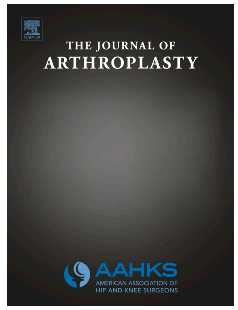

Differences in risk of revision and mortality between total and unicompartmental knee arthroplasty. The influence of hospital volume

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PII: S0883-5403(19)30091-9

DOI: https://doi.org/10.1016/j.arth.2019.01.046

Reference: YARTH 57026

To appear in: *The Journal of Arthroplasty*

Received Date: 29 October 2018

Revised Date: 18 January 2019

Accepted Date: 18 January 2019

Differences in risk of revision and mortality between total and unicompartmental knee arthroplasty. The influence of hospital volume.

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CONDFLICT OF INTERESTS: All authors declare they have no competing interests

ROLE OF FUNDING SOURCE: The present study was funded by CIBERESP as part of the aid for short internships granted to Jorge Arias-de la Torre.

ACKNOWLEDGEMENTS: We acknowledge Kayla Smith and Olga Martinez for their support in performing the study, and CIBER Epidemiology and Public Health (CIBERESP) for its funding

ETHICAL APPROVAL: The present project was be developed in the framework of the Catalan Arthroplasty Register (RACat). Due to the nature of the data used to address the objectives and the belonging of the RACat to the Catalan Health System as a public health registry, it is not necessary an ethical approval. To guaranty the confidentiality of the patients according to the Spanish en European current regulation on data protection, the data are anonymised and continuously supervised by the steering committee of the RACat. This committee is composed by experts both from the orthopaedic surgery services of the different hospitals involved in data collection, as from the Catalan Health Service (CatSalut), the Catalan Society of Orthopaedic Surgery and Traumatology (SCCOT), and the Agency for Health Quality and Assessment of Catalonia (AQuAS).

Differences in risk of revision and mortality between total and unicompartmental knee arthroplasty. The influence of hospital volume.

ABSTRACT

Background: The volume of arthroplasties performed in a hospital by year has an influence on the outcomes of Total Knee Arthroplasty (TKA) and Unicompartmental Knee Arthroplasty (UKA). The aims of this study are: 1) to evaluate and compare the risk of revision and mortality of TKA and UKA; and 2) to assess if hospital volume is related to differences in revision risk and mortality. **Methods**: All individuals recorded in the Catalan Arthroplasty Register between 1/1/2005 and 31/12/2016, diagnosed with osteoarthritis, undergoing cemented TKA and UKA were included. A propensity score matching method was used to obtain comparable cohorts, including 2,374 matched prostheses overall. Hospital volume was considered as a dichotomous variable (lower/higher). Descriptive analyses were done prior to and after matching. Risks of revision and mortality at 30 days, 90 days, 1, 3 and 5 years were calculated and competing risks models and Cox models were fitted. **Results:** For the population as a whole, higher risk of revision (SHR 1.98; 95%CI: 1.25-3.17) was found in UKA than in TKA but higher mortality was not. Considering the volume groups, significantly higher risk of revision in UKA than TKA was found in the lower volume group only (SHR: 1.95; 95%CI: 1.11-3.44). No differences in mortality between TKA and UKA were found in either group. **Conclusions:** Mortality and revision rates after TKA and UKA at higher volume hospitals are similar. UKAs performed at lower volume hospitals have higher revision rates. Volume-dependent specialization thus might help to reduce revision and mortality after surgery.

KEYWORDS: Total Knee Arthroplasty; Unicompartmental Knee Arthroplasty; Risk of revision; Mortality; Register studies.

INTRODUCTION

Decisions on type of implant choice for knee arthroplasty should consider the evidence for all available implant-specific outcomes. Current literature suggests that Unicompartmental Knee Arthroplasty (UKA) may be associated with a higher rate of revision than Total Knee Arthroplasty (TKA), but with similar mortality rates [1–7]. In some studies, these results have been attributed, among other factors, to an imbalance in the characteristics of the population operated on, as well as to the hospital where the surgery was performed.

