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ORIGINAL ARTICLE – OPEN ACCESS

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Distribution of Orthopedic Surgery Interventions: Evaluation of 6236 Cases

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ABSTRACT

Objective: Epidemiological studies can provide valuable guidance for the planning and improvement of healthcare services and medical education. In developing as well as developed countries, orthopedic interventions are considered basic healthcare and there is very high demand. The aim of this study was to determine the distribution of orthopedic and traumatological surgical interventions performed at state hospitals in a province of Turkey and to calculate the number of orthopedic beds required for that population.

Materials and Methods: The data of all patients who underwent an orthopedic surgery at 2 state hospitals between March 1, 2019 and February 29, 2020 were reviewed. The interventions were grouped according to 11 types and assessed with details of age, sex, and length of hospitalization.

Results: In total, 6236 orthopedic surgical procedures were performed in 5971 hospitalizations. The average duration of hospitalization was 3.2±6.1 days, and the average daily bed requirement was 52.2 beds. The surgical procedures most frequently performed were due to hand injuries, gonarthrosis, and femur fractures. Approximately half of all of the procedures were due to trauma. In all, 54.3% of all orthopedic interventions and 66.7% of trauma cases were observed in male patients. Trauma cases were more common in spring and summer.

Conclusion: Approximately 2 trauma cases were observed per 1000 people in the population. The most common elective surgeries were arthroplasty and arthroscopic interventions, whereas the most frequent traumatological cases were hand injuries and femoral fractures.

Keywords: Arthroplasty incidence, arthroscopy incidence, hand trauma incidence, orthopedic epidemiology, trauma epidemiology

INTRODUCTION

Epidemiological studies play an important role in the planning of healthcare services and medical education. The trends in orthopedic surgeries are related to technological development, and the distribution of surgical applications may change over the years. In addition, modifications to the habits of society (diet, movement, occupations, etc.) and age distribution may also lead to changes in orthopedic requirements. Although orthopedic and traumatological cases are very important to public health, both economically and socially, a review of the literature revealed no known extensive study. Most often, reports are narrow-group epidemiological studies of surgical methods (1–5).

Kayseri province is a socioeconomically blended city that reflects average global statistics of income distribution, occupational classes, and lifestyle. The total population is around 1.4 million, according to the 2019 census. Two state hospitals in the province, Kayseri Education and Research Hospital (KERH) and Erciyes University Hospital (ERU), provide orthopedic surgical interventions in their orthopedics and traumatology clinics, which employ 11 academics, 21 specialists, and 24 residents.

The aim of this study was to examine the orthopedic surgical interventions of the state hospitals of an average community of 1.4 million inhabitants and the distribution of patients who underwent orthopedic surgery in order to provide useful information to anticipate healthcare needs.

MATERIALS and METHODS

After obtaining the approval of the local ethics committee of KERH for the study (App. No. 198/2020), a list of patients who underwent orthopedic surgery between March 1, 2019 and February 29, 2020 was retrieved from the archives of ERU and KERH. Details of the residential address, age, sex, reason for surgical procedure, nature of surgical procedure performed, and the total length of hospitalization of the patients were recorded. Patients who had incomplete or unreliable data and those residing outside the province were excluded from the study. The analysis was performed using the data of a total of 6236 cases.

