

# Knee Arthroplasty Incidence Rate vs. Revision of Knee Arthroplasty and Its Associated Comorbidities in Colombia

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## Abstract

**Introduction:** Total knee arthroplasty (TKA) has been established as a transformative solution in the treatment of advanced degenerative diseases of the knee, such as osteoarthritis, rheumatoid arthritis, and posttraumatic arthritis. In this sense, TKA surgery, which seeks to replace the damaged joint with prosthetic components, has proven to be highly effective in relieving pain, improving joint function, and, ultimately, significantly increasing patients' quality of life. The present study describes the TKA and revision knee arthroplasty (RKA) rates and, identifies the associated co morbidities in the Colombian context. **Methods:** A retrospective cohort study was carried out. It describes demographic and clinical characteristics between two groups of patients, TKA or RKA, and its association with mortality at 30 days, 90 days, or one year after the intervention. **Results:** The incidence rate of the population undergoing TKA was approximately 11.71 cases per 100,000 inhabitants. Furthermore, the incidence rate for revision knee arthroplasty (RKA) procedures in the same period was around 0.96 per 100,000 inhabitants. In both groups at 30 days postoperatively, a total mortality rate of 0.09% was recorded. When the follow-up was extended to 90 days, it increased to 0.15%; at one year postoperatively, it rose to 0.88%. **Conclusion:** Mortality after surgery was low in Colombia in 2019. Although RKA is a beneficial procedure, in certain circumstances, it was noted that it carries a higher risk compared to primary TKA. Our results emphasize the importance of careful evaluation of co morbidities and risk factors in patients undergoing these surgical procedures. The application of quality-of-life questionnaires should be considered in future studies on effectiveness and mortality for TKA and RKA in our country.

## Keywords

Arthroplasty, Co Morbidities, Incidence Rate, Pain, Mortality

## 1. Introduction

Total knee arthroplasty (TKA) has been established as a transformative solution in treating advanced degenerative diseases of the knee, such as osteoarthritis, rheumatoid arthritis, and posttraumatic arthritis [1]. Osteoarthritis is a degenerative joint disease that affects millions of people worldwide, being a significant cause of disability and deterioration in the quality of life [2] [3] because it progressively leads to a loss or decrease in joint function, one that is characterized by mechanical pain frequently associated with stiffness.

In this sense, TKA surgery, which seeks to replace the damaged joint with prosthetic components, has proven to be highly effective in relieving pain, improving joint function, and, ultimately, significantly increasing the quality of life of patients [4].

In the United States, more than 600,000 procedures are made every year, highlighting the increasing prevalence and need for TKA [5]; meanwhile, in regions like Denmark, Norway, and Sweden, the prevalence of TKA has also been on the rise, with specific patterns in the conductivity of these procedures [6].

Within the Latin American context, specifically Colombia, degenerative joint diseases are a considerable public health problem. According to the *Colombian Journal of Orthopedics and Traumatology*, osteoarthritis is estimated to affect more than one million Colombians and increases with age, impacting nearly 40% of individuals over 70 years old [7].

In terms of mortality, several studies have indicated that the mortality rate 30 days after a Total Knee Arthroplasty (TKA) procedure can reach up to 0.2% [8]. However, this mortality rate may vary according to different geographical contexts and population characteristics.

In the United States, a bimodal pattern in survival after a TKA has been identified, where, initially, there is a higher survival rate compared with the general population, but after 15 years, mortality tends to be higher [9].

Despite the advancements and success of TKA, there are situations where implanted prostheses can fail, leading to the need for RKA. These failures can arise because of various factors, including infections, material wear, and loosening [10] [11].

Mobility and autonomy are essential for life quality in all human stages, and joint health is a cornerstone in ensuring it. TKA has emerged as a primary solution for threatening advanced degenerative diseases, providing mobility to thousands of people each year. However, information and studies are scarce, especially in Colombia, addressing the incidence rates of TKA and RKA. Therefore, the present study describes the TKA and RKA rates and identifies the associated co morbidities in the Colombian context.

