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Utilization rates of hip arthroplasty in OECD countries

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SUMMARY

Background: Hip arthroplasty and revision surgery is growing exponentially in OECD countries, but rates vary between countries.
Methods: We extracted economic data and utilization rates data about hip arthroplasty done in OECD countries between 1990 and 2011. Absolute number of implantations and compound annual growth rates were computed per 100,000 population and for patients aged 65 years old and over and for patients aged 64 years and younger.
Results: In the majority of OECD countries, there has been a significant increase in the utilization of total hip arthroplasty in the last 10 years, but rates vary to a great extent: In the United States, Switzerland, and Germany the utilization rate exceeds 200/100,000 population whereas in Spain and Mexico rates are 102 and 8, respectively. There is a strong correlation between gross domestic product (GDP) and health care expenditures per capita with utilization rate. Utilization rates in all age groups have continued to rise up to present day. A seven fold higher growth rate was seen in patients aged 64 years and younger as compared to older patients.
Conclusion: We observed a 38-fold variation in the utilization of hip arthroplasty among OECD countries, correlating with GDP and health care expenditures. Over recent years, there has been an increase in the utilization rate in most countries. This was particularly evident in the younger patients. Due to increasing life expectancy and the disproportionally high use of arthroplasty in younger patients we expect an exponential increase of revision rate in the future.

Introduction

Osteoarthritis is one of the 10 most disabling diseases in developed countries and worldwide affects approximately 10% of men and 18% of women aged older than 60 years[1]. The WHO estimates that ageing populations and increasing life expectancy will make osteoarthritis the fourth leading cause of disability in 2020[2,3]. Total hip arthroplasty (THA), can provide effective relief for patients with osteoarthritis of the hip where conservative treatment patterns have failed. Despite worldwide variations in cost[4], arthroplasty does appear to be cost effective in the long term[5]. Arthroplasty is also being used more frequently in the emergency setting with those patients with hip fractures[6,7].

The use of specific endoprostheses with unfavourable results has lead to safety concerns among hip surgeons[8,9], but the establishment of national joint registers has improved knowledge and the quality of hip implants[10].

To our knowledge no study has been performed analysing recent data and the different utilization rates of hip arthroplasty across countries and over time. In addition, it remains unclear why and how much utilization and growth rates of hip arthroplasty differ among countries.

Therefore, the goal of the study is to analyse the historical and epidemiological trend of hip arthroplasty utilization rates across countries using Organisation for Economic Co-operation and Development (OECD) health data by discussing the following questions:

(a) What is the incidence of primary hip arthroplasty in OECD countries according to age and economic parameters?

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(b) How has utilization rate and population rate changed over time?
(c) Which trends can be derived to predict the future use of hip arthroplasty?

Material and methods

We extracted economic variables and medical data about hip arthroplasty done in OECD countries between 1990 and 2011 from the OECD health data 2013 databases[11]. However, the majority of data were reported later than 2005 and we therefore focused on the time period between 2005 and 2011 or the latest available. We retrieved the following variables for hip replacement which is internationally identified by ICD-9-CM codes 81.51 (total replacement), 81.52 (partial replacement) and 81.53 (revision) from OECD data base: Inpatient cases per 100,000 population and total procedures per 100,000 population (both variables also for patients aged 65 years old and over), total population and population aged 65 years and over, annual gross domestic product (GDP) per capita and annual health care expenditures per capita. Access to essential care was retrieved from United Nations webpage[12].

Data validation for the different variables was done as follows: Economic and population data appeared in multiple OECD databases and were similar. No differences exceeding 5% were found between inpatient cases and total procedures (including in- and outpatient cases). For Australia and Mexico, only total procedures per 100,000 population were reported. Furthermore OECD data were compared with register data, where available and differences did not exceed 5% as well[13].

A Pearson correlation between medical and economic data was done.