It is well-established that the decision regarding type of surgery should depend on an extensive evaluation of a patient's characteristics, since populations undergoing TKA, versus those having UKA, are generally not comparable. Patients undergoing UKA usually have fewer comorbidities and are less demanding, in surgical terms, than those having TKA [2,8,9]. These differences in patient characteristics make it challenging to compare surgical outcomes like mortality and the risk of prosthesis revision between TKA and UKA and could lead to biased results and incorrect conclusions since the baseline characteristics of patients undergoing these procedures are dissimilar. To solve this problem, propensity-score matching methods have moved a step forward in comparing populations in observational studies [10,11], which could lead to obtaining comparable patient populations of TKA and UKA, at least in terms of their baseline characteristics, thus allowing more precise comparisons to be made.

Another group of variables with a possible relationship to the risk of revision is hospital characteristics. Taking these characteristics into account, some register-based studies have suggested that the volume of arthroplasties performed in a hospital by year is particularly relevant due to its influence on surgical outcomes [12–16]. This volume could have an influence on the outcomes, depending on the type of surgery the study focused on, and might be especially pertinent in UKA [13,15]. As previously found, hospitals performing a higher volume of UKA by year might have better results in terms of revision, and similar results in terms of mortality compared with those shown in lower volume hospitals. Slightly less of a difference in TKA over UKA has also been shown between higher and lower volume hospitals in risk of revision, with higher rates of revision among lower volume hospitals [12,16]. The volume-related differences in mortality in TKA are unclear, and might be influenced by differences in the populations operated on in lower and higher volume hospitals.

Therefore, in this framework and after obtaining comparable TKA and UKA populations, the aims of the present study are: 1) to evaluate and compare the risk of revision and mortality of matched TKA and UKA cohorts; and 2) to assess if the hospital volume is related to differences in revision and mortality between TKA and UKA.

MATERIAL AND METHODS

Data and study population

For the present study, data from the Catalan Arthroplasty Register (RACat) and the Minimum Basic Dataset at Hospital Discharge (MBDS-HD) were used. The RACat is a population-based arthroplasty registry that has collected information about hip and knee arthroplasty procedures performed in the Catalan region since 2005. The registry includes 51 out of 56 public hospitals performing knee arthroplasty surgery in Catalonia, with a completeness of about 90% for primary arthroplasties and about 70% for revision procedures. The MBDS-HD is a mandatory population-based registry that compiles information about procedures and morbidities for the entire population attended to in Catalan Hospitals. Its dataset includes information about different aspects of the hospitalization process, such as diagnosis and other factors related to patients and surgery like comorbidity, hospital discharge data and hospital admission data.

To develop the proposed objectives, all individuals recorded in the Catalan Arthroplasty Register (RACat) between 1/1/2005 and 31/12/2016, with a primary diagnosis of osteoarthritis, undergoing cemented UKA (n=1,210) or cemented TKA (n=38,032 posterior-cruciate retaining, posterior-cruciate sacrificed and posterior stabilised) were included in the study population. Patients with a diagnosis for the primary procedure other than Osteoarthritis (OA), those with other types of knee arthroplasty, and those whose prosthesis had a cementless, hybrid or inverse hybrid fixation were excluded. After matching, a total of 2,374 patients, 1,187 patients for each type of intervention, remained in the study to perform the comparative analyses between UKA and TKA outcomes in the whole population.

Study variables

Two main outcomes were considered: mortality and risk of revision for any reason. A revision arthroplasty was defined as any procedure involving removal, exchange or addition of any implant part. Additionally, for competing risks models, the death of the patient was considered as a competing risk, i.e. an event that changes the likelihood that the main event occurs.

The main exposure variable considered was the type of arthroplasty (TKA and UKA).

The volume of procedures, defined as a dichotomous variable (higher and lower), was considered as the absolute frequency of a specific type of arthroplasty performed in each hospital for each year of the study period prior to matching. The cut-off point for lower volume was fixed at 10 procedures for UKA and 100 procedures for TKA, based on the lower volume groups for UKA and TKA observed in previous literature [13,15,16], and the population distribution within the volume groups. The same hospital could contribute to a different volume group depending on the year and number of procedures performed.

The following confounders were taken into account for propensity score matching: sex (male and female), age (in years, defined as a continuous variable), number of comorbidities from the Elixhauser index, year of intervention (categorized: 2005-2006, 2007-2008, 2009-2010, 2011-2012 and 2013-2016), type of hospital (high technology, reference, regional and other type or not specified), type of admission (Emergency, scheduled and other types) and healthcare region (Barcelona, Girona, Catalunya Central, Camp de Tarragona, Lleida, Terres de l'Ebre, Alt Pirineu i Aran and other healthcare region or not specified).

