Musculoskeletal Conditions in the Emergency Room: A Teaching Opportunity for Medical Students and Residents

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Objective: Assess the potential value of an emergency room (ER) for the teaching of musculoskeletal (MSK) medicine to medical students and residents in training.

Methods: Data from all encounters to the ER of a teaching hospital for calendar years 2016-2019 were extracted from an electronic database. Encounters with ICD-10-CM M codes (MSK system) and S codes (injury) were selected (MSK encounters). Frequency distributions were calculated by year, sex, and age group for all encounters and MSK encounters. Annual distributions of encounters involving the shoulder, hip, knee, and ankle joints were assessed.

Results: The number of unique patients seen during the four-year period was 84,094, and the number of encounters was 187,829 (Median: 1 encounter; interquartile range: 1-2). The mean number of encounters per year was 46,957 (range: 45,311- 48,382). There was no seasonal variation. Most patients were women (45,868; 54.6%) and young (20-29 yr.) adults (15,012; 17.8%), and these groups generated the largest numbers of encounters (women: 108,799; 57.9%; young adults: 35,969; 19.1%). A total of 41,353 encounters (22.0% of all encounters) involved the MSK system. The shoulder, hip, knee, and ankle were involved in 2,768 (1.5%), 1,592 (0.8%), 3,082 (1.6%), and 1,718 (0.9%) encounters, respectively. The most common conditions for each joint were shoulder pain, femoral fracture, knee contusion, and ankle sprain.

Conclusion: Our findings suggest that ER physicians should have broad knowledge of MSK conditions and injuries. An ER is an excellent location for the teaching of MSK medicine to medical students and residents of other training programs. [*P R Health Sci J 2021;40:68-74*]

Key words: Musculoskeletal injury, ICD-10, Joint health conditions, Emergency room encounters

Musculoskeletal (MSK) complaints and injuries are a leading cause of global disability and pain, representing one of the most common causes of clinical encounters. In 2004 in the United States, MSK injuries accounted for more than 57 million health care encounters, representing 60% of all injury treatment encounters in diverse care settings (1). Another study reported that 22.3% of Ontario's population saw a physician for an MSK disorder in fiscal year 2006-2007 (2). Furthermore, it has been estimated that approximately 8% of emergency room (ER) encounters in the US and Canada are due to complaints associated with the MSK system (2,3) and some authors have estimated orthopedic injuries to account for 30% of ER and urgent care visits (4). A study of data from the National Hospital Ambulatory Medical Care Survey estimated 41.9 million injury-related visits to the Emergency Department, or 14.4 visits per 100 persons in the United States in 2005 (3). Utilization of the ER is higher among older adults and MSK complaints or injuries accounted for 31.4% of encounters in this age group in the United States (5). One contributing factor to this state of affairs is the observation that patients are electing to visit the ER for the evaluation and management of common MSK complaints that are neither acute nor severe (6). Several factors may contribute to an increase in this practice, including the aging of the population (5), barriers to access to other types of facilities or clinics (7), and the high number of uninsured patients that depend on ER services for usual care (8).

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The authors have no conflict of interest to disclose.

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Because the demand on ER services may continue to increase, it becomes necessary to further understand the frequency and nature of the MSK problem at the first contact with the healthcare system. In addition, discharge diagnosis from the ER may help in targeting patients that require follow-up (5).

Training in the management of MSK injuries reduces mortality, complications, and length of stay in the ER (9). A better understanding of the volume and nature of MSK conditions presenting in an ER may also help in the design of a more comprehensive curriculum and teaching experiences for medical students and residents in various medical specialties. This is an important issue because several authors have noted that the teaching of MSK medicine in medical schools (10) and in primary care residencies (11) is inadequate.

Few data exist regarding the prevalence and distribution of MSK conditions evaluated and treated in an ER by age group, sex, and anatomical location. Recent studies have looked at the most common MSK complaints in the ER using general classifications of MSK disorders, but not specific diagnostic codes (2,6).

