

THE IMPACT OF COVID-19 ON THE ORTHOPAEDIC PATIENT IN SLOVENIA: HIP AND KNEE REPLACEMENT SURGERY, 90-DAY MORTALITY, OUTPATIENT VISITS AND WAITING TIMES

VPLIV PANDEMIJE COVID-19 NA ORTOPEDSKEGA PACIENTA V SLOVENIJI: NA OPERACIJE ZAMENJAVE KOLKA IN KOLENA, SMRTNOST 90 DNI PO OPERACIJI, AMBULANTNE PREGLEDE IN ČAKALNE VRSTE

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ABSTRACT

Keywords:

COVID-19, hip replacements, knee replacements, 90-day mortality, outpatient clinics, waiting times

Introduction: The purpose of the study was to analyse the impact of the COVID-19 pandemic on the healthcare of the orthopaedic patient, i.e. numbers of hip and knee replacement surgeries, 90-day mortality, waiting times and outpatient clinic visits.

Methods: The Hip (HR) and Knee Replacement (KR) records from The National Arthroplasty Registry of Slovenia in the pandemic year 2020 were compared to the year 2019. To compare reasons for revision and 90-day mortality the Chi-square test was used. The median values of the number of operations and waiting times were compared with the 95% confidence intervals. The number of outpatient clinic visits was tested with the Wilcoxon Signed Ranked test.

Results: All operations fell by 19%, from 7825 to 6335. The number of Primary Total HR declined from 3530 to 2792 (21%) and the number of Primary KR from 3191 to 2423 (24%). The number of hip revisions declined by 10% and knee revisions by 25%. We did not find differences in 90-day mortality ($p=0.408$). Outpatient clinic visits fell from 228682 to 196582 (14%) per year. Waiting times increased by 15% for HR and by 12% for KR.

Conclusion: There was an inevitable drop in the number of surgeries and outpatient clinic visits in the spring and autumn lockdown. With the reorganisation of the orthopaedic service in Slovenia, the number of KR and HR stayed at a relatively high level despite the pandemic. An epidemiological model and mechanisms for the reduction of waiting times could overcome the impact of the epidemic.

IZVLEČEK

Ključne besede:

COVID-19, endoproteze kolka, endoproteze kolena, smrtnost v 90 dneh, ambulantna dejavnost, čakalne dobe

Uvod: Namen študije je bil analizirati vpliv pandemije COVID-19 na ortopedskega pacienta in sicer na dostopnost operacij zamenjave kolka in kolena, smrtnost v 90 dneh po operaciji, čakalne dobe na te posege in obiske ortopedskih ambulant v Sloveniji.

Metode: Primerjali smo podatke bolnikov iz Registra endoprotetike Slovenije (RES), ki so imeli v pandemičnem letu 2020 opravljeno zamenjavo kolka in kolena v primerjavi s predhodnim letom 2019. Vzroke revizij in smrtnost v 90 dneh po operaciji smo primerjali s testom Hi-kvadrat, vrednosti števila operacij in čakalnih dob pa s primerjavo medianskih vrednosti s 95-odstotnim intervalom zaupanja. Obiske ambulant smo primerjali z neparametričnim testom za odvisne vzorce - testom Wilcoxon Signed Ranked.

Rezultati: Število vseh operacij kolka in kolena, vključno s parcialnimi kolčnimi artroplastikami, se je zmanjšalo za 19 %, s 7.825 na 6.335. Število elektivnih primarnih totalnih kolčnih artroplastik se je zmanjšalo za 21 %, s 3.530 na 2.792. Število primarnih kolenskih artroplastik je padlo za 24 %, s 3.191 na 2.423. Število revizij kolčnih se je zmanjšalo za 10 %, revizij kolenskih endoprotez pa za 25 %. Razlik v 90-dnevni smrtnosti po operaciji nismo našli ($p = 0,408$). Obiski ambulant so se zmanjšali za 14 % z 228.682 na 196.582 letno. Čakalne dobe so se podaljšale za 56 dni (15 %) za artroplastiko kolka in 54 (12 %) za artroplastiko kolena.

