



## EVALUATION OF HIP ARTHROPLASTIES IN TÜRKİYE IN TERMS OF HEALTH POLICY

## TÜRKİYE'DE KALÇA ARTROPLASTİLERİNİN SAĞLIK POLİTİKASI AÇISINDAN DEĞERLENDİRİLMESİ

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### Abstract

The aim of this study is to evaluate primary and revision total hip arthroplasty (THA) in terms of the burden it brings to the health system.. Primary and revision THAs, which were performed between 2013 and 2017 in public hospitals in Türkiye, were investigated retrospectively. Patients who underwent primary and revision THAs were examined in terms of their demographic and clinical characteristics. A total of 50,647 (7,472 revisions and 43,175 primary) procedures, were evaluated over a five-year period. The total number of hip arthroplasties has increased over the years. 84% of patients were 50 or older and 63.6% were women. Mechanical complications of the implant and every implant-related infection increase the probability of revision by approximately 77 times. The primary and revision THA numbers in Türkiye are increasing every year. Revision THA rates have been decreasing over the years in Türkiye.

**Keywords:** Revision rate, total hip arthroplasty, Turkiye

### INTRODUCTION

Total hip arthroplasty (THA) is a highly effective method to reduce pain and increase function in patients with severe symptomatic end-stage hip arthrosis (Melvin et al., 2014). It is reported that the life of prostheses with newly developed implants and surgical methods can extend up to 20 years in 85% to 94% of cases (Melvin et al., 2014). THA is the second most common inpatient procedure across the USA and is the reason behind 166.6 of every 100,000 hospitalizations (Healthcare Cost and Utilization Project 2020, n.d.). In Türkiye, 7.983 primary hip replacements were performed in 2014 and 8.686 replacements were performed in 2015; the number of procedures was increased significantly every year (Cetin, 2017).

Despite the successful application of hip prosthesis, revision surgery is needed as a result of the advance of the age of application, increasing prevalence (Wolford, Palso and Bercovitz, 2015), and failures in the process (Kurtz et al., 2005; Ong et al., 2006; Prokopetz et al., 2012). Joint prostheses



may fail due to improper surgical technique, infection, osteolysis, loosening and fracture of the implant, fractures in the bone structure, and the patient's inability to adapt to the prosthesis (Gwam et al., 2017). In addition, the possibility of revision is higher in older ages compared to younger ages, and in women compared to men (Kurtz et al., 2005). One of the most important risks for revision is that the same joint has been revised before (Ong et al., 2006).

The increase in revision procedures in the general population and as a percentage brings certain risks, both epidemiologically and financially. Revision burden (Kurtz et al., 2005), which is defined as the ratio of revision arthroplasties to the total number of arthroplasties, is increasing with each passing year. Typically, revision procedures have a shorter lifespan than primary procedures, as well as causing more complications, longer hospitalizations, and higher resource use, and therefore higher costs (Weber et al., 2018).

Revision hip replacements are likely to affect public health and the budgets of reimbursement agencies. The aim of this study is to evaluate primary and revision total hip arthroplasty in terms of the burden it brings to the health system. For this purpose, the annual number of arthroplasties, rates, and revision reasons of total hip arthroplasty performed in Turkey between 2013-2017 were examined.

## METHODS

### Data and ethical issues

The data covers Primary and Revision Hip Arthroplasty operations performed in public hospitals in Türkiye. In this study, the data of Primary Hip Arthroplasty and Revision Hip Arthroplasty performed between 2013 and 2017 were retrospectively analysed.

Patients who underwent primary and revision THA and aged 18 and over whose all data were fully accessed and whose invoices were processed by the Social Security Institution were included in the study. The exclusion criteria were determined as having malignancy, having revision secondary to trauma, patients aged under 18 years and whose data could not be obtained.

Patients who underwent primary and revision THA were examined in terms of their age, sex, and year of operation. These patients were examined in terms of having intensive care treatment, mechanical complications (dislocation, non-infectious loosening of the implant, malposition, insert wear, the implant breakage), periprosthetic joint infection, presence of knee arthrosis, polyarthrosis, diabetes mellitus (DM), hypertension (HT), cardiac disease, osteoporosis, and the presence of knee arthroplasty.

Research data was obtained from the Republic of Türkiye Ministry of Health Diagnosis-related groups database. Ethics committee approval dated 26.07.2023 and numbered E-93802310-050.01.04-2300023133 was obtained from Izmir Bakırçay University Non-Interventional Clinical Research Ethics Committee.

