ORIGINAL ARTICLE
HIP
DOI: http://dx.doi.org/10.1590/1413-785220223005e251150

TOTAL HIP ARTHROPLASTY IN THE PUBLIC HEALTH SYSTEM OF SÃO PAULO: COMPARING TYPES OF FIXATION

ARTROPLASTIA TOTAL DE QUADRIL NO SISTEMA PÚBLICO DE SÃO PAULO: COMPARANDO OS TIPOS DE FIXAÇÃO

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ABSTRACT

Brazil lacks registries on the prevalence of primary total hip arthroplasty (THA) fixation methods. Objective: (i) to describe the demographic profile of patients who underwent THA in the public health system of the municipality of São Paulo during the last 12 years and (ii) to compare fixation methods regarding costs, hospital stay length, and death rates. Methods: This is an ecological study conducted with data available on TabNet, a platform belonging to DATASUS. Public data (from the government health system) on THA procedures performed in São Paulo from 2008 to 2019 were extracted. Gender, age, city region, THA fixation method, number of surgeries, costs, hospital stay length, and death rates were analyzed. Results: We analyzed 7,673 THA, of which 6220 (81%) were performed via cementless/hybrid fixation and 1453 (19%), via the cemented technique. Cementless/hybrid fixation had a higher cost (US$ 495.27) than the cemented one ($p < 0.001$). Nevertheless, hospital stay length was 0.87 days longer for cemented fixation than the cementless/hybrid one. We found no significant difference in death rates between THA fixation methods. Conclusion: THA cementless/hybrid fixation is prevalent in the municipality of São Paulo, which had higher total costs and shorter hospitalizations than cemented fixation. We found no difference between THA fixation methods and death rates. ***Level of Evidence IV, Case Series.***

Keywords: Hip. Arthroplasty, Replacement, Hip. Public Health. Prosthesis Retention

RESUMO

No Brasil, não há registros da prevalência do tipo de fixação da artroplastia total de quadril (ATQ). Objetivo: (i) Descrever perfil demográfico de pacientes submetidos à ATQ no Sistema Único de Saúde de São Paulo durante os últimos doze anos; e (ii) comparar as técnicas de fixação de ATQ quanto aos custos, tempo de internação (TI) e taxa de óbito. Métodos: Estudo ecológico, com dados disponíveis na TabNet do DATASUS. Dados públicos de procedimentos de ATQ eletivos realizados em São Paulo de 2008 a 2019 foram extraídos. Foram analisados: sexo, idade, região municipal, método de fixação em ATQ, número de cirurgias, custo, tempo de internação e óbitos. Resultados: Foram analisadas 7.673 ATQs, sendo 6.220 (81%) não-cimentada/híbridas e 1.453 (19%) cimentadas. A fixação não-cimentada/híbrida teve custo maior em US$ 495,27 do que a cimentada ($p < 0,001$). Entretanto, TI foi 0,87 dia mais longo na fixação cimentada. Não houve diferença significativa nas taxas de óbito entre os métodos de fixação. Conclusão: A fixação não-cimentada/híbrida na ATQ é prevalente em São Paulo, e apresentou maior custo total, porém menor tempo de internação do que a fixação cimentada. Não houve diferença entre o método de fixação em ATQ e a taxa de óbito. ***Nível de Evidência IV, Série de Casos.***

Descritores: *Quadril. Artroplastia de Quadril. Saúde Pública. Retenção da Prótese.*

Citation: Guimarães RP, Viamont-Guerra MR, Antonioli E, Lenza M. Total hip arthroplasty in the public health system of São Paulo: comparing types of fixation. Acta Ortop Bras. [online]. 2022;30(5): Page 1 of 7. Available from URL: http://www.scielo.br/aob.

