



# Epidemiological Evolution of Hip and Knee Arthroplasties over the Course of 17 Years in a Single Hospital in Chile

## *Evolución epidemiológica de las artroplastias de cadera y rodilla durante 17 años en un hospital chileno*

Maximiliano Barahona<sup>1</sup>  Juan Pablo Prieto<sup>1</sup>  Felipe Ceron<sup>1</sup>  Jaime Catalán<sup>1</sup>  Carlos Infante<sup>1</sup>   
Cristian Barrientos<sup>1</sup> 

<sup>1</sup> Orthopedics and Traumatology Department, Hospital Clínico, Universidad de Chile, Santiago, Chile

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Address for correspondence Maximiliano Barahona, MD, MBIostat, Departamento de Ortopedia y Traumatología, Hospital Clínico, Universidad de Chile, Santos Dumont 999, Tercer Piso, Oficina 351, Independencia, Santiago, Chile (e-mail: maxbarahonavasquez@gmail.com).

### Abstract

**Introduction** Total hip arthroplasty (THA) is considered the surgery of the twentieth century due to its impact on quality of life, and knee arthroplasty (KA) has been proven to be a cost-effective procedure in cases of gonarthrosis.

**Objective** To describe the evolution of THA and KA in a general hospital in terms of number of procedures and the average age and gender of the patients.

**Method** Analytical cross-sectional study. All procedures performed in a single center, between January 2002 and December 2018, that were registered by the Chilean National Health Fund (Fondo Nacional de Salud, FONASA, in spanish) codes for surgeries 2104129 and 2104153 were included. All revision surgeries, as well as tumor- or fracture-related procedures were excluded. The following data were obtained from the registry: patients' gender and age at the time of surgery and year of the procedure. A Spearman correlation analysis was performed, and the significance level was set at 0.05.

**Results** A total of 3,270 procedures were included: 1,975 THAs (60.4%) and 1,295 KAs (39.6%). The number of THAs has increased over time, with a total of 122 procedures in 2002 and 164 in 2018. In addition, the number of KAs has also increased, from 40 in 2002 to 155 in 2018. The ratio between THA and KA has been decreasing significantly. The average age of patients undergoing KAs has decreased, while that of patients undergoing THAs has increased, without statistical significance. Regarding THAs, we observed an increase in the proportion of men submitted to the procedure.

**Conclusions** The epidemiological profile of the patients undergoing arthroplasties has changed significantly. The epidemiology of the studies in the world literature, as well as that of the present study, show a significant increase in the number of patients who require KAs; therefore, it seems important to include this procedure in the development of new public healthcare policies.

### Keywords

- ▶ hip arthroplasty
- ▶ knee arthroplasty
- ▶ osteoarthritis
- ▶ epidemiology

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## Resumen

**Introducción** La artroplastia total de cadera (ATC) es la cirugía del siglo XX por el impacto en la calidad de vida, y la artroplastia de rodilla (AR) ha demostrado ser un procedimiento provechoso en casos de gonartrosis.

**Objetivo** Describir la evolución de ATC y AR en un hospital general en cuanto a número de procedimientos, y edad y sexo de los pacientes operados.

**Método** Estudio transversal analítico en el que fueron incluidos todos los procedimientos realizados en un único centro entre enero de 2002 y diciembre 2018, que estuvieran registrados por los códigos de prestación 2104129 y 2104153 del Fondo Nacional de Salud (Fonasa). Se excluyeron todas las cirugías de revisión, así como los procedimientos relacionados con tumores o fracturas. Se obtuvieron los siguientes datos del registro: sexo y edad de los pacientes en el momento de la cirugía y año del procedimiento. Se realizó un análisis de correlación de Spearman, y se estableció una significancia de 0.05.

**Resultados** Fueron incluidos 3.270 procedimientos: 1.975 corresponden a ATC (60,4%), y 1.295, a AR (39,6%). El número de ATCs ha aumentado: en 2002, fueron realizadas 122, mientras que 164 en 2018. Por su parte, las ARs también aumentaron: en 2002, fueron realizadas 40, mientras que 155 en 2018. La proporción ATC/AR ha disminuido significativamente. La edad promedio de los pacientes ha disminuido en las ARs y aumentado en las ATCs, sin significación estadística. En las ATCs, se observa un incremento en la proporción de hombres operados.