### Analysis

The data were arranged with Microsoft Excel (2016) and analysed with the SPSS 23 program. In the comparison of the two groups, the 2x2  $\chi^2$  test, and the independent sample t-test were used (Alpar, 2013).

Patients' gender, age, loosening and infection of existing implants, knee arthrosis, polyarthrosis, diabetes, blood pressure, heart failure, osteoporosis diagnosis, and presence of knee arthroplasty were taken as independent variables and the effects on the dependent variable, revision hip

arthroplasty procedure, were evaluated. To evaluate the reasons for the revision hip arthroplasty gender, age, mechanical loosening of the implant, the infectious complication of implant, knee arthrosis, diabetes, hypertension, cardiac disease, and the presence of knee implant variables were used to perform Binary Logistic Regression Analysis. The significance level was taken as  $p < 0.05$ .

## RESULTS

According to the results of the study, a total of 50.647 procedures, 7.472 patients undergoing revision hip arthroplasty, and 43,175 patients with primary hip arthroplasty, were evaluated in a five-year period. At least one of the primary hip arthroplasty or revision hip arthroplasty operations a conducted in every city in Türkiye. During this period, hip arthroplasty was performed the most in Istanbul (n = 8.426) and the least in Bayburt (n = 1). Table 1 lists the first seven cities where hip arthroplasty was performed, and it is seen that these provinces cover approximately 50% of the procedures performed.

**Table 1. Cities Where Hip Arthroplasty Procedures Were Performed the Most**

City	n	%	Cumulative %
İstanbul	8426	16.6	16.7
Ankara	5624	11.1	27.8
Trabzon	3044	6.0	33.8
İzmir	2517	5.0	38.8
Samsun	2324	4.6	43.4
Antalya	1840	3.6	47.0
Bursa	1829	3.6	50.6
Other Cities	25043	49.4	100.0
Total	50647	100.0	100.0

Table 2 shows the distribution of primary and revision hip arthroplasty procedures by years, gender, and age groups. It is observed that the number of total hip arthroplasties has increased over the years. While the share of primary hip arthroplasty procedures in total hip arthroplasty procedures has increased over the years, the rate of revision hip arthroplasty procedures has decreased. The rate of arthroplasty was higher in women (63,6%). Approximately 84% of hip arthroplasty procedures are patients aged 50 and over, and the rate of patients who underwent revision hip arthroplasty in this age group (15%) was higher than the revision rate of patients under 50 (13.4%).

**Table 2. Distribution of Hip Arthroplasty Types by Year, Gender, and Age**

		Arthroplasty of hip	Revision arthroplasty of hip	Total
2013	n	7099	1377	8476
	% within year	83.8	16.2	100
	% within Type of Arthroplasty	16.4	18.4	16.7
2014	n	7914	1489	9403
	% within year	84.2	15.8	100
	% within Type of Arthroplasty	18.3	19.9	18.6
2015	n	8640	1596	10236
	% within year	84.4	15.6	100
	% within Type of Arthroplasty	20	21.4	20.2
2016	n	9522	1497	11019
	% within year	86.4	13.6	100
	% within Type of Arthroplasty	22.1	20	21.8
2017	n	10000	1513	11513
	% within year	86.9	13.1	100
	% within Type of Arthroplasty	23.2	20.2	22.7
Male	n	15591	2828	18419
	% within year	84.6	15.4	100
	% within Type of Arthroplasty	36.1	37.8	36.4
Female	n	27584	4644	32228
	% within year	85.6	14.4	100
	% within Type of Arthroplasty	63.9	62.2	63.6
<50	n	5982	923	6905
	% within year	86.6	13.4	100
	% within Type of Arthroplasty	13.9	12.4	13.6
≥50	n	37193	6549	43742
	% with in the year	85	15	100
	% within Type of Arthroplasty	86.1	87.6	86.4
Total	n	43175	7472	50647
	% with in the year	85.2	14.8	100
	% within Type of Arthroplasty	100	100	100

Table 3 shows the comparison of revision hip arthroplasty rates between groups according to gender, age, intensive care treatment, a mechanical complication of the implant, an infectious complication of the implant, the presence of knee arthrosis, polyarthrosis, post-procedural infection status, diabetes diagnosis, blood pressure diagnosis, heart disease diagnosis, osteoporosis diagnosis, and the presence of knee implants.

According to the revision rates given in Table 3 based on the results of 2x2  $\chi^2$  test analysis, male patients, age group  $\geq 50$ , patients treated at intensive care unit, mechanical complications of the implant, infection due to implant, hypertension, cardiac disease, and knee implants had higher revision rates compared with the counterparts. In patients who underwent revision hip arthroplasty, the rate of infection after the procedure was found to be higher than the primary hip arthroplasty procedure.