The purpose of this investigation was to describe the use of the ER for MSK care. This will assist in evaluating the potential value of an emergency room for the teaching of musculoskeletal medicine to medical students and residents in training. Our specific aims were to 1) quantify the frequency of musculoskeletal complaints in the emergency room of a secondary level teaching hospital, 2) describe the age and sex of the patient population, and 3) identify the volume and type of conditions affecting four major joints (shoulder, hip, knee, and ankle) because they are the most frequently injured joints requiring evaluation in our outpatient clinics. We hypothesized that: 1) musculoskeletal complaints represent a large proportion of all encounters, 2) younger adults and women represent most encounters in the ER, and 3) shoulder, hip, knee and ankle complaints represent a substantial proportion of the encounters. A high frequency and types of MSK conditions will support the use of the ER as a teaching environment for medical students and residents in training of specialties such as physical medicine and rehabilitation and primary care.

Methods and Materials

Setting

The study was conducted at the ER of the University of Puerto Rico Dr. Federico Trilla Hospital in Carolina, Puerto Rico, with the approval of the Institutional Review Board. The hospital is a secondary level teaching institution associated with the University of Puerto Rico School of Medicine, and is the primary training site for a residency training program in Emergency Medicine. The ER is staffed by 13 board-certified attending physicans and 30 residents. It has 42 acute care beds and 8 fast track exam areas, and offers a wide-variety of services including bedside ultrasonography. The hospital has 234 staffed acute beds, provides care to the northeast area of the island with an estimated catchment area of 311,355 inhabitants in the neighboring towns served by the Hospital (12), and offers full scope MSK (physical medicine and rehabilitation, orthopedic surgery, and physical therapy) and radiological services.

Study design, data source and collection

We conducted a retrospective analysis of administrative data from all clinical encounters at the ER between January 1, 2016 and December 31, 2019. Data was extracted from the ER's electronic medical record system. These included date of the encounter, age and sex of the patient, as well as the International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) code for the encounter (13,14). This code also contains data on the anatomical area and side of the disease or condition.

ICD-10-CM codes

The frequency of all primary diagnoses with M (musculoskeletal system and connective tissue) codes and S (injury or certain other consequences of external causes) codes was determined. We did not include M and S codes for secondary diagnoses (present in 3% of encounters) to focus on the main complaint/diagnosis only. The most frequent primary diagnoses codes for shoulder, hip, knee, and ankle are reported. In the analysis of diagnostic codes for individual joints, encounters with codes related to rheumatologic conditions, infections, bites, and skin injuries were excluded because these conditions are not frequently seen in our musculoskeletal clinics. Age of each unique patient attending the ER during the period under study was assigned by calculating the median of the age registered in his/her encounters. Sex of unique patients was assigned according to the sex code appearing in his/her first encounter for the period.

Statistical analysis

The number of total encounters per month was calculated for each year to explore seasonal variations. Medians and interquartile ranges (IQR's) were used to describe age distributions as a continuous variable. The Mann-Whitney test was used to statistically test differences in age distributions (15). Percents were used to describe categorical variables including sex and diagnostic code. Changes in the annual proportion of encounters with specific diagnostic codes was assessed with the chi-square test for trend (16). Data were managed and analyzed with R version 4.0.2 (17), RStudio version 1.3.1093 (18), and R Commander Version 2.7-0 (19).

Results

The total number of unique patients visiting the ER during the four year period was 84,094. The total number of encounters during the four-year period was 187,829 (98 had no information on sex). There was an average of 46,957 encounters per year (range: 45,311 – 48,382), exhibiting no

seasonal patterns. The median number of encounters was 1 (IQR: 1 - 2). The number of encounters per month by year is presented in Figure 1.

Figure 2 shows the number of encounters by age group and sex for all years combined. Young adults (20-29 years) represented the most frequent age group for encounters (35,969; 19.1%) and unique patients (15,012; 17.8%). The median age of patients at the time of the encounters was 39 years (IQR: 22 - 60). Most of the encounters (108,799; 57.9%) involved female patients (median age: 37 years, IQR: 22 - 59) who were also the most frequent unique patients by sex (45,868; 54.6%). With the exception of the 0 – 9 age group, all other age groups had a preponderance of encounters from female patients. The median age for encounters from males was higher ($p < 0.01$) at 41 yr. (IQR: 22 - 60).

