Trends in Use of Total Knee Arthroplasty in Korea From 2001 to 2010

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Abstract

Background The use of total knee arthroplasty (TKA) has increased substantially in most Western countries. However, the trends in TKA use and changes in demographic characteristics of patients having TKA in Korea remain unclear.

Questions/purposes We documented the trends in TKA use and in the demographics of patients undergoing TKA in Korea over the past decade and determined whether current TKA use in Korea corresponds to worldwide trends.

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Methods Using the Health Insurance Review and Assessment Service of Korea database, we analyzed TKA records (n = 398,218) from 2001 to 2010 in Korea. Trends in TKA use and demographics, including numbers and rates of primary and revision TKA, growth rate and the revision burden, and age- and sex-specific rates, were estimated. They were compared with nationwide TKA registry reports from other countries, and a systematic review was performed.

Results Over the past decade, the primary and revision TKA rates increased by 407% and 267%, respectively. However, the revision burden remained 2%. The highest proportion was observed in 65 to 74 years old and the greatest increase in 75 to 84 years old, but a decrease was observed in those 55 to 64 years old. Women consistently had a ninefold higher TKA rate. The primary TKA rate was comparable with that of other countries, but the revision burden remained lower. In addition, old and female patients comprised considerably higher proportions in Korea.

Conclusions During the past decade, TKA use in Korea has markedly increased and caught up with the use levels of

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most developed Western countries. Trends toward consistent growth in elderly patients and higher rates in females were observed. Appropriate healthcare strategies reflecting these trends in demographics are urgently needed in Korea.

Introduction

TKA is one of the most efficacious, successful, and cost-effective treatments for advanced knee arthritis in terms of pain relief, function restoration, and quality-of-life enhancement [4, 6, 12, 24, 26]. As TKA is being increasingly recognized as a standard treatment option for end-stage knee disease with widespread acceptance, its use has increased substantially in most developed Western countries over the past few decades [1, 5, 10, 15, 19, 25, 29, 31–33, 35, 38, 42–44]. Recent studies on the projected future demand reported that TKA use will rapidly increase based on changing demographics and past use trends [11, 14, 20–22]. The trends in TKA use are associated with the prevalence of diseases that lead to TKA, which is influenced mainly by changes in demographics such as the age and sex distribution of the population, life expectancy, obesity, and activity level [9, 10, 18, 21, 41, 44]. Therefore, accurate and carefully updated information on TKA use based on trends in demographics is essential not only for precise estimation of the future growth of demand, but also for establishment of appropriate healthcare strategies for meeting the future demand for TKA.

Numerous recent epidemiologic studies in Western countries have reported similar trends with joint arthroplasties, namely, a steady growth of use in the aging population, an increasing proportion of younger patients (< 65 years), and greater use in females [9, 10, 13–16, 18, 19, 21, 25, 29, 35, 37, 41, 44]. Two previous studies of the changing demographics of Asian patients undergoing TKA have reported an increase in elderly patients, a stable young patient demand, and a remarkable female predominance [17, 45]. However, of the two studies, one performed in Korea focused mainly on sexual disparity over a relatively short period and did not document the trends by age [17], and the other performed in Hong Kong was based only on the database of a hospital [45]. Furthermore, both studies were limited to primary TKA for primary osteoarthritis (OA) and excluded the revision TKA use trend. Therefore, the longitudinal trends in primary and revision TKA use in Korea over the past decade remain unclear. In addition, the appropriateness of recent TKA use levels in Korea, compared with those in Western countries, has not been elucidated.

We therefore documented the longitudinal trends in use of primary and revision TKA in terms of the procedural number and rate, growth rate, and revision burden and the

demographic trends by age and sex in Korea over the past decade based on a national registry database. We also determined whether the current TKA use levels and demographic trends in Korea correspond to those worldwide based on nationwide TKA registry reports and a recent literature review.

Materials and Methods

This study comprised three parts. First, we assessed TKA use in Korea between 2001 and 2010 using the Health Insurance Review and Assessment Service (HIRA) of Korea database. Second, we searched and reviewed the publications of nationwide TKA registries on the Internet. Finally, we systematically reviewed published original studies dealing with the current trends in nationwide TKA use of a single or multiple countries to compare with those of Korea.