**Table 3. The Evaluation of Differences in Revision Hip Arthroplasty Procedure According to the Patient Groups Variable**

		Arthroplasty of hip (n)	Revision arthroplasty of hip (n)	Total (n)	p
Gender	Male	15591	2828	18419	0.004*
	Female	27584	4644	32228	
Age	<50	5982	923	6905	<0.001*
	$\geq 50$	37193	6549	43742	
Intensive care	No	34888	5510	40398	<0.001*
	Yes	8287	1962	10249	
Loosening	No	42630	3966	46596	<0.001*
	Yes	545	3506	4051	
Infection	No	43078	6836	49914	<0.001*
	Yes	97	636	733	
Knee arthrosis	No	41981	7375	49356	<0.001*
	Yes	1194	97	1291	
Polyarthrosis	No	43158	7467	50625	0.291
	Yes	17	5	22	
Diabetes	No	39172	6659	45831	<0.001*
	Yes	4003	813	4816	
Hypertension	No	37954	6453	44407	<0.001*
	Yes	5221	1019	6240	
Heart diseases	No	42317	7275	49592	<0.001*
	Yes	858	197	1055	
Osteoporosis	No	42938	7426	50364	0.475
	Yes	237	46	283	



Knee Prosthesis Presence	No	43096	7449	50545	0.026*
	Yes	79	23	102	
Total		43175	7472	50647	

\*p<0.05

According to the results of logistic regression analysis, each of the mechanical complications of the implant and the infection due to the implant increases the probability of revision by approximately 77 times. Therefore, the two types of complications were considered to be the most common causes of revision. It was concluded that the revision rate was approximately 1.32 times higher in patients without a diagnosis of knee arthrosis (Tablo 4). We found that the average correct classification rate of the Binary Logistic Regression model was 92.1% (Table 5). According to these results, the significance of the chi-square test result and the R2 test statistics being above 0.20 demonstrated that the model fitness was good (Alpar, 2013).

**Table 4. Logistic Regression Results of the Revision Hip Arthroplasty Procedure**

	Wald	P	Exp(B)	95% C.I.for EXP(B)	
				Lower	Upper
Constant	1.207.165	<0.001*	360.900		
Revision due to loosening (1)	7.813.568	<0.001*	0.013	0.011	0.014
Revision due to infection (1)	1.509.976	<0.001*	0.013	0.011	0.017
Knee arthrosis (1)	5.439	0.02	1.319	1.045	1.665

Dependent Variables: Revision arthroplasty of hip

Model Chi-square=14480.118; p<0.05

Cox-Snell R2=0.249; Nagelkerke R2=0.439

\*p<0.05

**Table 5. Correct Classification Table for Logistic Regression Model**

	Predicted		Percentage Correct
	Arthroplasty of hip	Revision arthroplasty of hip	
Arthroplasty of hip	42541	634	98.5
Revision arthroplasty of hip	3377	4095	54.8
Overall Percentage			92.1

The cut value is 0.500

## DISCUSSION

In recent years, there has been an increase in the number of total hip arthroplasty performed in Türkiye. The increasing number of primary and revision total hip arthroplasties creates an increasing financial burden on the social security system. A regular increase was observed in primary procedures every year. The number of revision transactions also increased in 2013-2015. After the decrease in 2014, the increase continued in 2015. There was a steady decline in the



proportion of revision procedures within the total number of total hip arthroplasties over the research period. Considering that revision total hip arthroplasty is more costly and more difficult for the patient than primary arthroplasty (Weber, et. al., 2018), the result is positive. It is thought that the operation technique and the success of the prosthesis have a share in this positive result.

It has been found that primary total hip arthroplasty procedures are more common in female gender and patients aged 50 and over. Revision total hip arthroplasty procedures were applied more frequently to patients aged 50 and over. Considering that the revision process is done after a certain period of time after the primary procedure, this result is natural. When primary and revision procedure rates were evaluated according to gender, it was found that the rate was higher in male patients. Brinker et al., found that the mean age of total hip arthroplasty patients to be 65 years (Brinker et al., 1996). Basques et al. concluded that total hip arthroplasty patients consisted of approximately 61% of female patients and 68% of patients aged 60 and over (Basques et al., 2019). In another study, it was determined that approximately 60% of patients who underwent total hip arthroplasty were women (Delanois et al., 2018). Patel et al., were found that the rate of female patients was found to be approximately 59% (Patel et al., 2020). In our study, the rate of female patients who underwent total hip arthroplasty was 63.6%, and the rate of patients aged 50 and over was 86.4%. It is seen that the findings of this study are compatible with the literature information.