**Conclusión** El perfil epidemiológico de los pacientes operados de artroplastia ha cambiado significativamente. La epidemiología de los estudios en la literatura mundial y la de este estudio muestran un significativo incremento de pacientes que requieren AR, por lo cual parece importante incluir este procedimiento en las necesidades sanitarias a satisfacer en el diseño de nuevas políticas públicas.

## Palabras Claves

- ▶ artroplastia de cadera
- ▶ artroplastia de rodilla
- ▶ artrosis
- ▶ epidemiología

## Introduction

Total hip arthroplasty (THA) and knee arthroplasty (KA) are recognized treatments for hip and knee osteoarthritis respectively. Total hip arthroplasty is considered the surgery of the twentieth century due to its impact on the quality of life of patients,<sup>1</sup> and KA numbers are increasing due to its good outcomes and cost-effectiveness in cases of gonarthrosis.<sup>2</sup>

An important factor to consider when indicating THA and KA is the survival time of the implants. Survival of both hip and knee implants has been increasing, with a 25-year survival rate of 77.6% for THA<sup>3</sup> and of 82.3% for KA.<sup>4</sup>

Chile is no stranger to this reality, with increasing numbers of THA and KA. In 2006, THA was included among the explicit health care guarantees (garantías explícitas en salud, GES, in Spanish) for patients over 65 years old with severe osteoarthritis and significant disability;<sup>5</sup> however, surgical treatment of severe knee osteoarthritis has not been included as one of the GES.<sup>6</sup>

The present paper aims to describe the evolution of THA and KA in a Chilean general hospital in terms of the number of procedures performed and average age and gender of the operated patients. We hypothesized that the number of THAs and KAs has increased over the years, with a decreasing THA/KA ratio, reduced patient's average age in both procedures, and an increased proportion of male subjects.

## Material and Methods

A cross-sectional study carried out at Hospital Clínico de Universidad de Chile. All procedures performed in this center from January 2002 to December 2018, registered under benefit codes 2104129 and 2104153 of the Chilean National Health Fund (Fondo Nacional de Salud, Fonasa, in Spanish), were included. Arthroplasty revisions and bone fracture- or tumor-related surgeries were excluded.

The registries were reviewed in two ways. Procedures performed from 2012 to 2018 were reviewed from the hospital electronic file (TiCares, Telvent Global Services). Procedures performed from 2002 to 2011 were reviewed according to institutional surgical statistics due to the lack of electronic records at that time.

The following registry data were obtained: patients' gender and age at the time of surgery and year of the procedure.

A Spearman correlation analysis was performed to establish whether there was any association between the study period and the number of surgeries, the THA/KA ratio, the average age at the time of surgery, and gender proportion. The level of significance was set at 0.05. Data were analyzed using the Stata (Statacorp, LLC, College Station, TX, US) software, version 11.

## Results

Out of the 3,270 procedures included, 1,975 were THAs (60.4%) and 1,295, KAs (39.6%). A total of 1,099 procedures were performed on men (33.6%), while 2,171 were performed on women (66.4%).

The number of THAs has been increasing over time, with a total of 122 procedures performed in 2002, and 164, in 2018. A rho value of 0.44 was obtained, with no statistical significance ( $p=0.077$ ). The number of KAs has also increased, from 40 in 2002 to 164 in 2018 (► **Figure 1**); this increasing trend presents a Spearman correlation value of 0.94, which is statistically significant ( $p=0.000$ ). The THA/KA ratio decreased remarkably (► **Table 1** and ► **Figure 2**), due to the significantly greater increase in KA compared to THA.

The average age of the patients decreased for KA and increased for THA but with no statistical significance (► **Table 1**). Remarkably, during the last 3 years, the average age of the patients for both procedures stabilized between 66 and 67 years old (► **Figure 3**). For THA, the proportion of patients under 65 years old decreased until 2006 and then it started to increase; however, during the last 5 years, it has remained > 40% (► **Table 2**). In contrast, the number of KA patients under 65 years old increased from 27% in 2002 to 38% in 2018 (► **Table 2**).