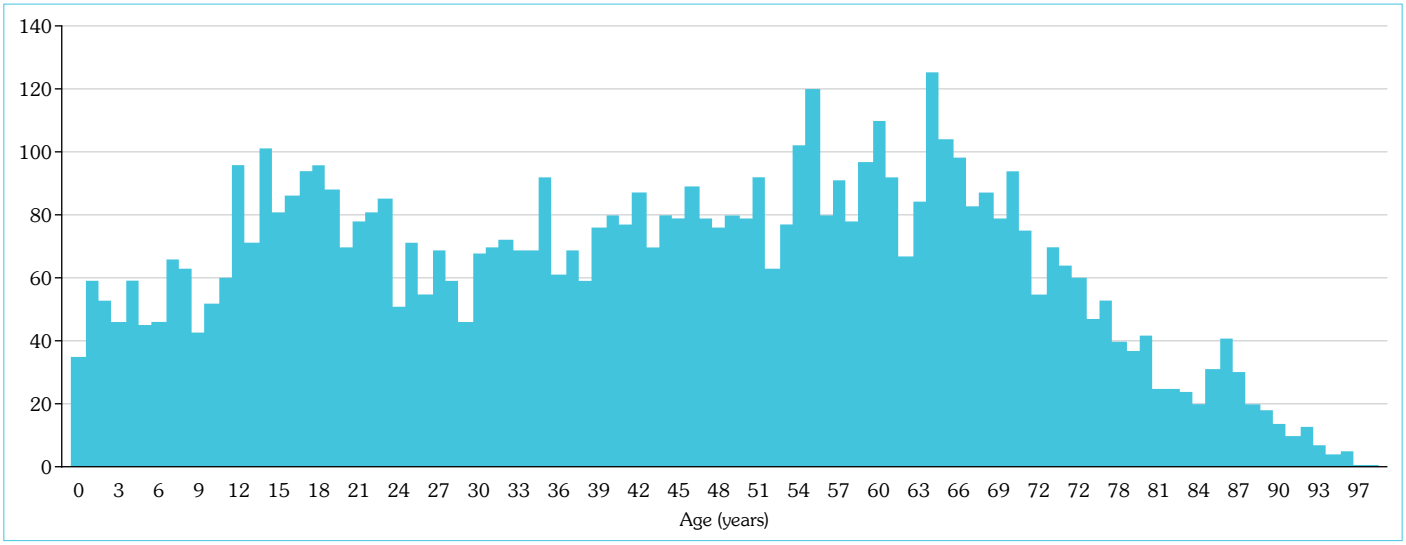


Figure 1. Distribution of orthopedic interventions according to age

The surgical procedures were grouped into the following categories:

1. Arthrodesis and arthroplasty: Knee, shoulder, and hip arthrodesis, or prosthetic applications due to nontraumatic causes of arthrosis (gonarthrosis, coxarthrosis, etc.)
2. Arthroscopy of a large joint: Rotator cuff repair, shoulder instability repair, anterior cruciate ligament reconstruction, and repair of meniscus and talar osteochondral lesions.
3. Foot surgery: Surgical correction of toe deformities, tarsal osteoarthritis sequelae, and ingrown toenails.
4. Corrective surgery for deformities in children and adults: Corrective surgeries for pes echinovarus sequelae, developmental hip dysplasia, limb inequalities, cerebral palsy sequelae, etc.
5. Surgery for emergency hand injuries: Surgeries performed due to hand crush injuries, cuts to the wrist, tendon damage, vascular and nerve laceration, and phalangeal, metacarpal, and carpal bone fractures, as well as surgeries related to the sequelae of the aforementioned injuries.
6. Elective hand surgery: Surgeries performed for trigger finger, nerve entrapment, Dupuytren's contracture, carpal osteonecrosis, etc.
7. Tumor and oncology surgery: Masses removed from the soft tissue or bones of the vertebrae and extremities, procedures performed for pathological fractures, biopsies, and surgical interventions to prevent pathological fractures (such as prophylactic nailing).
8. Trauma surgery: Surgical interventions due to bone fractures (including pathological fractures and periprosthetic fractures and excluding vertebral fractures) and complications associated with these procedures, such as dislocation, infection, pseudoarthrosis, surgically treated components of patients with multiple fracture, removal of implants placed due to trauma, etc.
9. Non-surgical area infection and amputation: Diabetic and non-diabetic chronic wounds caused by non-surgical factors.
10. Spinal surgery: Surgeries performed due to vertebral fractures, vertebral osteomyelitis, and spinal deformities.
11. General orthopedic intervention: Other surgeries not included in the previous categories, such as for avascular necrosis.

