



# One year of the COVID-19 pandemic in Poland—the incidence of osteoporotic forearm, arm, and hip fractures

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Received: 8 November 2021 / Accepted: 23 February 2022

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## Abstract

**Summary** The study attempts to analyse whether the COVID-19 pandemic affected the incidence of forearm, arm, and hip fractures during a 1-year observation period. Additionally, changes in the overall treatment costs of those fractures were estimated. During the COVID-19 pandemic, the incidence of forearm, arm, and hip fractures remained statistically unchanged, neither were any significant changes observed in the expenditure, incurred for the treatment of the fracture cases.

**Purpose** The purpose of the study was to find out and evaluate if the consequences of COVID-19 pandemic (including lockdown and the fear of infection) influenced the incidence of osteoporotic forearm, arm, and hip fractures and to estimate the changes in the costs of their management during one-year observation period.

**Methods** The incidence of forearm, arm, and hip fractures was collected for the population, aged  $\geq 50$ , residing at the district of Tarnowskie Góry and the Town of Piekary Śląskie, Poland, during 1 year of COVID-19 pandemic (from March 16th 2020 to March 15th 2021). The obtained results were compared with the number of corresponding limb fractures, recorded before the pandemic during five consecutive yearly periods, each starting from 16th March and ending on the 15th March of a subsequent year, the entire period covering the years 2015–2020. The rates of the analysed fractures were calculated per 100,000 inhabitants together with their economic impact.

**Results** The mean numbers and the incidence rates of upper extremity fractures were slightly lower during the COVID-19 pandemic than in the previous 5 years, whereas hip fracture figures remained almost stable. The observed changes were not statistically significant. That annual observation revealed a slight decrease in expenditure volumes, when compared to the analysed period before the pandemic (−0.33%).

**Conclusion** The decreased incidence rate of forearm, arm, and hip fractures, observed during the first months of the COVID-19 pandemic, was not statistically significant in the 1-year observation. After several weeks/months under the shock, caused by government limitations and the fear of infection, the number of patients remained unchanged during the one-year observation.

**Keywords** Fracture · COVID-19 pandemic · Forearm · Arm · Hip

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## Introduction

The COVID-19 outbreak that began in China has infected millions of people worldwide [1]. The first patient in Poland, infected with SARS-CoV-2, was officially diagnosed on 4th March 2020 [2]. On the 11th March 2020, The World Health Organization (WHO) declared that the global crisis over the new coronavirus was a pandemic [3]. Before the declaration of the pandemic in our country (20th March 2020), very worrisome reports were published in Italy [4]. The first lockdown procedure in Poland was announced on the 16th of March [5]. It was the first official restriction, imposed on human migration and meetings. TV programs and websites all over the world brought streams of information about dangers, associated with SARS-CoV-2 infection, influencing populations' behaviours [6], as the raised fear of COVID-19 infection became really huge [7]. Because of government restrictions (lockdowns, quarantines) and COVID-19-phobia, people locked themselves at their houses, avoiding going outdoors as much as possible and stayed at home even if they needed medical consultation. The COVID-19 pandemic has had a marked impact on societies around the world. Patients did not arrive at hospitals or call ambulance services even for cardiological or surgical reasons [8, 9]. That situation affects both adults and children [8–11]. These circumstances refer also to patients after a fall from a standing position [10]. Considering the most common osteoporotic fractures, the situation looks similar [12]. In case of upper extremity fractures, people suffer from pain for several weeks but, afterwards, they usually recover achieving almost their normal fitness [13, 14]. The situation is different after hip injury (femoral neck or per/subtrochanteric fractures), which is the most challenging type of fracture both for affected patients and their families, due to the patient's inability to carry out daily activities—patients remain in bed for many weeks suffer from severe pain and symptoms related to blood loss. Furthermore, the cumulative mortality rate for the 12 months is about 30% [15].

Regarding our previous report, analysing the early pandemic period, we observed decreased fracture incidence rates in Poland at each analysed location, i.e. the forearm, the arm and the hip [16]. We collected the data for the first weeks of the COVID-19 pandemic when a very strict 'lockdown' strategy was introduced (the first 77 days, from 16th March to 31st May 2020). Currently, we extended the observation period to one year. The aims of our study remain unchanged. The longer observation period should give a wider data with a more accurate analysis of the pandemic impact on possible changes in people's behaviour. Numbers of patients with low-energy fractures at emergency departments may be linked to these behaviour changes.

The primary aim of this study was to evaluate the impact of the pandemic restrictions and the fear of the SARS-CoV-2 virus on the number of patients at the emergency department with osteoporotic fractures, mainly of the forearm, arm and hip.