Data of TKA use in Korea were obtained from the HIRA database for the years 2001 to 2010. Korea has a compulsory National Health Insurance system with universal coverage, and the Ministry for Health, Welfare and Family Affairs (MIHWFA) has a supervisory role in health insurance policy. The HIRA, a public agency sponsored by MIHWFA, reviews the cost of healthcare benefits and evaluates the reasonableness of healthcare services provided by medical institutions. Its database contains reimbursement records from all medical institutions in Korea. Primary and revision TKAs were identified by their principal procedure codes in the HIRA database. Records with the procedural codes of primary TKA (N2072) and revision TKA (N3712) were selected. Primary unicompartmental knee arthroplasty (UKA) (N2712) and revision UKA (N4712) were excluded from this study.

From 2001 through 2010, a total of 390,888 primary TKAs and 7338 revision TKAs were performed in Korea. Of these, more than 90% (range, 93%–94%) of procedures were performed on a population aged 55 to 84 years, and consistently, 90% of procedures were performed on females throughout the study period. During the same period, the overall Korean civilian population increased by 3%, whereas the proportion of those aged > 65 years increased by 50%. Females comprised more than 60% of the aged population (Table 1).

The rates of both primary and revision TKA were calculated by dividing each HIRA-reported TKA procedural number by the corresponding year-specific Korean civilian population based on a census database managed by the National Statistical Office and then adjusted to the rate per 100,000 population. The growth rate was calculated by dividing the difference in the procedural TKA number between years by the TKA number in the previous year.

Table 1. Demographic and TKA use trends in Korea, 2001–2010

Demographics and TKA use trends	2001		2010		Growth (%)*
Demographics					
Total population	47,537,362		48,874,539		3
Age category (years)					
≤ 54	85%		80%		−3
55–64	8%		10%		34
65–74	5%		7%		46
75–84	2%		3%		72
≥ 85	0.4%		0.8%		94
Sex composition	< 65 years	≥ 65 years	< 65 years	≥ 65 years	
Male	51%	38%	53%	40%	97 [†]
Female	49%	62%	47%	60%	79 [†]
TKA use					
Number of procedure [‡]					
Primary TKA	14,887 (31)		75,434 (154)		407
Revision TKA	343 (0.7)		1259 (2.6)		267
Revision Burden [§]	2.3		1.6		
Primary TKA use					
Age category (years)					
55–64	31% (118)		19% (274)		211
65–74	53% (331)		57% (1,233)		445
75–84	10% (157)		17% (833)		812
Sex composition [¶]					
Male	9% (6)		11% (34)		467
Female	91% (57)		89% (276)		384

* Growth rate of each variable between 2001 and 2010; [†] growth rate of each sex in ≥ 65-year population; [‡] rate for primary or revision TKA per 100,000 population is shown in parentheses; [§] revision burden was defined as the ratio of revision TKA to the total number of primary and revision TKAs; ^{||} age-specific TKA rate is shown in parentheses; [¶] sex-specific TKA rate is shown in parentheses.

The growth rate for the last 10 years and the annualized growth rate for each year between 2001 and 2010 were calculated. The revision burden was calculated by dividing the number of revision TKAs by the total number of primary and revision TKAs [27]. To evaluate the function of age and sex, age was categorized into five groups (≤ 54, 55–64, 65–74, 75–84, and ≥ 85 years), and sex was categorized into male and female. Age- and sex-specific TKA rates were also calculated by dividing the number of TKA procedures in a given age or sex group by the corresponding population and then adjusted to the rate per 100,000 population.

We performed an extensive search for publications of nationwide TKA registries on the Internet. This search included publications that (1) were reported by a national ongoing TKA registry; (2) were publicly accessible on the Internet; (3) were written in English; (4) presented the raw TKA procedure numbers or rate per 100,000 population; and (5) presented trends in demographics after 2001. The search was initially performed in September 2011 and updated in April 2012. The following search terms were

used: “knee” AND “arthroplasty” or “replacement” AND “register” or “registry” AND country names such as “Sweden” or “Denmark”. We also assessed all linked registry sites presented in the other registry. Of the 23 identified nationwide registries, 14 were excluded because of unavailable information on the Internet or using their own languages. After exclusion, there were nine TKA registries, including one North American, two Oceanian, and six European registries in final analysis and full reports [1, 5, 31–34, 40, 42, 43] were reviewed by one of the authors (CCB). The name of the registry, record periods, and trends by age and sex were collected and the TKA rate per 100,000, growth rate, and revision burden were calculated and compared (Table 2).

