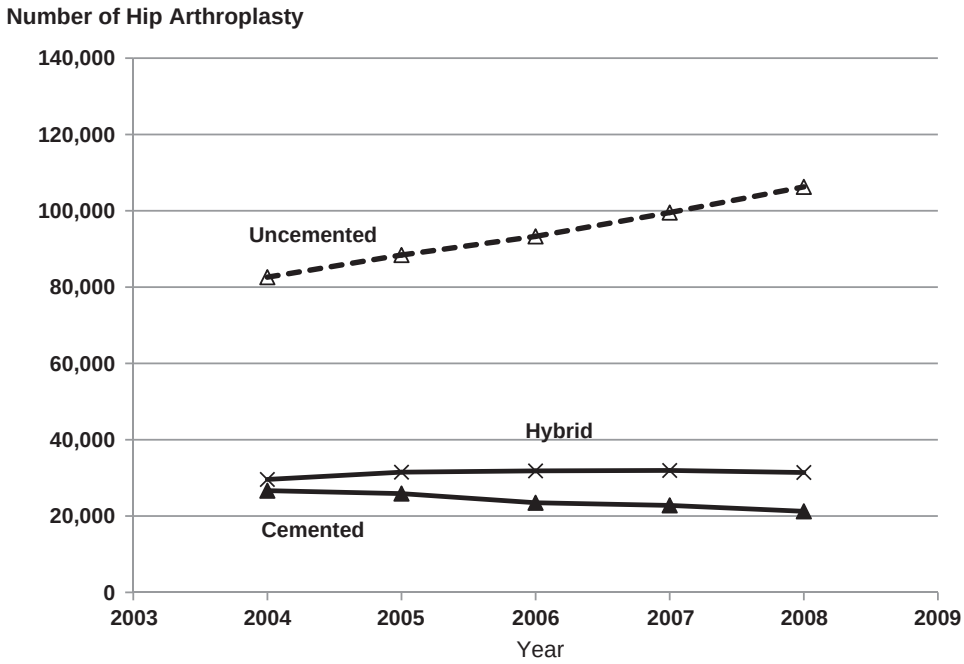

Fig. 3. Types of primary THAs performed in Germany.

that of THAs in most European countries. Between 1998 and 2008 in the European union, the number of THAs increased by one-third but the number of TKAs doubled during the same time period [13]. In the United Kingdom, where the rate of increase is relatively steeper, the incidence rate of THAs increased by 40% since 2000 while that of TKAs increased by 112% [13].

There is substantial evidence that obesity contributes to osteoarthritis [14,15] and future arthroplasties [16–18]. The association between hip osteoarthritis and obesity remains controversial [19], yet studies support obesity as a strong risk factor for knee arthritis [19]. As obesity is more strongly associated with TKAs than with THAs [20], the excessive increase in TKAs compared to THAs suggests that obesity could be a contributor to the recent steeper growth in TKAs in Germany. Over the last couple of decades, the level of obesity has increased at an alarming rate in Germany [21–25]. Between 1985 and 2002, the prevalence of obesity increased from 16% to 23% in in men and

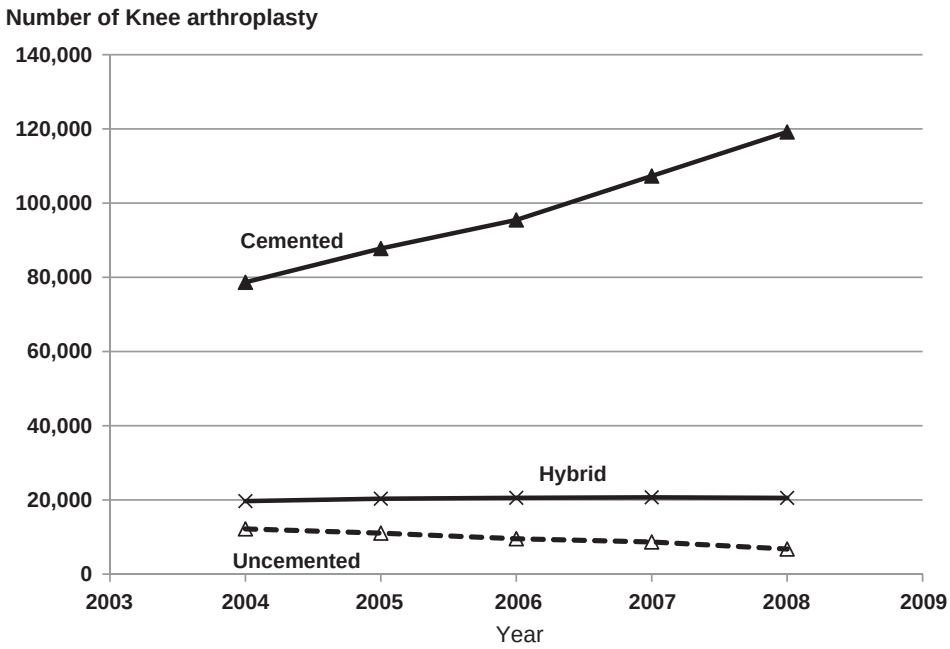

Fig. 4. Types of primary TKAs performed in Germany.