Zaključek: Spomladi in jeseni se je število operacij in obiskov v ambulantah zaradi epidemije neizogibno zmanjšalo. Vendar smo z reorganizacijo ortopedske službe v Sloveniji v letu 2020 kljub pandemiji omogočili ohranitev števila kolčnih in kolenskih endoprotez na dokaj visoki ravni. Epidemiološki model, telemedicina in spodbujevalni mehanizmi za skrajševanje čakalnih dob bi lahko pomagali premagati vpliv epidemije na elektivne posege.

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1 INTRODUCTION

Coronavirus epidemics started in March 2020 and had a huge effect on elective surgery during the first wave, hip and knee arthroplasty included (1). Slovenia was one of the countries least affected in the first wave and most affected in the second wave of the epidemics (2). The health system had to prepare for high numbers of hospitalized COVID-19 patients. One of the measures was a reorganization of orthopaedic wards into COVID-19 treatment units in most general and both University Hospitals. At the same time, the public hospital specialized exclusively in orthopaedics remained open for most of the urgent revisions and other urgent orthopaedic cases as a referral hospital. A drop in elective surgeries, which we followed in The National Arthroplasty Registry of Slovenia (RES), i.e. hip and knee replacements, was inevitable.

Slovenia is a central European country with approximately two million inhabitants. The health system provides near-universal coverage paid by The Health Insurance Institute of Slovenia; co-payments are covered by private health insurance (3). They apply to most health services but not for infectious diseases, cancer, diabetes, congenital anomalies and neuromuscular diseases. In 2017, health expenditure accounted for 8.2% of GDP (4).

The first confirmed COVID-19 infection was reported on 4 March 2020 followed by the first lockdown on 12 March 2020. The country was successful in the control of the first wave in less than two months. The approach taken enabled the country to be the first in the EU to declare the end of the epidemic on 31 May 2020 (5). But after the summer holiday season the numbers started to increase very rapidly, so the declaration of the second wave and lockdown on 19 October 2020 was inevitable (2).

After the first wave, orthopaedic programmes were re-established as soon as the legal causes were eliminated (elective programmes were banned by a government decree) and the organizational issues of individual hospitals were resolved. In both lockdowns, the Minister of Health implemented strict control measures, all schools and educational institutions were closed, all public transport services stopped and all non-essential services shut. All non-essential outpatient visits and surgery appointments were put on hold with the exception of oncological services. This resulted in the cancellation of most elective surgeries. In the first lockdown, the recommendation was based on concerns about the quantity of personal protective equipment and blood components available at the time (6).

In May 2020 a study by the European Hip Society and European Knee Associates from 40 different countries stated that nearly all primary total joint arthroplasties were cancelled (92.6%), as well as aseptic revisions (94.7%). Urgent procedures (periprosthetic fractures, hip

arthroplasty for femoral neck fractures and septic revisions for acute infection) were still being performed (7).

During the second lockdown, all general and university hospitals in Slovenia recruited all resources for COVID-19 patients' treatment. The two University Medical Centres and general hospitals had to reorganize because of the massive input of COVID-19 patients. Orthopaedic departments were converted into COVID-19 departments and a part of the medical staff was transferred from surgery to COVID-19 departments (8).

Nevertheless, between the spring wave (March-May 2020) and the autumn wave of epidemics (October-December 2020), the registry recorded an increased number of elective arthroplasty surgeries.

The study aimed to analyse what the impact was of the COVID-19 pandemic on the healthcare of the orthopaedic patient, i.e. access to primary and revision hip and knee replacement surgery, change in 90-day mortality, waiting times and outpatient clinic visits in Slovenia.

