How Do Mortality Rates Following Total Knee Arthroplasty Vary Worldwide? A Meta-Analysis of 6,051,261 Patients From 17 Countries

Xuankang (kong) Pan, Oguz Alp Turan, Pedro Javier Rullan, Hannah Simmons, Ahmed Emara, John McLaughlin, Trevor G Murray, Nicolas Santiago Piuzzi

INTRODUCTION:

Long-term survival of patients who undergo total knee arthroplasty (TKA) has not been compared for patients worldwide. Therefore, the present meta-analysis aimed to: 1) examine international short- (i.e. 30- and 90-days, and 1-year) and long-term (i.e. 5- and 10-year) mortality rates after TKA; and 2) compare mortality rates by country.

METHODS:

The PubMed, MEDLINE, Cochrane, EBSCO host, and Google Scholar databases were queried from January 2011 through October 2021 for all studies reporting all-cause mortality following primary, unilateral TKA. Only full text, English-language manuscripts were eligible. We excluded studies that: 1) reported in-patient mortality only; 2) observed no mortality events; 3) had fewer than 90 patients; 4) and included non-elective TKA patients. A meta-analysis of proportions was conducted to ascertain pooled mortality rates (95% confidence interval [CI]). Due to the inherent heterogeneity of aggregate international data and the infrequent occurrence of mortality, a random-effect model with an inverse variance method and DerSimonian-Laird estimator for τ^2 with meta-regression was employed. Meta-regression was conducted to account for the effect of country, average patient age, median date of study data, and patient gender ratios, with a level of significance maintained at P-value <0.05.

RESULTS:

Forty-four studies reporting on a total of 6,051,261 TKA patients, from 5 continents and 17 countries, were included in the meta-analysis. The overall pooled 30-day mortality was 0.14% (95% CI [0.05%-0.22%]; n=1,817,647). Meta-regression demonstrated that country was a confounding factor for 30-day mortality (p<0.0001). On average, Chile (0.05%) Holland (0.08%), Hong Kong (0.10%), and Colombia (0.14%) had the lowest 30-day mortality rates, while Australia (1.44%) and Denmark (0.26%) had the highest 30-day mortality rates among the included studies. USA (0.15%) had a similar 30-day mortality rate compared to the overall pooled 30-day mortality rate (**Table 1)**. The overall pooled 1-year mortality rate was 1.10% (95% CI [0.71%-1.49%]; n=1,178,698). Meta-regression demonstrated that country was a confounding factor for 1-year mortality (p<0.05; **Table 2).** Holland (0.52%), Japan (0.62%), Chile (0.64%), Hong Kong (0.73%), USA (0.77%), UK (0.82%), Spain (0.90%), Canada (0.91%), and New Zealand (0.95%) had lower 1-year mortality rates compared to the overall pooled 1-year mortality rate. Australia (2.02%) and Taiwan (2.90%) had higher 1-year mortality rates on average. The pooled 90-day, 5-year, and 10-year mortality rate was 0.35% (95% CI [0.28%-0.43%]; n=1,641,974), 5.4% (95% CI [4.35%-6.42%]; n=597,041), and 10.2% (95% CI [7.78%-12.64%]; n=815,901), respectively. However, meta-regression demonstrated that country was not a confounding factor for mortality rates at these time points (p>0.05).

DISCUSSION AND CONCLUSION:

Short-term mortality rates after TKA are low worldwide. Notable differences in 30-day and 1-year mortality rates for TKA patients were observed for various countries around the world. This may be due to inherent variability in all-cause mortality, comorbidity burden, behavioral and socioeconomic factors, as well as, the quality and access to healthcare among the countries of the included studies. We would expect these factors may a have potentially greater effect on the variability for even longer periods of observation. However, we did not observe any differences in long-term (5- and 10-years after TKA) mortality among the countries of the included studies. Future studies analyzing mortality rates for TKA worldwide, should account for more granular geographical and regional specific factors.

Table 1. Average 30-day mortality rates following TKA by country

Country	Number of patients	30-day mortality rate	P-Value
Chile	1733	0.05	**<0.0001**
Holland	108687	0.08	**<0.0001**
Hong Kong	6588	0.10	**<0.0001**
Colombia	12453	0.11	**<0.0001**
pooled results	1817647	0.14	
USA	839977	0.15	**<0.0001**
China	1542	0.16	**<0.0001**
New Zealand	44606	0.19	**<0.0001**
UK	733220	0.19	**<0.0001**
Denmark	32754	0.26	**<0.0001**
Australia	36087	1.44	**<0.0001**

Results from meta-regression adjusting for the study country of origin.
Green shade: Mortality rates lower than the pooled 30-day mortality rate
Red shade: Mortality rates higher than the pooled 30-day mortality rate

Table 2. Average one-year mortality rates following TKA by country

Country	Number of patients	1-year mortality rate	P-Value
Holland	108687	0.52	**<0.0001**
Japan	326	0.62	**0.00434**
Chile	1733	0.64	**<0.0001**
Hong Kong	6588	0.73	**<0.0001**
USA	428900	0.77	**<0.0001**
UK	472417	0.82	**0.00003**
Spain	1569	0.90	**0.00065**
Canada	17243	0.91	**<0.0001**
New Zealand	30341	0.95	**<0.0001**
pooled results		1.10	
Finland	435	1.39	0.30274
Australia	18972	2.02	**<0.0001**
Taiwan	91487	2.90	**0.00019**

Results from meta-regression adjusting for the study country of origin.
Green shade: Mortality rates lower than the pooled 1-year mortality rate
Red shade: Mortality rates higher than the pooled 1-year mortality rate