Title
A Multicenter Evaluation of Emergency Department Pain Care Across Different Types of Fractures

Journal
Pain Medicine, 18(1)

ISSN
1526-2375

Authors
Siddiqui, Ammar
Belland, Laura
Rivera-Reyes, Laura
et al.

Publication Date
2017

DOI
10.1093/pm/pnw072

Peer reviewed

Pain Medicine 2017; 18: 41–48
doi: 10.1093/pm/pnw072

OXFORD

PAIN & AGING SECTION

Original Research Article

A Multicenter Evaluation of Emergency Department Pain Care Across Different Types of Fractures

Ammar Siddiqui, BA,* Laura Belland, MD,* Laura Rivera-Reyes, MPH,* Daniel Handel, MD,† Kabir Yadav, MD,‡ Kennon Heard, MD,§ Amanda Eisenberg, MD,¶ Yury Khelemsky, MD,* and Ula Hwang, MD*

*Department of Emergency Medicine, Icahn School of Medicine at Mount Sinai, New York, New York; †Division of Emergency Medicine, Medical University of South Carolina, Charleston, South Carolina; ‡Department of Emergency Medicine, Harbor-UCLA Medical Center, Torrance, California; §Department of Emergency Medicine, University of Colorado School of Medicine, Aurora, Colorado; ¶Department of Internal Medicine, Mount Sinai Beth Israel, New York, New York, USA

Correspondence to: Ammar Siddiqui, BA, Emergency Department, Icahn School of Medicine at Mount Sinai, 50 East 98th Street, Apt 4B, New York, NY 10029, USA. Tel: 603-729-6180; Fax: 646-537-9497; E-mail: Ammar.Siddiqui@mssm.edu; and Ula Hwang, MD, Emergency Department, Icahn School of Medicine at Mount Sinai, 1 Gustave Levy Place 1062, New York, NY 10029, USA. E-mail: ula.hwang@mountsinai.org.

Funding sources: Ula Hwang was supported by a K23 award from the National Institute on Aging (K23 AG031218). Ammar Siddiqui was supported by the Patient Oriented Research Training and Leadership Program through the Icahn School of Medicine at Mount Sinai, New York, New York.

Conflicts of interest: There are no conflicts of interest to report.

Abstract

Objectives. To identify differences in emergency department (ED) pain-care based on the type of fracture sustained and to examine whether fracture type may influence the more aggressive analgesic use previously demonstrated in older patients.

Design. Secondary analysis of retrospective cohort study.

Setting. Five EDs (four academic, one community) in the United States.

Participants. Patients (1,664) who presented in January, March, July, and October 2009 with a final diagnosis of fracture (774 long bone [LBF], 890 shorter bone [SBF]).

Measurements. Primary-predictor was type of fracture (LBF vs. SBF). Pain-care process outcomes included likelihood of analgesic administration, opioid-dose, and time to first analgesic. General estimating equations were used to control for age, gender, race, baseline pain score, triage acuity, comorbidities and ED crowding. Subgroup analyses were conducted to analyze age-based differences in pain care by fracture type.

Results. A larger proportion of patients with LBF (30%) were older (>65 years old) compared to SBF (13%). Compared with SBF, patients with LBF were associated with greater likelihood of analgesic-administration (OR = 2.03; 95 CI = 1.58 to 2.62; *P* < 0.001) and higher opioid-doses (parameter estimate = 0.268; 95 CI = 0.239 to 0.297; *P* < 0.001). When LBF were examined separately, older-patients had a trend to longer analgesic wait-times (99 [55–163] vs. 76 [35–149] minutes, *P* = 0.057), but no other differences in process outcomes were found.

Conclusion. Long bone fractures were associated with more aggressive pain care than SBF. When fracture types were examined separately, older patients did not appear to receive more aggressive pain care. This difference should be accounted for in further research.

Key Words. Fractures; Emergency Medicine; Geriatrics; Opioids; Pain Management

Introduction

Although pain is prevalent in the emergency department (ED), it is underreported and undertreated [1–3]. Previous studies have found that oligoanalgesia is common in the ED, caused by both delays to analgesic administration and under administration of analgesic doses [4,5]. Older patients are thought to be particularly exposed to risk of oligoanalgesia because of poor ability to self-advocate and system-level (and potentially provider-level) age bias [6].