## 2. Methods

A retrospective cohort study was conducted using administrative data provided by the capitation unit's sufficiency database (UPC) from the integrated social

protection information system (SISPRO) of the Colombian Ministry of Health for 2019.

### 2.1. Eligibility Criteria

Male and female aged 18 years or older who underwent TKA or RKA were included; these patients were identified through the unique classification of health procedures (CUPS) codes within the time range from January 1 to December 31, 2019. The exclusion criteria were patients with rheumatoid arthritis, pregnancy, neurologic or psychiatric disease. The medical records of all deceased cases before January 1, 2021.

### 2.2. Study Variables

The main exposure variable was the type of surgical procedure performed, either TKA or RKA. Demographical characteristics data such as the patient's age, gender, and department of origin were analyzed, identifying coexisting diseases. To identify these characteristics, the Carlson index was used, which provided a weighted classification of co morbidities and determined the severity and potential impact of these coexisting diseases on postoperative outcomes and other relevant study results.

### 2.3. Population

All registered populations were included in the capitation unit's sufficiency database UPC from SISPRO of the Colombian Ministry of Health for 2019.

### 2.4. Statistical Analysis

For the description of quantitative variables, measures of central tendency and dispersion were used according to the distribution behavior.

The quantitative variables were described using frequencies and percentages to explore the relation between arthroplasty exposure versus RKA, calculating the mortality at 30 days, 90 days, and one year.

For the survival study using multivariate analysis with Cox proportional hazards, the risk ratio of the variables of interest was estimated, modeling for variables that could potentially act as predictors of mortality. A p-value < 0.005 was considered for statistical significance. Statistical software STATA 17.0 [12] and R Studio 4.3 [13] were used for data analysis.

## 3. Results

A total of 6631 patients were included. From this number, 5879 (92.42%) underwent a TKA, while 482 (7.57%) had an RKA. In the TKA group, the age of the media was 69 years, with an interquartile range (IQR) from 62 to 75 years, with 28.9% (1699/5879) being men. On the other hand, in the RKA group, the median age was 68.5 years, with an IQR from 62 to 75 years, with 34% (164/482) being men.

**Table 1.** Baseline characteristics of the TKA and RKA groups.

Baseline Characteristics	TKA	KAR	P value
	n = 5.879	n = 482	
Group, age----- no. (%)			
18 - 39 yr.	31 (0.5)	4 (0.8)	0.014
40 - 49 yr.	96 (1.6)	12 (2.5)	0.014
50 - 59 yr.	795 (13.5)	77 (16.0)	0.014
60 - 69 yr.	2236 (38.0)	162 (33.6)	0.014
70 - 79 yr.	2149 (36.6)	162 (33.6)	0.014
≥80 yr.	572 (9.7)	65 (13.5)	0.014
Gender-----no. (%)			
Male	1669(28.9)	164(34.0)	0.020
Coexistent diseases----- no. (%)			
Arterial hypertension	4177 (71.0)	330 (68.5)	0.251
Diabetes mellitus	1184 (20.1)	114 (23.7)	0.075
Connective tissue disorder	437 (7.4)	61 (12.7)	<0.001
Chronic pulmonary disease	398 (6.8)	45 (9.3)	0.042
Myocardial infarction	177 (3.0)	8 (1.7)	0.120
Dementia	92 (1.6)	9 (1.9)	0.748
Cerebrovascular disease	80 (1.4)	13 (2.7)	0.031
Peripheral vascular disease	38 (0.6)	3 (0.6)	<1.000
HIV/AIDS	33 (0.6)	2 (0.4)	0.922
Congestive heart failure	31 (0.5)	3 (0.6)	<1.000
Kidney disease	23 (0.4)	4 (0.8)	0.289
Cancer	21 (0.4)	3 (0.6)	0.598
Liver disease	5 (0.1)	3 (0.6)	0.011
Plegía	1 (0.0)	0 (0.0)	<1.000
Death	91(1.5)	13(2.7)	0.084