INTRODUCTION

Total hip arthroplasty (THA) is considered the surgery of the 20th century since it greatly alleviates pain and improves function, quality of life, and risk-to-benefit ratio in patients who underwent this procedure.[1,2] However, the literature still lacks a consensus on the most efficient technique to fixate bone implants,[3,4] which may be cemented or non-cemented (or hybrid, i.e., one of its components is non-cemented).[5] Whereas cemented prostheses achieve their stability via bone-cement mechanical blocks after polymethylmethacrylate polymerization, non-cemented ones do so by intraoperative press-fit and postoperative bone ingrowth, characterizing biological fixation.[6] THA fixation techniques must meet two main conditions: patients' health and economic viability.[7] The literature evaluates patients' health not only by the obtained clinical results but also by implant survival time and revision rate. Abdulkarim et al.,[3] in a systematic review and meta-analysis of randomized clinical trials of cemented and non-cemented THAs found no difference in implant survival and revision rate between fixation techniques.

All authors declare no potential conflict of interest related to this article.

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Article received on 04/15/2021, approved on 09/22/2021.

On the other hand, Zhang, Yan, and Zhang,[8] after evaluating national arthroplasty records from Sweden, Norway, England-Wales, Australia, and New Zealand and reviewing randomized clinical trials and meta-analyses, concluded that cemented THAs show better long-term survival than non-cemented ones. Moreover, when stratified by age, they found that non-cemented THAs show higher survival rates in younger patients, whereas cemented ones, in older ones.[8] Another study, analyzing nationwide THA records in developed countries, concluded that patients over 75 years of age have a lower risk of revision if they receive cemented THAs.[9]

Regarding its economic viability, some studies have observed that non-cemented prostheses have a higher cost than cemented or hybrid ones.[10,11] However, other studies consider the opposite since non-cemented prostheses require shorter surgeries and dispense with the auxiliary products necessary for cementation.[12-14]

Brazil has neither national records on these procedures nor information on the prevalence of THA fixation type and its related costs. Considering the clinical and economic relevance of THA, it is essential to identify and evaluate how prevalent is the use of these fixation techniques and its costs to the public health system of the municipality of São Paulo, which is the most populous in Brazil[15] and represents an important influence on the national public health system. This study aims (i) to describe, via DATASUS data, the demographic profile of patients subjected to primary and elective THA in public hospitals in the municipality of São Paulo between 2008 and 2019 and (ii) to compare procedure costs, hospitalization length, and death rates in patients subjected to cemented or non-cemented/hybrid THAs, according to their demographic profile.

METHODS

Data related to primary and elective THA procedures, performed in public hospitals in the municipality of São Paulo between 2008 and 2019, were analyzed in this retrospective ecological study. Data were collected from a public platform (TabNet)[16] available online which belongs to DATASUS, providing open data on surgical procedures performed in the public health system of the municipality. Patients subjected to primary and elective cemented (code: 04.08.04.008-4) or non-cemented/hybrid (code: 04.08.04.009-2) THAs and with a preoperative diagnosis of coxarthrosis (ICD: M16), osteonecrosis (ICD: M87) or seropositive rheumatoid arthritis (ICD: M05) were assessed.

DATASUS data enabled the collection and analysis of the total number of cemented and non-cemented/hybrid THAs per year. For each type of fixation, patients' demographic profile was evaluated by gender, age group, and region of the municipality of São Paulo (center, east, north, west, southeast, and south). Moreover, total and intensive care unit (ICU) costs, length of stay, ICU stay, and death rates were evaluated. Total cost is the amount hospitals receive for hospitalizations, materials, and procedures per patient subjected to THA.

Total and ICU costs for THA procedures were converted to US dollars (US$) by its average annual value (Table 1).

Before it began, this study was approved by the Institutional Ethics Committee (26628219.0.0000.0071).

Statistical analysis

The demographic profile of the population subjected to THA was descriptively analyzed. Associations among THA type (cemented and non-cemented/hybrid), gender, age group, and region of the municipality were evaluated by the Chi-square test.

To evaluate total cost and hospitalization length per THA type, their averages a patient per year were considered, respectively. Regarding ICU cost and stay per THA type, its mean was estimated based on the number of patients subjected to each THA type per year since the number of patients who were admitted to ICUs was unavailable.