The number of female patients undergoing THA and KA exceeded that of male patients throughout the study period. However, the proportion of men in the THA group has been increasing significantly over time (► **Table 1** and ► **Figure 4**).

A total of 1,196 (92%) knee replacements were total knee arthroplasties (TKAs), while 99 were unicompartmental (8%). There was a slight increase in the indication for unicompartmental prostheses during the study, with no statistical significance ( $\rho=0.04$ ;  $p=0.14$ ).

## Discussion

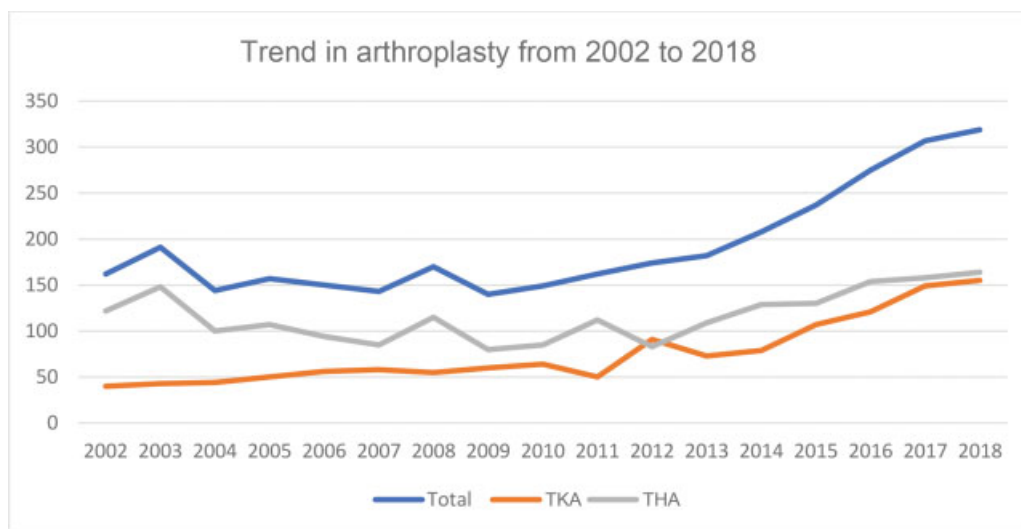
The number of hip arthroplasties (HAs) and KAs is increasing throughout the world, and Chile is no exception. Several

**Table 1** Spearman correlation regarding the total number of arthroplasties, knee arthroplasties (KAs), and hip arthroplasties (THAs) from 2002 to 2018

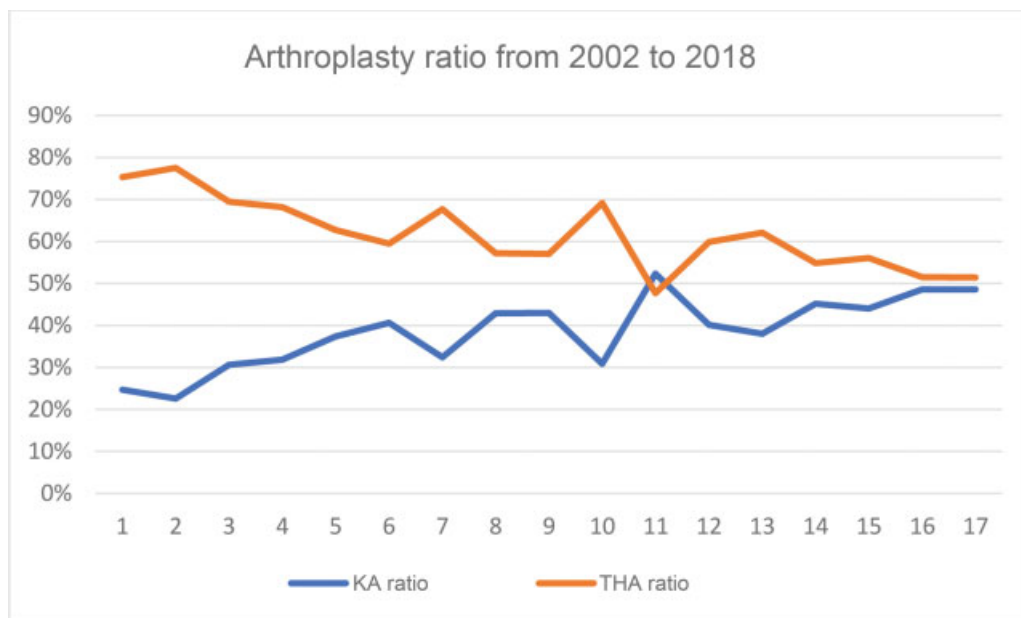
Correlation	2002–2018 (rho)	p-value
Total number of KAs	0.94	0.000*
Total number of THAs	0.44	0.077
Total number of arthroplasties	0.70	0.002*
THA/KA ratio	-0.811	0.002*
Age at KA	-0.43	0.088
Age at THA	0.43	0.084
Number of THAs in patients > 65 years old	0.34	0.187
Number of KAs in patients < 65 years old	0.18	0.488
Ratio of patients aged > 65/ < 65 undergoing THA	0.34	0.188
Ratio of patients aged > 65/ < 65 undergoing KA	-0.32	0.205
Proportion of male patients undergoing KA	-0.04	0.881
Proportion of male patients undergoing THA	0.75	0.001*
Proportion of male patients undergoing arthroplasty	0.79	0.000*