2 METHODS

A retrospective study analysing data routinely collected from the RES registry, which had 92% and nearly 100% completeness in 2019 for hip and knee replacements, respectively, has been made (9, 10). The calculation of completeness was made regarding the comparison of the forms gathered in the registry and the data of procedures paid by The Health Insurance Institute of Slovenia (11). The publicly available data on waiting times and outpatient clinic visits, comparing the years 2019 and 2020, stratified by month, has been studied.

2.1 Description of patients in registry study

The characteristics of the patients involved in our study are described in Table 1.

The number of all operations in the RES registry was 7825 in 2019 and 6335 in 2020 (9, 10). To evaluate the influence on elective operations we excluded partial HR since they are done for hip fractures. So we analysed in total 6322 records of Primary Total Hip Replacement (THR) and 5614 records of Primary Unicondylar and Total Knee Replacements (KR) in the period from 1 January 2019 to 31 December 2020 from the RES registry. We compared Primary THR in 2019 ($N^{\circ}=3530$) to those made in 2020 ($N^{\circ}=2792$) and Primary Partial and Total KR in 2019 ($N^{\circ}=3191$) to 2020 ($N^{\circ}=2423$), stratified by month.

The same analysis was made on 669 hip and 372 knee revision operations, separately. We also compared them for reason for revision.

For 90-days mortality analysis after the procedure in the non-COVID-19 (2019) and COVID-19 year (2020), we

Table 1. Demographics of patients in 2019 and 2020.

Type of operation	Gender	2019			2020		
		N°	%	Age at operation (±SD)	N°	%	Age at operation (±SD)
Primary THR	Male	1610	46%	66.64 (±10.26)	1269	45%	66.14 (±10.87)
	Female	1920	54%	69.18 (±10.24)	1523	55%	69.71 (±10.50)
Primary Total and Partial KR	Male	1157	36%	67.80 (±8.54)	929	38%	67.97 (±8.84)
	Female	2034	64%	70.12 (±8.38)	1494	62%	70.19 (±8.67)
Revision HR	Male	168	48%	69.28 (±11.13)	123	39%	69.84 (±11.99)
	Female	184	52%	73.99 (±9.23)	194	61%	75.03 (±10.52)
Revision KR	Male	84	39%	68.13 (±9.74)	65	41%	68.40 (±7.84)
	Female	129	61%	69.83 (±10.01)	94	59%	71.53 (±8.80)
Sum of THR and KR	Male	3019	41%	67.96 (±9.92)	2386	42%	68.09 (±9.89)
	Female	4267	59%	70.78 (±9.47)	3305	58%	71.62 (±9.62)

reviewed the data on the vital status of patients in the RES registry from the Population Registration Division at the Slovenian Ministry of the Interior.

We compared the waiting times for primary HR and KR from The National Institute of Public Health (NIJZ) data service. Waiting periods for the surgery are evaluated on the first day of every month. In the article, the median change is presented.

We looked at the number of outpatient clinic visits in 2019 and 2020. The data are published on the website of The Health Insurance Institute of Slovenia (ZZZS), which covers all public services provided in Slovenia (11).

2.2 Statistics

The normality and homogeneity of variance were tested using the Kolmogorov-Smirnov test. The reasons for revision and 90-day mortality were analysed with a Chi-square test with a p-value of <0.05 as statistically significant. Median values of the number of operations and waiting times were analysed with 95% confidence intervals (CI). To check for statistically significant differences in the number of outpatient clinic visits per clinic, the nonparametric Wilcoxon Signed Ranked test for paired samples was used.

2.3 Technical information

The programme IBM SPSS Statistics for Windows, version 26.0 was used for statistical analysis.

3 RESULTS

3.1 Primary hip replacement

Comparing the pandemic year 2020 to the non-pandemic year 2019, we noticed an evident drop in all operations, including partial HR, of 19% from 7825 to 6335. To see more clearly the impact on elective hip surgery, we compared Primary THR. They fell 21% from 3530 operations in 2019 to 2792 in 2020 (9).