In order to compare growth rates across countries and over time we calculated the compound annual growth rate (CAGR) as the *x*th root of the total percentage growth rate, where *x* is the number of observed years:

$$\text{CAGR} = (\text{value last year}/\text{value first year})\hat{}(1/\#\text{years}) - 1$$

We separated the patients into two age groups – for "patients aged 65 years old and over" and for "patients aged 64 years and younger". Numbers and rates per 100,000 population in "patients aged 64 years and younger" were calculated as the total number of hip arthroplasties minus the number of implants in patients aged 65 years and older.

OECD health database reports "rates" in the meaning of "incidence", which equals "inpatient cases per 100,000 total population" for every age group. In this case, the denominator is always the "total population" for all age groups, while the numerator changes according to age group. This definition leads to the phenomenon that total rate is much higher than the rates of the subgroups might suggest (Tables I–III): In 2011 in Austria for example, total utilization rate per 100,000 total population is 273 and rate of patients aged 65 old and over is 154 and rate of patients aged 64 old and under is 119. One would assume at first sight, that total rate would be a value between 119 and 154 and not be 273, but the confusion is due to the fact, that there are 1.5 million people of age 65 and over and 6.9 million people of age 64 and under. According to OECD, the values are always divided by 100,000 of total population, which is 8.4 millions in Austria. We therefore distinguish between "incidence", according to OECD definition and introduced a new parameter, named "mean utilization rate", where numerator and denominator refer to the same group of population. Using this definition, values from the different age groups can be compared and the total "mean utilization rate" ranges between the age-specific "mean utilization rates": In the example of Austria, 12,972 implants in the group of patients aged 65 years and older (1.5 million people) equal an incidence of 154 (12,972 implants/8,400,000 total population × 100,000) or a mean utilization rate of 865 (12,972 implants/1,500,000 population aged 65 and over × 100,000). This is compared to an incidence of 119 (9900 implants/8,400,000 total population × 100,000) and a mean utilization rate of 144 (9900 implants/6,930,000 aged 64 old and less × 100,000) in patients aged 64 old and less. Therefore, patients aged 65 and older present a 30% higher incidence for a hip arthroplasty as compared to younger patients, which means that mean utilization rate in this group of patients is actually six times higher.

Results

The OECD health database contains specific data relating to hip arthroplasty for 32 countries. Canada, Denmark and Finland have continuously reported data since 1990. The majority of countries (27) have reported valid data since 2005 (Table I). Five countries (Chile, Czech Republic, Greece, Iceland and Slovak Republic) had to be excluded due to poor data availability.

The number of hip arthroplasties per 100,000 population increased since 2000 (Fig. 3) but varies between individual OECD countries by a factor of 38. The latest available incidence rates show a broad range from 306 hip replacement cases per 100,000 population in Switzerland to eight per 100,000 population in Mexico. Similar differences can be demonstrated in the older group. In Switzerland 180 hip procedures in the population over age of 65 years are performed per 100,000 total population, whereas Korea reports 15 cases for the same population (Table II). Switzerland, Germany and Austria show the highest utilization rates with 286–306 cases per 100,000 population, followed by Belgium, Sweden and Denmark with 225–237, whereas the USA report 204, respectively.

Annual GDP per capita ranged from 18,321 (Mexico) to 88,276 (Luxembourg) and annual health care expenditures per capita ranged from 620 USD (Mexico) to 9121 (Switzerland), which accounted for 3% (Mexico) to 17% (Switzerland) of GDP expenditures. Access to essential care was 100% in all countries, except for Mexico with 46%, respectively.

A strong correlation ($r = .764$, $P < .001$) was found between utilization rate of hip arthroplasty and health care expenditures and a significant and moderate correlation ($r = .642$, $P < .001$) was found between utilization rate and GDP: Countries with a higher GDP per capita and higher health care expenditures had a significantly higher utilization rate of hip arthroplasty (Fig. 4).