Notes: Rho value obtained using the Spearman correlation method, assuming the probability that the correlation is not zero. The total number of arthroplasties and knee arthroplasties have increased significantly. For total hip arthroplasty, the proportion of males and the average age of the patients have increased significantly from 2002 to 2018. \* $p < 0.05$ , that is, the null hypothesis is rejected, and the correlation is significant.

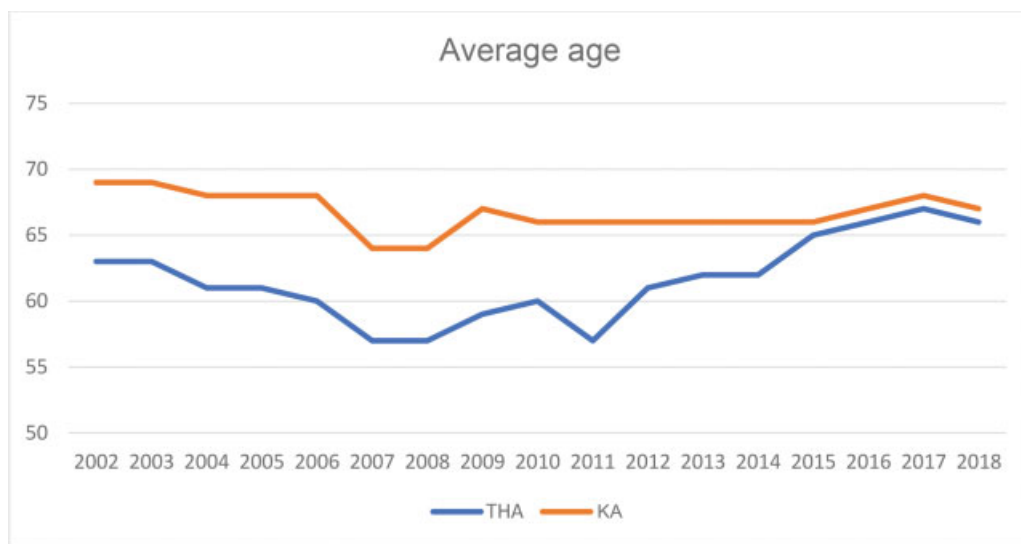
factors influence this fact, including the technological improvement in implant design, the greater number of surgeons trained in these procedures, the better functional



**Fig. 1** Number of arthroplasties from 2002 to 2018. The numbers of total hip arthroplasties (THAs) and total knee arthroplasties (TKAs) have increased over time.



**Fig. 2** Evolution of the knee arthroplasty (KA) and total hip arthroplasty (THA) ratio from 2002 to 2018. This ratio has decreased significantly, mainly due to the greater increase in the number of KA compared to THA procedures.



**Fig. 3** Patient's average age per year of surgery from 2002 to 2018. The average age decreased for knee arthroplasty (KA) and total hip arthroplasty (THA).

outcomes, the lower complication rate, the greater availability of the procedure, and the impact on quality of life.