Data analysis

Descriptive analyses of the population's characteristics were done. A matching method based on propensity score was used to obtain comparable populations from the main exposure. The score was calculated considering arthroplasty type (UKA or TKA) as the exposure variable, and including the following confounders: sex, age, number of comorbidities (Elixhauser), year of the primary intervention (continuous), type of hospital, type of admission and healthcare region. Matching between UKA and TKA was 1:1 without replacement, and included 2,374 matched prostheses overall (1,187 of each type). Differences in UKA and TKA populations at the bivariable level were assessed before and after matching using Chi-square tests and Mann-Whitney U tests for age, due to its non-normal distribution. Mortality and risk of revision rates at 30 days, 90 days and 1, 3 and 5 years were obtained using the Kaplan-Meier method, and Cox regression models were fitted to assess differences in mortality between TKA and UKA. Incidence of revision was calculated taking the competing risk of death into account. The risk of revision was estimated by summing up to t *S(t-1) * h'(t)*, where S(t-1) is the Kaplan-Meier estimate of the overall survival function and h'(t) is the cause-specific hazard at the time t. In addition, to evaluate differences in the risk of revision, Competing Risks models considering death as the competing event were implemented. From these models, hazard ratios (HR) for mortality, sub-hazard ratios (SHR) for revision and their 95% Confidence Interval (95%CI) were obtained. To account for the possible effect of infection as the cause of revision, all competing risks models were adjusted for the cause of revision. Additionally, to assess the influence of hospital volume on the risk of revision, all analyses were stratified by volume group. The stratified matched samples included 1,472 patients in the higher volume group (736 UKA and TKA) and 632 in the lower volume group (316 UKA and TKA). Statistical significance of the study variables was evaluated using a Likelihood Ratio test for Cox models and a Wald test for Competing Risks models. The significance level was fixed at α=0.05 and all analyses were carried out using the statistical software Stata v.14 [17].

RESULTS

Comparison of patient characteristics

Table 1 shows the characteristics of the study population before and after matching. Statistically significant ($p<0.001$) differences between the UKA and the TKA populations in all study variables were found, except in circumstances of hospital admission. After matching, none of these differences remained statistically significant. When taking patient characteristics into account by volume groups (Table 2), prior to matching, statistically significant differences in all study variables were found, except in the type of hospital admission and, in the lower volume group, in the year of the primary intervention and in median follow-up. None of these differences remained significant in any group after matching. After matching, 18 hospitals' patients contributed to the higher volume group for TKA and 4 for UKA; and in the lower volume group the contribution was 42 for TKA and 29 for UKA.

Risk of revision, mortality and the influence of hospital volume

Table 3 shows that the risk of revision for TKA was 0.1% at 30 days, 0.3% at 90 days, 0.4% at 1 year, 2.9% at 3 years and 4.2% at 5 years, while for UKA, no revision was performed at 30 days follow-up, and it was 0.1% at 90 days, 1.3% at 1 year, 5.5% at 3 years, and 6.6% at 5 years . The mortality for TKA was <0.1% at 30 days, 0.1% at 90 days, 0.5% at 1 year, 3.0% at 3 years and 4.1% at 5 years, while for UKA it was <0.1% at 30 days, 0.2% at 90 days, 0.3% at 1 year, 2.3% at 3 years and 3.0% at 5 years, as shown in Figure 1. Additionally, Table 3 shows a significant adjusted revision risk of SHR of 1.98 (95% CI: 1.25-3.17) for UKA compared to TKA (the reference category) in a Competing Risks model, and a non-significant adjusted HR of 0.74 (95% CI: 0.46-1.21) for mortality in a Cox model.

Table 4 shows the risk of revision (Figure 2) and mortality rates (Figure 3) for higher volume and lower volume hospitals. Higher volume hospitals performing TKA had a higher, but not statistically significant, risk of revision than UKA (SHR: 1.36; 95% CI: 0.57-3.21), while in lower volume hospitals, UKA had a higher, statistically significant, risk of revision than TKA (SHR: 1.95; 95% CI: 1.11-3.44). Non-statistically significant differences were found in mortality between UKA and TKA, independent of hospital volume (HR higher volume: 0.83, 95% CI: 0.43-1.60; HR lower volume: 0.49, 95% CI: 0.21-1.15), with lower rates among UKA than among TKA, particularly in the lower volume group.