Fractures are the second most commonly presenting pain syndrome to the ED for older patients, and are associated with high morbidity and mortality [7]. Pain control is especially important in patients with fractures, as poorer pain management has been linked closely with functional decline in the elderly [8,9]. Studies investigating age-related disparities in fracture pain care have yielded conflicting results. While several smaller studies have noted that older patients with specific fractures were at increased risk of oligoanalgesia compared to younger patients [5,10,11], they have been limited to long bone fractures (LBF). The few studies on fracture pain care in the ED have been limited to a single center and single fracture type, have had a small cohort, and/or were poorly controlled for confounders [5,10,12–14]. A recent multicenter study by Hwang et al. in 2014 [7] on all fractures made the surprising discovery that older patients with fractures were more likely to receive analgesics and opioids, and had better self-reported pain outcomes than younger patients. Hwang et al. posited that the difference in pain care may be driven by the greater prevalence in the elderly of LBF, which may elicit more aggressive pain treatment than other types of fractures. To our knowledge, no multi-center study has investigated differences in analgesic administration between patients with different types of fractures.

The objective of this study was to identify differences in ED pain care based on the type of fracture sustained. Our hypothesis is that long bone fractures may elicit a more aggressive pain response and, therefore, drive analgesic administration differences between younger and older patients.

Methods

Design and Setting

This was a retrospective review of data from a multicenter cohort of 1,782 patients collected by Hwang et al. for a study on age-related disparities in emergency department pain care [7]. The original study by Hwang et al. found no age-related disparities in differences in fracture pain care. The cohort includes all adult (>18 years old) patients with fracture presenting to five hospital emergency departments in the months of January, April, July and October 2009 (Jan 1–31, 2009; April 1–30, 2009; July 1–31, 2009; and October 1–31, 2009), chosen to account for seasonal variation. Four of the EDs were academic centers, and one was a community hospital. Four of the sites were considered urban, and one suburban. Two sites were located in the Northeast region of the United States, one in the Mid-Atlantic, one in the Rocky Mountain Region, and one on the West Coast. We excluded patients who did not have data available about the time of their ED triage, discharge or medication administration, and those whose ED visit did not follow a plausible timeline (e.g., patients who were recorded to receive an analgesic after ED discharge). This study received institutional board approval with a waiver of informed consent at all five sites. Further details about the sample assembly can be found in the original paper by Hwang et al. [7].

Variables

The primary patient predictor was the type of fracture, which was characterized into LBF (femur, tibia, ulnar, radial, humerus, fibula, pelvis and clavicle fractures) and shorter bone fractures (SBF) (vertebral, hand, foot, rib, facial fractures). Covariates included in analysis were primarily patient-related factors that may affect the quality of pain care received in the ED based on construct validity or literature review. These included age (continuous variable), gender, race/ethnicity, the first reported pain score (0 to 10; 0 = no pain, 10 = worst pain), Charlson comorbidity index, number of medications patients were taking at home, emergency severity index (ESI) (1 to 5; 1 = urgent, 5 = non-urgent), and emergency department occupancy rate (a validated measure of ED crowding [15]; defined as ED census divided by the number of ED treatment bays) at the time of triage. For analysis of age-based differences by LBF and SBF, the covariates used in analyses were gender, Charlson comorbidity index, ESI, ED crowding, and sub-type of LBF/SBF.

Pain Care Process Outcomes

Analgesic administration during the ED visit was examined and included whether an analgesic was provided, whether an opioid was provided, and the total equianalgesic dose of opioids administered during the ED visit [16,17]. Additional treatment outcomes examined included time to first analgesic administration.

Patient Pain Outcomes

All five sites used a 10-point numerical rating scale to assess patients' pain. This study examined the change in pain score reported by patients during their ED visit. This number was calculated similar to previous studies: Total ED pain score change is calculated by subtracting the first recorded pain score from the last recorded pain score before discharge [7].