The two waves had an impact on Primary THR, which decreased by 84% in April 2020, compared to the value in April 2019, and increased by 99% in August 2020, compared to the same month in 2019, and then dropped again by 86% in November 2020 compared to November 2019 (Figure 1).

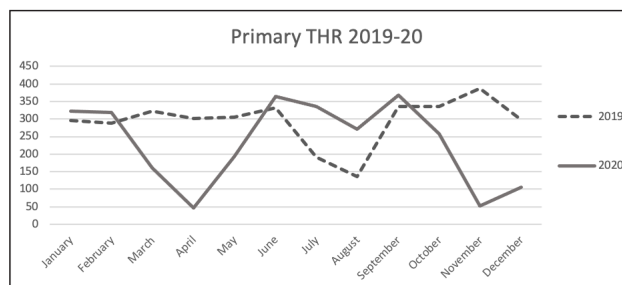


Figure 1. Comparison of surgery volumes of THR in 2019 and 2020 per month.

Comparing the 95% CI of THR performed monthly in 2019 and 2020, the difference was not statistically significant. The median in 2019 was 304 operations per month, 95% CI 289 to 335. The Median in 2020 was 264 operations per month, 95% CI 105 to 336 (Figure 2).

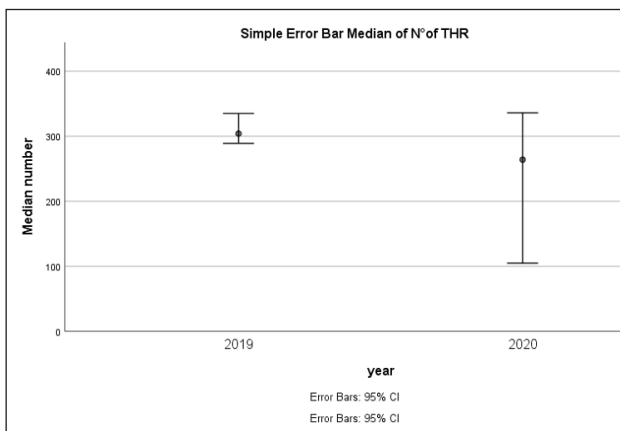


Figure 2. Simple Error Bar comparing 95% CI of two medians of THR per month in 2019 and 2020.

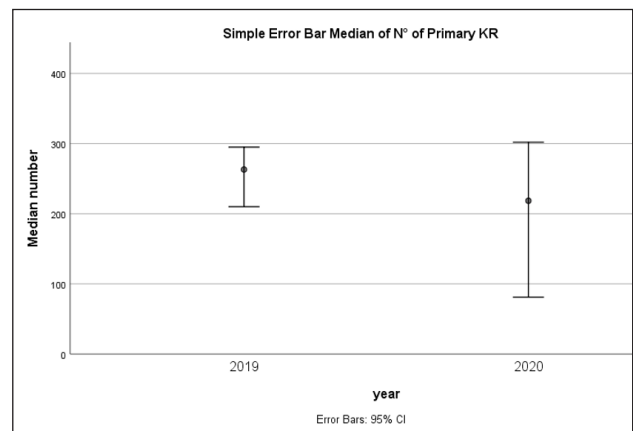


Figure 4. Simple Error Bar comparing 95% CI of two medians of KR per month in 2019 and 2020.

3.2 Primary knee replacement

Primary KR has fallen from 3191 to 2423 (24%) operations from 2019 to 2020 (10).

The number of KR surgeries decreased by 91% in April 2020 below the levels in April 2019. The volume then increased during the summer, reaching a 59% higher level in August 2020 compared to the same month in 2019, but reaching the bottom again in November 2020 with 90% fewer KRs compared to November 2019 (Figure 3).

