

REVIEW OF TOTAL KNEE ARTHROPLASTY AND THE BRAZILIAN UNIFIED HEALTH SYSTEM: A NATIONAL PROBLEM

REVISÃO DE ARTROPLASTIA TOTAL DE JOELHO E O SISTEMA ÚNICO DE SAÚDE: UM PROBLEMA NACIONAL

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ABSTRACT

Objectives: To analyze, through DATASUS data, the historical trend of revision of total knee arthroplasty (TKA) in the period between 2008-2016 and to relate them to demographic, regional and national aspects. **Methods:** Elaboration of a historical series between the period 2008-2016, using the database of DATASUS, in the area of Health Information (TABNET). In order to calculate the incidence, the total number of TKA revisions and as denominator the total national, regional or state population for the period studied was used as numerator. **Results:** The national rate of procedures per 100,000 inhabitants varied between 0.41 and 0.48 in the analyzed period (mean of 0.44). The Southeast region, with 69% of the SBCJ accredited services and 61% of the SBCJ members, was responsible for 60% of the absolute number of procedures performed in Brazil. **Conclusions:** In absolute numbers, the Southeast region has the highest volume of procedures. However, the highest rate is found in the South region. The North, Northeast and Central-West regions presented unsatisfactory results, well below the others. **Level of evidence IV, Economic and decision analysis - development of economic model or decision.**

Keywords: Reviews. Arthroplasty. Knee. Public Health. Osteoarthritis.

RESUMO

Objetivos: Analisar, através dos dados do DATASUS, a tendência histórica das revisões de artroplastia total de joelho (ATJ) no período entre 2008-2016 e relacioná-las com aspectos demográficos, regional e nacionalmente. **Métodos:** Elaboração de uma série histórica entre o período de 2008-2016, utilizando-se do banco de dados do DATASUS, na área de Informações de Saúde (TABNET). Para calcular a incidência, foi usado como numerador o total de revisões de ATJ e como denominador a população total nacional, da região ou do estado pelo período estudado. **Resultados:** A taxa nacional de procedimentos por 100.000 habitantes apresentou variação entre 0,41 e 0,48 no período analisado (média de 0,44). A região Sudeste, onde estão 69% dos serviços credenciados à SBCJ e 61% dos membros titulares da SBCJ, foi responsável por 60% do número absoluto de procedimentos realizados no Brasil. **Conclusões:** Em números absolutos, a região Sudeste possui o maior volume de procedimentos. Entretanto, a taxa mais alta é encontrada na região Sul. As regiões Norte, Nordeste e Centro-Oeste apresentaram resultados insatisfatórios, bem abaixo das demais. **Nível de evidência IV, Análises econômicas e de decisão – desenvolvimento de modelo econômico ou de decisão.**

Descritores: Revisão. Artroplastia. Joelho. Saúde Pública. Osteoartrose.

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INTRODUCTION

The progressive aging of the population is a worldwide phenomenon. As a result, there is an increase in the prevalence of osteoarthritis (OA) and, consequently, in the number of total knee arthroplasties (TKA) performed, a cost-effective procedure with good clinical results.¹

With the greatest number of TKA, invariably, there is a growing need for review procedures,¹ which are technically more difficult and more costly, with an estimated cost of \$ 75,000 per procedure in the United States.² There are no published current epidemiological studies in Brazil that quantify the number of surgeries performed for TKA revision. The survival rate and clinical outcomes of revision of arthroplasties are lower than the primary TKA, so that their

performance should preferably be in specialized centers and with experienced surgeons.³ However, it is known that there is no such distinction by specialized centers in our environment, so that any service is authorized to perform these procedures.

According to studies of published TKA indications, the main causes of failure are aseptic loosening, instability and infection. Lombardi Jr et al,³ in a multicentric analysis of 844 cases of TKA revision, found aseptic loosening (31.2%) as the predominant mechanism of failure in primary TKA, followed by instability (18.7%) and infection (16.2%), with mean time to failure of 5.9 years. These data are in agreement with those published by Khan et al,⁴ with aseptic loosening (29.8%), infection (14.8%) and pain (9.5%) as the main indications for revision.