A total of 41,353 encounters (22.0%) involved MSK complaints as the primary diagnosis; 6.7% (12,525) were classified as diseases of the musculoskeletal system and connective tissue (M codes) and 15.3% (28,828) were classified as injuries (S codes). There was a predominance of the S codes in all studied anatomical areas. The percent of all encounters due to MSK health conditions was very similar for various age groups

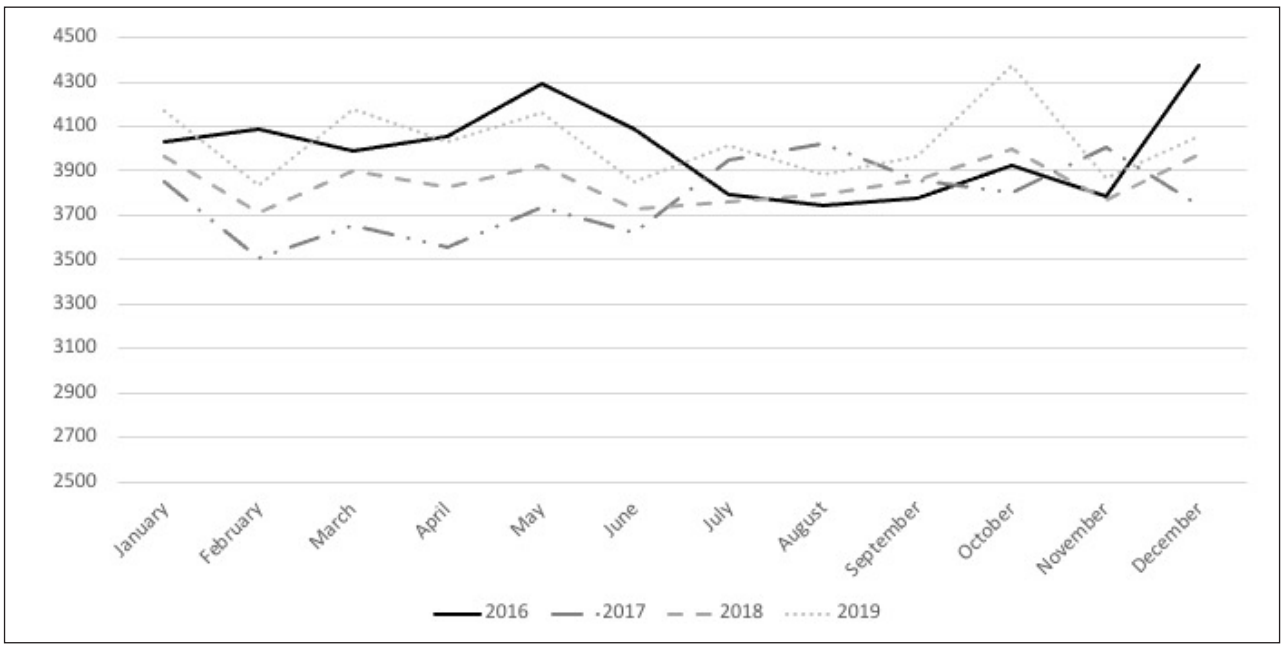

Figure 1. Total encounters (n=187,829) to the Emergency Room per month for each of the four calendar years 2016-2019.