There was a 23% rise in the total number of hip arthroplasties performed between 2005 and 2011 in OECD, while population grew only by 4% during the same time frame. This increase is attributed to the increasing use of arthroplasty in younger patients (+35%) (Table III) compared to the older population (+16%) (Table II). This is in stark contrast to population growth during the same time frame, which was 3% and 12%, respectively (Fig. 1). CAGR of "mean utilization rate" is seven times higher in younger patients than in older ones (3.9% vs 0.6%).

Korea and Poland show the highest growth rates of hip arthroplasty. In contrast, Ireland shows massive decreasing utilization rates despite the population grows slightly. In Estonia, Finland and New Zealand as well a decline was noted in the use of hip arthroplasty in patients aged 65 or older (Fig. 2).

There was a trend for a higher CAGR in countries with a lower utilization rate as compared to countries with a higher utilization rate that demonstrated lower CAGR values.

The significant increase in total utilizations is attributed to the increasing use of hip arthroplasty in patients aged less than 65 years, where CAGR rates are higher as compared to older patients.

Table I
Total utilization rate of hip arthroplasty per 100,000 population from 2000 to 2011

	Population in 2011 [Mio]	Data available since year	Inpatient cases per 100,000 total population												Total number of implants in 2011	Health expenditure per capita [$]	GDP per capita [$]
			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011			
Australia	22.3	1993	125	136	140	145	148	148	151	155	154	163	167	171‡	38,063	5939	44,784
Austria	8.4	2002			225	239	248	251	254	257	263	260	270	273	22,963	5280	43,848
Belgium	11.0	2005						237	236	239	245	230	236	234‡	25,867	4962	40,068
Canada	34.5	1990	79	82	99	105	110	117	119	119	122	124	125	127‡	43,644	5630	41,455
Denmark	5.6	1990	162	166	190	184	198	206	209	210	198	236	225	229‡	12,743	6648	42,176
Estonia	1.3	2003				87	80	81	86	85	90	88	85	82	1095	987	23,625
Finland	5.4	1990	174	179	189	197	187	211	220	206	220	215	226	225	12,097	4325	38,282
France	63.2	1997	207	212	215	214	212	217	215	217	220	223	225	230	145,157	4952	36,249
Germany	81.8	2005						255	260	268	277	283	284	286	233,696	4875	41,231
Hungary	10.0	2005						110	109	95	101	100	96	115	11,467	1085	22,011
Ireland	4.6	1995	132	126	132	132	133	138	135	129	120	117	120	118	5405	4542	43,579
Israel	7.8	2000	45	50	48	49	51	50	52	53	52	51	52	53‡	4085	2426	29,830
Italy	60.7	2001		130	137	140	146	148	152	153	153	153	156	157	95,093	3436	33,117
Korea	49.8	2004					10	11‡	12	15	16	17	18	17	8612	1616	30,800
Luxembourg	0.5	1998	194	201	221	219	227	220	216	233	219	219	206	228	1181	8798	88,276
Mexico	109.2	1995	4	6	6	6	6	6	7	7	7	8	8	8	8628	620	18,321
Netherlands	16.7	1995	167	174	183	190	193	191	193	196	204	207	216	220‡	36,670	5995	43,146
New Zealand	4.4	1996	119	117	109	105	129	133	135	146	144	145	143	141	6202	3666	32,898
Norway	5.0	1996	171	186	187	212	192	203	197	231	232	242	250‡	258‡	12,791	8987	65,638
Poland	38.5	2005						40	47	46	52	58	63	75	29,048	899	22,167
Portugal	10.6	1993	72	78	87	76	80	77	82	81	85	88	90‡	93‡	9783	2311	25,275
Slovenia	2.1	2005						157	175	164	184	182	158	187	3836	2218	25,323
Spain	46.2	1997	72	79	81	82	82	87	89	93	91	93	98	102	47,006	3027	32,081
Sweden	9.4	2005						210	210	212	220	234	237	233	22,016	5331	43,176
Switzerland	7.9	2002			241	251	260	266	274	289	292	296	304	306	24,188	9121	53,733
United Kingdom	63.3	2005						144	153	164	170	171	175	181	114,293	3609	37,446
United States	311.6	2000	102	112	119	124	175	167	162	154	183	205	204	210‡	655,272	8608	51,689
Total	**991.8**														**1,630,903**	**Mean 4440**	**38,897**
							Incidence*	**140**	**140**	**140**	**151**	**159**	**160**	**164**	**+2.3% CAGR**		
							Mean utilization rate†	**140**	**140**	**140**	**151**	**159**	**160**	**164**	**+2.3% CAGR**		