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Unfortunately, because of the difficulty in dealing with bone loss and the lack of soft tissues present in these cases, the results of the revisions are not as predictable as in cases of primary arthroplasties,⁵ and may lead to catastrophic evolutions, such as arthrodesis and, in the last case, amputations, which greatly impairs patients' quality of life. Unlike trauma-related amputations, the outcome of transfemoral amputations after uncontrolled TKA infection is not satisfactory, with few patients resuming the ability to ambulate. Helito et al,⁶ in a series of cases, showed that only 25% of the patients undergoing amputation in this context were able to maintain the ability to ambulate.

Thus, trying to establish a national epidemiological profile, in order to understand how we deal with revisions of arthroplasty in our country, the objective of the present study is to evaluate the historical trend of revision of TKA performed by the Public Healthcare Service (Sistema Único de Saúde - SUS), analyzing regional differences and comparing findings with existing data from other countries. In addition, as a secondary objective, to establish a parallel between the number of reviews of TKA performed and the number of services accredited to the Brazilian Society of Knee Surgery (Sociedade Brasileira de Cirurgia do Joelho - SBCJ).

OBJECTIVE

To analyze, through DATASUS data, the historical trend of revision total knee arthroplasty (TKA) in the period between 2008-2016 and to relate it to demographic aspects, at a regional and national level.

MATERIALS AND METHODS

A research was performed using the DATASUS database, in the area of Health Information (TABNET). After definition of the period between

2008 and 2016, the procedure "0408050055 ARTROPLASTIA TOTAL DE JOELHO - REVISAO / RECONSTRUCAO" was selected as a filter.⁷ To calculate the incidence, the total of revisions of TKA was used as numerator and the total national, regional or state population for the period studied was used as denominator. Population data were obtained by the National Census of the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística - IBGE) and the projections for the other years. The number of accredited services by region/state is available on the SBCJ website.⁷

The obtained results were allocated in tables, according to the studied questions. The main objective of the study was to describe the incidence of TKA revision in Brazil.

For the statistical analysis, the data related to the TKA revisions were presented in absolute and percentage values, with a total for Brazil and stratified according to the Region or Federal Unit, in relation to the year of the procedure. The surgery rate was presented by groups of 100,000 inhabitants. Finally, a statistical analysis was performed to allow a descriptive evaluation of the results obtained.

RESULTS

Between 2008-2016, the nine-year period used for the study, 7,844 TKA revision surgeries were recorded. We highlight the significant contribution of the Southeast region, with 60% of the absolute number of procedures performed in Brazil, with the state of São Paulo accounting for 37% of the total national amount (Tables 1, 2, 3). The national rate of procedures per 100,000 inhabitants presented a variation between 0.41 and 0.48 in the analyzed period (mean of 0.44) (Figure 1).

Although the absolute number is much higher in the Southeast region, we highlight that the highest rate of TKA revision is found

Table 1. Hospital procedures of the Brazilian Unified Health System (SUS) - by admission facility location - Brazil.

