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Is There Gender Discrimination in Acute Renal Colic Pain Management? A Retrospective Analysis in an Emergency Department Setting

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ABSTRACT

Background: Pain is a widespread problem, affecting both men and women; studies have found that women in the emergency department receive analgesic medication and opioids less often compared with men.
Aims: The aim of this study was to examine the administration and management of analgesics by the medical/paramedical staff in relation to the patients' gender, and thereby to examine the extent of gender discrimination in treating pain.
Design: This is a single-center retrospective cohort study that included 824 patients.
Settings: Emergency department of tertiary hospital in Israel.
Participants/Subjects: The patients stratified by gender to compare pain treatments and waiting times between men and women in renal colic complaint.
Methods: As an acute pain model, we used renal colic with a nephrolithiasis diagnosis confirmed by imaging. We recorded pain level by Visual Analog Scale (VAS) scores and number of VAS examinations. Time intervals were calculated between admissions to different stations in the emergency department. We recorded the number of analgesic drugs administered, type of drugs prescribed, and drug class (opioids or others).
Results: A total of 824 patients (414 women and 410 men) participated. There were no significant differences in age, ethnicity, and laboratory findings. VAS assessments were higher in men than in women (6.43 versus 5.90, $p = .001$, respectively). More men than women received analgesics (68.8% versus 62.1%, $p = .04$, respectively) and opioids were prescribed more often for men than for women (48.3 versus 35.7%, $p = .001$). The number of drugs prescribed per patient was also higher in men compared with women (1.06 versus 0.93, $p = .03$). A significant difference was found in waiting time length from admission to medical examination between non-Jewish women and Jewish women.
Conclusions: We found differences in pain management between genders, which could be interpreted as gender discrimination. Yet these differences could also be attributed to other factors not based on gender discrimination but rather on gender differences.

Efficient and adequate analgesic treatments for patients in emergency departments (ED) are lacking based on patient's satisfaction surveys worldwide (Ducharme & Barber, 1995; Guru & Dubinsky, 2000; Pretorius et al., 2015; Weimer et al., 2013).

Many studies have reported that treatment of pain and the provision of analgesics in the ED vary with the patient's gender, ethnicity, age, and socioeconomic status (Alexander & Manno, 2003; Boissoneault et al., 2016; Hostetler, Auinger, & Szilagyi, 2002; Jones, Johnson, & McNinch, 1996).

Numerous studies have also found that delivery of analgesics is related to the patient's recorded data, local pain protocol, the medical sector type involved (nurses, physicians) and their clinical experience, perception of the patient's pain by the caregiver, and

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other factors such as the degree of crowding in the ED and source of pain, whether from traumatic injury or other causes (Chen et al., 2008; Hwang et al., 2006; Miner et al., 2006; Pierik et al., 2016).

We used renal colic caused by nephrolithiasis as a model of acute pain because it is a very common problem in the general population that is diagnosed in our ED. Approximately 13% of men and 7.5% of women will experience at least one renal colic attack as a result of nephrolithiasis during their lifetime (Litwin et al., 2005; Scales et al., 2012). Usually the presenting symptoms are sharp pains at the waist, which may radiate to the lower abdomen and/or to the groin (testicles in men).

The pain of renal colic is described by patients as one of the worst forms of pain they ever experienced. Women compare this pain to labor pains, if not worse (Behzadnia et al., 2012; Romero, Akpinar, & Assimos, 2010).

The research aim was to identify and assess potential factors affecting gender differences in the administration and management of analgesics by the medical and paramedical staff. The primary outcomes were gender differences in pain severity and differences in the analgesic treatment administered. The secondary outcome was differences in pain management between majority and minority populations. Because pain management is of universal interest, the significance of this study lies in raising the awareness of medical and paramedical staff regarding gender aspects of pain management in an ED setting. Throughout the text we used *gender* as an umbrella term for sex- and gender-based issues.

Literature Review

Differences between pain severity and gender have been reported in numerous studies describing medical and behavioral events (Barnabe et al., 2012; Hampton, Cavalier, & Langford, 2015; Meints, Wang, & Edwards, 2018; Zheng et al., 2017).