Arterial hypertension was the most common co morbidity observed in both the TKA and RKA groups. Specifically, in the TKA group, 4177 out of 5879 patients (71%) had arterial hypertension. In contrast, in the RKA group, 330 out of 482 patients (68.5%) were affected by this condition. Additionally, diabetes mellitus was present in 1184 patients undergoing TKA, accounting for (20.1%) of that group, and in 114 patients undergoing RKA, comprising (23%) of that group. Connective tissue disorders were also notable, occurring in 437 TKA patients (7.4%) and 113 RKA patients (23.7%). These co morbidities and other demographic characteristics of the patients in both groups are detailed in **Table 1.**

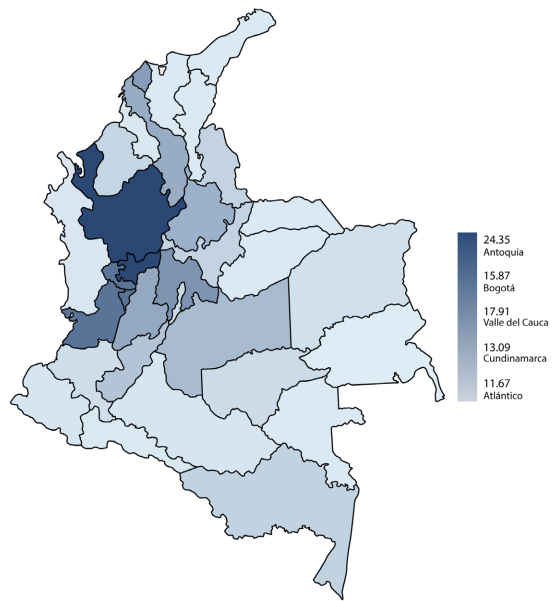
**Table 2.** Adjusted hazard ratio of mortality by year in patients with arthroplasty knee.

Independietn variables Comorbidities	HR (IC 95%)	P value
Gender	1.567e + 00 (1.0452 - 2.350)	0.0297*
Myocardial infarction	6.702e – 01 (0.2091 - 2.149)	0.5008
Congestive heart failure	9.719e – 01 (0.1295 - 7.292)	0.9779
Peripheral vascular disease	1.279e + 00 (0.2903 - 5.636)	0.7450
Cerebrovascular disease	1.527e + 00 (0.4809 - 4.849)	0.4727
Chronic pulmonary disease	1.320e + 00 (0.7161 - 2.433)	0.3737
Connective tissue disorder	1.844e + 00 (0.9732 - 3.496)	0.0606
Liver disease	1.822e – -06 (0.0000 - Inf)	0.9949
Diabetes mellitus	1.763e + 00 (1.1626 - 2.673)	0.0076**
Cancer	8.292e + 00 (2.9095 - 23.634)	7.54e – 05***
Dementia	1.619e + 00 (0.6305 - 4.158)	0.3167
Kidney disease	3.194e + 00(0.7437 - 13.714)	0.1184
HIV/AIDS	1.458e + 00 (0.1978 - 10.743)	0.7115
Arterial hypertension	8.377e – 01 (0.5262 - 1.334)	0.455
Age	1.089e + 00 (1.0623 - 1.117)	2.15e – 11***

A survival analysis adjusted by the cox model was conducted to assess the relationship between various co morbidities and other factors with the risk of mortality. Among the examined covariates, a cancer diagnosis showed a significant increase in the risk of death, with a hazard ratio (HR) of 8.292 (95% CI: 2.9095 - 23.634,  $p < 0.001$ ). Diabetes mellitus was also associated with a higher risk of mortality with an HR of 1.763 (95% CI: 1.1626 - 2.673,  $p = 0.0076$ ). Additionally, being male increased the risk of death, with an HR of 1.567 (95% CI: 1.0452 - 2.350,  $p = 0.0297$ ). Finally, each additional year of age was associated with an 8.9% increase in the risk of death (HR: 1.089, 95% CI: 1.0623 - 1.117,  $p < 0.001$ ). Although other factors were evaluated, they did not show a statistically significant relationship with mortality. The model demonstrated moderate discriminative ability, with a concordance of 0.743, and the likelihood ratio, Wald, and score (log-rank) statistical tests confirmed the adequacy of the model ( $p < 0.001$  for all three tests), as described in **Table 2**.