Bold figures show summary.
Shaded values demonstrate the time interval of our analyses from 2005 to 2011.
Comments:
* Implants/100,000 total population.
† Implants/100,000 total population all ages.
‡ Rates calculated according to CAGR of implants of previous years.

Table II
Utilization rate of patients aged 65 old and over per 100,000 total population from 2000 to 2011

	Population in 2011 [Mio]	Share of total population [%]	Inpatient cases aged 65 years old and over per 100,000 total population												Total number of implants in 2011
			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	
Australia	3.1	14	101	108	111	114	116	115	116	118	117	122	123	125‡	27,808
Austria	1.5	18			145	154	157	155	153	151	153	149	153	154	12,972
Belgium	1.9	17						138	138	140	143	134	137	136‡	15,046
Canada	5.0	15	63	65	77	82	85	90	89	89	89	89	89	89‡	30,604
Denmark	1.0	17	109	112	128	124	132	137	137	136	126	146	136	136‡	7565
Estonia	0.2	17				54	49	49	51	49	52	51	50	48	643
Finland	1.0	18	117	119	124	127	119	132	136	125	132	127	131	126	6789
France	10.8	17	132	134	136	135	133	135	134	135	136	138	138	138	87,284
Germany	16.9	21						134	133	134	137	138	138	138	112,881
Hungary	1.7	17						70	69	59	62	61	58	68	6781
Ireland	0.5	12	118	113	119	119	120	125	124	118	110	105	105	101	4623
Israel	0.8	10	46	51	48	50	51	51	52	54	54	52	53	53‡	4132
Italy	12.4	21		70	72	73	75	76	76	76	76	76	77	77	46,757
Korea	5.7	11					12	n/a	12	16	15	16	16	15	7467
Luxembourg	0.1	14	132	139	151	150	155	150	146	158	149	148	140	154	798
Mexico	6.6	6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Netherlands	2.7	16	123	127	134	138	138	135	134	134	137	136	140	141‡	23,473
New Zealand	0.6	13	101	99	92	89	108	111	110	117	114	113	110	106	4669
Norway	0.8	15	113	124	126	143	131	138	134	158	158	164	169‡	174‡	8634
Poland	5.3	14						31	35	34	38	43	47	55	21,189
Portugal	2.0	19	44	47	52	46	47	45	47	47	48	49	50‡	51‡	5371
Slovenia	0.3	17						101	111	102	113	110	95	112	2299
Spain	8.0	17	43	46	48	48	49	52	53	56	55	55	58	58	26,781
Sweden	1.8	19						121	121	121	125	131	130	121	11,433
Switzerland	1.3	17			154	161	165	167	171	177	177	172	175	180	14,242
United Kingdom	10.5	17						93	99	106	109	108	110	112	70,879
United States	41.4	13	82	90	96	100	141	135	130	123	144	159	156	160‡	498,095
	143.6	**14**													**1,059,216**
							Incidence*	**95**	**94**	**93**	**100**	**105**	**105**	**107**	**+1.6% CAGR**
							Mean utilization rate†	**707**	**692**	**676**	**720**	**748**	**737**	**738**	**+0.6% CAGR**

Bold figures show summary.
Shaded values demonstrate the time interval of our analyses from 2005 to 2011.
Comments:
n/a – not available.
* Implants/100,000 total population.
† Implants/100,000 aged 65 years old and over.
‡ Rates calculated according to CAGR of implants of previous years.