Finally, we systematically reviewed the literature reporting current trends in nationwide TKA use. Studies were identified with a PubMed search. The review was initially performed in September 2011 and updated in April 2012. This systematic review included studies that (1) were published as original articles in English after 2000; (2) reported trends in TKA use of a country, including at least

Table 2. Summary of nationwide trends in TKA use based on a national TKA registry report

Country	Registry	Record period	TKA rate*	TKA growth rate [†]	Revision burden (%) [‡]	Age distribution trend [§]	Female (%)
Current study (Korea)	HIRA	2001–2010	154 (2010)	407% (2001–2010) 8% (2009–2010)	2	Highest in 65–74 years; largest increase in 75–84 years; decreased in 55–64 years	91
Australia	NJRR [1]	2003–2010	166 (2010)	72% (2003–2010) 10% (2009–2010)	9	Highest in 65–74 years; increased in 55–64 years; decreased in 75–84 years	57
Canada	CIHI [5]	1995–2006	117 (2006)	141% (1995–2006) 21% (2005–2006)	7	Highest in 65–74 years; increased in 45–54 years	61
England and Wales	NJR [31]	2009–2010	127 (2010)	29% (2006–2010) –2% (2009–2010)	6	In 2010, 37% in 65–74 years, 29% in 75–84 years, 23% in 55–64 years females using cement	57
New Zealand	NZJR [32]	1999–2010	139 (2010)	151% (1999–2010) 1% (2009–2010)	7	Mean age at operation, 69 years (range, 8–101 years)	51
Norway	NAR [42]	1994–2009	91 (2009)	178% (1994–2009) 11% (2008–2009)	9	Increased and highest in 60–69 years, decreased in 70–79 years, constant in 45–59 years	67
Portugal	PAR [34]	2009–2010	65 (2010)	Not presented	6	In 2009, 35% in 71–80 years, 27% in 61–70 years, 15% in 81–90 years	73
Scotland	SAP [33]	2008–2009	135 (2009)	106% (2001–2009) 8% (2008–2009)	8	Median age at operation, 69 years	60
Slovakia	SAR [40]	2006–2010	40 (2010)	146% (2006–2010) 9% (2009–2010)	4	Increased in 55–64 years; decreased in 65–74 years, and > 75 years	67
Sweden	SKAR [43]	2001–2010	133 (2010)	61% (2000–2009) 0.3% (2009–2010)	4	Decreased in 75–84 years female; constant in 65–74 years; increased in 45–64 years	58

* The TKA rate per 100,000 population in the latest record; [†]the increasing rate of the number of TKAs during the period shown in parentheses; [‡]revision burden was defined as the ratio of revision TKA to the total number of primary and revision TKAs in the latest record; [§]changing patterns in age distribution (the proportion of TKA use) during the record period; ^{||}the proportion of females in the latest record; HIRA = Health Insurance Review and Assessment Service; NJRR = National Joint Replacement Registry [1]; CIHI = Canadian Institute of Health Information [5]; NJR = National Joint Registry [31]; NZJR = New Zealand Joint Registry [32]; NAR = Norwegian Arthroplasty Register [42]; PAR = Portuguese Arthroplasty Register [34]; SAP = Scottish Arthroplasty Project [33]; SAR = Slovakian Arthroplasty Register [40]; SKAR = Swedish Knee Arthroplasty Register [43].

the raw procedure numbers or TKA rate; and (3) reported trends in TKA epidemiology of a country. The following search terms were used for the literature search: “knee arthroplasty” or “knee replacement” AND “utilization” or “trend” or “epidemiology” or “prevalence”. The identified studies were filtered to limit the search to publications after 2000. All titles and abstracts were screened and excluded if (1) they were limited to revision TKA; (2) they were limited to a specific disease such as OA or rheumatoid arthritis; and (3) the study period was less than 5 years. One of the authors (CHJ) reviewed the full articles to determine whether the TKA number or rate and trends in demographics had been reported adequately. Of the 132 identified articles, 107 were excluded because they did not meet the inclusion criteria. Thus, the detailed, full articles of 25 studies were reviewed. Of these, 14 were excluded; because six did not report TKA use, three were limited to revision TKA, three were limited to primary OA, and two had a less than 5-year study period. Finally, 11 articles

remained in this systematic review (Fig. 1). The TKA rate, growth rate, revision burden, and trends by age and sex were compared (Table 3).