To compare THA types, total and ICU costs, and hospitalization and ICU stay length, generalized estimation equation models[17] were adjusted via gamma distribution and logarithmic connection functions, considering the correlation between the measurements obtained in the same year for both THA types. As for deaths, due to their absence for some demographic variables, Gamma and Poisson (Tweedie) distributions were used.[18] Analyses were performed on SPSS,[19] considering a 5% significance level.

Table 1. Average annual exchange rate between real (R$) and US dollar (US$) in 2008 and 2019.

Year	Exchange (R$ per US$)
2008	1.8346
2009	1.9976
2010	1.7603
2011	1.6750
2012	1.9546
2013	2.1576
2014	2.3534
2015	3.3315
2016	3.4901
2017	3.1920
2018	3.6542
2019	3.9451

Source: http://www.ipeadata.gov.br/ExibeSerie.aspx?serid=31924.

RESULTS

Public hospitals in the municipality of São Paulo performed 7,673 THAs between 2008 and 2019, of which 1,453 (19%) employed cemented fixation and 6,220 (81%), non-cemented/hybrid one (Figure 1). We found a 65% increase in the number of non-cemented/hybrid THAs and no change in the number of cemented THAs between 2008 and 2013.

We found a significant association between THA fixation type with age group ($p = 0.004$) and São Paulo region ($p < 0.001$) (Table 2). Despite the similar proportion of patients in each age group who underwent both fixation types, we observed that the proportion of cemented THAs is higher (31.3%) than

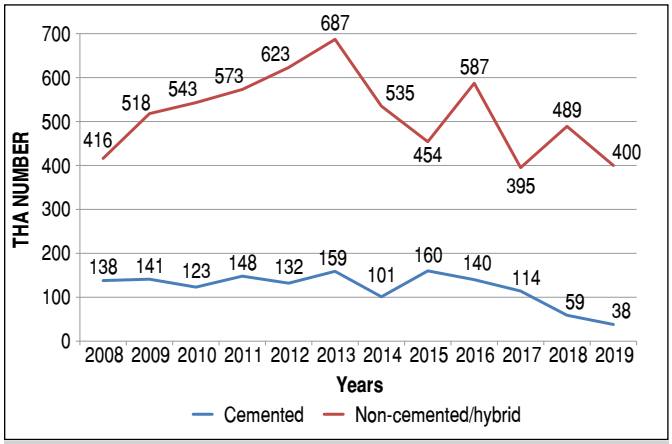

Figure 1. Total number of cemented and non-cemented/hybrid THAs performed per year in public hospitals in the municipality of São Paulo between 2008 and 2019.

THA: total hip arthroplasty.

non-cemented/hybrid ones (26.8%) for patients between 55 and 64 years of age, whereas for those under 55 and those between 65 and 74 years of age, the proportion of non-cemented/hybrid THAs is higher (34.4% and 26.3%, respectively) than of cemented ones (31.7% and 24.3%, respectively). Regarding São Paulo regions, we found a higher proportion of patients subjected to cemented THAs in central (31%), northern (22%), and southern (13%) São Paulo and a predominance of patients subjected to non-cemented/hybrid THAs in its southeastern (49%) and western (30%) regions.

Total cost, assessed by mean total cost per patient, showed that non-cemented/hybrid THA costed US$ 495.27 more than cemented ones ($p < 0.001$) (Table 3). When we compared total costs between THA types regarding gender, age group, and São Paulo region, we found an association between THA cost and all three variables, with an even higher cost for non-cemented/hybrid THAs.

ICU cost, estimated by its average per patient subjected to THA failed to show significant differences between fixation types (Table 4). Comparing ICU costs per THA types and gender, age group, and São Paulo region showed no significant differences, except for region, in which eastern São Paulo showed the highest ICU cost for cemented THA ($p = 0.011$).