DISCUSSION

Our study shows that UKA has a higher risk of revision when compared to TKA. However, when the annual volume of UKA and TKA procedures performed in a specific hospital is taken into account, this difference is not seen. While hospitals conducting a higher volume of UKA have reduced their revision rate to that commensurate with or even lower than TKA levels, hospitals conducting a lower volume of UKA have a clearly increased revision rate over hospitals conducting a low volume of TKA. Additionally, our study shows that these volume-related differences do not exist in terms of mortality since the rates in UKA are lower but not significant like in TKA.

Regarding the risk of revision, after discarding differences in baseline characteristics of the UKA and TKA populations and the stratification done, it is reasonable to attribute the differences found to the volume of the hospital where the arthroplasty was performed. In this sense, it should be emphasized that, after obtaining comparable populations, a higher risk of revision was found in UKA over TKA for the entire population and especially in the lower volume group, since the risk of revision in UKA was more than 2.5 times higher than in TKA. Moreover, in the higher volume group, a lower but statistically non-significant risk of revision was found for UKA compared to TKA. These results support, for the entire population, those obtained from one previous study in which the risk of revision in UKA was higher than in TKA [7], and are comparable to the evidence obtained by other studies that focused on UKA only [13,15,18]. These studies show that lower volume hospitals had worse results when compared to higher volume hospitals. Taking into account the mortality, no statistically significant differences between TKA and UKA were found in the population as a whole or when the analyses were stratified by volume group. Nevertheless, despite that the differences found were non-significant, we should highlight that the mortality rates were lower for UKA than for TKA in all groups studied. These results show new evidence supporting the hypothesis pointed out by previous research about the similarity in results in terms of mortality between UKA and TKA [1,8,10]. Thus, to carry out studies with larger sample sizes, longer follow-up times and taking hospital volume into account, might be adequate to confirm the abovementioned hypothesis. Finally, though there are outcomes that were not considered in our research, previous studies have shown lower rates of complications and readmission and better results in terms of Patient Related Outcome Measures (PROMs) in UKA than TKA [1,8,9,19]. These studies have also shown that UKA could be a cost-effective option, additionally suggesting that these outcomes might be better in higher volume hospitals than in lower volume hospitals. Therefore, all proposed evidence suggests TKA might be a suitable decision for patients undergoing knee arthroplasty, both in higher and lower volume hospitals, while UKA is appropriate only in higher volume hospitals. Furthermore, due to the evidence-based consequences that implanting UKA in lower volume performing hospitals might have, from the results in our context, it might be pertinent to limit UKA procedures to hospitals that can guarantee that a higher volume of this type of procedure is performed.

There are some limitations in this study that need to be discussed. First, limitations related to the number of volume groups and the differences in the number of contributing hospitals. In our context, only four hospitals were included in the UKA higher volume hospital group when the cut-off point was fixed at 10 procedures per year. However, despite this limitation, we can assume that higher volume hospitals performing TKA and UKA are highly specialized in this these types of procedures and therefore can be considered as suitable candidates for comparison. Besides, crossover between hospital volume groups was not taken into account. Nevertheless, as observed in hospitals participating in the

RACat [5], this change of volume group was, in most cases, an increasing or decreasing trend of hospital activity. In terms of the limitations related to the study variables, the indication for surgery was unknown and could be different between TKA and UKA. Furthermore, surgeon related variables, like differences in surgeons' expertise by volume group, were not taken into account. Despite this, given that reporting this data to the RACat has been mandatory since 2017, we expect to be able to take these aspects into account in the upcoming years. In addition, we should emphasize the limitation related to including all implant sub-types. Though some registers and studies show differences between sub-types, these differences are unclear [3–5,20,21]. Besides, including all models together could be advantageous when establishing conclusions at the population level. Finally, we want to stress that the completeness of the information, particularly in revision arthroplasties, is not perfect, but we expect an improvement in these rates in the upcoming years since hospital participation in the registry is now mandatory. Moreover, it might be advantageous to explore the influence of the volume of procedures by hospital with longer follow-up times, as well as with other outcomes like complications, readmissions or PROMs [1,19]. Future research considering long-term results, other outcomes and volume-dependent specialization might be useful in reducing the burden of morbidity and revision of knee arthroplasties and improving patient-specific decision-making.