Discussion

Utilization rates vary

Utilization rates vary between individual OECD countries by a factor of 38. Similar findings were shown for knee arthroplasty but not for hip arthroplasty[14]: Although these differences might be explained by national and regional factors, no correlation with economic data was published up to now.

Different access to care due to economic factors

Economical factors such as GDP and health care expenditures could be identified in our study to correlate significantly with utilization rates. Additionally incentives of a hospital payment system (i.e., fee for service vs global budgets vs DRG-based payments) or budgetary restrictions have an influence[15]. Nursing by family members might also reduce the willingness for patients to undergo an operation: More than one in 10 adults provides care to frail people in Spain, where utilization rate is 40% below mean OECD rate, but GDP is only 14% below mean OECD rate[16]. Access to "essential care" according to United Nations's definition in all reported countries is 100%, with the exemption of Mexico, where 46% is reported, explaining low rates[12].

A major break in the growth of health expenditure was observed in Ireland and Estonia, with a simultaneous decrease in utilization rates of hip arthroplasty, presumably due to the economic crisis. No explanation was found in Portugal, where utilization rate increased despite expenditures reducing significantly[17]. In countries with stable health expenditures, a negative correlation between total utilization and growth rate was observed. Countries with a low utilization rate like Korea and Poland tried to catch up and present a high annual growth rate.

Increasing CAGR of countries

This leads to an increasing utilization rate of hip arthroplasty in OECD countries, especially in younger patients, which corresponds to register data. Between 2003 and 2011 in Australia there has been an 18% increase in patients aged 55–64 years and an 11% increase in patients younger than 55 years receiving a total hip replacement[18]. In Sweden from 1994 to 2011 the number of men and women of age 70 and below receiving hip arthroplasty showed an increase of 16% and 23%, respectively[19]. In contrast in England there was a slight decrease of mean implantation age from 67.2 years in 2011 compared to 66.7 years in 2009[20].

Increasing CAGR of young

In absolute figures, there are less joint replacements performed in patients younger than 65 years as compared to patients aged 65 years and older, but CAGR of "mean utilization rate" is seven times higher in younger population than in older ones. In OECD countries more and more citizens reach the age of 65. There is a three fold difference between CAGR of population over 65 years *versus* younger population with 1.6% *versus* 0.5%, respectively. But

Table III
Utilization rate of patients aged 64 old and under per 100,000 total population from 2005 to 2011

	Population in 2011 [Mio]	Share of total population [%]	Inpatient cases aged 64 years old and under per 100,000 total population							Total number of implants in 2011
			2005	2006	2007	2008	2009	2010	2011	
Australia	19.25	86	33	35	37	37	41	44	46‡	10,255
Austria	6.93	82	96	101	106	110	111	117	119	9990
Belgium	9.1	83	99	98	99	102	96	99	98‡	10,822
Canada	29.5	86	27	30	30	33	35	36	38‡	13,040
Denmark	4.6	83	69	72	74	72	90	89	93‡	5178
Estonia	1.1	83	32	35	36	38	37	35	34	452
Finland	4.4	82	79	84	81	88	88	95	99	5307
France	52.4	83	82	81	82	84	85	87	92	57,873
Germany	64.9	79	121	127	134	140	145	146	148	120,815
Hungary	8.3	83	40	40	36	39	39	38	47	4687
Ireland	4.0	88	13	11	11	10	12	15	17	783
Israel	7.0	90	<1	<1	<1	<1	<1	<1	<1	n/a
Italy	48.3	80	72	76	77	77	77	79	80	48,336
Korea	44.1	89	0‡	0	0‡	1	1	2	2	1145
Luxembourg	0.4	86	70	70	75	70	71	66	74	383
Mexico	102.6	94	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Netherlands	14.0	84	56	59	62	67	71	76		13,197
New Zealand	3.8	87	22	25	29	30	32	33	35‡	1533
Norway	4.2	85	65	63	73	74	78	81	84‡	4157
Poland	33.3	86	9	12	12	14	15	16	20	7859
Portugal	8.6	81	32	35	34	37	39	40	42‡	4412
Slovenia	1.7	83	56	64	62	71	72	63	75	1537
Spain	38.2	83	35	36	37	36	38	40	44	20,224
Sweden	7.6	81	89	89	91	95	103	107	112	10,583
Switzerland	6.6	83	99	103	112	115	124	129	126	9946
United Kingdom	52.8	84	51	54	58	61	63	65	69	43,414
United States	270.2	87	32	32	31	39	46	48	50‡	157,177
Total	**848.2**	**86**								**571,686**
		Incidence*	**44**	**45**	**46**	**50**	**53**	**54**	**57**	**+3.8% CAGR**
		Mean utilization rate†	**51**	**52**	**53**	**58**	**62**	**63**	**66**	**+3.9% CAGR**