Results

During the past decade, the numbers and rates of both primary and revision TKA have increased substantially, whereas the revision burden has remained stable. The numbers of primary and revision TKAs increased by 407% and 267%, respectively, and rates of those procedures increased by 391% and 261%, respectively (Fig. 2). However, the revision burden has remained at 2% (range, 1.6%–2.3%) (Table 1). Meanwhile, the annualized primary TKA growth rate was consistently over 20% from 2001 to 2007, but it has been decreasing year by year since 2007 (19% for 2007–2008 to 10% for 2009–2010).

Fig. 1 A flowchart shows the search strategy.

The number and rate of TKAs increased in all age groups and both sexes during the study period. However, the highest rate and largest number of TKAs were observed in the 65- to 74-year age group (Fig. 3) and a consistent ninefold higher female prevalence remained (Fig. 4). The greatest age-specific rate for TKA was observed in the 65- to 74-year age group, the largest growth rate in the 75- to 84-year age group, and the lowest TKA and growth rates in the 55- to 64-year age group. Meanwhile, although males had a greater increase in TKA rates (467% in males versus 384% in females), females consistently comprised 90% of primary and revision TKAs and the sex-specific TKA rate throughout the study period (Fig. 4). In terms of the proportions of TKA numbers, those in both 65- to 74-year and 75- to 84-year age groups increased, whereas they decreased in the 55- to 64-year age group (Table 1).

Although the growth rates of primary and revision TKA were much higher than those of other countries during the past 10 years, the rate of primary TKA remained lower than in the United States and similar to many developed Western countries (Tables 2, 3). In addition, the revision burden in Korea remained lower than in other countries. Meanwhile, the proportion of elderly patients (≥ 65 years)

was higher, whereas the use in young patients (< 65 years) was not pronounced, and the world's highest female proportion of TKA use (91%) remains throughout the study period in Korea.

Discussion

TKA use has increased steadily over the past few decades, and an increasing future demand for TKA is being expected throughout the world [10, 11, 13–15, 17–20, 22, 23, 44, 45]. Therefore, worldwide concerns regarding a rapidly expanding TKA burden are emerging. Accurate information on TKA use based on demographic trends is vital to establish appropriate healthcare policies. However, only one previous study reported the demographics of Asian patients undergoing TKA based on a national registry database [17]. We therefore sought to document the longitudinal trends in TKA use and demographic trends by age and sex in Korean patients undergoing TKA over the past decade and wanted to determine whether the current TKA use levels and demographic trends in Korea correspond to worldwide trends.

Several limitations of this study should be noted. First, we evaluated only age and sex as demographic characteristics. Because other demographic factors such as body mass index, activity level, lifestyle, and socioeconomic status are also reported to affect the use of TKA, these factors should be considered. However, heterogeneity among studies in reporting demographic characteristics makes uniform comparison difficult; therefore, we focused on age and sex, which were presented in relatively identical manners. Second, we did not evaluate the prevalence of diseases that lead to primary TKA or the causes of revision TKA; these data would better enable us to understand the nationwide use trends. Future studies that investigate these issues in more detail are required. Third, we did not evaluate the national health insurance system, which might restrict TKA use. This difference in the national health system among countries should be considered before estimation of TKA use and further studies that evaluate the effect of national insurance system on TKA use are needed. Fourth, we reviewed the published TKA registry reports in English that are publicly accessible on the Internet. Therefore, registry reports written in their own language or unavailable on the Internet were excluded. However, most representative TKA registries in developed countries were included in our study. Finally, although we evaluated the latest studies or registry reports, the study/reporting periods were not identical, especially in the United States. These differences in study periods should be considered before comparing the data presented in this study.