Statistical Analysis

The data were analyzed using IBM SPSS Statistics for Windows, Version 22.0 software (IBM Corp., Armonk, NY, USA). The mean age and duration of hospitalization as well as the frequency of other data were used to interpret the findings. A chi-squared test was used to perform the statistical analyses and a p value of <0.05 was accepted as statistically significant.

RESULTS

Overall Surgery Results

A total of 6236 orthopedic surgeries were performed during the study period; however, 265 interventions were made during a single hospitalization period; therefore, the average results of 5971 hospitalizations were analyzed. The average length of hospitalization was 3.2±6.1 days. The daily bed requirement was calculated to be 52.2 (average length of hospital stay × number of admissions /366).

The age of the patients demonstrated a bimodal pattern of distribution (Fig. 1). The average age was lowest among patients who underwent surgery due to trauma, deformities, and sports injuries, and the average was highest in arthroplasty cases. The overall male/female ratio was approximately 1.2; however, more female patients than males had arthroplasty, rotator cuff repair, vertebrae surgery, elective hand surgery, and tumor surgery (Table 1).

Frequently performed non-traumatic procedures included total knee arthroplasty (635/year), total hip arthroplasty (138/year), ingrown nail correction (212/year), removal of hand and wrist masses (198/year), trigger finger release (138/year), meniscus lesion repair (163/year), anterior cruciate ligament reconstruction (130/year), and rotator cuff repair (217/year).

Table 1. Distribution of gender, age, and length of hospital stay according to surgical procedure

	Male		Female		Total		Age (years)		Hospitalization (days)	
	n	%*	n	%*	n	%**	Mean±SD	Min.–Max.	Mean±SD	Min.–Max.
Arthroplasty	157	18.1	710	81.9	867	13.9	65.3±9.6	15–97	5.0±4.4	1–90
Arthroscopy	364	58.5	258	41.5	622	10.0	44.1±15.6	11–83	1.6±1.3	1–19
Foot surgery	158	52.7	142	47.3	300	4.8	32.1±17.4	0–74	0.8±2.1	0–26
Deformity	114	45.1	139	54.9	253	4.1	11.7±16.8	0–75	1.6±1.8	0–16
Hand trauma	752	79.6	193	20.4	945	15.2	34.1±16.6	0–86	1.4±1.7	0–19
NTHS	167	43.9	213	56.1	380	6.1	44.4±20.0	0–87	0.9±1.3	0–17
Tumor surgery	182	46.8	207	53.2	389	6.2	36.2±18.4	0–91	1.21±1.8	0–23
Trauma	1272	60.8	819	39.2	2091	33.5	42.9±26.9	0–98	3.8±6.8	0–171
Vertebrae	12	22.6	41	77.4	53	0.8	25.7±12.2	12–61	3.1±2.8	0–20
General orthopedic	15	83.3	3	16.7	18	0.3	34.1±14.2	15–67	2.8±4.6	0–20
NSA infection	192	60.4	126	39.6	318	5.1	59.0±16.9	6–88	9.6±13.1	0–106
Total	**3385**	**54.3**	**2851**	**45.7**	**6236**	**100**	**47.3±23.5**	**0–98**	**3.2±6.1**	**0–171**

*: Row percent; **: Column percent; NSA: Non-surgical area; NTHS: Non-traumatic hand surgery; SD: Standard deviation; Min.: Minimum; Max.: Maximum