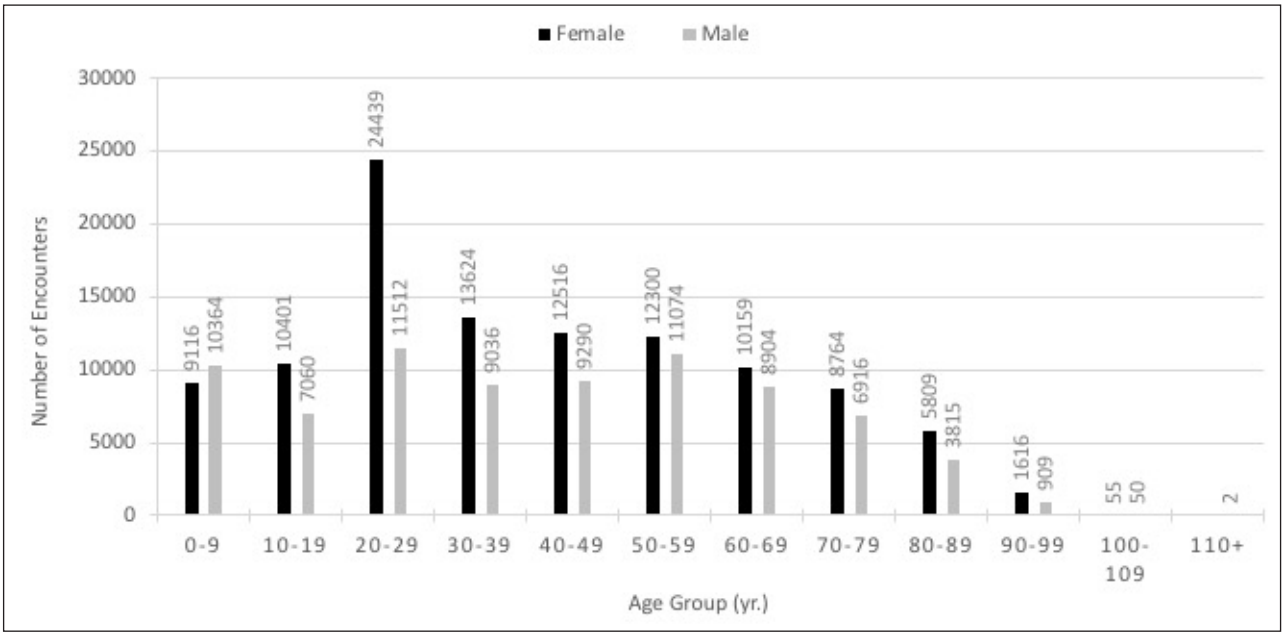

Figure 2. Total number of encounters (n=187,829) to the Emergency Room by sex and age group for calendar years 2016-2019.

including 65 years and older (see Table 1). The distribution of MSK-related encounters by age group and sex for the four years combined is presented in Figure 3. The proportion of MSK encounters for female patients was lower than for males in the younger age groups up to 30-39, but this relation was reversed in older age groups (test for trend p<0.01). The median age of patients with MSK health complaints was 43 years (IQR: 23 - 60) with a median of 46 for females (IQR: 26 - 64) and 38 years for males (IQR: 21 - 57) (p < 0.01).

The number and percent of encounters due to complaints of the four major joints are presented in Figure 4. These (9,160) represented 22.2% of all MSK encounters. Encounters associated with diagnoses of the shoulder joint (2,768) represented 1.5% of all encounters and 6.7% of all MSK complaints (Table 2). Most encounters related to health conditions of the shoulder involved female (1,524; 55.1%) and middle-aged patients (926; 33.5% in the 40-59 age group). The most common shoulder condition was pain in shoulder (M25.51), followed by contusion of the shoulder (S40.01) and dislocation and sprain of joints and ligaments of shoulder girdle (S43). Pain and dislocation presented increasing and decreasing trends with time, respectively.

Complaints in the anatomical area of the hip (1,592) represented 0.8% of all encounters and 3.8% of all MSK complaints (Table 2). Females had most encounters with health conditions of the hip (1,002; 63.1%) as well as older patients (726; 45.6% with patients 70 years or older). The most common hip conditions were fracture of the femur (S72), which exhibited a decreasing trend, pain in the hip (M25.55), which showed an increasing trend, and contusion of the hip (S70.0).

Encounters with complaints related to the knee joint (3,082) represented 1.6% of all encounters and 7.5% of all MSK complaints (Table 2). Most patients with health conditions of the knee were female (1,786; 58.0%) and middle-aged (1,003; 32.5% in the 40-59 age group). The most common knee conditions were contusion of the knee (S80.0), pain in the knee (M25.56), and dislocation and sprain of joints and ligaments of the knee (S83). Pain and dislocation revealed opposite trends over time.