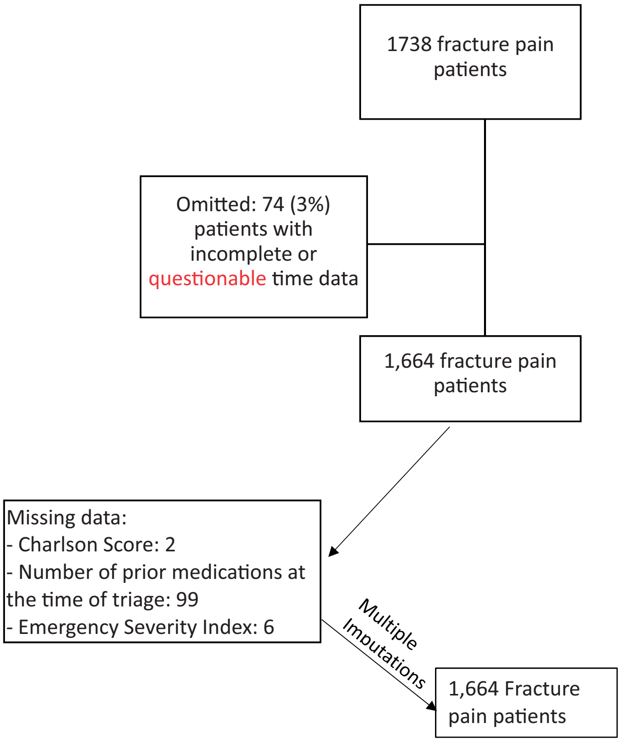

Figure 1 Missing data flowchart.

Multiple imputations (five iterations) were used to compute the missing data points, using gender, Charlson comorbidity index, ESI, ED crowding, first pain score and sub-type of LBF/SBF as the input variables.

Data Collection

The five sites in the primary study all had ED electronic medical records (EMRs) (four used ED Pulsecheck, PICIS Inc, Wakefield, MA; one used Epic ASAP, Epic Systems Corp, Verona, WI, USA). The EMRs used at each of the five sites time stamp data when entered; thus time of pain care processes including pain assessments, medication orders and administration, disposition and discharge were all logged. Time data, together with patient characteristics and pain process data, were abstracted by research personnel trained at each of the five sites according to methods established and described by investigators of prior ED pain studies [4,11,12]. The abstractors were blinded to the study hypothesis, and were trained using the 12 recommended criteria for medical record review studies [18]. Each abstractor received at least a 4-hour training session, shadowed the chart review process of the investigator, did chart abstractions that were compared to those of the investigators, and were deemed qualified to abstract independently when test abstractions were completed with 95% agreement.

Medications: For our analysis, we considered opioids, acetaminophen, topical anesthetics, and non-steroidal anti-inflammatory drugs (NSAIDs) as analgesics. Opioids included codeine, fentanyl, hydrocodone, hydromorphone, morphine, methadone as well as combination medications containing opioids (such as Percocet). NSAIDs included ibuprofen, aspirin, indomethacin, naproxen, and ketorolac. Topical anesthetics consisted mainly of topical lidocaine. Equianalgesic doses were calculated for all opioids using opioid conversion metrics developed in prior studies [16,17].

Time Data

Time stamp data from the study were reviewed manually for accuracy and consistency. Patients missing crucial time data (e.g., the time of medication administration and order) were excluded from analysis. Additionally, any patients with time points that did not adhere to a plausible timeline (e.g., recorded as receiving pain medication several days after ED discharge) were removed from the final analysis (Figure 1).

Data Analysis

All data were collected in Microsoft Excel (Microsoft Corp., Redmond, WA, USA), and analyzed using SPSS 20.0.0 (SPSS Inc., Chicago, IL, USA). Descriptive analyses were completed for the cohort by type of fracture. Variables that could impact the outcome measure, based on construct validity or existing evidence in literature, was included in adjusted analysis. These covariates included race [19], age [7], gender [20], Charlson comorbidity index, triage acuity, the first recorded pain score, and the type of long or shorter bone fracture. Adjusted analysis were completed using generalized estimating equations clustered by study site, using linear models for continuous outcomes, logistic models for categorical outcomes, and gamma with log link function for time-based outcomes (which had a non-normal, gamma distribution); 95% confidence intervals were calculated using Wald analysis. Values reported represent those of adjusted analyses.