Bold figures show summary.
Shaded values demonstrate the time interval of our analyses from 2005 to 2011.
Comments:
n/a – not available.
* Implants/100,000 total population.
† Implants/100,000 aged 64 years old and under.
‡ Rates calculated according to CAGR of implants of previous years.

nevertheless, mean utilization rate in the younger population is growing faster. CAGR of mean utilization rate in younger patients is seven fold higher when compared to older patients (3.9% *versus* 0.6%). Improved longevity may be the reason that hip arthroplasty has been described as "the operation of the 20th century"[21].

The increasing use of THA in younger patients is also a sign for a better accessibility to THA for patients independently from age, since countries with a lower total utilization rate showed an even lower utilization rate in younger patients, which means, that in those countries older patients are preferred candidates for THA. This may be due to limited economic resources.

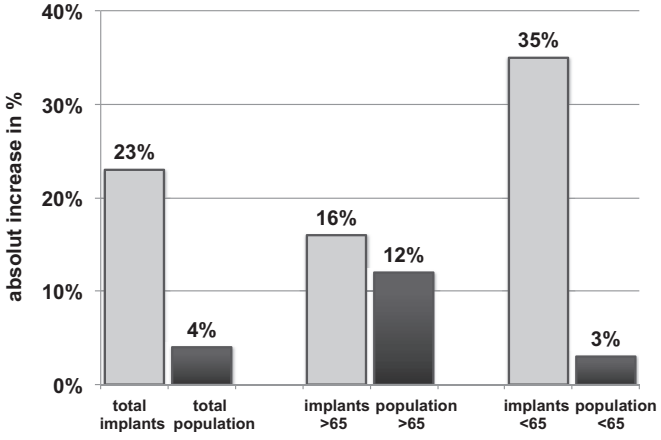

Fig. 1. Increase of population and total utilization of hip arthroplasty from 2005 to 2011.

"Mean utilization rate" as a new parameter

In this context it becomes obvious that mean utilization rate can not be described accurately for different age groups by using the term "incidence", because using total population in the denominator would disguise this finding: A six fold utilization rate in the group of older patients as compared to younger ones is mathematically reflected by an only 30% higher incidence, as demonstrated in the example of Austria. We therefore point out that whenever groups of patients with a different number of patients in each group are compared, numerator and denominator should refer to the same group and the introduced "mean utilization rate" shall be used, as described in the methods above.