CONCLUSIONS

After overcoming the possible bias related to differences in patients' characteristics, our results show that in Catalonia there are currently differences in the risk of revision between UKA and TKA, but not in mortality. The evidence presented in this article shows that the seemingly poorer results in terms of risk of revision of UKA when compared to TKA, are closely related to the volume of UKA procedures performed in a specific hospital.

Therefore, to improve results in terms of revisions, we suggest performing TKA in both higher and lower volume hospitals, while UKA should be done only in hospitals performing a higher annual volume of this type of procedure.

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Table 1. Characteristics of the whole study sample before and after matching

	Crude sample			Matched sample		
	TKA	**UKA**	***p* value**	**TKA**	**UKA**	***p* value**
Number of patients	38,032	1,210		1,187	1,187	
Number of hospitals	49	31		45	31	
Median follow-up (IQR)	4.6 (4.9)	3.1 (4.0)	<0.001	3.3 (4.1)	3.1 (4.0)	0.326
Median age in years (IQR)	73.4 (10.1)	67.7 (12.4)	<0.001	68.5 (10.9)	67.9 (12.2)	0.515
Median number of comorbidities (min-max)*	1 (0-7)	1 (0-5)	<0.001	1 (0-5)	1 (0-5)	0.555
Sex (male)	10,526 (27.7%)	478 (39.5%)	<0.001	454 (38.3)	460 (38.8%)	0.800
Year of the primary surgery			<0.001			0.922
2005-2007	5,114 (13.5%)	77 (6.4%)		84 (7.1%)	77 (6.5%)	
2008-2009	6,030 (15.9%)	143 (11.8%)		131 (11.0%)	141 (11.9%)	
2010-2011	8,175 (21.5%)	169 (14.0%)		175 (14.7%)	169 (14.2%)	
2012-2013	7,723 (20.3%)	283 (23.4%)		285 (24.0%)	279 (23.5%)	
2005-2010	10,990 (28.9%)	538 (44.5%)		512 (43.1%)	521 (43.9%)	
Circumstances of hospital admission			0.488			-
Emergency	44 (0.1%)	-		-	-	
Scheduled	37,987 (99.9%)	1,210 (100%)		1,187 (100%)	1,187 (100%)	
Other types	1 (<0.1%)	-		-	-	
Type of hospital			<0.001			0.968
High technology	15,551 (40.9%)	834 (68.9%)		816 (68.7%)	811 (68.3%)	
Reference hospital	14,578 (38.3%)	207 (17.1%)		206 (17.4%)	207 (17.4%)	
Regional hospital	7,794 (20.5%)	169 (14.0%)		165 (13.9%)	169 (14.2%)	
Other type or not specified	109 (0.29%)	-		-	-	
Healthcare region			<0.001			0.522
Barcelona	23,657 (62.2%)	1,022 (84.5%)		1,021 (86.0%)	1,001 (84.3%)	
Girona	5,728 (15.1%)	51 (4.2%)		45 (3.8%)	51 (4.3%)	
Catalunya Central	3,287 (8.6%)	68 (5.6%)		70 (5.9%)	68 (5.7%)	
Camp de Tarragona	2,881 (7.6%)	48 4.0%)		35 (3.0%)	47 (4.0%)	
Lleida	1,098 (2.9%)	-		-	-	
Terres de l'Ebre	744 (2.0%)	5 (0.4%)		7 (0.6%)	5 (0.4%)	
Alt Pirineu i Aran	521 (1.4%)	15 (1.2%)		9 (0.8%)	15 (1.3%)	
Other region or not specified	116 (0.3%)	1 (0.1%)		-	-	

TKA: Total Knee Arthroplasty; UKA: Unicompartmental Knee Arthroplasty; p value: from Chi-square test and Mann-Whitney U test; IQR: Interquartile Range; Min-max: minimum-maximum; * Comorbidities from those included in the Elixhauser Index.