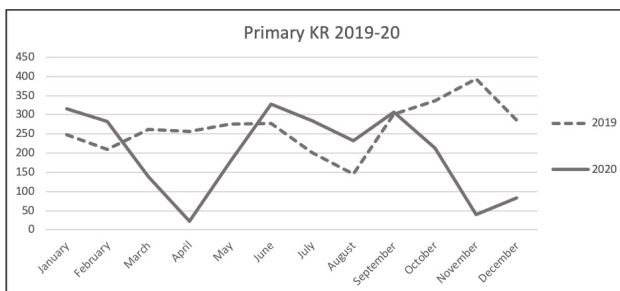


Figure 3. Comparison of surgery volumes of KR in 2019 and 2020 per month.

Comparing the 95% CI of KR performed monthly in 2019 and 2020, the difference was not statistically significant. The median in 2019 was 263 operations per month, 95% CI 210 to 295. The median in 2020 was 218.5 operations per month, 95% CI 81 to 302 (Figure 4).

3.3 Revision procedures

There were 35 fewer (10%) hip revisions and 54 fewer (25%) knee revisions in 2020 compared to 2019. Comparing the 95% CI of the two years for Hip Revisions, stratified by month, the difference was not statistically significant. The median in 2019 was 27.5 operations per month, 95% CI 26 to 34. The median in 2020 was 26.5 operations per month, 95% CI 19 to 36. The difference was also not statistically significant in Knee Revisions stratified by month. The median in 2019 was 18 operations per month, 95% CI 15 to 19. The median in 2020 was 15.5 operations per month, 95% CI 5 to 19.

We analysed also the influence of the pandemic on reasons for revision in 2020 compared to 2019. The Chi-square value was statistically significant at the 0.05 level ($p=0.025$) for reasons for HR revisions, but when comparing a single reason, only pain ($p=0.001$) was statistically significant. The Chi-square value was not statistically significant at the 0.05 level for reasons for KR revisions ($p=0.073$), so we did not find differences in reasons for KR revisions between 2019 and 2020, except for pain as the reason ($p=0.036$) (Table 2).

3.4 Mortality

The 90-day mortality after HR and KR is presented in Table 3. The table contains numbers of operated patients by type of operation and the number and percentage of deaths in 90 days after operation in two time periods (2019 and 2020).

With the numbers available we cannot support the notion that there was a difference in 90-days mortality between 2019 and 2020 ($p=0.408$) for all types of operations. The Chi-square test for 90-days mortality after each type of operation separately in 2019 compared to 2020 showed no statistically significant difference either.

Table 2. Reasons for revision for hip and knee replacements.

Reason for revision	Hips			Knees		
	2019	2020	χ^2 df(1)	2019	2020	χ^2 df(1)
	N°	N°	p-value	N°	N°	p-value
2-stage revision	20	22	0.503	22	21	0.390
Aseptic loosening	117	99	0.579	34	32	0.298
Deep infection	42	48	0.224	82	50	0.160
Dislocation	37	21	0.074	0	0	NA
Broken Implant	12	9	0.673	0	0	NA
Malalignment	0	0	NA	21	21	0.313
Other	41	28	0.232	29	19	0.636
Pain	10	27	0.001	20	6	0.036
Periprosthetic fracture	73	63	0.781	5	10	0.056
Chi-square test	χ^2 df(7) p=0.025			χ^2 df(6) p=0.073		

χ^2 =Chi-square test; df= degrees of freedom; NA= not applicable

Table 3. 90-day mortality after primary and revision HR and KR.

Type of operation	2019			2020			χ^2 df(1)
	N° of operations	N° of deaths in 90-days	% of deaths	N° of operations	N° of deaths in 90-days	% of deaths	p-value
Primary THR	3691	15	0.4	3436	14	0.4	0.994
Primary Total and Partial KR	3191	4	0.1	2423	8	0.3	0.100
Revision HR	352	11	3.1	317	14	4.4	0.379
Revision KR	213	5	2.4	159	2	1.3	0.444
χ^2 df(3)	p=0.408						

χ^2 =Chi square test; df= degrees of freedom

3.5 Waiting times

There were on average 56 days (15%) of increased waiting times for hip surgery and 54 (12%) for knee surgery in 2020 compared to 2019, stratified by month. The median in 2019 for HR was 393 days, 95% CI 349 to 397; in 2020 it was 472 days, 95% CI 393 to 499. The median in 2019 for KR was 496 days, 95% CI 370 to 534. The median in 2020 was 572 days, 95% CI 511 to 582. The difference in waiting times was still not statistically significant.