Finally, encounters with ICD-10 codes related to the ankle joint (1,718) represented 0.9% of all encounters and 4.2% of all MSK encounters (Table 2). Most encounters with ankle conditions were from females (955; 55.6%) and children (468; 27.2%) in the 10-19 age group. The most common ankle condition (79.3%) by far was sprain of ankle ligaments (S93.4) which exhibited an increasing trend.

Table 1. Distribution of encounters due to health conditions of the musculoskeletal (MSK) system and total encounters by age group.

Age group (yrs.)	Encounters due to all MSK conditions n (% of total encounters for the corresponding age group)	Total encounters for all conditions
0-9	3603 (18.5)	19488
10-19	4184 (24.0)	17469
20-29	6286 (17.5)	35969
30-39	5024 (22.2)	22679
40-49	5467 (25.1)	21811
50-59	6033 (25.8)	23393
60-69	4658 (24.4)	19078
70-79	3484 (22.2)	15682
80-89	2057 (21.4)	9628
90-99	536 (21.2)	2525
>100	21 (19.6)	107
	Total = 41,353	Total = 187,829

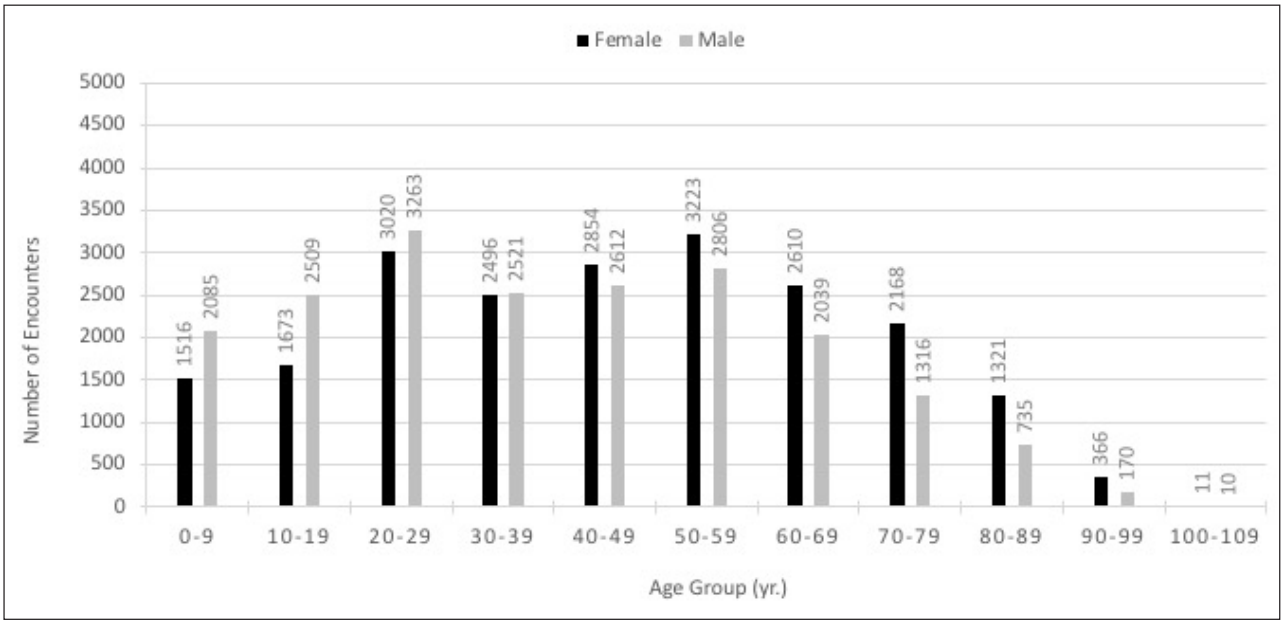

Figure 3. Distribution by age group and sex of all the encounters (n=41,353) related to complaints of the musculoskeletal system during calendar years 2016-2019.