Results

Cohort Characteristics

A total of 1,738 subjects met inclusion criteria. Of these, 1,664 had time data available and were retained for analysis; 774 patients had LBF and 890 had SBF (Figure 1). The characteristics of the cohort are listed in Table 1. There were significant differences by age, gender, race, triage acuity, number of prior medications and Charlson comorbidity scores between groups. A breakdown of the types of fractures is provided in Table 2.

Analgesic Use

Analgesic administration varied by the type of fracture. On unadjusted analysis, when compared to SBF, LBF were more likely to receive any analgesic, more likely to receive an opioid, and received higher doses of opioids (Table 3). These differences remained significant on adjusted analyses (Table 3). The time-to-medication administration was slightly longer with LBF than SBF, which remained significant on adjusted analyses (Table 3).

Patient Outcomes

Compared to LBF, patients with SBF had lower first initial pain scores. There was a statistically significant difference in final pain scores between LBF and SBF on adjusted analysis ($P = 0.044$), but the differences were not clinically meaningful (5.12 vs. 5.19).

Difference in Pain Care Process and Patient Outcomes by Age

When SBF and LBF fractures were examined separately, few age-based disparities in pain care were found (Table 4). Compared to younger patients, older patients with LBF were not less likely to receive an analgesic ($P = 0.361$), nor receive lower total opioid doses ($P = 0.581$). However, compared to younger patients, older patients waited longer for an analgesic with a trend to significance, but not statistical significance [99 (55–163) vs. 76 (35–149) minutes, $P = 0.057$]. Nonetheless older patients reported lower final pain scores compared to younger patients (PE: −0.206 [−0.236 to 0.648], $P = 0.001$).

The dearth of age-based differences extended to SBF. Compared to younger patients, older patients with SBF were not less likely to receive an analgesic ($P = 0.165$), an opioid ($P = 0.423$), or lower doses of opioids ($P = 0.111$). However, compared to younger patients, older patients with SBF did wait longer for an analgesic (102 [66–192] vs. 85 [41–142], $P = 0.040$). Finally, older patients with SBF reported lower final ED pain score (PE: −0.722 [−0.990 to −0.455], $P = 0.001$).

Sensitivity Analyses

We ran two sensitivity analyses. First, we excluded rib fractures and facial fractures from our analysis since these may be managed differently from other shorter bone fractures. Second, we added length of stay as a covariate to ensure that the increased morphine equivalents associated with long bone fractures was not due to simply longer ED stays. Neither of these sensitivity analyses changed our results appreciably (data not shown).

Discussion

Although several prior studies have investigated fracture pain treatment disparities in older adults, few have examined treatment across different types of fracture [5,10]. Older adults are more likely to present with LBF. It is conceivable that treatment differences in fracture pain that may appear to be driven by age, may in fact be confounded by difference in fracture type. Literature in inpatient settings suggests that even different types of LBF may require different doses of opioids. For example, in a study of elderly patients undergoing hip fracture repair, patients with femoral neck fractures had higher analgesic requirements on post-op days 1–3 compared to patients with intertrochanteric fractures [21]. It is, therefore, reasonable to expect differences in analgesic use between LBF and SBF in an ED setting.

The results of this study are notable for several reasons. First, as expected, the study demonstrates that demographic differences exist between fracture types: 66% of older patients in this cohort sustained LBF, compared to just 41% of younger patients. This may be explained by the fact older patients are more likely to sustain LBF (e.g., hip fractures) due to age-related conditions such as osteoporosis, and is consistent with prior studies in which a greater percentage of older patients had LBF [10,14,22]. Alternatively, older patients may be less likely to seek care for what they perceive to be smaller injuries [23,24]. Our study finds LBF elicited more aggressive pain treatment in the emergency department compared to SBF. On univariate analysis, patients with LBF were more likely to receive any analgesics and opioids, and they received more than twice the dose of opioids

Table 1 Cohort characteristics

Characteristics	Long N = 774	Shorter N = 890	*P* value
Age mean (SD)	53.88 (21.10)	42.58 (18.44)	<0.001
Female, N (%)	453 (58.5)	386 (43.4)	<0.001
Race/ethnicity, N (%)			<0.001
White	481 (62.1)	457 (51.3)	
Black	106 (13.7)	159 (17.9)	
Hispanic	107 (13.8)	169 (19.0)	
ESI,* mean (SD)	3.18 (0.67)	3.46 (0.66)	<0.001
No. of prior medications, mean (SD)	2.44 (3.26)	1.54 (2.79)	<0.001
Charlson comorbditiy index, mean (SD)	0.73 (1.45)	0.36 (1.10)	<0.001
Emergency department occupancy rate,† mean (SD)	1.36 (0.62)	1.34 (0.64)	0.483

*Emergency severity index 0 to 5 (1 = acute, 5 = non acute).
†ED census/number of treatment bays.