Table 3. Summary of nationwide trends in TKA use based on literature review

Author	Country (region)	Database	Study period	TKA rate* rate*	TKA growth rate [†]	Revision burden [‡]	Age distribution trend [§]	Female
Current study, 2011	Korea	HIRA	2001–2010	154 (2010)	407% (2001–2010) Decreased 2007–2010	2%	Highest and increase proportion in 65–74 years, greatest increase in 75–84 years, decrease in 55–64 years; increase rate in all age group	90%
Losina et al., 2012 [25]	USA	NIS	1999–2008	211 (2008)	134% (1999–2008)	Not presented	Increase proportion in 45–64 years, decrease in > 65 years, increase rate in all age group	Not presented
Singh et al., 2010 [39]	USA (Olmsted)	REP	1969–2008	221 (2005–2008)	608% (1971–2008) Decreased 2001–2004 and 2005–2008	Not presented	Highest proportion in 70–79 years, decrease in > 80 years, increase in 0–49 years during 1997–2000 and 2005–2008, 38% in < 65 years during 2005–2008	Higher rate (129 versus 104)
Memtsoudis et al., 2009 [29]	USA	NHDS	1990–2004	634 (2000–2004)	125% (1990–2004)	Not presented	Highest proportion in 65–84 years, greatest increase in 45–64 years	64%
Khatod et al., 2008 [16]	USA (southern California)	KPSC	1995–2004	110 (2004)	75% (1995–2004)	5 to 8%	Highest proportion and greatest increase rate in 75–79 years, greatest increase proportion in < 65 years	62%
Kim, 2008 [18]	USA	NIS	1997–2004	142 (2004)	53% (2000–2004)	8%	Highest proportion in 65–84 years, greatest increase in 45–64 years	57% to 64%
Kurtz et al., 2005 [19]	USA	NHDS	1990–2002	136 (2002)	195% (1990–2002)	7% to 10%	Highest rate in 65–84 years, increase proportion in 45–64 years	67% higher rate
Jain et al., 2005 [15]	USA	NIS	1990–2000	547 in ≥ 70 years (2000)	42% (1990–2000)	Not presented	Highest proportion and rate in ≥ 70 years, increase proportion and rate in 50–59 years	63%
Mehrotra et al., 2005 [28]	USA (Wisconsin)	WIHD	1990–2000	294 (2000)	82% (1990–2000)	Not presented	Highest proportion and rate in ≥ 70 years, largest increase in 45–49 years	60%

Table 3. continued

Author	Country (region)	Database	Study period	TKA rate* (1991–2004)	TKA growth rate [†]	Revision burden [‡]	Age distribution trend [§]	Female
Ibrahim et al., 2010 [13]	UK (Trent)	TRAS	1991–2004	106 (1991–2004)	42% (1991–2004)	Not presented	Highest rate in 76–85 years, relative years constant	22% higher rate
Culliford et al., 2010 [10]	UK	GPR	1991–2006	139 in female (2006)	226% in female (1991–2006)	Not presented	Highest rate in 70–79 years female, mean age at operation remained stable	59%
Robertsson et al., 2010 [35]	Denmark, Norway, Sweden	NARA	1997–2007	Not presented	Consistent increase in all 3 countries, highest in Denmark	Not presented	In all 3 countries, highest proportion in 75–84 years, decrease in 65–84 years, increase in 55–64 years	64% (Denmark), 70% (Norway), 63% (Sweden)

* The study year of TKA rate per 100,000 population is shown in parentheses; [†] the increasing rate of the number of TKAs during the period is shown in parentheses; [‡] revision burden was defined as the ratio of revision TKA to the total number of primary and revision TKAs; [§] changing patterns in age distribution during the study period; ^{||} the proportion of females; HIRA = Health Insurance Review and Assessment Service; NIS = Nationwide Inpatient Survey [15, 18, 25]; REP = Rochester Epidemiology Project [39]; NHDS = National Hospital Discharge Survey [19, 29]; KPSC = Kaiser Permanente Southern California [16]; WHD = Wisconsin Inpatient Hospital Discharge [28]; TRAS = Trent Regional Arthroplasty Study [13]; GPR = General Practice Research [10]; NARA = Nordic Arthroplasty Register Association [35].

Fig. 2 A graph shows trends in the number of primary and revision TKAs in Korea over the past decade. The use of both primary and revision TKAs has increased substantially, whereas the revision burden has remained stable.

Fig. 3 A graph shows trends in the age-specific TKA rate in Korea over the past decade. The proportions of TKA numbers in both 65- to 74-year and 75- to 84-year age groups increased, whereas they decreased in the 55- to 64-year age group.