Table 2. Characteristics of the study sample stratified by type of surgery and volume groups after matching

	Higher volume crude sample			Higher volume matched sample			Lower volume crude sample			Lower volume matched sample		
	TKA	**UKA**	***p* value**	**TKA**	**UKA**	***p* value**	**TKA**	**UKA**	***p* value**	**TKA**	**UKA**	***p* value**
Number of patients	23,790	846		736	736		14,242	364		316	316	
Number of hospitals	30	4		18	4		47	31		42	29	
Median follow-up (IQR)	4.3 (4.8)	2.7 (2.8)	<0.001	3.1 (2.7)	3.2 (2.7)	0.428	5.3 (5.0)	5.1 (5.3)	0.336	5.2 (4.8)	5.2 (4.3)	0.976
Median age in years (IQR)	73.4 (10.2)	69.6 (11.5)	<0.001	70.8 (10.0)	70.3 (10.6)	0.327	73.4 (10.0)	63.0 (10.6)	<0.001	65.0 (12.2)	64.5 (10.3)	0.515
Median number of comorbidities (min-max)*	1 (0-7)	1 (0-5)	<0.001	1 (0-4)	1 (0-5)	0.450	1 (0-6)	1 (0-4)	<0.001	1 (0-4)	1 (0-4)	0.548
Sex (male)	6,552 (27.5%)	339 (40.1%)	<0.001	259 (35.2%)	279 (37.9%)	0.279	3,974 (27.9%)	139 (38.2%)	<0.001	127 (40.2%)	110 (34.8%)	0.162
Year of the primary surgery			<0.001			0.520			0.066			0.535
2005-2007	2,750 (11.6%)	15 (1.8%)		14 (1.9%)	15 (2.0%)		2,364 (16.6%)	62 (17.0%)		41 (13.0%)	54 (17.1%)	
2008-2009	3,476 (14.6%)	66 (7.8%)		56 (7.6%)	63 (8.6%)		2,554 (17.9%)	77 (21.2%)		69 (21.8%)	71 (22.5%)	
2010-2011	5,040 (21.2%)	98 (11.6%)		92 (12.5%)	73 (9.9%)		3,135 (22.0%)	71 (19.5%)		61 (16.3%)	63 (19.9%)	
2012-2013	4,910 (20.6%)	198 (23.4%)		160 (21.7%)	174 (23.6%)		2,813 (19.8%)	85 (23.4%)		75 (23.7%)	70 (22.2%)	
2014-2016	7,614 (32.0%)	469 (55.4%)		414 (56.3%)	411 (55.8%)		3,376 (23.7%)	69 (19.0%)		70 (22.2%)	58 (18.4%)	
Circumstances of hospital admission			0.411			-			0.717			-
Emergency	19 (0.1%)	-		-	-		25 (0.2%)	-		-	-	
Scheduled	23,771 (99.9%)	846 (100%)		736 (100%)	736 (100%)		14,216 (99.8%)	364 (100%)		316 (100%)	316 (100%)	
Other types	-	-		-	-		1 (<0.1%)	-		-	-	
Type of hospital			<0.001			0.940			<0.001			0.820
High technology	6,432 (27.9%)	731 (86.4)		618 (84.0%)	621 (84.4%)		9,119 (64.0%)	103 (28.3%)		94 (29.8%)	101 (32.0%)	
Reference hospital	10,026 (42.1%)	13 (1.5%)		12 (1.6%)	13 (1.8%)		4,552 (32.0%)	194 (53.3%)		171 (54.1%)	164 (51.9%)	
Regional hospital	7,226 (30.4%)	102 (12.1%)		106 (14.4%)	102 (13.9%)		568 (4.0%)	67 (18.4%)		51 (16.1%)	51 (16.1%)	
Other type or not specified	106 (0.5%)	-					3 (<0.1%)	-		-	-	
Healthcare region			<0.001			0.519			<0.001			0.329
Barcelona	17,424 (73.2%)	815 (96.3%)		715 (97.2%)	706 (95.9%)		6,233 (43.8%)	207 (56.9%)		146 (46.2%)	169 (53.5%)	
Girona	281 (1.2%)	1 (0.1%)		1 (0.1%)	1 (0.1%)		463 (3.3%)	4 (1.1%)		9 (2.9%)	4 (1.3%)	
Catalunya Central	701 (3.0%)	1 (0.1%)		-	1 (0.1%)		2,180 (15.3)	47 (12.9)		46 (14.6%)	42 (13.3%)	
Camp de Tarragona	1,512 (6.4%)	19 (2.3%)		16 (2.2%)	19 (2.3%)		1,775 (12.5%)	49 (13.5%)		48 (15.2%)	45 (14.2)	
Lleida	700 (2.9%)	-		-	-		398 (2.8%)	.		12 (3.8%)	14 (4.4%)	
Terres de l'Ebre	3,067 (12.9%)	9 (1.1%)		4 (0.5%)	9 (1.2%)		2,661 (18.7%)	42 (11.5%)		55 (17.4%)	42 (13.3%)	
Alt Pirineu i Aran	30 (0.1%	-		-	-		491 (3.5%)	15 (4.1%)		12 (3.8%)	14 (4.4%)	
Other region or not specified	75 (0.3%)	1 (0.1%)		-	-		41 (0.3%)	.		.	.	