The μ-opioid receptors (MOR), located mainly in the central nervous system, are inhibitory G-protein–coupled receptors that activate the Gi α subunit, reducing cyclic adenosine monophosphate (cAMP) production by lowering cAMP levels (McDonald & Lambert, 2015). This causes reduced neuronal cell excitability leading to a reduction in transmission of nerve impulses and inhibition of neurotransmitter release (Gould & Kaye, 2018). MOR has high affinity to endogenic enkephalins and β-endorphins and is exeogenic for most clinically and recreationally used opioids (Reed, Butelman, & Kreek, 2017).

In animal models using ligation of the masseter tendon, MORs are upregulated to a greater extent in male animals compared with females; this observation is linked to testosterone and correlates with better analgesic response in male to opioid (Bai et al., 2015).

A study conducted in humans found significant regional differences in the activation of MORs in response to pain. Men largely had activation in the anterior thalamus, ventral basal ganglia, and amygdala; whereas women had more active MORs in the nucleus accumbens, suggesting a different response between genders to pain and analgesia (Zubieta et al., 2002).

Psychosocial mechanisms have also been found to have a significant impact on differential pain perception and expression differences in men and women (Miller & Newton, 2006). Women tend to develop higher degrees of catastrophizing than men (Jensen, Nygren, Gamberale, Goldie, & Westerholm, 1994; Meints et al., 2018), a coping modality based on magnification and reflection on the information (Sullivan et al., 2001). Increased catastrophizing is associated with poor health status and disability (Jensen et al., 1994). Another difference found to relate to coping mechanisms is that women reporting more intense pain used more coping strategies, among them positive self-statement and emotional support (Ramírez-Maestre & Esteve, 2014). Self-efficacy as a coping modality was also found to be used more often among women compared with men (Jackson Iezzi, Gunderson, Nagasaka, & Fritch, 2002).

Gender bias in treating pain has been repeatedly investigated. In one large study (Keogh & Herdenfeldt, 2002) it was found that women were given more sedatives whereas men were given more analgesics, an outcome that could indicate that women experiencing pain are undertreated.

Methods

Design

This study was conducted as a single-center retrospective review at the ED during January 1 to December 31, 2016. The sample included 824 patients stratified by gender to compare pain treatments and waiting times between men and women. Data were collected for all patients older than age 18 years who presented to our ED with the initial diagnosis of renal colic. This initial diagnosis of nephrolithiasis was confirmed during their ED visit by ultrasonography or computed tomography (CT).

The data were retrieved from computerized charts. Inclusion criteria were considered fulfilled when a patient's chart included all the required parameters: demographic characteristics (e.g., age, ethnicity), time of admission to ED, Visual Analog Scale (VAS) score, number of VAS examinations, imaging type (CT or ultrasonography), time interval from admission to discharge, time interval from admission to first analgesic order, time interval from admission to nurses' and physicians' examination, time interval from physician examination to imaging time, time interval from first order of analgesic to second order, number of analgesic drugs given, type of drugs prescribed, and drug class (opioids or others). Laboratory characteristics retrieved included white blood cell counts, creatinine, and estimated glomerular filtration rate calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation (Levey et al., 2009).

Patients were excluded from the study if they required nonstandard management because of their presenting conditions or if nephrolithiasis was not noted in the image modalities.

VAS was measured uniformly for all patients using a standard numeric scale ranging from no pain (0) to worst pain imaginable (10). We used the VAS score in accordance with the original paper scale (Huskisson, 1974). The nurses at the triage area of our ED are responsible for administering the initial analgesia, in accordance with a general local protocol and according to the patient's VAS assessment. Patients complaining of pain with VAS scores ranging between 4 and 6 are treated by the nurses with first-line analgesia over-the-counter medications, such as dipyrone (Optalgin) or acetaminophen (Acamol).

Patients with VAS scores of 7 or higher are prescribed stronger analgesic drugs only after consultation with a physician. “Stronger” analgesics include nonsteroidal anti-inflammatory drugs (NSAIDs) such as Diclofenac (Voltaren) intramuscular and opioids such as tramadol (Tramdex), oxycodone (Oxycode), and meperidine (Pethidine) intramuscular, and intravenous morphine. Those medications are administered to the patients after verifying allergies, contraindications (renal failure), and VAS assessment.

Because no data were available for the time gap between the prescription timing of analgesics and the actual time when the patients were given the drug, two of the authors (E. N. and S. S.) performed an auxiliary observation study for 14 days to assess this time window. The observers were physicians with experience in conducting prospective studies and had attended good-practice

clinical courses. Before conducting those observations, all the authors collaborated on an observation protocol as described here.