Table 2. Distribution of patients who underwent surgery for bone fractures

Orthopedic trauma	Male	Female	Total	p	Age (years)
Femoral fracture	259	324	583	**0.007**	66.1±25.0 (0–98)
Tibial fracture	207	141	348	**<0.001**	38.5±20.8 (3–92)
Humerus fracture	186	97	283	**<0.001**	21.4±22.7 (1–85)
Radius fracture	151	73	224	**<0.001**	28.8±20.5 (3–93)
İmplant removal	155	68	223	**<0.001**	30.9±18.2 (3–76)
Fibula fracture	78	45	123	**0.003**	43.0±19.7 (9–88)
Ulna fracture	86	29	115	**<0.001**	28.7±22.9 (4–92)
Foreign body removal	43	28	71	0.075	30.3±20.2 (3–84)
Pseudoarthrosis	35	26	61	0.249	44.2±14.6 (13–80)
Metatarsal/phalangeal fracture	48	9	57	**<0.001**	36.3±16.7 (9–86)
Infected implant	32	21	53	0.131	58.4±18.9 (14–88)
Tarsal fracture	37	4	41	**<0.001**	40.3±10.9 (12–61)
Laceration of soft tissue	26	11	37	**0.020**	40.5±20.2 (3–78)
Pelvic fracture	19	9	28	0.073	42.9±18.6 (12–86)
Tendon rupture (Achille's/patella/biceps/quadriceps/triceps)	18	5	23	**0.011**	34.1±14.6 (9–68)
Patellar fracture	13	7	20	0.180	38.8±21.6 (14–74)
Clavicle fracture	12	3	15	**0.020**	28.5±13.7 (10–56)
Joint dislocation (patella/knee/acromioclavicular)	9	3	12	0.093	41.1±15.5 (20–68)
Hemiarthroplasty dislocation	5	3	8	0.480	80.6±5.0 (71–89)
Scapular fracture*	1	0	1	N/A	48.0
Total	1420	906	**2326**	**<0.001**	42.9±26.9 (0–98)

*: p value; mean age±SD and min–max values could not be provided. Only 1 patient underwent surgery due to a fracture of the scapula

The average monthly number of cases was 520; however, fewer than the average number of surgeries were performed in the months of June, August, September, October, and November (Fig. 2).

Traumatological Results

The hand and wrist were the most frequent sites of injury; 812 patients underwent surgery for hand and finger injuries, and 133 patients for cuts to the wrist. While the monthly average number