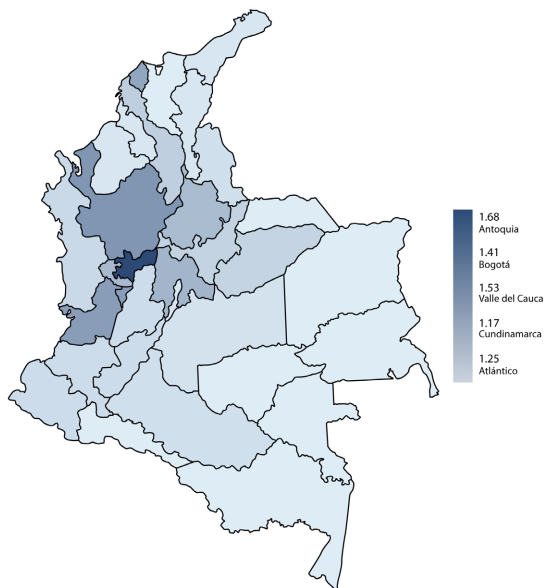
Given that the total population of Colombia in 2019 was 50,187,406 million, the incidence rate for TKA procedures was approximately 11.71 cases per 100,000 inhabitants. Additionally, the incidence rate for RKA procedures in the same period was around 0.96 per 100,000 inhabitants. **Figure 1** displays a visual summary in the form of a heatmap representing the incidence rate of TKA across all departments in Colombia. **Figure 2** presents a similar heatmap representing the incidence rate of RKA in those departments.

Incidencia de ATR (Número de casos por 100mil habitantes)



**Figure 1.** TKA incidence rate (Knee Arthroplasty), number of cases per 100,000 habitants.

Incidencia de RAR (Número de casos por 100mil habitantes)



**Figure 2.** RKA incidence rate (Revision Knee Arthroplasty), number of cases per 100,000 habitants.

Antioquia and Valle del Cauca had the highest incidence rates of TKA, with 24.35 and 17.91 cases per 100,000 inhabitants, respectively. Bogotá D. C. and Cundinamarca showed lower TKA rates of 15.87 and 13.09 cases per 100,000 inhabitants, respectively. Regarding RKA, Antioquia presented the highest rate with 1.68 cases per 100,000 inhabitants, followed by Valle del Cauca with 1.53. Detailed information is given in **Table 3**.

**Table 3.** Incidence rate of knee arthroplasty and revision knee arthroplasty by department.

Departament	Populación	TKA Cases	KAR Cases	Incidence rate* 100,000 Hab TKA	Incidence rate* 100,000 Hab KAR
Antioquia	6,550,206	1595	110	24,35	1,68
Bogotá D. C.	7,592,871	1205	107	15,87	1,41
Valle del Cauca	4,506,768	807	69	17,91	1,53
Cundinamarca	3,085,522	404	36	13,09	1,17
Atlántico	2,638,151	308	33	11,67	1,25

**Table 4.** Mortality rate of arthroplasty knee and revision knee arthroplasty.

Mortality	Total	%	TKA	%	KAR	%
30 days	6	0.09	4	0.07	2	0.41
90 days	10	0.15	6	0.10	4	0.83
1 year	56	0.88	48	0.82	8	1.66

During the postoperative follow-up of patients undergoing TKA and RKA, differences in total mortality were observed at 30 days, 90 days, and one year. At 30 days postoperatively, a mortality rate of 0.09% was recorded. Extending the follow-up to 90 days increased the rate to 0.15%, and at one year postoperatively, it rose to 0.88%.