Increasing revisions

After THA, a lifelong implant survival is desirable. Nevertheless a variety of complications can occur, such as early infections or late aseptic loosening, which are reflected in Kaplan–Meier implant survival curves for total hip replacements, varying from 90 to 96% at 10 years, according to fixation type and age groups[22]. Both, increasing life expectancy and a higher mean utilization rate in the younger population, will result in higher revision rates in the future. In a register study of the Nordic Arthroplasty Register Association database including 536,962 hips, operated on between 1995 and

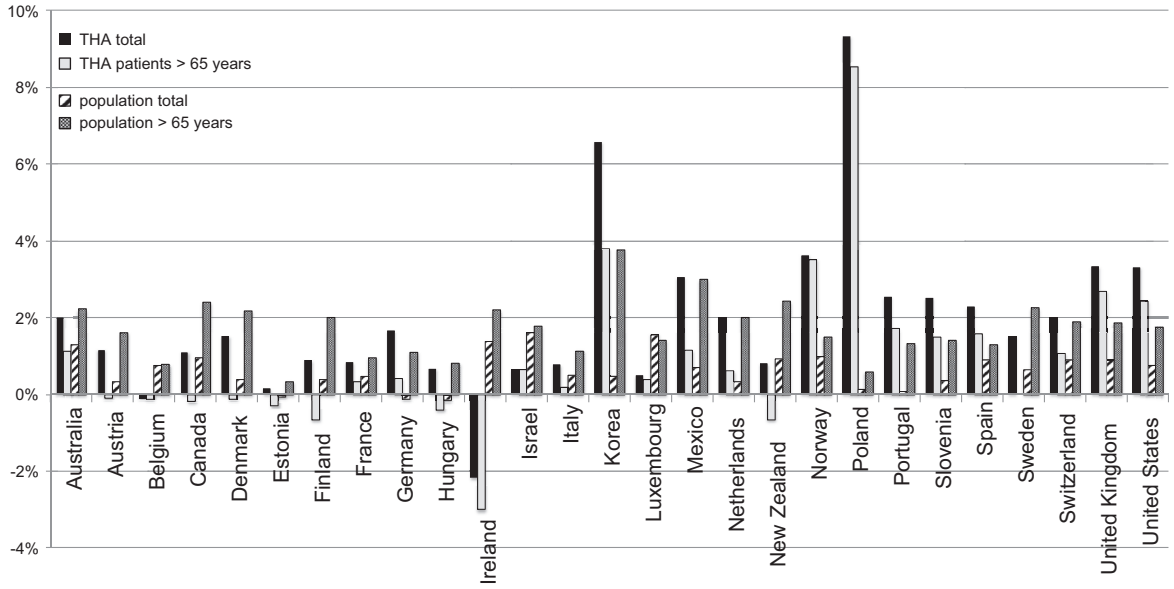

Fig. 2. CAGR and population development in OECD countries from 2005 to 2011.

2011, the 10-year implant survival of patients below the age of 65 was only slightly higher as compared to older patients (90.0–92.4% as compared to 90.7–95.9%), according to cementation technique used[22]. But in a previous study based on the Finnish Arthroplasty Register, the 10-year implant survival of patients operated on between 1987 and 2006 who were younger than 55 years ranges between 79% and 80%, respectively[23]. As a consequence implantations in younger patients will increase the demand for revision hip arthroplasty in the group of older patients in the future.

But revision rate is not only a function of the age of patients and other patient specific factors, but also of the type of prostheses used. As more implants will be revised in the future, the choice of which implant will become more critical. Furthermore, health care budgets in OECD countries will be subjected to more pressure as more costly revision surgeries increase[4].

Limitations of the study

OECD health data is currently the most comprehensive database for aggregated health measures worldwide, in particular due to specific utilization measures such as the number of hip arthroplasty procedures. However data need to be reviewed carefully for the purpose of cross-country analyses because it can be affected by different drawbacks. Firstly, procedure coding systems vary to a large extent across countries. Therefore the common ICD-9-CM catalogue needs to be translated into country specific codes in order to identify similar patients in national databases. Secondly, OCED captures just a part of the world and we were not able to incorporate data from non-OECD countries such as BRICS countries (Brasil, Russia, India, China and South Africa). Thirdly, data from small private institutions, who do not report to national governmental institutions are not captured by OECD data, however, according to OECD and registries, over 95% of all procedures in the participating countries are reported and validated and therefore a possible selection bias is negligible.