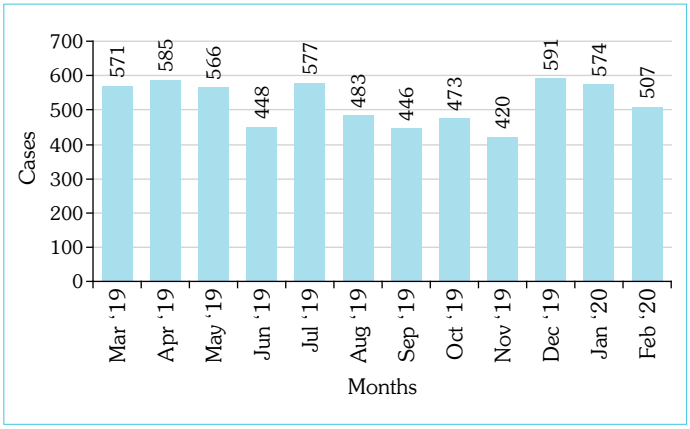


Figure 2. **Distribution of orthopedic interventions by month**

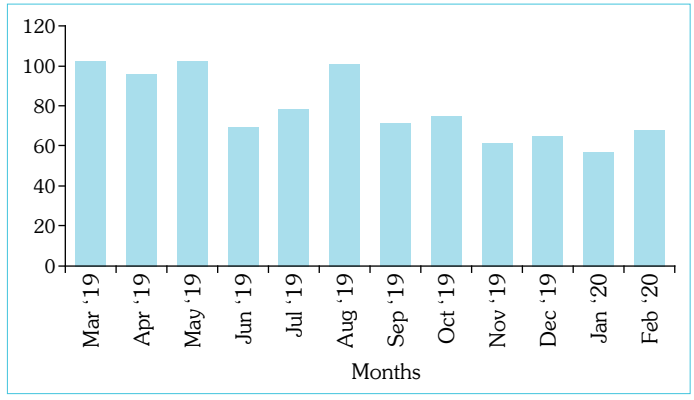


Figure 3. **Distribution of interventions for hand and wrist trauma by month**

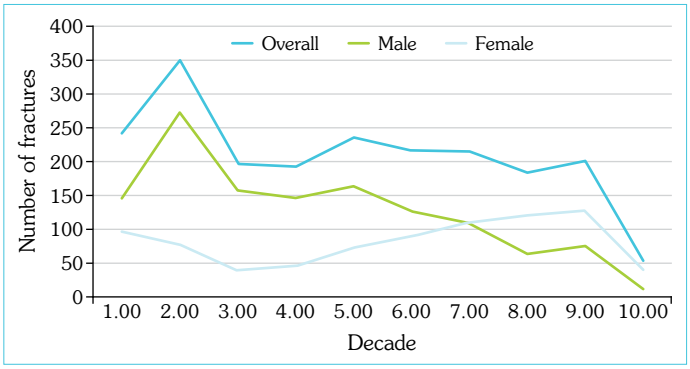


Figure 4. **Distribution of interventions for fracture by decade of life and gender**

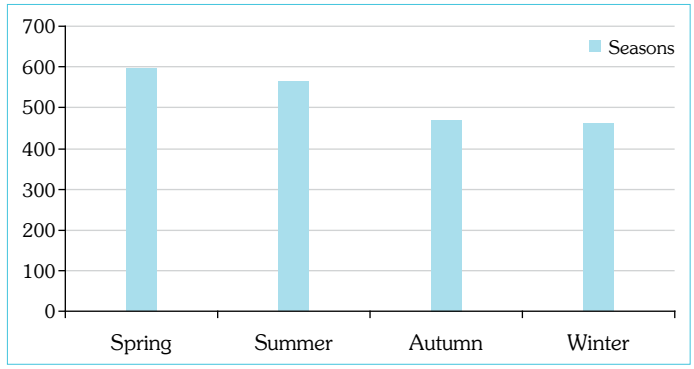


Figure 5. **Distribution of surgical interventions for trauma by season**

of hand/wrist surgeries was 78.75, the monthly average in March, April, May, and August was 100 (Fig. 3).

The femur was the next most frequently operated bone in trauma surgeries. Of all surgical interventions, 27.9% were corrective surgeries for a femoral fracture. In this group, 279 underwent hip arthroplasty (partial/total) due to a proximal femur fracture. The rate of a femur fracture that required surgery was higher in females, however, all other bone fractures predominantly occurred in men (Table 2).

In this study, 207 (9.9%) of the patients were operated on due to multiple bone fractures. The most frequent were bimalleolar fractures (92/year) and both bone forearm fractures (59/year) (concomitant but surgically untreated bone fractures were excluded).

Surgical operations performed due to fractures were greatest in men during the second decade of life (10–19 years) and during the nineth decade in women. Although the total male/female ratio was 1.57, more fracture-related surgeries were performed in women than in men after the seventh decade (Fig. 4). More orthopedic trauma surgeries were performed in spring and summer than in autumn and winter ($p<0.001$) (Fig. 5).

DISCUSSION

Epidemiological studies have great value for the planning of healthcare services and medical education. Orthopedic operating room and outpatient clinics are among the busiest units of hospitals. Interventions require significant planning due to the use of techniques such as fluoroscopy, endoscopy, and microscopy, and devices such as special surgical kits and implants. Knowledge of the distribution of surgical procedures is necessary to accurately predict the nature and expected number of surgical interventions in order to effectively manage resources, including the possibility of deferring elective surgical procedures. However, to the best of our knowledge, there is no extensive study on this topic in the literature. Further studies of the epidemiology of orthopedics and traumatology are needed in Turkey, as the distribution can vary in different regions and at different times. The fact that 6236 procedures were performed in the state hospitals of a province with a population of approximately 1.4 million means that at least 4 orthopedic surgical procedures were performed for every 1000 people. Canizares et al. (6) found a rate of 12/1000 in a study in Ontario, Canada. The difference may be due to the fact that patients who came from outside Ontario were not excluded from the study, as well as the inclusion of patients in private hospitals.