women [22]. Approximately 70% of men and 50% of women in Germany are overweight or obese, and the prevalence continues to increase [23].

Our study revealed that in Germany, the rate of THAs/TKAs performed on younger adults increased faster than that of older adults. We believe that this phenomenon is largely due to the increase in the overweight population and obesity starting at an earlier age [21,25]. Despite the differences in health care system across countries, a faster increase in arthroplasties among younger adults was also observed in the United States [4], and Finland [26]. In Finland, the rapid increase in the incidence of TKAs was particularly prominent in those aged 50 to 59 years with primary knee osteoarthritis. In addition to obesity, as longer-lasting prostheses are introduced, surgeons may feel more comfortable operating on younger patients [3,18]. As a patient factor, a younger patient may have the expectation of an active, pain-free life and may not be willing to put off joint arthroplasty. As multiple factors along the path from the onset of the disease to the decision of elective arthroplasty surgery, there are likely to be multiple explanatory factors behind this phenomenon. Regardless of the reason, the increase of younger adults undergoing THAs and TKAs has some important implications. Total joint arthroplasties performed on younger adults have a higher failure rate [27]. In addition, younger adults are more likely to outlive the lifespan of their artificial joints. Unless a longer lasting, more robust prosthesis is introduced, more failures are likely to happen and more revisions will likely be necessary.

In Germany, where the elderly population is growing faster than in most other countries, the proportion of joint arthroplasties on younger adults remained the same during the study period. Among those who underwent arthroplasties, approximately 31% of THAs and 24% of TKAs were performed on younger adults each year. Despite the rapidly increasing elderly population size, the proportion of joint arthroplasties on younger adults remained the same over time due to steeper rate increase among younger adults. This fact suggests that factor(s) other than the expansion of the elderly population are clearly contributing to the recent increase in THAs and TKAs.

In terms of arthroplasty types, we noted the heightened popularity of uncemented THAs and cemented TKAs in Germany. Uncemented THAs was 5 times more frequent than cemented THAs, whereas cemented TKAs were 18 times more frequent than uncemented TKAs in 2008. Orthopedic surgeons in Germany evaluated that the current state of cemented THA, particularly cementing technique, has improved significantly [28] and clinical results of improved cementing techniques were favorable [29]. A review article by Ni et al [30] recommended a cemented femoral component based on short- and mid-term clinical trials. However, our study showed that an increasing number of uncemented THAs have been performed. This may, in part, be due to the increasing number of younger patients undergoing THAs.

The strength of this study relate to the comprehensive nature of the database. The Federal Joint Committee and the Ministry of Health mandated the reporting of hip and knee arthroplasty. Although reporting of hip and knee arthroplasty is mandated and we have no reason to believe it was underreported, the actual level of compliance is unknown. The prediction is important to better understand the future demand of arthroplasties, yet the nature of any projection is the extrapolation of a model by assuming that the same trend in the future. Finally, although the trends of arthroplasty surgery largely reflect the epidemiology of osteoarthritis, we recognize that not all cases are managed surgically. Making inferences regarding epidemiology of arthritis based on our study could be biased.

In conclusion, younger adults are undergoing THAs and TKAs at an increasing rate compared to older adults in Germany. Because Germany has a larger proportion of elderly population than other industrialized countries, it is commonly believed that this increased surgical volume of THAs and TKAs is due to growing elderly population. This study, however, suggests that factors other than the expansion of the elderly population are clearly contributing to the increase in THAs and TKAs in Germany. As longer-lasting prostheses are introduced, surgeons and non-elderly patients may feel more comfortable to choose surgical treatment. Because obesity is more strongly associated with TKAs than with THAs, the recent steep increase in TKAs compared to THAs suggests that increasing obesity starting at an earlier age could be a contributor to this epidemiological trend. Further study is needed to better understand multiple explanatory factors behind this phenomenon.

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