Table 2. Demographic profile of patients subjected to total hip arthroplasty in public hospitals in the municipality of São Paulo between 2008 and 2019.

	Total (n = 7,673)	Cemented THA (n = 1,453)	Non-cemented/ hybrid THA (n = 6,220)	p-value#
Gender				0.467
Female	3,937 (51.3%)	758 (52.2%)	3,179 (51.1%)	
Male	3,736 (48.7%)	695 (47.8%)	3,041 (48.9%)	
Age Group				0.004
< 55 years	2,597 (33.8%)	460 (31.7%)	2,137 (34.4%)	
55-64 years	2,119 (27.6%)	455 (31.3%)	1,664 (26.8%)	
65-74 years	1,988 (25.9%)	353 (24.3%)	1,635 (26.3%)	
≥ 75 years	969 (12.6%)	185 (12.7%)	784 (12.6%)	
São Paulo Region				< 0.001
Center	801 (10.4%)	449 (30.9%)	352 (5.7%)	
East	536 (7.0%)	38 (2.6%)	498 (8.0%)	
North	537 (7.0%)	324 (22.3%)	213 (3.4%)	
West	1,903 (24.8%)	34 (2.3%)	1,869 (30.0%)	
Southeast	3,441 (44.8%)	419 (28.8%)	3,022 (48.6%)	
South	455 (5.9%)	189 (13.0%)	266 (4.3%)	

#: Chi-square test; THA: total hip arthroplasty.

Table 3. Average total cost per patient due to types of total hip arthroplasty performed in public hospitals in the municipality of São Paulo between 2008 and 2019, according to gender, age group, and municipality region.

	Cemented THA [US$]*	Non-cemented/hybrid THA [US$]*	Difference between non-cemented/hybrid –– cemented [US$]*	p-value
Average total cost	1,345.15 1,206.97 (1,499.14)	1,840.42 1,639.94 (2,065.41)	495.27 406.91 (583.64)	< 0.001
Gender				
Female	1,382.71 1,247.45 (1,532.63)	1,864.69 1,662.28 (2,091.76)	481.99 399.55 (564.42)	< 0.001
Male	1,312.21 1,170.94 (1,470.52)	1,814.46 1,615.35 (2,038.11)	502.25 394.11 (610.38)	< 0.001
p-value	0.024	< 0.001		
Age group				
< 55 years	1,253.35 1,127.50 (1,393.26)	1,774.14 1,585.77 (1,984.87)	520.78 433.21 (608.36)	< 0.001
55-64 years	1,338.85 1,195.98 (1,498.79)	1,844.79 1,635.54 (2,080.81)	505.94 398.87 (613.01)	< 0.001
65-74 years	1,413.86 1,260.09 (1,586.40)	1,894.00 1,680.20 (2,135.01)	480.14 365.35 (594.94)	< 0.001
≥ 75 years	1,457.12 1,295.27 (1,639.19)	1,912.45 1,713.13 (2,134.97)	455.34 378.32 (532.35)	< 0.001
p-value	< 0.001	< 0.001		
Region				
Center	1,487.71 1,208.94 (1,830.76)	1,763.87 1,428.20 (2,178.43)	276.16 206.92 (345.39)	< 0.001
East	1,159.54 989.72 (1,358.50)	1,774.99 1,462.62 (2,154.06)	615.45 (391.48; 839.41)	< 0.001
North	994.88 (842.97; 1,174.18)	1,123.85 (1,076.57; 1,173.21)	128.97 (−43.81; 301.75)	0.143
West	1,508.22 (1,115.64; 2,038.93)	1,910.42 (1,652.17; 2,209.03)	402.20 (20.37; 784.03)	0.039
Southeast	1,318.15 (1,213.23; 1,432.15)	1,873.19 (1,547.26; 2,267.77)	555.03 (231.11; 878.96)	< 0.001
South	1,412.99 (1,182.93; 1,687.79)	1,707.27 (1,438.70; 2,025.96)	294.27 (125.50; 463.05)	< 0.001
p-value	< 0.001	< 0.001		

Results expressed by mean values (95 CI%); *values in US dollars [US$]; p-values corrected by the sequential Bonferroni method. THA: total hip arthroplasty.