According to the Australian Orthopaedic Association National Joint Replacement Registry 2017, 24,510 THAs were performed in 2002, and, in 2018, this number grew to 48,802; in addition, 25,547 TKAs were performed in 2002, and 64,600, in 2018.<sup>7</sup> Findings from the 2019 Finnish Arthroplasty Register were similar, with 5 thousand THAs and 6 thousand TKAs reported in 2002, and 9 thousand THAs and 12 thousand TKAs in 2017.<sup>8</sup> Both registries showed a higher increase for TKA compared to THA. Although this phenomenon has not yet occurred in Chile, given that the

trend observed in the country is similar to what happens around the world, it may be observed in the near future.

In 2005, THA for people older than 65 years of age with severe osteoarthritis was included in the GES, increasing the availability of this procedure for the Chilean population. However, as showed here, the current average age of patients is 66 years old, and the percentage of patients requiring THA before the age of 65 remained above 40% from 2014 to 2018; this shows that a significant number of patients who require surgery are not eligible for the GES. This is supported by international registries showing an increase in the number of cases of severe osteoarthritis among people aged 60 to

**Table 2** Proportion of patients under 65 years of age undergoing knee arthroplasty (KA) and total hip arthroplasty (THA) from 2002 to 2018

< 65 years old	THA	KA
2002	65 (53.28%)	11 (27.50%)
2003	93 (62.84%)	12 (27.91%)
2004	60 (60.00%)	17 (38.64%)
2005	67(62.62%)	20 (40.00%)
2006	63(67.02%)	20 (35.71%)
2007	65(76.475%)	32 (55.17%)
2008	90 (78.26%)	33 (60.00%)
2009	59 (73.75%)	25 (41.67%)
2010	62 (72.94%)	28 (43.75%)
2011	94 (83.93%)	22 (44.00%)
2012	63 (75.90%)	40 (43.96%)
2013	77 (70.64%)	40 (54.79%)
2014	77 (59.69%)	37 (46.84%)
2015	70 (53.85%)	45 (42.06%)
2016	70 (45.45%)	58 (47.93%)
2017	64(40.51%)	57 (38.26%)
2018	76 (46.34%)	59 (38.06%)

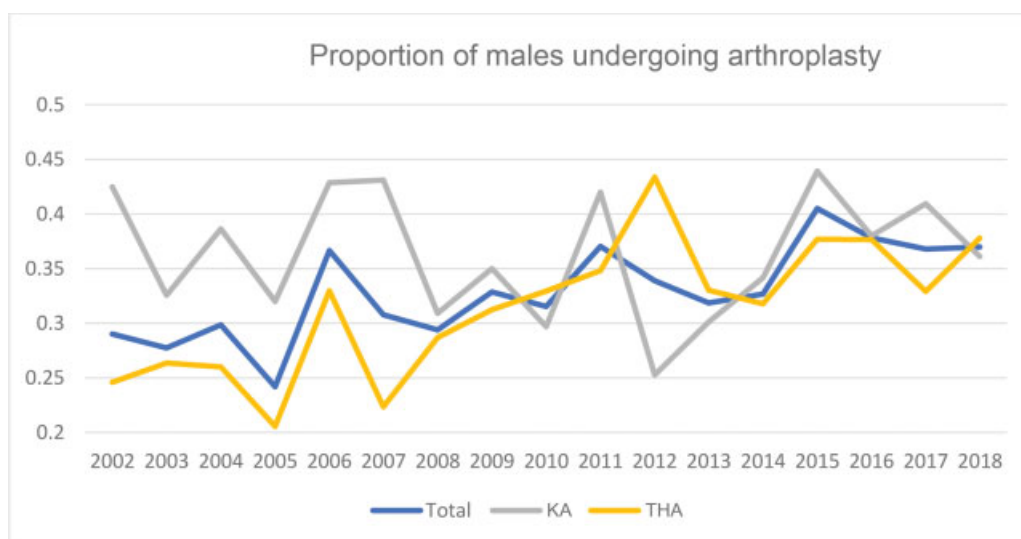
Notes: There was a decrease in the number of patients under 65 years of age undergoing total hip arthroplasty, probably because this procedure was included as an explicit health care guarantee (GES). In contrast, the proportion of patients under 65 years of age undergoing knee arthroplasty has increased.