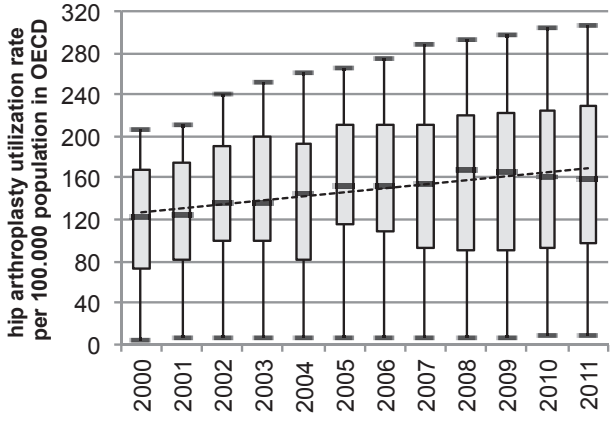

Fig. 3. Box plot of hip arthroplasty utilization rate per 100,000 population in OECD countries from 2000 to 2011.

Conclusion

We observed a 38-fold variation in the utilization of hip arthroplasty among OECD countries, ranging between eight and 306 cases per 100,000 population. These findings can be explained by differences in health expenditure and correlate well with GDP per capita. There is a significant increase of utilization rate in most countries. Furthermore there is a seven fold difference in growth rate between mean utilization rate of younger and older patients. The higher growth rate in younger patients in recent years will consequently lead to an increase in the number of revisions in the upcoming years in older patients.

Contributions

All authors were involved in study conception and gave final approval for the submission. AG created the information as source for the study. CP and AG were involved with the study design and CP and AG with the statistical analysis. CP and AG wrote the initial draft and were responsible for subsequent modifications based on feedback from the reviewers. CP affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

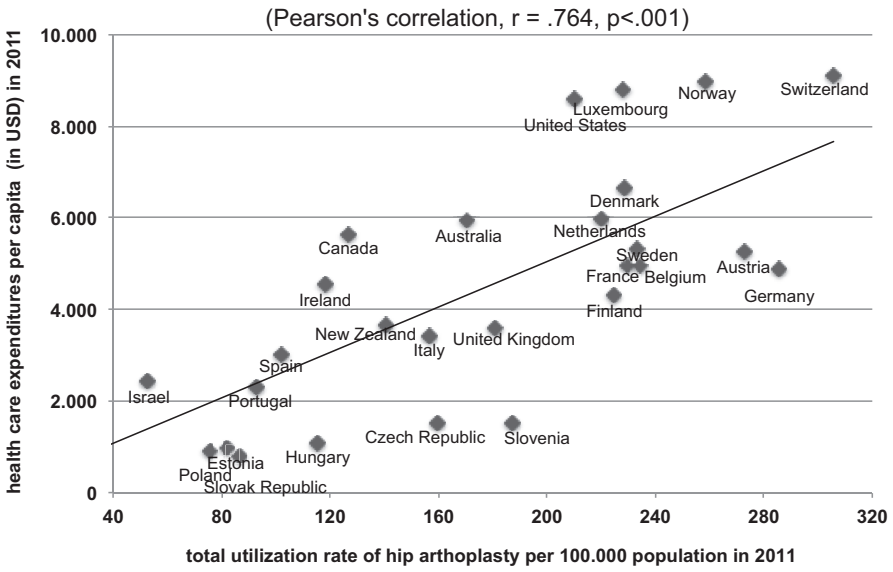

Fig. 4. Correlation of health care expenditures per capita and utilization rate of hip arthroplasty.

Conflict of interests

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years; no other relationships or activities that could appear to have influenced the submitted work.

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