Our results indicated that the overall duration of hospitalization was 3.2 days and the average daily number of admissions was 16.3. The average length of hospitalization of orthopedic patients was 10.5 days in a study conducted in Nepal (7). In another study performed by Gholson et al. (8) in the USA, the hospital stay in total knee and hip arthroplasty surgeries was 3.2 days. The data in our study may reflect the success of at-home health care after discharge in Turkey and that rapid patient turnover is required in order to continue to provide needed orthopedic services.

When the surgeries were categorized according to patient age, a bimodal distribution pattern was observed, with the first peak occurring in patients in their second decade of life and the second peak occurring in those in their seventh decade. A similar distribution pattern was noted by Canizares et al. (6), with the greatest number of interventions among men in the second and sixth decades and the second and eighth decades in women. This likely illustrates the predominance of traumatic surgeries in young patients and that of surgeries for osteoarthritis and rotator cuff repair in older patients. Trauma surgeries in women peaked in the ninth decade in our study, which contributed to the overall second peak in the seventh decade.

The distribution of traumatic and non-traumatic surgeries varies by sex. Velpula et al. (5) observed a male/female ratio of 1.56 in their trauma epidemiology study. Our study also found a similar sex ratio overall in cases of orthopedic fractures, with an increase in fracture-related surgeries in women after the seventh decade, most likely due to an increase in the prevalence of osteoporosis and the longer life expectancy for women. Many studies have found that the fracture incidence and rate of surgery for a fracture were higher in women than men (5, 6, 9).

In our study, a break in the femur, tibia, humerus, or radius was the most common etiology of fracture surgery. Beerekamp et al. (10) the most frequent extremities requiring surgical treatment for trauma among 24,975 patients were the upper leg, hand/wrist, lower leg, forearm, and the upper arm, respectively. Feichtinger et al. (11) reported that in 2019, multiple fractures were detected in approximately 6% of trauma patients. In our study, 9.9% of the trauma patients had multiple fractures and the most common was the tibia and fibula bones. However, a direct comparison is not possible since Feichtinger et al. (11) conservatively treated patients, as well as patients with thoracic trauma or axial skeletal injuries.

Trauma cases are more common during the spring and summer, possibly due to the fact that people are more engaged in agriculture and outdoor activities, such as sports, as well as increased traffic congestion, which contributes to a rise in the number of motor vehicle accidents. Wilson et al. (12) found that the severity and number of injuries increased in relation to air temperature. When elective surgeries are also considered, it seems that the most surgical interventions take place in April and December. Malik et al. (13) showed that the risk of complications after knee replacement was greater during the warmest months in a region of in Pakistan. The fact that hospital staffing may be more limited during the summer was noted as a potential contributing factor.

Limitations

The retrospective design, analysis of a single province, the exclusion of private hospitals, and the lack of examination of etiological factors are limitations to the interpretation of the results of this study.

CONCLUSION

Half of the orthopedic interventions performed during the study period were due to orthopedic trauma, and approximately 2 trauma surgeries were performed per 1000 people in the province. The most common elective surgeries were arthroplasty and arthroscopic interventions, and the most frequent trauma cases were hand injuries and femoral fractures.

Ethics Committee Approval: The Health Sciences University Clinical Research Ethics Committee granted approval for this study (date: 01.10.2020, number: 198).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – AEG, AY; Design – AEG, İK; Supervision – AEG, ME; Data Collection and/or Processing – AEG, İK, AY, MÖ, ME, İHK, İA, MÇ, MK, ZEY, YUC, AÖ, RİÖ, KT, SO, ECM, SD, ÖCÜ, MM, EŞ, GS, KTO, HA, OA, SG; Analysis and/or Interpretation – AEG; Literature Search – AEG; Writing – AEG, SO; Critical Reviews – AEG, SO.

Conflict of Interest: The authors have no conflict of interest to declare.

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