TKA: Total Knee Arthroplasty; UKA: Unicompartmental Knee Arthroplasty

***p* value: from Chi-square test and Mann-Whitney U test; IQR: Interquartile Range; Min-max: minimum-maximum; * Comorbidities from those included in the Elixhauser Index.**

Table 3: Risk of revision and mortality from all causes, using Kaplan-Meier (entire population after matching)

	TKA				UKA				
	n	**Fail**	**%**	**95% CI**	**n**	**Fail**	**%**	**95% CI**	**SHR/HR (95% CI)**
Risk of revision									**1.98 (1.25-3.17)**
30 days	1182	1	0.08	0.01-0.47	1185	0	NC	NC	
90 days	1151	2	0.25	0.07-0.71	1158	1	0.09	0.01-0.47	
1 year	1024	1	0.35	0.12-0.85	1010	13	1.28	0.74-2.09	
3 years	636	22	2.86	1.91-4.11	604	37	5.48	4.13-7.09	
5 years	354	7	4.08	2.83-5.57	337	6	6.54	4.99-8.36	
Mortality									**0.74 (0.46-1.21)**
30 days	1182	0	NC	NC	1185	1	0.08	0.01-0.60	
90 days	1151	1	0.09	0.01-0.60	1158	1	0.17	0.04-0.68	
1 year	1024	4	0.45	0.19-1.09	1010	1	0.26	0.08-0.79	
3 years	636	21	3.00	2.04-4.41	604	16	2.27	1.44-3.57	
5 years	354	6	4.14	2.90-5.89	337	4	2.98	1.97-4.50	

TKA: Total Knee Arthroplasty; UKA: Unicompartmental Knee Arthroplasty
n: number of primary procedures at risk remaining at the cut-off point; Fail: number of events (revision/dead); % cumulative risk of revision/mortality; 95% CI: 95% Confidence Interval; SHR/HR: Sub Hazard ratio for risk of revision from competing risks models/ Hazard ratio for mortality from Cox models.
NC: Not Calculable.

Table 4: Risk of revision and mortality TKA vs UKA stratified by volume groups (after matching)

	TKA				UKA				
	n	**Fail**	**%**	**95% CI**	**n**	**Fail**	**%**	**95% CI**	**SHR/HR (95% CI)**
Risk of revision									
Higher Volume									**1.36 (0.57-3.21)**
30 days	733	1	0.13	0.01-0.74	736	0	NC	NC	
90 days	707	2	0.41	0.12-1.14	716	1	0.14	0.01-0.75	
1 year	605	7	1.47	0.76-2.62	606	5	0.88	0.37-1.83	
3 years	304	9	3.42	2.10-5.22	306	8	2.50	1.41-4.09	
5 years	139	8	6.35	4.15-9.17	136	1	2.96	1.65-4.88	
Lower volume									**1.95 (1.11-3.44)**
30 days	314	0	NC	NC	314	0	NC	NC	
90 days	305	0	NC	NC	309	0	NC	NC	
1 year	286	0	NC	NC	282	7	2.39	1.06-4.65	
3 years	235	8	3.07	1.44-5.70	225	22	10.54	7.26-14.51	
5 years	153	4	4.86	2.64-8.07	159	4	12.19	8.62-16.42	
Mortality									
Higher Volume									**0.83 (0.43-1.60)**
30 days	733	0	NC	NC	736	0	NC	NC	
90 days	707	0	NC	NC	716	1	0.14	0.02-0.97	
1 year	605	4	0.62	0.23-1.64	606	1	0.28	0.07-1.11	
3 years	304	9	2.56	1.47-4.43	306	9	2.09	1.15-3.78	
5 years	139	4	4.09	2.47-6.73	136	3	3.21	1.85-5.53	
Lower volume									**0.49 (0.21-1.15)**
30 days	314	0	NC	NC	314	1	0.32	0.04-2.23	
90 days	305	0	NC	NC	309	0	0.32	0.04-2.23	
1 year	286	2	0.67	0.17-2.67	282	0	0.32	0.04-2.23	
3 years	235	2	1.41	0.53-2.71	225	4	2.04	0.85-4.86	
5 years	153	5	3.97	2.05-7.59	159	1	2.48	1.12-5.46	

TKA: Total Knee Arthroplasty; UKA: Unicompartmental Knee Arthroplasty
n: number of primary procedures at risk remaining at the cut-off point; Fail: number of events (revision/dead); % cumulative risk of revision/mortality; 95% CI: 95% Confidence Interval; SHR/HR: Sub Hazard ratio for risk of revision from competing risks models/ Hazard ratio for mortality from Cox models
NC: Not Calculable.