Region/State	2008			2009			2010			2011			2012		
	Surgeries	Population	Rate												
Acre	19	705.635	2.69	13	720.132	1.81	1	733.559	0.14	1	746.375	0.13	3	758.786	0.40
Amapá	0	651.977	0.00	0	669.360	0.00	0	669.526	0.00	0	684.301	0.00	0	698.602	0.00
Amazonas	10	3.463.562	0.29	10	3.534.456	0.28	6	3.483.985	0.17	2	3.538.359	0.06	1	3.590.985	0.03
Pará	36	7.402.515	0.49	15	7.521.656	0.20	46	7.581.051	0.61	9	7.688.531	0.12	8	7.792.561	0.10
Rondônia	0	1.616.992	0.00	0	1.640.607	0.00	0	1.562.409	0.00	1	1.576.423	0.06	1	1.590.011	0.06
Roraima	0	440.533	0.00	0	450.969	0.00	0	450.479	0.00	0	460.157	0.00	0	469.524	0.00
Tocantins	8	1.376.898	0.58	1	1.398.334	0.07	6	1.383.445	0.43	1	1.400.813	0.07	3	1.417.694	0.21
Alagoas	4	3.177.975	0.13	1	3.205.791	0.03	5	3.120.494	0.16	3	3.143.338	0.10	3	3.165.472	0.09
Bahia	10	14.558.148	0.07	17	14.665.810	0.12	12	14.016.906	0.09	15	14.097.333	0.11	16	14.175.341	0.11
Ceará	77	8.412.055	0.92	59	8.493.155	0.69	13	8.452.381	0.15	6	8.530.058	0.07	3	8.606.005	0.03
Maranhão	11	6.458.789	0.17	4	6.533.027	0.06	3	6.574.789	0.05	0	6.645.665	0.00	3	6.714.314	0.04
Paraíba	0	3.751.507	0.00	2	3.785.598	0.05	3	3.766.528	0.08	3	3.791.200	0.08	4	3.815.171	0.10
Pernambuco	16	8.825.549	0.18	19	8.906.488	0.21	7	8.796.448	0.08	12	8.864.803	0.14	16	8.931.028	0.18
Piauí	0	3.106.597	0.00	1	3.125.918	0.03	4	3.118.360	0.13	5	3.140.213	0.16	1	3.160.748	0.03
Rio Grande do Norte	6	10.540.407	0.19	3	3.226.259	0.09	7	3.168.027	0.22	7	3.198.572	0.22	9	3.228.198	0.28
Sergipe	0	2.066.358	0.00	0	2.093.507	0.00	0	2.068.017	0.00	4	2.089.783	0.19	1	2.110.867	0.05
Espírito Santo	7	3.598.524	0.19	13	3.648.075	0.36	20	3.514.952	0.57	11	3.547.013	0.31	25	3.578.067	0.70
Minas Gerais	62	19.794.278	0.31	65	19.967.560	0.33	68	19.597.330	0.35	47	19.728.252	0.24	74	19.855.332	0.37
Rio de Janeiro	40	15.859.866	0.25	67	15.969.092	0.42	69	15.989.929	0.43	63	16.112.637	0.39	74	16.231.365	0.46
São Paulo	334	41.651.651	0.80	325	42.075.716	0.77	456	41.262.199	1.11	385	41.586.892	0.93	74	41.901.219	0.18
Paraná	33	10.540.407	0.31	67	10.636.065	0.63	68	10.444.526	0.65	80	10.512.151	0.76	74	10.577.755	0.70
Rio Grande do Sul	90	10.906.958	0.83	88	10.965.071	0.80	88	10.693.929	0.82	111	10.732.770	1.03	74	10.770.603	0.69
Santa Catarina	29	6.164.049	0.47	33	6.257.173	0.53	36	6.248.436	0.58	35	6.316.906	0.55	74	6.383.286	1.16
Distrito Federal	8	2.483.669	0.32	6	2.541.434	0.24	4	2.570.160	0.16	4	2.609.997	0.15	74	2.648.532	2.79
Goiás	1	5.957.260	0.02	4	6.057.367	0.07	3	6.003.788	0.05	3	6.080.588	0.05	74	6.154.996	1.20
Mato Grosso	1	2.956.496	0.03	1	3.003.310	0.03	3	3.035.122	0.10	1	3.075.862	0.03	74	3.115.336	2.38
Mato Grosso do Sul	0	2.417.300	0.00	4	2.452.039	0.16	2	2.449.024	0.08	2	2.477.504	0.08	74	2.505.088	2.95

Table 2. Hospital procedures of the Brazilian Unified Health System (SUS) - by admission facility location - Brazil.