Table 2 Frequency of the different types of fractures

Type of long bone fracture	Frequency (N = 774), N (%)	Type of small bone fracture	Frequency (N = 890), N (%)
Radius/ulna	253 (33)	Hand	353 (40)
Tibia/fibula	218 (28)	Foot	235 (26)
Humerus	93 (12)	Facial	92 (10)
Pelvis	119 (15)	Ribs	84 (9)
Femur	47 (6)	Vertebrae	40 (4)
Clavicle	41 (5)	Patella	27 (3)
Other	3 (0.5)	Other	59 (7)

Table 3 Treatment and patient outcomes for different fracture types (results reported are adjusted values)

Outcomes	Long (N = 774)	Shorter (N = 890)	*P* value*	Odds ratio/parameter estimate (PE)†	Adjusted 95% CI
Received analgesic, N (%)	577 (74.5)	503 (56.5)	<0.001	OR: 2.03	1.58 to 2.62
Received opioid, N (%)	503 (65.0)	377 (42.4)	<0.001	OR: 2.22	1.84 to 2.69
Total morphine equivalent dose, mg mean (SD)	4.70 (6.56)	2.10 (4.11)	<0.001	PE: 0.268	0.239 to 0.297
Time to first analgesic, minutes, median (25–75%)	87 (44–145)	85 (41–153)	0.576	PE: 0.026	−0.065 to 0.117
Baseline pain score, mean (SD)	6.95 (2.67)	6.56 (2.82)	0.005	N/A	N/A
Final pain score, mean (SD)	5.12 (3.18)	5.19 (3.04)	0.044	0.217	0.006 to 0.428

*Adjusted for age, gender, race/ethnicity, the first reported pain score (0 to 10; 0 = no pain, 10 = worst pain), Charlson comorbidity index, emergency severity index (1 to 5; 1 = urgent, 5 = non-urgent), and ED crowding using generalized estimating equations.
†A positive parameter estimate denotes a higher value of the outcome for long bone fractures.

compared to SBF. These differences remained significant after adjusting for several confounders. This may explain why previous studies examining age disparities in the treatment of fractures have found conflicting results. For example, studies that examined only LBF found older patients with fractures received less aggressive pain care [10,13], while studies that examined all fracture types found older patients receive more aggressive pain care [14,25]. Our findings suggest these differences may be driven by the type of fracture rather than age.

Table 4 Outcomes for long and shorter bone fractures by patient age (results reported are adjusted values)

	Long bone fractures				Shorter bone fractures			
Outcomes	Young (≤ 65 years) N = 539	Older (>65 years) N = 235	Adjusted *P* value*	OR/PE† (95% CI)	Young (≤ 65 years) N = 770	Older (>65 years) N = 120	*P* value*	OR/PE (95% CI)
Received an analgesic, N (%)	401 (74.4)	235 (74.9)	0.361	1.32 (0.73 to 2.37)	437 (56.8)	66 (55.0)	0.069	1.21 (0.985 to 1.49)
Received an opioid, N (%)	339 (62.9)	164 (69.8)	0.745	0.92 (0.56 to 1.52)	325 (42.2)	52 (43.3)	0.786	1.10 (0.540 to 2.26)
Total opioid dose, mg mean (SD)	4.65 (6.75)	4.83 (6.09)	0.581	PE: −0.366 (−0.449 to −0.283)	2.09 (3.91)	2.17 (5.28)	0.346	−0.185 (−0.571 to 0.200)
Time to first analgesic, minutes median (25–75%)	76 (35 to 149)	99 (55 to 163)	0.057	PE: 0.224 (0.454 to 3.64)	85 (41 to 142)	102 (66 to 192)	0.040	PE: 0.213 (0.009 to 0.416)
Baseline pain score, mean (SD)	7.14 (2.43)	6.50 (3.11)	<0.001		6.68 (2.74)	5.76 (3.00)	<0.001	
Last recorded pain score, mean (SD)	5.57 (2.95)	4.04 (3.45)	0.001	PE: −0.206 (0.236 to −0.648)	5.42 (2.96)	3.67 (3.17)	<0.001	PE: −0.722 (−0.990 to −0.455)

*Adjusted for gender, race, first pain score, number of prior medications, Charlson score, type of long bone fracture, emergency severity index, and ED crowding using generalized estimating equations.