Regardless of THA type, we found that both total and ICU costs were significantly higher for women, gradually increasing as age did (Tables 3 and 4). We also observed a significant variability in costs among municipality regions.

Hospitalization length, assessed by the mean hospital stay per patient, was 0.87 days longer for cemented THAs than for non-cemented/ hybrid ones ($p < 0.001$) (Table 5). Comparing hospitalization length for THA types and gender, age group, and São Paulo region showed that cemented THAs had longer hospitalizations for all genders ($p = 0.001$ and $p < 0.001$); those aged < 55 ($p < 0.001$), 55 to 64 ($p = 0.002$), and 65 to 74 years ($p < 0.014$); and in Western ($p = 0.002$) and Southeastern São Paulo ($p < 0.001$). Moreover, for THA type, comparing hospitalization length between age groups showed a gradual increase concomitant with patients' age only for non-cemented/ hybrid THAs ($p < 0.001$). Comparing hospitalization length between regions, we observed significant differences between THA types.

Table 4. Estimated average ICU cost per patient and type of total hip arthroplasty performed in public hospitals in the municipality of São Paulo between 2008 and 2019, according to gender, age group, and municipality region.

	Cemented THA [US$]*	Non-cemented/Hybrid THA [US$]*	Difference between non-cemented/hybrid – cemented [US$]*	p-value
Average ICU cost	90.73 [64.70; 127.24]	82.35 [68.30; 99.30]	−8.38 (−47.80-31.04)	0.677
Sex				
Female	108.64 [82.80; 142.43]	88.84 [73.56; 107.26]	−19.79 (−58.21-18.62)	0.313
Male	75.14 [44.54; 126.30]	75.24 [61.68; 91.73]	0.10 (−46.86-47.05)	0.997
p-value	0.034	< 0.001		
Age group				
< 55 years	60.28 [32.23; 111.99]	38.42 [30.94; 47.64]	−21.86 (−63.22-19.50)	0.300
55–64 years	89.32 [55.87; 142.47]	77.20 [62.12; 95.87]	−12.13 (−63.86-39.60)	0.646
65–74 years	106.13 [76.67; 146.77]	105.75 (85.45; 130.83)	−0.38 (−51.82; 51.07)	0.989
≥ 75 years	159.79 [115.07; 221.75]	162.93 [139.02; 190.94]	3.14 (−51.65; 57.92)	0.911
p-value	< 0.001	< 0.001		
Region				
Center	52.85 [28.51; 97.27]	33.11 [25.27; 43.30]	−19.74 (−51.71; 12.23)	0.226
East	249.77 [132.65; 469.51]	37.20 [22.54; 61.00]	−212.56 (−376.00; −49.12)	0.011
North	48.37 [35.77; 65.30]	27.67 [12.27; 60.94]	−20.71 (−55.15; 13.73)	0.239
West	298.28 [125.50; 707.02]	71.34 [61.76; 82.39]	−226.93 (−476.12; 22.25)	0.074
Southeast	119.89 [62.67; 228.53]	108.45 [68.06; 172.45]	−11.45 (−127.28; 104.38)	0.846
South	97.12 [70.63; 133.40]	100.65 [45.19; 222.73]	3.54 (−104.79; 111.86)	0.949
p-value	< 0.001	< 0.001		

Results expressed by mean values (95 CI%); *values in US dollars [US$]; p-values corrected by the sequential Bonferroni method. THA: total hip arthroplasty.

Table 5. Average hospitalization length per patient for types of total hip arthroplasty performed in public hospitals in the municipality of São Paulo between 2008 and 2019, according to gender, age group, and municipality region.