65 years.<sup>9</sup> As such, we need to review the current impact of the GES law and study the required modifications. The onset of new problems and challenges should not be overlooked, given that the risk of early implant failure in younger age groups is greater<sup>10</sup> both for knee and hip prostheses. The estimated lifetime risk of prosthesis revision in patients under the age of 55 years ranges from 29% to 35%, compared with 15% for those aged 60 years and 5% for those aged 70 years.<sup>11</sup>

The number of patients requiring KA has increased significantly over the past 17 years; one particular factor for this is the low satisfaction of patients with the drug treatment for moderate to severe gonarthrosis.<sup>12</sup> In addition, the impact of gonarthrosis on the quality of life of patients is significant in all dimensions of the 36-Item Short Form Survey (SF-36), except for social function; moreover, this impact is proportional to the severity of the osteoarthritis.<sup>13</sup> This information is very relevant when considering new public policies, since an impact similar to that of the inclusion of THA in the GES in 2006 would be expected in patients with severe gonarthrosis requiring TKA.

In contrast, unicompartmental prostheses are recommended for 8% of the total number of procedures. In the United Kingdom, unicompartmental prostheses account for 8% to 15% of the total;<sup>14</sup> even though the proportion of knee prostheses is within reported ranges, we believe that there is an opportunity to further indicate these devices. This is especially true in patients over 75 years old, since it was demonstrated that selected individuals in this age group present similar functional outcomes and lower complication rates.<sup>15,16</sup>

The Swedish,<sup>17,18</sup> Finnish,<sup>8</sup> and Australian<sup>7</sup> registries show that arthroplasties are more frequent in females



**Fig. 4** Evolution of the proportion of males undergoing arthroplasty. The proportion of male patients has been lower than 50% for knee arthroplasty (KA) and total hip arthroplasty (THA).

compared to males, which is consistent with the present review. Since gender is associated with different postarthroplasty complications, it should be considered by centers and surgeons. While men have a higher risk of mortality, myocardial infarction, and sepsis, women have a higher risk of thromboembolism, urinary infection, and need for transfusion.<sup>19</sup>

Finally, the national registries of patients undergoing arthroplasties are critical to improve procedural outcomes, being of utmost importance for patients and to increase cost-effectiveness. We believe that procedures performed under the GES, such as THA in people over 65 years old, should be followed up by health authorities in the long term to identify centers, implants, and local protocols with better outcomes, and to help centers with inferior results.<sup>20</sup> European registries have evolved substantially during the last 17 years, adding more countries, agreeing on covariates and outcomes, and focusing mainly on the durability of implants and the identification of those with lower reliability.<sup>21</sup> Scientific societies, such as the Chilean Society of Orthopedics and Traumatology (SCHOT) and the Chilean Health Department should work together to develop a national registry based on international experiences to define guidelines for this type of surgery.<sup>22</sup>

The present study has limitations; first, it has a small sample size, which is not enough to extrapolate to the whole country. However, as previously mentioned, the trends observed in international series and records are similar to those observed by us on a national level. On the other hand, our health center has not belonged to the public health network since 1999, therefore, does not directly benefit from state programs, so this sample represents patients who are operated on free demand, which reduces the selection bias. However, it is not possible to calculate rates per thousands of inhabitants, and we cannot know exactly the population at risk, as it would happen if the sample was from a public hospital, where the population to be treated is known.

## Conclusion

From 2002 to 2018, the epidemiological profile of patients undergoing arthroplasty has changed significantly. The average age of patients undergoing THA has been increasing, possibly due to GES access; even so, more than 40% of patients undergo surgery before the age of 65 years.

The number of KAs has increased significantly, reducing its compared with THA. As in the present study, the epidemiology of the studies in the world literature shows a significant increase in patients undergoing KA; therefore, it seems important to include this procedure in new public healthcare policies.

### Note

The present study was approved by the Ethics Committee at Hospital Clínico of Universidad de Chile. All authors agreed with the publication of this manuscript in its current state, and authorized Maximiliano Barahona to

send it to *RCHOT* for review. Moreover, the present study is not being reviewed by another journal and it did not have any external funding.

### Conflict of Interests

The authors have no conflict of interests to declare.

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