†A positive parameter estimate denotes a higher value of the outcome for long bone fractures.

Second, our study finds, when LBF and SBF were examined separately, no differences were found in the likelihood of analgesic administration between older and younger patients on adjusted analyses. However, consistent with previous single-site studies, older patients had slightly longer analgesic wait times (15 minutes) [5]. This time difference may be due to age-related disparities in pain care or because clinicians are more restrained when ordering medications for older patients. Further investigation using prospective studies may help clarify the cause.

A lingering question is why LBF elicit more aggressive pain care. One reason may be that LBF are simply more painful. In our analysis, we find the patients with LBF presented with significantly greater pain scores than patients with SBF. However, LBF continued to elicit more aggressive pain care, even after adjusting for initial pain scores. It may be the striking presentation of LBF, the fact LBF tend to have high mortality and morbidity and so are treated as higher priority, or clinicians are becoming better educated about the necessity of early pain management in hip fractures to prevent functional decline. Unfortunately, it is beyond the scope of this study to answer for certain why.

Our study has several limitations. First, its retrospective design leaves us unable to provide a full explanation as to why there are differences in pain care between fracture types and why older patients appear to wait longer for pain medication. Second, we were unable to account for patients' cognitive status, which may limit the ability of older patients with fractures to accurately characterize their pain. It may be that these patients were not able to communicate a clear pain score or that they were more likely to refuse pain medication. However, this possibility would actually bias against our findings (i.e., older patients are no less likely to receive pain medications). Third, regional blocks may have been used as a mode of analgesia in LBF and we did not detect their use in our study. However, regional block administration in LBF in lieu of traditional analgesics would bias against our conclusions that LBF receive more analgesics. Fourth, we grouped all patients over 65 into the "older" category, but significant heterogeneity may exist between treatment across the older age group. Further studies should examine potential differences in treatment within patients over 65. Fifth, our study did not account for the dose of non-steroidal anti-inflammatory drugs (NSAIDs) prescribed. It is possible that older patients receive larger doses of opioids because as a way to avoid NSAIDS (which have a poorer side effect profile in older adults). Sixth, there may be delays between when a medication is administrated and when it is logged in the EMR. However, there should be no documentation delays in medication order time as all medications need to be ordered through the EMR. This time is instantaneously logged in the EMR. Finally, we were unable to account for subcategories of fractures (i.e., intertrochanteric vs. femoral head hip fractures) and how these may affect analgesic administration. Prospective studies analyzing patient perception of pain and clinician perception of fracture pain would enable better evaluation of patient pain outcomes and provide a more detailed analysis of why LBF appear to elicit more potent pain control.

In conclusion, our study found SBF are associated with less aggressive pain care compared to LBF. When patients with SBF and LBF were analyzed separately, older patients were associated with slightly longer analgesic wait times, but were no less likely to receive analgesics. Our study suggests that more aggressive pain care in older patients found in previous studies is driven by the greater incidence of LBF. Future research and care interventions to alleviate fracture pain care should account for the type of fracture being treated.

References

1 Banz VM, Christen B, Paul K, et al. Gender, age and ethnic aspects of analgesia in acute abdominal pain: Is analgesia even across the groups? Int Med J 2012;42(3):281–8.

2 Dalton JA, Blau W, Lindley C, et al. Changing acute pain management to improve patient outcomes: An educational approach. J Pain Symptom Manage 1999;17(4):277–87.

3 Dalton JA, Carlson J, Blau W, et al. Documentation of pain assessment and treatment: How are we doing? Pain Manage Nurs 2001;2(2):54–64.

4 Bernstein SL, Aronsky D, Duseja R, et al. The effect of emergency department crowding on clinically oriented outcomes. Acad Emerg Med 2009;16(1): 1–10.