Hospital admissions by Region/State and year of processing												
Procedure:0408050055 total knee arthroplasty - revision / reconstruction -Period:2008-2016												
Region/State	2013			2014			2015			2016		
	Surgeries	Population	Rate									
Acre	2	776.463	0.26	1	790.101	0.13	2	803.513	0.25	1	816.687	0.12
Amapá	0	734.996	0.00	0	750.912	0.00	0	766.679	0.00	0	782.295	0.00
Amazonas	2	3.807.921	0.05	7	3.873.743	0.18	4	3.938.336	0.10	1	4.001.667	0.02
Pará	5	7.969.654	0.06	10	8.073.924	0.12	13	8.175.113	0.16	14	8.272.724	0.17
Rorônia	1	1.728.214	0.06	0	1.748.531	0.00	0	1.768.204	0.00	3	1.787.279	0.17
Roraima	0	488.072	0.00	0	496.936	0.00	0	505.665	0.00	0	514.229	0.00
Tocantins	3	1.478.164	0.20	0	1.496.880	0.00	1	1.515.126	0.07	0	1.532.902	0.00
Alagoas	5	3.300.935	0.15	4	3.321.730	0.12	1	3.340.932	0.03	2	3.358.963	0.06
Bahia	22	15.044.137	0.15	13	15.126.371	0.09	18	15.203.934	0.12	25	15.276.566	0.16
Ceará	6	8.778.576	0.07	21	8.842.791	0.24	15	8.904.459	0.17	10	8.963.663	0.11
Maranhão	3	6.794.301	0.04	4	6.850.884	0.06	0	6.904.241	0.00	3	6.954.036	0.04
Paraíba	11	3.914.421	0.28	9	3.943.885	0.23	3	3.972.202	0.08	2	3.999.415	0.05
Pernambuco	18	9.208.550	0.20	9	9.277.727	0.10	14	9.345.173	0.15	6	9.410.336	0.06
Piauí	2	3.184.166	0.06	3	3.194.718	0.09	15	3.204.028	0.47	9	3.212.180	0.28
Rio Grande do Norte	5	3.373.959	0.15	7	3.408.510	0.21	7	3.442.175	0.20	2	3.474.998	0.06
Sergipe	0	2.195.662	0.00	2	2.219.574	0.09	2	2.242.937	0.09	3	2.265.779	0.13
Espírito Santo	33	3.839.366	0.86	40	3.885.049	1.03	59	3.929.911	1.50	37	3.973.697	0.93
Minas Gerais	77	20.593.356	0.37	89	20.734.097	0.43	119	20.869.101	0.57	144	20.997.560	0.69
Rio de Janeiro	97	16.369.179	0.59	107	16.461.173	0.65	147	16.550.024	0.89	85	16.635.996	0.51
São Paulo	281	43.663.669	0.64	330	44.035.304	0.75	261	44.396.484	0.59	225	44.749.699	0.50
Paraná	82	10.997.465	0.75	91	11.081.692	0.82	111	11.163.018	0.99	102	11.242.720	0.91
Rio Grande do Sul	133	11.164.043	1.19	95	11.207.274	0.85	89	11.247.972	0.79	88	11.286.500	0.78
Santa Catarina	60	6.634.254	0.90	86	6.727.148	1.28	84	6.819.190	1.23	71	6.910.553	1.03
Distrito Federal	10	2.789.761	0.36	8	2.852.372	0.28	6	2.914.830	0.21	4	2.977.216	0.13
Goiás	6	6.434.048	0.09	2	6.523.222	0.03	5	6.610.681	0.08	2	6.695.855	0.03
Mato Grosso	2	3.182.113	0.06	3	3.224.357	0.09	9	3.265.486	0.28	3	3.305.531	0.09
Mato Grosso do Sul	2	2.587.269	0.08	1	2.619.657	0.04	3	2.651.235	0.11	4	2.682.386	0.15

Table 3. Hospital procedures of the Brazilian Unified Health System (SUS) - by admission facility location - Brazil.