3.6 Outpatient orthopaedic visits

The number of outpatient clinic visits has fallen by 32100 (14%), from 228682 in 2019 to 196582 in 2020. To check for statistically significant differences in the number of outpatient clinic visits per clinic between 2019 and 2020, the Wilcoxon Signed Ranked test for paired samples was used. The result ($z=-4.076$, $p<0.01$) confirms the hypothesis that there were statistically significant fewer outpatient clinic visits in 2020 compared to 2019.

4 DISCUSSION

The first wave of COVID-19 had a large impact on elective hip and knee primary replacements in Slovenia (84% and 92% decrease in April 2020, respectively), in the summer period the numbers mostly recovered up until the second wave when we noticed an 86% and 90% decline in November 2020, respectively. Very similar results were observed in Milan, Italy, where elective surgery in the first wave declined rapidly, going close to zero, outpatient admissions were restricted to cases that cannot be postponed, while emergencies increased due to the role played by the hospital as a referral orthopaedic centre during the pandemic (1). The history of pandemics suggests that there is no predictable temporal pattern for major pandemics, so the next waves of epidemics seemed inevitable (12). In the post-acute phase, a normal surgical programme can be resumed step-by-step, taking into account clear hygiene regulations, the occupancy of the ward and the operating room adjusted accordingly (13, 14). However, a quick return to the normal volume of surgeries

can be obstructed by the fact that many patients refuse to undergo rescheduled surgery (15). We managed to increase the number of surgeries in the summer months, between two lockdowns, substantially. Accepting rescheduled surgery was not a problem in our population of patients. The specialized orthopaedic hospital as a referral hospital took the main role in regaining the numbers between the two waves.

Despite the temporary increase, the number of HR and KR in 2020 was 19% lower than in 2019. Nevertheless, the difference was not as prominent as we expected. Within these numbers, we did not find the drop to be statistically significant. The number of surgeries did not decrease significantly, however it was lower than the year before COVID-19. But, if we take into account a steady yearly increase in the number of surgeries by approximately 5% per year before the pandemic (16), then the decrease in surgeries is even more obvious.

The COVID-19 epidemics and their consequences were associated with higher all-cause mortality compared to previous years. There were more than 530000 additional deaths from January to December 2020, against the average number of deaths during the same period between 2016 and 2019 in the EU and in Iceland, Norway, Liechtenstein and Switzerland (17). The data from Italy showed increased 7-week mortality after surgery, which was 1.2% in 2020 compared to 0% in 2019 (18). According to the Population Registration Division in Slovenia, there were 3648 (17%) additional deaths in 2020 compared with the average between 2015 and 2019 (2). The highest increase in mortality was in November 2020, at 89.5% compared to 2019. The age group over 72 represents 72% and the age group 62 -71 years an additional 16% of all excess deaths (2). Since the mean age of orthopaedic patients at surgery is 68 years for primary THR and 83 years for primary Partial HR, we expected increased 90-day mortality after the hip and knee arthroplasty (9, 10). But our data did not support that. The answer is perhaps in the selection of patients for elective surgery. They are all screened for other illnesses (in the COVID-19 era they are tested also for this disease). The patients who underwent hip or knee replacement have also better relative survival compared to the Slovenian population (19). Other outcome indicators such as Patient Related Outcome Measures (PROMs) should be analysed to see the change in the quality of life, but we did not have access to routinely gathered data.