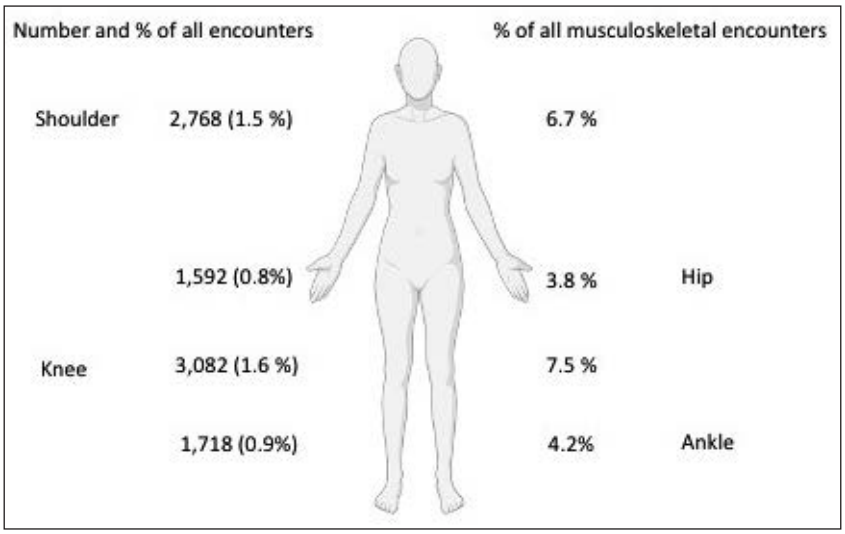

Figure 4. Number of encounters as a percent of all encounters and all musculoskeletal encounters in the shoulder, hip, knee, and ankle during calendar years 2016-2019.

Discussion

The most important findings of the present study were: 1) the majority of encounters to the ER during the four-year period involved females and young adults, 2) a substantial number of all encounters were related to complaints of the MSK system in both sexes and all age groups, and 3) complaints of the shoulder, hip, knee and ankle joints represented a large fraction of all MSK encounters. In our opinion, these findings convincingly support the inclusion of the ER as a teaching site for students and residents.

Studies have reported that most patients presenting to ambulatory care settings, including the ER, with MSK complaints are women (2,20). Similarly, in the present study, a higher number of encounters involved females. With regards to the distribution of encounters by age, Hastings et al. (5) reported that 31.4% of the patients presenting to the ER with a MSK health condition were older than 65 yr. This is higher than the 22% observed in the present study.

In the present study, a large proportion (22.0%) of all encounters were related to complaints of the MSK. This is higher than the 8.7% reported by MacKay and collaborators (2). In that study, however, 22.3% of all inhabitants of Ontario, Canada visited an ambulatory clinic with an MSK disorder suggesting that access to MSK care in the community may have reduced the need for ER level of care. Because they did not report the ICD code nor the specific injured joint, we cannot make a more detailed comparison of MSK health conditions by anatomical area.

Scant data exist on the distribution of encounters to the ER by anatomical area or joint. Others have reported that in ambulatory settings, complaints of the shoulder, knee, and ankle are highly prevalent (21,22). In the present study these three joints together with the hip, represented 22.1% of all MSK encounters. It is interesting that for these joints, female and middle-aged patients represented the majority of the encounters with the exception of the hip. In this case, most patients were in the >70 yr. age group. This might be explained by the high incidence of hip osteoarthritis and falls resulting in hip fractures and contusions in this age group (21). Lambers et al. (22) examined data of lower extremity injuries from the National Electronic Injury Surveillance System in 2009 and reported that the most commonly affected joint was the ankle and most injuries were sprains/strains. That study, however, was limited to one year, did not use the ICD-10-CM system to classify the complaints, and did not include upper extremity injuries. Interestingly, in the present study, significant changes in the frequency of some codes (Table 2) were recorded in calendar year 2018. A possible explanation for this is a change in administrative and billing practices implemented by the hospital.