The secondary aim was to analyse the influence of fracture rate changes on the expenditure pattern for the Polish health care system [17].

## Methods

The incidence of low-energy forearm, arm and hip fractures, defined as a result of falling from a standing height or less, were collected for the population aged  $\geq 50$  years, at the district of Tarnowskie Góry and the Town of Piekary Śląskie (both are in Upper Silesia Region at the South of Poland), during the first year of COVID-19 pandemic, when the 'lockdown' strategy was periodically introduced—from 16th March 2020 to 15th March 2021. The study area comprised both urban and rural settlements. The fractures were identified according to ICD-10 classification (appropriate subtypes of S42, S52, and S72 codes) from medical records at the Trauma Surgery Hospital in Piekary Śląskie—the only orthopaedic surgery hospital in that area. Each fracture was diagnosed by X-ray. Additionally, V00- Y99 ICD-10 codes, which describe the external causes of morbidity, were analysed to identify and exclude all high-energy fractures from the study. For comparisons with previous years, the numbers of forearm, arm and hip fractures were also collected for the five consecutive yearly periods between years 2015–2020, where each year of observation started from 16th March and ended on the 15th March of a subsequent year. Then, the rates of analysed fractures were calculated per 100,000 of the population, aged  $\geq 50$  years, with a 95% confidence interval, based on the number of inhabitants at this age category in the whole district. In consecutive years for period 2015–2020, there were 75,567, 76,194, 76,740, 77,151, 77,744, and 78,129 residents, respectively [18]. Incidence rate ratios of fractures rates before the pandemic and during the pandemic period were calculated based on the Poisson regression model. In order to estimate a potential impact of changes in the fracture incidence rates during the COVID-19 pandemic on the Polish healthcare system, the costs of individual patient management were taken into account and the financial data were sourced from the Polish National Health Service report, published in November 2019 [17]. The costs of medical care for an individual case of forearm, arm or hip fracture, expressed in Euro, were € 215, € 330 and € 1720, respectively. The mean total annual number of osteoporotic forearm, arm and hip fractures was then calculated for the whole country of Poland, based on the above-mentioned

**Table 1** The number and incidence rates of fractures before and during the COVID-19 pandemic in the studied area

Location	The mean number of fractures before the pandemic	The number of fractures during the pandemic	The mean incidence rate before the pandemic (n/100000 with 95% confidence interval)	The incidence rate during the pandemic (n/100000 with 95% confidence interval)	IRR with 95% confidence interval	<i>p</i>
Forearm	270.0 ± 36.5	225	352.1 (311.4–396.7)	288.0 (251.6–328.2)	0.82 (95% CI: 0.60–1.09)	0.19
Arm	141.4 ± 14.2	122	183.9 (154.8–216.9)	156.2 (129.7–186.4)	0.85 (95% CI: 0.65–1.08)	0.20
Hip	173.2 ± 9.1	182	225.6 (193.3–261.9)	232.9 (200.3–269.4)	1.03 (95% CI: 0.93–1.14)	0.56

IRR incidence rate ratio

rates. In order to estimate changes in costs of medical services for fractures treatment, provided during the pandemic period, the mean numbers of fractures for observing periods in the years 2015–2020 and the number of fractures in the current period of observation were multiplied by the medical care costs for each fracture site. All the results are presented for males and females together.

## Results

The numbers of forearm, arm and hip fractures during the first year of the COVID-19 pandemic in the analysed region were 225, 122 and 182. The mean numbers and incidence rates of upper extremity fractures during the COVID-19 pandemic were slightly lower than during the 5 previous years, whereas, the number of hip fractures remained almost stable. The differences were not statistically significant at any fracture location (Table 1).

The numbers of fractures and their treatment costs, estimated for the whole country in a period of five consecutive years 2015–2019 and in the current 365-day period of observation during the pandemic time are presented in Table 2. The estimated numbers of sustained forearm, arm, and hip fractures, adjusted for the whole country in the pandemic period were 41,486, 22,472, and 33,564. The total annual number of fractures at the analysed skeletal sites was for 10,451 (9.68%) lower than before the pandemic.

The expected nationwide reduction of expenditure for the forearm and arm fracture treatment was estimated for 17.04% and 15.67%. However, the costs of hip fracture treatment increased by 5%, compared to the time before the COVID-19 pandemic. In general, the entire costs of fractures treatment decreased for 0.33% only (Table 2).