Figure 1: Risk of revision and mortality of TKA and UKA (whole population)

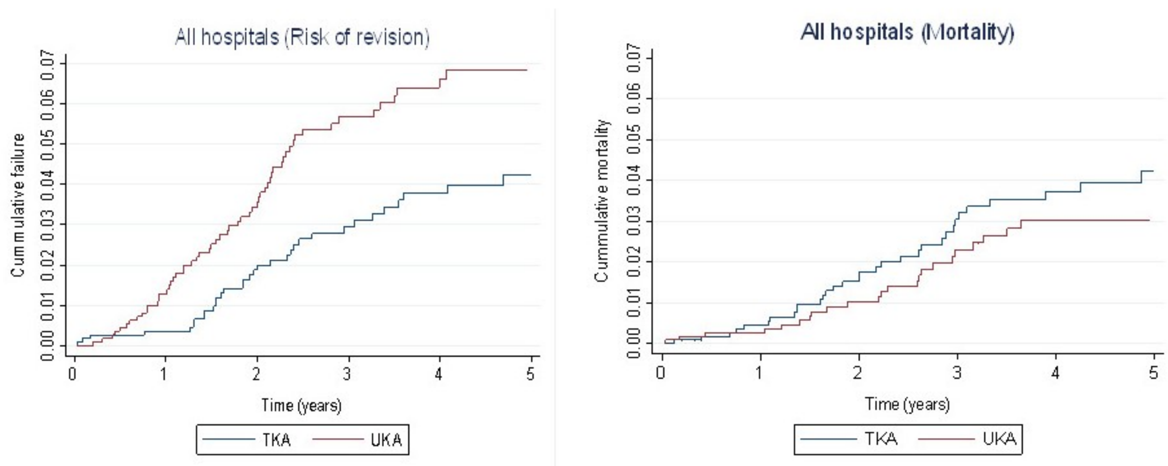

Figure 2: Risk of revision of TKA and UKA stratified by volume group

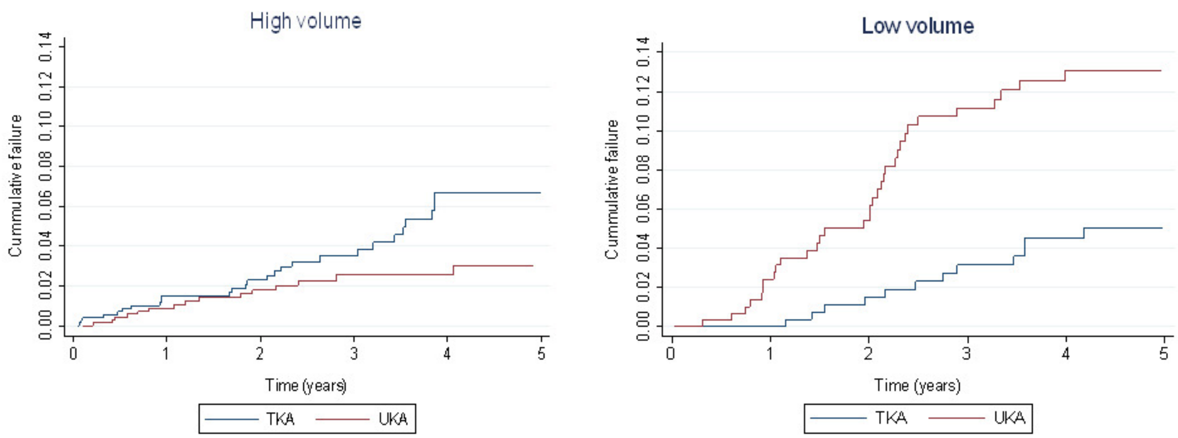

Figure 3: Mortality of TKA and UKA stratified by volume group