Patients with TKA at 30 days showed a mortality rate of 0.07%, while those with RKA had a slightly higher rate of 0.41%. Extending the follow-up to 90 days, TKA patients had a mortality rate of 0.10%. On the other hand, the KAR patients recorded a rate of 0.83%. At one year postoperative, the mortality in the TKA group was 0.82%, while in the KAR group, it was 1.66%, as described in the following **Table 4**.

Regarding the distribution of TKA surgeries by departments, Antioquia led with 1595 cases, representing 25%, followed by Bogotá with 1205 cases (19%), and Valle del Cauca in third place with 807 cases (13.7%). As for RKA surgeries, Antioquia also topped the list with 110 cases (1.75%), followed by Bogotá with 107 cases (1.71%), and Valle del Cauca with 69 cases (1.1%).

Regarding patients who underwent TKA, 10 departments in total (Meta, Bogotá D.C., Bolívar, Risaralda, Valle del Cauca, Santander, Cundinamarca, Atlántico, Antioquia, and Caldas) reported cases of mortality after one year of follow-up. Among these, six departments stood out for having the highest number of surgical interventions performed.

At 30 days, Risaralda reported a mortality rate of 0.56% out of 179 patients. At 90 days, Risaralda and Valle del Cauca showed mortality rates of 0.56% and 0.25%, respectively. At the one-year postoperative mark, Valle del Cauca, with 807 evaluated patients, presented a mortality rate of 0.99%. Risaralda, with 179 evaluated patients, presented a mortality rate of 1.12%. The highest mortality rate was observed in Bogotá D.C. with 1.49% out of 1,205 evaluated patients, as described in **Table 5**.

**Table 5.** Mortality rate by department in knee arthroplasty in 30, days 90 days, and one year.

Department	Total	30 days	%	90 days	%	1 year	%
Antioquia	1595	1	0.06	1	0.06	7	0.44
Atlántico	308	0	0	0	0	2	0.65
Bogotá D. C	1205	0	0	0	0	18	1.49
Cundinamarca	404	0	0	0	0	3	0.74
Risaralda	179	1	0.56	1	0.56	2	1.12
Valle del Cauca	807	1	0.12	2	0.25	8	0.99

**Table 6.** Mortality rate by department in revision knee arthroplasty in 30 days, 90 days, and one year.

Department	Total	30 days	%	90 days	%	1 year
Bogotá D. C	107	0	0	1	0.93	3
Caldas	32	0	0	0	0	1
Norte de Santander	4	1	25	1	25	1
Santander	21	0	0	0	0	1
Valle del Cauca	69	1	1.45	2	2.9	2

In Colombia, most departments did not report cases of mortality among patients undergoing RKA. However, cases were recorded in only five departments: Caldas, Bogotá D.C., Valle del Cauca, Santander, and Norte de Santander, where mortality was observed after one year of follow-up.

30 days after the RKA intervention, Norte de Santander presented the highest mortality rate at 25%. At 90 days, Bogotá D.C. registered a mortality rate of 0.93%. Norte de Santander and Valle del Cauca also reported mortalities, with rates of 25% and 2.9%, respectively. Once again, Norte de Santander showed the highest mortality rate, at 25%.

After one-year post intervention, Norte de Santander maintained the highest rate at 25%, followed by Santander at 4.76%. Valle del Cauca and Bogotá D.C. presented similar rates of 2.89% and 2.80%, respectively, while Caldas reported a rate of 3.13%, as shown in **Table 6**.

#### 4. Discussion

In 2019, an analysis of the incidence rate of TKA and RKA in Colombia revealed significant variations across departments. Antioquia and Valle del Cauca registered the highest rates of TKA, suggesting increased demand for or access to these treatments in these regions. Conversely, Cundinamarca and Atlántico had lower rates of TKA. Regarding RKA, Antioquia presented the highest rate, followed by Valle del Cauca. These data reflect regional differences that could be influenced by demographic distribution, the prevalence of diseases requiring such interventions, and the availability of health resources in each department.