Our findings suggest the TKA use in Korea has increased strikingly over the past decade. In this study, the rate of primary TKA increased fivefold and that of revision TKA almost quadrupled, whereas the revision burden remained stable. These findings suggest TKA use in Korea has consistently increased since a previous study that reported steadily increasing TKA use from 2002 to 2005 [17]. Moreover, compared with nationwide registry data, the growth rate in TKA use during the most recent 10 years in Korea (407%) is the highest in the world (Table 2). The reasons for the explosive increase in TKA use are unclear but may be the result of the remarkable economic development

Fig. 4 A graph shows trends in the sex-specific TKA rate in Korea over the past decade. The rate of TKAs in both sexes has increased, but females have a consistent ninefold higher TKA rate from 2001 to 2010.

and rapid growth of the aging population over the past few decades. Meanwhile, despite the increasing use of revision TKA, the revision burden has remained relatively low. However, taking the recent excessive growth of primary TKA use into account, the future revision burden is estimated to increase. The annualized growth rate has been decreasing since 2007 in Korea, and similar trends were reported by some population-based studies in the US and European registry data [2, 31–33, 39, 43]. One plausible explanation is that the current TKA use reached a peak as a result of already accounted for knee disease prevalence, accessibility to the healthcare system, and established indications for TKA [2]. Nonetheless, the rapid growth of the elderly population in Korea continues and therefore, further socioeconomic studies and updated registry data are necessary to ascertain whether these findings are temporary or persistent.

Our data indicate the increasing TKA use was more pronounced in the elderly and that a consistently extreme female predominance remained during the study period. In this study, the age-specific TKA rate in the 65- to 74-year and 75- to 84-year age groups increased by more than threefold and fivefold, respectively. Furthermore, the proportion of elderly patients increased, whereas that of young patients decreased. The reasons why the proportion of young patients decreased are unclear, but this finding may be the result of a rapidly aging population and a unique reimbursement indication for TKA by the government in Korea. The elderly population (> 65 years) increased by 50% during the study period and is estimated to be the fastest growing aging society in the world, which will result in a post-aged society in 2026. In addition, the HIRA

reimburses only patients with primary OA with Grade IV Kellgren-Lawrence radiographic OA if the patient is aged 60 to 64 years. Therefore, orthopaedic surgeons prefer to delay the timing of TKA after 65 years if the patient does not have severe radiographic knee OA. Meanwhile, a ninefold higher TKA rate in females has been observed consistently. Our findings concur with previous studies reporting a substantially higher female TKA rate in Asian countries [17, 30, 45]. Nonetheless, it is unclear why the female sex predominance in Korean patients is much more remarkable than in Western patients or even in other Asian patients. A recent population-based cohort study in Korea reported that women had more than 10 times the prevalence of TKA candidates than men, and female sex was the strongest risk factor of knee OA development among sex, obesity, and aging, especially for being a TKA candidate [7]. Another recent study reported that the patterns of OA symptom progression were notably different between men and women, and women have more severe symptoms than men in the same radiographic grade of knee OA in the Korean population [8]. Our findings suggest further detailed demographic studies dealing with body mass index, activity level, and lifestyle in young female populations are necessary and that more practical healthcare programs for preventing knee OA in females should be adopted in Korea.

Our data suggest the current TKA use levels in Korea have reached those of the most developed Western countries in 10 years owing to the rapid growth of TKA use, but the demographic trends are quite different. The current primary TKA rate in Korea was comparable or even higher than that in other countries, but the revision burden remained lower (Tables 2, 3). Considering that a fivefold increase in TKA use took 20 years in Sweden [36], these findings suggest the current issues of TKA use in most developed Western countries such as the expansion of the burden of revision TKA, lack of workforce, and decreasing reimbursement could be masked by the excessive growth rate in Korea [3, 11, 14, 20–23]. Therefore, policymakers and healthcare providers should prepare for the future changes that will likely soon take place in Korea. Meanwhile, the proportion of elderly patients was much higher, and demand in younger patients was not pronounced although the findings of reports on this issue vary. Trends toward increasing proportions of young patients have been observed in the United States and several European countries [1, 5, 8, 15, 16, 18, 19, 25, 28, 29, 35, 39, 40, 43] but not elsewhere [10, 42, 45] (Tables 2, 3). In addition, a consistent, substantial sex difference was observed in Korea. Our comparisons suggest national health policies on TKA use should be based not only on worldwide trends, but also the demographic characteristics of each country or region.

Our study demonstrates TKA use in Korea has increased rapidly over the past decade and has reached that of most developed Western countries. However, the proportions of elderly and female patients were more pronounced. Further studies of more detailed demographic characteristics and appropriate healthcare strategies, focused particularly on management of the rapidly increasing demand for TKA in elderly female patients, are urgently needed in Korea.

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