Accessibility to healthcare can be limited for several reasons, including cost, distance to the closest health facility and waiting times, and this may result in poorer health for people forgoing care (20). Nevertheless, hospital-related factors are more important than patient characteristics as explanations of variations in waiting times for orthopaedic surgery (21). The effect of the COVID-19 pandemic on waiting times for KR and HR in

Slovenia showed 15% days per month higher waiting time on average for hip surgery and 12% for knee surgery in 2020 compared to 2019, which was less than we expected. In an OECD report, median waiting times for HR in 2019 ranged from 35 in Denmark to 250 days in Estonia. Slovenia with 393 days was at the tail end. The long waiting times are partly explained by the limited volume of specialist consultations reimbursed by public health insurance. According to the OECD report of 2018, Slovenia has the feature of no large differences in unmet needs for medical examination between high and low-income populations (20). The pattern is generally the same for knee replacement, where Slovenian patients have to wait 496 days for KR (20). In the UK, up until November 2020 the waiting list remained approximately double the size of the pre- COVID-19 waiting list (22). This was not the case in Slovenia, where the increase was 15% for HR and 12% for KR. However, with already long waiting times, even a relatively small increase can have a pronounced impact on patients' health.

Analysis of the impact on outpatient visits of Medicare data showed overall outpatient visits decreased by 30.0% in the first half of 2020 (23). Cardiovascular visits conducted in the first 15 weeks of the COVID-19 pandemic decreased by 33.1% compared with the same period in 2019 (24). Interestingly, in our study outpatient orthopaedic visits dropped by only 14% in 2020 compared to 2019. The cause was in the disruption of services on the primary level as well as on the secondary level. This drop could be partially replaced by telemedicine solutions such as the telemonitoring, provision of healthcare services by remotely connecting patients with healthcare professionals and remote cooperation for the patient's treatment between healthcare professionals who are physically at different locations (25). The experts in epidemiology, data science and statistics should make an epidemiological model that simulates different scenarios of the dynamics of the disease (26).

There are limitations to our study. When comparing the number of THR and KR in Slovenia one year before the pandemic (2019) and in the first year of the pandemic (2020), only the difference between outpatient clinics was statistically significant. The reason that other differences did not show a significant result could be because the reorganisation of planned surgeries during the summer of 2020 resulted in large month-to-month variations, and also that just two years were taken into consideration. Since the collection of data for The National Arthroplasty Registry started in 2019, there were no prior data available.

5 CONCLUSION

Based on the results, we can conclude that there was an inevitable loss of elective surgery and outpatient clinic visits in 2020, with an impact on orthopaedic patients' needs. During the lockdowns, urgent surgeries were performed in a few hospitals with strictly divided departments and in a specialized orthopaedic hospital, which remained open for orthopaedic emergencies only and was all the time predominantly a COVID-19 "free" institution. A positive impact of the public system was that it enabled the circulation of patients between hospitals. So the majority of urgent revisions (KR and HR) during the first lockdown were made in the specialized orthopaedic hospital that served as a referral hospital. The same hospital was the first to resume a normal pre-pandemic volume of surgeries, followed by orthopaedic departments in general and university hospitals. This reorganization of the orthopaedic service in Slovenia and increasing volume of surgeries in COVID-19 "free" months have been an example of good practice to maintain the number of KR and HR at a fairly high level in 2020, so it should be taken as a recommendation for dealing with epidemic work conditions in orthopaedics.

In Slovenia, the cap on the number of surgeries per hospital can limit the yearly number of total HR and KR surgeries in public institutions (3). For the reduction of waiting times, it requires a range of policy initiatives, including higher spending, waiting-times target schemes, and other incentive mechanisms (27). Nevertheless, further investigations of lower health expenditure due to the outage of orthopaedic treatments are needed.

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CONFLICTS OF INTEREST

The author SK declared the following potential conflicts of interest concerning the research, authorship, and/or publication of this article: Personal fees from De Puy for lectures during the last 36 months. The other authors declare that no conflicts of interest exist.

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ETHICAL APPROVAL

This is a retrospective cohort study analysing data routinely collected from the national registry and publicly available data for audit and research. Upon the advice of the Institutional Ethical Board, we did not attempt to seek ethical approval.

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