Hospital admissions by Region/State and Year of processing															
Procedure:0408050055 total knee arthroplasty - revision/reconstruction - Period:2008-2016															
Region/State	2008			2009			2010			2011			2012		
	Surgeries	Population	Rate												
North	73	15.658.112	0.47	39	15.935.514	0.24	59	15.864.454	0.37	14	16.094.959	0.09	16	16.318.163	0.10
Northeast	124	53.543.869	0.23	106	54.035.553	0.20	54	53.081.950	0.10	55	53.500.965	0.10	56	53.907.144	0.10
Southeast	443	80.904.319	0.55	470	81.660.443	0.58	613	80.364.410	0.76	506	80.974.794	0.62	502	81.565.983	0.62
South	152	27.611.414	0.55	188	27.858.309	0.67	192	27.386.891	0.70	226	27.561.827	0.82	252	27.731.644	0.91
Midwest	10	13.814.725	0.07	15	14.054.150	0.11	12	14.058.094	0.09	10	14.243.951	0.07	13	14.423.952	0.09
Total	802	191.532.439	0.42	818	193.543.969	0.42	930	190.755.799	0.49	811	192.376.496	0.42	839	193.946.886	0.43
Region/State	2013			2014			2015			2016					
	Surgeries	Population	Rate												
North	13	16.983.484	0.08	18	17.231.027	0.10	20	17.472.636	0.11	19	17.707.783	0.11			
Northeast	72	55.794.707	0.13	72	56.186.190	0.13	75	56.560.081	0.13	62	56.915.936	0.11			
Southeast	488	84.465.570	0.58	566	85.115.623	0.66	586	85.745.520	0.68	491	86.356.952	0.57			
South	275	28.795.762	0.96	272	29.016.114	0.94	284	29.230.180	0.97	261	29.439.773	0.89			
Midwest	20	14.993.191	0.13	14	15.219.608	0.09	23	15.442.232	0.15	13	15.660.988	0.08			
Total	868	201.032.714	0.43	942	202.768.562	0.46	988	204.450.649	0.48	846	206.081.432	0.41			

in the South region, with a mean in the studied period of 0.82 per 100,000 inhabitants (Figure 2). Rio Grande do Sul (0.90) and São Paulo (0.75) are the states of the federation with the highest average revision rate of TKA.

On the other hand, the performance of the North (0.19), Northeast (0.14) and Midwest (0.10) regions, evaluated by the average rate in the studied period, is well below the South and Southeast regions, showing a worrying scenario at national level.

After a trend of growth between 2011-2015, the year 2016 presented a national fall in the revision rate of TKA (15%), with the Center-West region showing the most intense fall (44%).

The rate of accredited services and associate members in the SBCJ in 2017 per 10,000,000 population group is shown in table 4.

DISCUSSION

The analysis of the official data provided by the SUS presents a worrisome national scenario regarding the revision of TKA. The national average rate of 0.44/100,000 inhabitants is well below international indicators. In the state of New York, Bansal et al⁸ showed a growth of 246% between 1993 and 2010, with the rate increasing from 4.9 to 16.8 / 100,000 inhabitants. Bozic et al⁹ using the NIS (Nationwide Inpatients Sample) between 2005 and 2010 demonstrated a 39% increase in the number of TKA revisions in the American population.

This trend of growth, also observed in several other series in Europe, Australia and Canada,¹⁰⁻¹³ contrasts with the decrease in the number

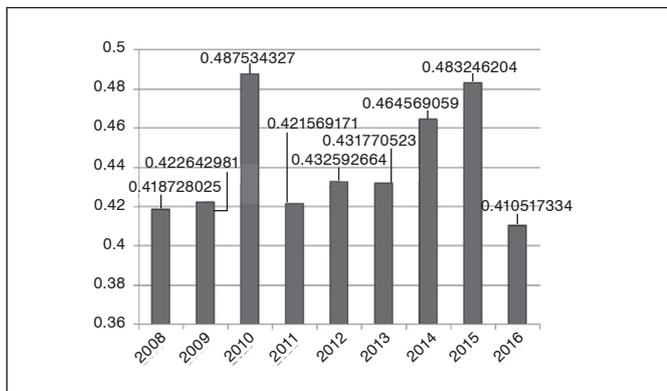


Figure 1. Rate of revision of total knee arthroplasty performed by the Brazilian Unified Health System from 2008 to 2019 (per 100,000 inhabitants).