## Discussion

In relation to analysed low-energy fractures of the upper extremity, the decrease of the incidence rate of forearm fractures was the most noticeable during the pandemic period, similar to other countries [19–21]. Regarding the results of the other study, the same situation was observed in other Polish regions [22], but this study reported the results just for 7 months (from March 15th to October 15th, 2020) only and the period of observation did not cover the winter season with an expected increase in fracture incidence. The trend of a low forearm fracture number during the pandemic could be due to the following three causes: firstly, people had to stay at home due to lockdown restrictions or quarantines, whereas, according to literature, the most common mechanism of forearm fracture is falling while walking outside [23]; secondly, there was the fear of catching COVID-19 infection at the hospital; thirdly, there were transport problems to hospital during quarantines and injury symptoms were reduced after the quarantine expires and the refusal

**Table 2** The number of fractures in the whole country and the costs of their treatment

Location	'Background' mean annual number of fractures in 2015–2019 years	The number of fractures during the pandemic year (2020/2021)	The costs of treatment of individual fracture in Poland (euro)	The mean annual cost of treatment before the pandemic (euro)	The cost of treatment during the pandemic (euro)	Difference (euro)
Forearm	50008	41486	215	10 751 720	8 919 490	-1832230 (-17.04%)
Arm	25999	22472	330	8 579 670	7 415 760	-1163910 (-13.57%)
Hip	31966	33564	1720	54 981 520	57 730 080	+2748560 (+5.00%)
Total	107973	97522	xxxx	74 312 910	74 065 330	-247580 (-0.33%)

of elderly patients to participate in diagnostic procedures, regarding suspected fractures.

The incidence rate of humeral fractures was also lower but that decrease was less pronounced. As described in the literature, the epidemiology of humeral fractures is still unclear. Some studies refer that the majority of the fractures result from falls on the floor at home, while other studies refer that humeral fractures take place mostly in winter months, suggesting a higher incidence of outdoor falls [24, 25]. Our results confirmed the thesis that staying at home reduces the number of humeral fractures. However, we could not exclude the impact of the problems described above (COVID-19 phobia and quarantine-related issues). A similar situation of less humeral fractures was also described in Italian and British hospitals [26, 27].

It is quite different in the case of hip fractures, where the imposed circumstances, including the immediate inability for personal care, as the affected patient is bedridden and suffering, are far from inducing the patient's refusal to admit the emergency department and orthopaedic ward. At the beginning of the pandemic, we observed a decrease in the number of patients with hip injury [16]. However, the situation changed during the entire year of observation. Many families used to call the ambulance after a fall due to the patient's immediate walking inability. Furthermore, the most common mechanism of injury was indoor falling, thus, according to results from our study, there could be considered that lockdown had not affected the overall hip fracture rate [28]. Then, it is also necessary to take into account greater care for the elderly because families either did not need to go to work or worked at home. According to worldwide literature reports, the impact of the COVID-19 pandemic on the number of patients with hip fractures was different. A decrease in hip fracture incidence was observed in India, Hong Kong and in one region of Spain but in those studies, the period of observation was only two months maximum [20, 29, 30]. In another Spanish region, the number of osteoporotic hip fractures remained stable throughout the observation period, except of only the first 20 days of the pandemic [31]. British observations confirmed that estimation [32].

Economically, the COVID-19 pandemic did not affect the financial funding of osteoporotic fracture treatment. The annual observation shows a slight decrease in the expenditure, compared to the period before the pandemic (-0.33%). However, considering the annual increase of elderly population rate in Poland [33], which increases the total costs of their medical treatment, even a slight decrease in expenditure seems to be remarkable.

Our study has several limitations. We studied a population of one region of Poland only and the extrapolation of the results for the whole country to estimate the number of fractures and the costs of their treatment may not be relevant to the whole country. Due to the

relatively small number of fractures, no separate studies were undertaken for females and males. We also did not collect data on the trends in the use of anti-resorptive therapy or vitamin D supplementation over the prior years or on any other confounding factors that could have impacted the fracture risk in the current year, what could be considered as a limitation of the study. We did not estimate the number of spine fractures because of poor clinical symptoms and no fall history in most cases and possible bias consequently [34].

Concluding, the substantial decrease in the incidence rates of forearm and arm fractures, observed during the first months of the COVID-19 pandemic, was not statistically significant during the one-year observation. The studied patients, after several weeks/months of shock, caused by governmental restrictions and the fear of infection, did not reveal any changes during the one-year observation. The number of hip fractures in our region also remained stable during the pandemic period in comparison to previous years [28]. The decrease in treatment costs, which was confirmed by observations of the early pandemic period with a strict-lockdown-strategy, became almost negligible during the whole year observation. There could be summarised that the outbreak of the pandemic caused only short-term changes in the incidence of the forearm, arm and hip fractures, with subsequent 'rebound' phenomena after the release of pandemic strategy.

## Declarations

**Conflict of interest** None.

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