	Cemented THA*	Non-cemented/hybrid THA*	Difference between non-cemented/hybrid – cemented*	p-value
Average hospitalization	5.42 [5.09; 5.77]	4.55 [4.33; 4.79]	−0.87 (−1.27; −0.46)	< 0.001
Sex				
Female	5.77 [5.17; 6.45]	4.60 [4.38; 4.84]	−1.17 (−1.86; −0.48)	0.001
Male	5.12 [4.76; 5.50]	4.50 [4.25; 4.77]	−0.61 (−0.97; −0.26)	< 0.001
p-value	0.087	0.199		
Age group				
< 55 years	5.58 [5.04; 6.19]	4.33 [4.07; 4.62]	−1.25 (−1.93; −0.57)	< 0.001
55-64 years	5.30 [4.75; 5.91]	4.37 [4.15; 4.60]	−0.93 (−1.52; −0.33)	0.002
65-74 years	5.08 [4.70; 5.48]	4.58 [4.35; 4.82]	−0.49 (−0.89; −0.10)	0.014
≥ 75 years	6.01 [5.43; 6.65]	5.39 [5.05; 5.75]	−0.62 (−1.26; 0.02)	0.059
p-value	0.082	< 0.001		
Region				
Center	6.37 [5.31; 7.65]	5.22 [4.64; 5.87]	−1.15 (−2.49; 0.18)	0.090
East	6.21 [4.35; 8.87]	5.72 [4.46; 7.34]	−0.49 (−1.40; 0.42)	0.288
North	6.45 [5.59; 7.45]	6.06 [5.13; 7.15]	−0.40 (−1.18; 0.38)	0.318
West	7.06 [5.73; 8.70]	4.47 [4.02; 4.96]	−2.59 (−4.23; −0.96)	0.002
Southeast	4.76 [4.60; 4.93]	4.21 [4.08; 4.34]	−0.55 (−0.66; −0.45)	< 0.001
South	4.70 [3.47; 6.39]	5.00 [4.08; 6.13]	0.30 (−2.05; 2.65)	0.805
p-value	< 0.001	< 0.001		

Results expressed by mean values (95 CI%); *values in number of days; p-values corrected by the sequential Bonferroni method. THA: total hip arthroplasty.

ICU stay length, estimated by mean ICU stay per patient subjected to THA, was 0.36 days longer for non-cemented/hybrid THAs than for cemented ones (p = 0.013) (Table 6). Comparing ICU stay length per THA types with gender, age group, and São Paulo region showed that non-cemented/hybrid THAs had longer ICU stays for all genders (p = 0.020 and p = 0.033) and those aged 55 to 64 years (p = 0.044), 65 to 74 years (p = 0.002), and ≥ 75 years (p = 0.004), whereas cemented THA showed longer ICU stays only in Eastern São Paulo (p = 0.004). We also found that THA types showed significant differences in ICU stay length among gender, age groups, and regions.

Death rates, assessed by the total number of deaths per patient subjected to THA failed to show a significant difference between THA types (Table 7). Comparing death rates and THA types with gender showed no significant differences. We were unable to adjust a comparison model for age group and São Paulo region due to the absence of deaths for some of these demographic variables.

Table 6. Estimated average length of ICU stay per patient for types of total hip arthroplasty performed in public hospitals in the municipality of São Paulo between 2008 and 2019, according to gender, age group, and municipality region.