Other studies of MSK conditions in the ER have been conducted but with different objectives such as exploring the timely management of acute MSK pain (23), the long-term outcomes associate with ER discharge diagnosis (5), and the concordance between physicians and physiotherapists for care of patients with MSK conditions (24). Those studies, however, had small sample sizes (82 and 132 patients), included only one age group (>65 yr.) and did not classify the ER encounters using ICD-10-CM codes. Another study, conducted in the ER of a teaching hospital, limited data collection to fractures and did not include soft tissue injuries that usually represent the majority of patient encounters to a typical ER (9). In that study most patients were male and young (<35 yr.). The difference in sex distribution between that study and the present study may be due to the focus on fractures while we included many MSK conditions. Finally, a multi-year and large cross-sectional study using the ICD-9 and ICD-10 systems to classify encounters to the ER was limited to low back pain (20). The authors reported that approximately 2-3% of patients presented to the ER with a primary complaint of low back pain. Frequency estimates, however, differed depending on the definition of low back pain which may reflect the non-specific nature of this complaint.

It has been suggested that the high incidence of MSK disorders together with the wait time in the ER, and total cost of ER services may justify the creation of dedicated MSK urgent care centers to improve access and decrease cost (4). The high volume of relatively minor MSK complaints in the present study, the need to manage pain in the ER appropriately (23), and the relationship between ER discharge diagnosis and long-term outcomes (5) support this suggestion.

An important objective of the present study was to use the descriptive and statistical results to evaluate the potential of the ER as a clinical learning site for medical students and residents in several medical specialties. The amount and quality of MSK teaching in medical schools and many residency training programs have been noted to be very limited (10,11) although it has been shown that training in the management of MSK injuries reduces mortality, complications, and length of stay in the ER (9). Our findings strongly support the idea that inclusion of ER's care could strengthened the curriculum of medical schools and graduate medical education programs as it relates to MSK teaching. The high volume of encounters (estimated at 28 MSK encounters per day), the inclusion of both sexes and all age groups, and the wide variety of MSK conditions (ICD-10 codes) in major joints (see Table 2 and Figure 4) could provide excellent training opportunities for residents in specialties that focus on the MSK system (e.g., Physical Medicine and Rehabilitation) as well as for those who will manage similar patients in primary care settings (e.g., Family Medicine).

The present study has some limitations. We based our analysis on the ICD-10-CM classification system as used in the hospital's administrative database. It is possible that the application of the codes varies among physicians and among coders in the billing office. Nevertheless, our analysis is limited to general classification (MSK system) and anatomical areas (shoulder, hip, knee, and ankle) that are not likely to be confused. Another consideration may be that the primary diagnosis field in the ER's database includes some complaints (for example "pain in the shoulder") that must be evaluated further in the outpatient clinic to make a more precise diagnosis and others that are easily recognized in an ER (femoral fracture). Finally, the ER in the present study is part of a teaching hospital and our findings may not be similar to those in ER's of private non-teaching hospitals, which might serve a different patient population and/or may have a different referral pattern. Furthermore, the availability of non-primary care services such as Emergency Medicine, Orthopedics, and Physical Medicine and Rehabilitation might influence patient's selection of ER.

Table 2. Number (%) of annual encounters for the top three of selected ICD-10-CM codes for the shoulder, hip, knee, and ankle joints. (*Chi-square test for trend).