5 Boccio E, Wie B, Pasternak S, et al. The relationship between patient age and pain management of acute long-bone fracture in the ED. Am J Emerg Med 2014;32(12):1516–9.

6 Kaye AD, Baluch A, Scott JT. Pain management in the elderly population: A review. Ochsner J 2010;10(3): 179–87.

7 Hwang U, Belland LK, Handel DA, et al. Is all pain is treated equally? A multicenter evaluation of acute pain care by age. Pain 2014;155(12): 2568–74.

8 Dubljanin-Raspopovic E, Markovic-Denic L, Ivkovic K, et al. The impact of postoperative pain on early ambulation after hip fracture. Acta Chir Iugosl 2013; 60(1):61–4.

9 Herrick C, Steger-May K, Sinacore DR, et al. Persistent pain in frail older adults after hip fracture repair. J Am Geriatr Soc 2004;52(12):2062–8.

10 Brown JC, Klein EJ, Lewis CW, Johnston BD, Cummings P. Emergency department analgesia for fracture pain. Ann Emerg Med 2003;42(2):197–205.

11 Hwang U, Richardson LD, Sonuyi TO, Morrison RS. The effect of emergency department crowding on the management of pain in older adults with hip fracture. J Am Geriatr Soc 2006;54(2):270–5.

12 Hwang U, Richardson L, Livote E, et al. Emergency department crowding and decreased quality of pain care. Acad Emerg Med 2008;15(12):1248–55.

13 Jones JS, Johnson K, McNinch M. Age as a risk factor for inadequate emergency department analgesia. Am J Emerg Med 1996;14(2):157–60.

14 Minick P, Clark PC, Dalton JA, et al. Long-bone fracture pain management in the emergency department. J Emerg Nurs 2012;38(3):211–7.

15 McCarthy ML, Aronsky D, Jones ID, et al. The emergency department occupancy rate: A simple measure of emergency department crowding? Ann Emerg Med 2008;51(1):15–24.

16 Pereira J, Lawlor P, Vigano A, Dorgan M, Bruera E. Equianalgesic dose ratios for opioids. a critical review and proposals for long-term dosing. J Pain Symptom Manage 2001;22(2):672–87.

17 Knotkova H, Fine PG, Portenoy RK. Opioid rotation: The science and the limitations of the equianalgesic dose table. J Pain Symptom Manage 2009;38(3):426–39.

18 Worster A, Bledsoe RD, Cleve P, et al. Reassessing the methods of medical record review studies in emergency medicine research. Ann Emerg Med 2005;45(4):448–51.

19 Mills AM, Shofer FS, Boulis AK, Holena DN, Abbuhl SB. Racial disparity in analgesic treatment for ED patients with abdominal or back pain. Am J Emerg Med 2011;29(7):752–6.

20 Musey PI Jr, Linnstaedt SD, Platts-Mills TF, et al. Gender differences in acute and chronic pain in the emergency department: Results of the 2014 academic emergency medicine consensus conference pain section. Acad Emerg Med 2014;21(12): 1421–30.

21 Strike SA, Sieber FE, Gottschalk A, Mears SC. Role of fracture and repair type on pain and opioid use after hip fracture in the elderly. Geriatr Orthop Surg Rehabil 2013;4(4):103–8.

22 Herr K, Titler M. Acute pain assessment and pharmacological management practices for the older adult with a hip fracture: Review of ED trends. J Emerg Nurs 2009;35(4):312–20.

23 Nguyen HL, Saczynski JS, Gore JM, Goldberg RJ. Age and sex differences in duration of prehospital delay in patients with acute myocardial infarction: A systematic review. Circ Cardiovasc Qual Outcomes 2010;3(1):82–92.

24 Pitsavos C, Kourlaba G, Panagiotakos DB, Stefanadis C, Investigators GS. Factors associated with delay in seeking health care for hospitalized patients with acute coronary syndromes: The GREECS study. Hellenic J Cardiol 2006;47(6):329–36.

25 Min JJ, Bae JY, Kim TK, et al. Association between red blood cell storage duration and clinical outcome in patients undergoing off-pump coronary artery bypass surgery: A retrospective study. BMC Anesthesiol 2014;14:95.