	Cemented THA*	Non-cemented/hybrid THA*	Difference between non-cemented/hybrid – cemented*	p-value
Average ICU stay	0.61 [0.42; 0.88]	0.97 [0.82; 1.14]	0.36 [0.08; 0.65]	0.013
Sex				
Female	0.73 [0.52; 0.97]	1.06 [0.90; 1.24]	0.34 [0.05; 0.62]	0.020
Male	0.50 [0.25; 0.81]	0.87 [0.72; 1.04]	0.37 [0.03; 0.71]	0.033
p-value	0.048	< 0.001		
Age group				
< 55 years	0.41 [0.18; 0.69]	0.43 [0.36; 0.51]	0.02 (−0.25; 0.28)	0.907
55-64 years	0.60 [0.32; 0.94]	0.99 [0.84; 1.15]	0.39 [0.01; 0.77]	0.044
65-74 years	0.72 [0.47; 1.00]	1.29 [1.10; 1.50]	0.58 [0.21; 0.95]	0.002
≥ 75 years	1.02 [0.75; 1.33]	1.65 [1.39; 1.93]	0.63 [0.20; 1.06]	0.004
p-value	< 0.001	< 0.001		
Region				
Center	0.40 [0.22; 0.61]	0.23 [0.15; 0.32]	−0.17 (−0.35; 0.02)	0.078
East	1.25 [0.69; 2.00]	0.22 [0.08; 0.37]	−1.03 (−1.73; −0.34)	0.004
North	0.32 [0.28; 0.37]	0.18 [0.03; 0.35]	−0.15 (−0.35; 0.06)	0.161
West	1.78 [0.43; 4.39]	0.42 [0.29; 0.57]	−1.36 (−3.09; 0.38)	0.126
Southeast	0.76 [0.25; 1.46]	1.60 [1.21; 2.06]	0.84 (−0.03; 1.72)	0.059
South	0.55 [0.29; 0.85]	0.62 [0.15; 1.28]	0.08 (−0.62; 0.77)	0.832
p-value	0.048	< 0.001		

Results expressed by mean values (95 CI%); *values in number of days; p-values corrected by the sequential Bonferroni method. THA: total hip arthroplasty.

Table 7. Death rates by type of total hip arthroplasty performed in public hospitals in the municipality of São Paulo between 2008 and 2019, according to gender, age group, and municipality region.

	Cemented THA	Non-cemented/hybrid THA	Difference between non-cemented/hybrid – cemented	p-value
Death rate	0.26 [0.09; 0.76]	0.50 [0.34; 0.73]	0.24% (−0.08%; 0.56%)	0.142
Gender				
Female*	0.36% [0.13%; 0.96%]	0.57% [0.32%; 1.05%]	0.22% (−0.22%; 0.66%)	0.333
Male*	0.15% [0.02%; 1.01%]	0.40% [0.25%; 0.63%]	0.24% (−0.15%; 0.64%)	0.225
p-value	0.048	< 0.001		
Age group				
< 55 years	0.00%	0.09%		N/A
55-64 years	0.00%	0.30%		N/A
65-74 years	0.28%	0.37%		N/A
≥ 75 years	1.62%	2.30%		N/A
p-value	N/A	N/A		
Region				
Center	0.67%	0.28%		N/A
East	0.00%	0.40%		N/A
North	0.00%	0.94%		N/A
West	0.00%	0.70%		N/A
Southeast	0.24%	0.33%		N/A
South	0.00%	1.13%		N/A
p-value	N/A	N/A		

Results expressed by estimated mean values (95 CI%); p-values corrected by the sequential Bonferroni method. THA: total hip arthroplasty; N/A: not applicable.

DISCUSSION

The Department of Informatics of the Unified Health System (DATASUS) is an online, free-access electronic platform that stores and organizes information from the Unified Health System (SUS) in Brazil. This enables us to assess epidemiology and health care data, including on surgical procedures.[16] Based on this platform, we evaluated its information on the types of primary and elective THA fixation in public hospitals in São Paulo (the most populous municipality in the country) between 2008 and 2019, totaling 7,673 procedures.

We found a predominance of non-cemented/hybrid THA fixation, with 6,220 (81%) procedures. This technique is also predominant in Canada, Denmark,[20] and USA (99%).[21] However, cemented fixation still prevails in a few countries, such as Sweden (60%).[22] We find a global tendency toward cemented THA in older patients,[20] unlike this study.