ICD-10-CM codes	Year				Total	p-value
	2016	2017	2018	2019		
Shoulder						
M25.51 - Pain in shoulder	63 (10.8)	75 (10.9)	219 (31.2)	323 (40.7)	680 (24.6)	< 0.01
S40.01 - Contusion of shoulder	130 (22.4)	168 (24.3)	183 (26.0)	188 (23.7)	669 (24.2)	0.52
S43 - Dislocation and sprain of joints and ligaments of shoulder girdle	213 (36.7)	224 (32.4)	97 (13.8)	80 (10.1)	614 (22.2)	< 0.01
Other	175 (30.1)	224 (32.4)	204 (29.0)	202 (25.5)	805 (29.1)	0.02
Total	581	691	703	793	2768	
Hip						
S72 - Fracture of femur	147 (40.8)	165 (40.0)	147 (37.6)	138 (32.2)	597 (37.5)	0.01
M25.55 - Pain in hip	71 (19.7)	62 (15.0)	115 (29.4)	144 (33.6)	392 (24.6)	< 0.01
S70.0 - Contusion of hip	82 (22.8)	104 (25.2)	81 (20.7)	98 (22.8)	365 (22.9)	0.63
Other	60 (16.7)	81 (19.7)	48 (12.3)	49 (11.4)	238 (15.0)	< 0.01
Total	360	412	391	429	1592	
Knee						
S80.0 - Contusion of knee	251 (33.2)	303 (37.8)	231 (30.9)	249 (32.0)	1034 (33.6)	0.17
M25.56 - Pain in knee	120 (15.9)	124 (15.5)	278 (37.2)	362 (46.6)	884 (28.7)	< 0.01
S83 - Dislocation and sprain of joints and ligaments of knee	226 (29.9)	214 (26.7)	89 (11.9)	59 (7.6)	588 (19.1)	< 0.01
Other	159 (21.0)	161 (20.1)	149 (19.9)	107 (13.8)	576 (18.7)	< 0.01
Total	756	802	747	777	3082	
Ankle						
S93.4 - Sprain of ankle	314 (79.3)	356 (85.2)	344 (76.4)	348 (76.7)	1362 (79.3)	0.05
S90.0 - Contusion of ankle	43 (10.9)	34 (8.1)	45 (10.0)	42 (9.3)	164 (9.6)	0.67
M25.57 - Pain in ankle and joints of foot	19 (4.8)	11 (2.6)	46 (10.2)	55 (12.1)	131 (7.6)	< 0.01
Other	20 (5.1)	17 (4.1)	15 (3.3)	9 (2.0)	61 (3.6)	0.01
Total	396	418	450	454	1718	

Conclusion

MSK complaints represent a substantial volume of the total encounters to the ER in a teaching hospital in Puerto Rico. Physicians working in the ER should have broad knowledge of MSK conditions. Medical schools and residency training programs should consider the emergency room as a valuable teaching site for medical students and residents that need to learn the basics of MSK medicine.

Resumen

Objetivo: Evaluar el potencial de una sala de emergencias (SE) para enseñar medicina musculoesqueletal (MSQ) a estudiantes de medicina y médicos residentes. Métodos: Los datos de todos los encuentros en SE

de un hospital universitario (años 2016-2019) se extrajeron del sistema electrónico de expedientes. Los encuentros con prefijos M y S en los códigos ICD-10-CM se designaron como encuentros MSQ. Se calcularon distribuciones de frecuencia por año, sexo y grupo de edad para todos los encuentros y encuentros MSQ. Se evaluaron las distribuciones anuales de encuentros relacionados con cuatro articulaciones: hombro, cadera, rodilla y tobillo. Resultados: La media de encuentros por año fue de 46,957 (rango: 45,311- 48,382), sin variación estacional. Se atendieron 84,094 pacientes en el período, que generaron 187,829 encuentros (mediana: 1 encuentro; rango intercuartil: 1-2). La mayoría de los pacientes eran mujeres (45,868; 54.6%) y adultos jóvenes (15,012; 17.8%). Estos grupos originaron la mayoría de los encuentros (mujeres: 108,799; 57.9%; adultos jóvenes: 35,969; 19.1%). Del total de encuentros, 41,353 (22.0%) involucraron el sistema MSQ. El hombro, la cadera, la rodilla y el tobillo estuvieron involucrados en 2,768 (1.5%), 1,592 (0.8%), 3,082 (1.6%) y 1,718 (0.9%) encuentros, respectivamente. Las condiciones más comunes para cada área anatómica fueron dolor de hombro, fractura femoral, contusión de rodilla y esguince de tobillo. Conclusión: Nuestros hallazgos sugieren que los médicos de salas de emergencias deben tener un amplio conocimiento de las afecciones y lesiones de MSQ. Una sala de emergencias es un lugar excelente para enseñar medicina MSQ a estudiantes de medicina y médicos residentes.

Acknowledgment

Dr. Frontera's research is partially funded by Grant S21 MD001830-04, NIMHD, NIH. Dr. Conde's research activities are partially funded by RCMI Grant U54 MD 007600, NIMHD, NIH. The content of this report is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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