The accuracy of these data is reinforced by being based on the 2019 population statistics from the National Administrative Department of Statistics (DANE) for each department in Colombia.

It is vital to underscore the importance of the proper management of comorbidities in the context of TKA and RKA. A study by Bozic *et al.* identified that, although postoperative complications are rare, they have a notable impact on mortality rates [4]. The demographic characteristics of our studied population are consistent with those of patients undergoing these procedures in other countries and we could agree with a low mortality of patients in the short term [14] [15].

Among the comorbidities associated with mortality in our study, we found that cancer and diabetes were the most prevalent. In a study conducted in Denmark, Norway, and Sweden, cardiovascular diseases and diabetes increased the risk of mortality after TKA [6]. It is essential to consider these comorbidities during the preoperative evaluation and postoperative management to minimize the risk of complications and mortality.

Although TKA is generally safe, any surgical procedure carries certain risks, including mortality. In our study, we found a mortality rate of 0.09% at 30 days, 0.15% at 90 days, and 0.88% at one year postoperatively in patients undergoing TKA. These figures are consistent with other studies worldwide. For example, in a study involving 6588 patients in Hong Kong, the mortality rates at 30 days, 90 days, and 1 year after TKA were 0.1%, 0.2%, and 0.7%, respectively [16].

Notably, there were geographical variations in postoperative mortality across different departments in Colombia. Although most departments did not report mortality, for TKA at one year postoperatively, Bogotá D.C. had the highest figures, followed by Risaralda and Valle del Cauca. For RKA, Norte de Santander had the highest at 30, 90 days, and one year. This variability could be attributed to factors such as access to healthcare, quality of surgical care, and differences in population characteristics. These findings highlight the importance of considering temporal and regional variations as well as the need for caution when generalizing data, especially from regions with small sample sizes.

Comparatively, RKA is a more complex procedure than primary TKA and is often associated with a higher risk of complications. In our study, the mortality rate in patients undergoing RKA was higher than in those undergoing primary TKA. These findings align with a study conducted in Brazil, where KAR exhibited higher complication and mortality rates than TKA [17].

However, it is essential to mention that the decision to undergo TKA or RKA should be based on a detailed risk-benefit assessment, here considering the patient's comorbidities and potential to improve postoperative quality of life. A systematic review found that TKA significantly enhanced patients' quality of life compared with the preoperative period [16]. However, it is essential to mention that the decision to undergo TKA or RKA should be based on a detailed risk-benefit assessment, considering the patient's comorbidities and the potential for enhancing postoperative quality of life. Our study lacked sufficient in-

formation such as the application of validated questionnaires for Colombia to evaluate the quality of life of patients in their postoperative state, so, it is necessary to carry out studies that consider key variables such as pain, functionality for self-care activities, social function, emotional performance, among others, to know objectively the real impact of such interventions on the lives of Colombians.

The present study has some limitations. First, because 0.88% and 1.16% of mortality for TKA and RKA, respectively, occurred within one year of the surgical intervention, the analysis of variables associated with mortality was not performed at the previous cut-off points. On the other hand, a lack of reports of incidence and mortality for TKA or RKA in recent years, to report useful trends and comparisons.

## 5. Conclusion

Mortality after surgery was low in Colombia in 2019. Although RKA is a beneficial procedure, in certain circumstances, it was noted that it carries a higher risk compared to primary TKA. Our results emphasize the importance of careful evaluation of co morbidities and risk factors in patients undergoing these surgical procedures. The application of quality-of-life questionnaires in future studies on effectiveness and mortality for TKA and RKA in our country should be considered.

## Ethical Considerations

Given the retrospective nature of the study and the use of administrative data, precautions were taken to ensure the privacy and confidentiality of the participants in accordance with the ethical standards laid down in the Declaration of Helsinki. The study protocol was approved by the research committee of the faculty of medicine of the author's affiliated institution (Act N 632 of December 15, 2023).

## Conflicts of Interest

The authors certify that they have no conflicts of interest regarding this publication.

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