Non-cemented/hybrid THA total costs (i.e., the amount hospitals receive for hospitalizations, materials) were US$ 495.27 ($p < 0.001$) higher than cemented ones, as were if assessed by gender and age group. However, DATASUS[16] fails to stratify implant cost, operating room time, and auxiliary material costs, only reporting their total value. This absence precludes a detailed cost analysis, which would enable us to define which are the most relevant in the final cost of the entire process.[23]

THA hospitalization length has substantially decreased in the last two decades due to improved analgesia, anesthesia, surgical technique, preoperative preparation, and early rehabilitation.[24] In the 1980s, mean hospitalization spanned from two to three weeks.[25] Recent studies report recoveries between two and five days.[24,26] This study found that mean hospitalization length for cemented THA (5.42 days) was significantly higher than for non-cemented/hybrid ones (4.55 days) ($p < 0.001$). Oh et al.,[27] described a different result, finding no significant difference between hospitalization time for cemented (4.88 days) and non-cemented THAs (3.76 days).

This study found that mean ICU stays were 0.36 days ($p = 0.013$) higher in patients who underwent non-cemented/hybrid THAs. This increase may be associated with a higher frequency of comorbidities and/or intraoperative complications, which required postoperative intensive care. Studies show a higher frequency of perioperative periprosthetic fractures in non-cemented THAs,[28,29] which could be one of the causes for longer ICU stays.

Increase in age may be associated with longer periods of hospitalization,[30] as found in patients who underwent non-cemented/hybrid THAs ($p < 0.001$). However, we found no such association for cemented THAs, probably due to their decreased number of cases, about five times lower than non-cemented/hybrid THA ones.

Note that, although all age groups had longer hospital stays due to cemented THA, their costs were still lower. Thus, although shorter hospitalizations relate to decreased hospital costs,[24] this seems to be neither the only nor the most important factor affecting costs.

Post-THA mortality rate is low and has decreased over the years,[31,32] around 0.7% for the first 90-postoperative days.[33,34] We found extremely low death rates, with no difference between THA types. However, we found that death rates tended to increase with patients' age, regardless of THA type.

This study has limitations we should mention. First, data capture and quality solely depends on how it is logged and made publicly available on the DATASUS TabNet platform. Second, this database enabled us to only categorize primary THA types into two groups, via codes 04.08.04.008-4 and 04.08.04.009-2 (for cemented and non-cemented/hybrid techniques, respectively). This limits the comparison of data between more groups, such as cemented, non-cemented, hybrid, and reverse hybrid techniques. Another limitation is the absence of clinical outcome and complication records, making it impossible to assess whether fixation types may relate to patients' recovery and quality of life.

Assessing THA fixation, involved cost, and patients' profile enables research to inform the public policies to be adopted for this population. Thus, our results help to describe this procedure for the relevant population by assessing the differences in hospitalization length, costs, and THA fixation types and providing data to managers and healthcare providers aiming toward the best adequacy of public resources.

CONCLUSION

Public hospitals in the municipality of São Paulo performed 7,673 primary and elective THAs between 2008 and 2019, showing a predominance of non-cemented/hybrid fixation (81%). Non-cemented/hybrid THA total costs (the amount hospitals receive for hospitalizations, materials, and produces) was higher than cemented ones. Regardless of fixation type, we found that both total and ICU costs were significantly higher for women and that they gradually increased as age did. Hospital stays were longer for cemented THAs. Death rates showed no significant differences between fixation types.

ACKNOWLEDGMENTS

The authors appreciate Dr. Edson Amaro Júnior and Prof. Dr. Nelson Wolosker's (from the Big Data Analytics and Data Science Center at Hospital Israelita Albert Einstein) support and encouragement. They also appreciate Mrs. Sandra Regina Malagutti's (statistician of the Research Support Center of the Albert Einstein Israeli Institute) support on statistical analyses.

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to the development of this manuscript. RPG: literature review, study design, data interpretation, manuscript writing; MRVG: literature review, data collection, data interpretation, figures and tables, manuscript writing and editing; EA: study design, data interpretation, figures and tables, manuscript editing and review; ML: study design, supervision, final approval of the manuscript.

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