Birrell et al., in their projection study for the estimation of total hip arthroplasty numbers, predicted that the number of total hip arthroplasties will increase by approximately 40% by 2030 in the United Kingdom, provided that arthroplasty rates by sex, age, and gender remain the same (Birrell et al., 1999). In another study, Pilz et al. predicted that primary total hip arthroplasty procedures will increase by 27% in Germany by 2040, and this increase will occur mostly in patients aged 60 to 70 years (Pilz et al., 2018). Another study involving 20 OECD countries predicted that the total number of hip arthroplasty would increase by 100% in 35 years. In parallel with the increase in the procedure load, it is predicted that the budgetary burden of the total hip arthroplasty procedure and its share in the healthcare budget will also increase (Pabinger et al., 2018). In another study involving OECD countries, significant increases in total hip arthroplasty rates were reported. In the same study, it was reported that increases in hip arthroplasty expenditures are higher than the GDP and health expenditures of countries (Pabinger et al., 2018). In another projection study of the number of hip arthroplasty in the United States in 2030, it was estimated that the number of primary total hip arthroscopy procedures would increase by 174% in 2030 (Kurtz et al., 2007). According to the results of this study, it was determined that the number of total hip arthroplasties increased over the years, and the number of primary hip arthroplasties increased at a higher rate than revision hip arthroplasty procedures. It is thought that total hip arthroplasty will increase in parallel with the increase in population and elderly population in Türkiye. This can be interpreted as the number of revision total hip arthroplasty procedures and the financial burden of total hip arthroplasty will increase in the coming years.

In this study, revision total hip arthroplasty rates were found to be high in men and patients aged 50 and over. In addition, it was determined that the rate of revision hip arthroplasty was higher in patients who received intensive care treatment, with mechanical and infection complications of the implant, with diabetes, hypertension, and heart disease, and with knee implants compared to the patients in the opposite group. Mechanical complications, metallosis, dislocation or instability, infection, hematoma or delayed wound healing, periprosthetic fracture, pain, and other factors are among the causes of failure and revision of total hip arthroplasty (Badarudeen et al., 2017; Kelmer et al., 2021; Nugent et al., 2021; Ulrich et al., 2008). Bottle et al. reported that emergency applications for revision total hip arthroplasty procedures, drug use, being in the age group of 60 and over, and conditions such as Parkinson's disease are among the risk factors (Bottle et al., 2019).



## ULUSLARARASI SAĞLIK YÖNETİMİ VE STRATEJİLERİ ARAŞTIRMA DERGİSİ

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It has been reported that the operation time, complication rates, and, as a result, hospital costs are higher in revision hip arthroplasty procedures (Bozic et al., 2005). In this study, mechanical loosening and periostetic infection were found to be the most common revision causes. It has been calculated that mechanical loosening and periostetic infection increase the risk of revision 80 times.

The strength of this research is that it examines hip arthroplasty procedures performed in all public hospitals in Türkiye. In addition, the fact that it covers a five-year period instead of a single year data also shows the change over the years. On the other hand, the research is retrospective in nature, and the lack of cost analyses and projections can be seen among the limitations of this study.

### CONCLUSION

THAs are they are as expensive operations and affect large segments of society. So that is a significant cost for reimbursement agencies and an important public health issue. THA numbers (primary, revision, and total) in Türkiye show a steady increase every year. On the other hand, the revision rates among the total THA numbers have been decreasing over the years. The decrease in the revision rate is a positive indicator. However, it is seen that the main reason for this decrease is the rapid increase in primary THA numbers. Due to the increase in the number of primary THA and the prolongation of life expectancy, it is possible that the need for revision of THA will increase in the coming years. It is beneficial to develop health policies to meet the primary and revision THA needs.

The most common causes of revision THA are aseptic loosening and periprosthetic infection. In addition, the risk of revision is higher in the male gender, those aged 50 and over, those with hypertension and heart disease and knee replacement, and those receiving intensive care treatment at the first operation. It is thought that closer monitoring of the patients with these risks in the first operation and taking the necessary measures may contribute to the control of the revision numbers.

Estimating the primary and revision THA numbers in the coming years will be useful in guiding health policies. For this reason, it is recommended to carry out projection studies, as is done in other developed countries, to make the necessary preparations.

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