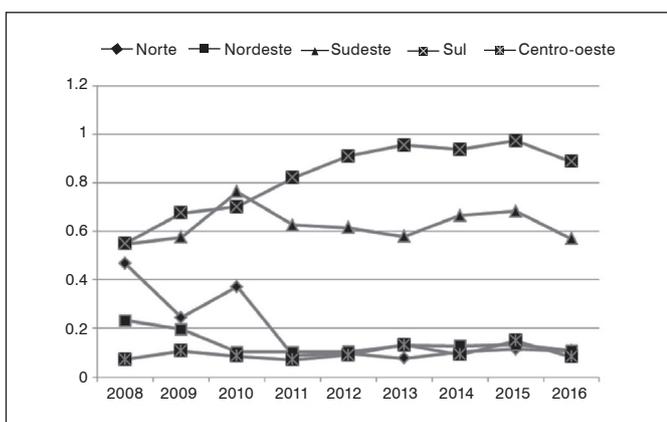


Figure 2. Rate of revision of total knee arthroplasty performed by the Brazilian Unified Health System from 2008 to 2019 (per 100,000 inhabitants).

Table 4. Rate of accredited services and associated members of the Brazilian Knee Surgery Society (SBCJ), by regions of Brazil, in 2017 (per 10,000,000).

Region	Accredited services	Associated members
North	2	36
Northeast	7	194
Southeast	58	867
South	14	222
Midwest	3	96

of TKA revisions made in Brazil in 2016, when there was a reduction of 15% compared to 2015, which may eventually be related to a worsening of the country's economic indicators in this period, with a direct impact on the public health system.

In England and Wales, it is estimated that 332% increase in the number of revisions of TKA between 2012 and 2030.¹⁴ In the United States, a 601% increase in TKA revision demand is estimated in 2030 when compared to 2005.² Although there are no national estimates of the number of TKA revisions in 2030, the chronological

evolution shown in figure 1 shows that public health policies are needed for an attempt to reverse this situation.

A recent national publication brought a picture of the primary TKA in the SUS. Between 2008 and 2015, there was an average annual increase of 8.7% in the number of primary TKA.¹⁵ Comparing with our study, after compiling the data in a linear regression curve, we found a growth of only 12.78 procedures per year. Although we use different parameters in this comparison, there appears to be a lag in the number of revisions, which can not grow analogously to the primary procedures.

The delay in performing the TKA review procedure, after its indication, is associated with an increase in complications and technical difficulties. Unresolved loosening tend to provoke a positive feedback in the process of osteolysis and bone loss. The need for endoprosthetic reconstruction, as an alternative to rescue the limb, has worse results, with higher infection rates and a greater need for further revisions.¹⁶ In cases of prolonged use of the cement spacer, late follow-up showed mechanical failure in 87%, with supracondylar fractures and spacer dislocation being the most common complications.¹⁷

As shown in table 4, there is a large regional disparity in the rate of accredited services and members associated with SBCJ, with more than 50% of services and members of society being in the Southeast region. This reflects a national lack of reference centers for conducting a revision of TKA. Jeschke et al,¹⁸ showed a clear association between the need for revision after a primary TKA and the surgical volume of the hospital where the procedure was performed. These data allow extrapolations for cases of TKA revisions. Because it is a high-cost, large-scale procedure with many complications, it is important to create regional centers of excellence, with professionals trained to perform this procedure, seeking better results and optimizing public health policy.

We know that underreporting makes it difficult to interpret the Brazilian TKA revisions more reliably. With use in the United States and the United Kingdom, the American Joint Replacement Registry¹⁹ and the National Joint Registry²⁰ are important tools for the prospective monitoring of performed arthroplasties and implant surveillance, generating a broader national perspective, rather than a purely institutional view. This reinforces the need to create a Brazilian registry of implants, facilitating control and helping to guide decisions about investments and improvements to be made in the SUS network care.

The fact that we use data only from the SUS generates a limitation to our study, since we can not size the impact of the revision of TKA in the supplementary health system, which is responsible for an important portion in the total amount of cases. In addition, a statistical analysis based on numbers alone may not reflect the presence of good services, which certainly exist in all regions of the country, with a qualified team that, although perform a low number of procedures.

CONCLUSIONS

In Brazil, an average rate of TKA revisions was 0.44 per 100,000 inhabitants between 2008 and 2016. In absolute numbers, the Southeast region has the highest volume of procedures. However, the highest rate found is in the South region. 69% of the services accredited to the SBCJ and 61% of the SBCJ members are in the Southeast region.

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