The auxiliary study covered day and night shifts and included 50 patients. In addition to monitoring the time interval from prescribing a drug to the time the drug was administered to the patients, we interviewed nurses about their subjective perception of the duration of this time interval. These responses were corroborated with our observations, with differences between physician and nurse time estimates of <3 (2:56 ± 1.2) minutes.

In all service shifts throughout any 24-hour cycle, the medical and paramedical staff includes more than 30 male and female nurses and doctors from different ethnicities, mostly of Jewish and Arab ethnicities. In Israel, 11% of physicians and 14% of nurses are of Arab ethnicity, and at our ED 7.5% of physicians and 30% of nurses are of Arab ethnicity.

The Institutional Review Board (Helsinki Committee) approved the study (approval number IRB-01765), and the study was conducted according to the STROBE guidelines for observational studies.

Statistics

The statistical analysis for this paper was generated using SAS Software, Version 9.4 (Cary, NC, USA). Continuous variables were presented as mean ± SD, and categorical variables were presented numerically as a percentage of total patients in the cohort (N, %). The Student's *t* test was used to compare the values of continuous variables between genders and Fisher exact test to compare the values of categorical variables with statistical significance as defined by $p < .05$. A general linear model (GLM) suitable for unbalanced designs was used for multivariate analysis. Two-sided *p* values < .05 were considered statistically significant. Also, because only patients with full and detailed information were included in the study, we had no invalid data or missing information for any patient.

Results

Of the 824 patients included in this study, 414 were women and 410 were men (50.2% versus 49.8%, respectively). There were no significant differences between men and women regarding age (51.5 ± 15.4 versus 48.4 ± 16.4 years, $p = .26$, respectively), ethnicity (90.2 versus 90.3% Jewish decent, $p = .95$), or laboratory findings for glomerular filtration rate and white blood cell count (73.3 ± 22.2 versus 81.1 ± 24 [>60 milliliters/minute per 1.73 m^2, $p = .12$] and 6.1 ± 2.84 versus 6.2 ± 2.6 [4.8-10.8, 1,000/microliter], $p = .9$, respectively).

The first VAS score and the number of VAS assessments were significantly higher in men than in women. More men than women received analgesic treatments, and opioid therapy was prescribed significantly more often to men compared with women. The most commonly prescribed drug in both groups was diclofenac (Voltaren). The number of drugs prescribed per patient was also higher in men compared with women (Table 1).

Orders for imaging studies differed significantly among men, who more commonly underwent CT imaging than women (360 [88%] versus 291 [77%] CT imaging, $p = .01$, respectively).

The time gap (Δ in hours) between different stations in the ED is presented in Table 2.

We used a multivariate GLM to test the combined effects of gender, first VAS and ethnicity on time from admission to medical examination. This model indicated a significant interaction ($p = .08$) between gender and ethnicity: We found that ethnicity did not affect the time spans between admission and medical examination (1:13 hours versus 1:16 hours for Jews and non-Jews, respectively). However, the time spans for non-Jewish and Jewish women differed significantly (2:07 hours versus 1:30 hours, respectively, $p < .001$) (Fig. 1).

A second multivariate GLM was used to examine the influence of gender, age, morphine use, and first VAS on the time interval from admission to medical examination. The effects of both gender and VAS were significant ($p = .04$ and $p < .001$, respectively).

A third multivariate GLM used to examine the influence of the same factors on the time interval between admission to nurse examination found gender had a significant effect ($p = .03$).

Discussion

Analgesia administration in the ED involves complex decisions based on local protocols, patients' characteristics, presentation of symptoms, and experience of caregivers and factors such as availability and time of day (night shift or day shift) (Banz et al., 2012; Van Woerden et al., 2016). Unfortunately, there are still no easily available methods to objectively define clinical pain, and therefore assessment is basically a subjective interpretation of a subjective presentation. Diagnostic and therapeutic procedures may depend to a large extent on the first assessment, which is hampered by the lack of objective metrics. It is possible that men complaining about pain might trigger stronger pain relief efforts by caregivers than when women complain, which by itself may be related to a sociocultural gender bias.

Gender bias may also play an additional role. Chen et al. (2008) examined a prospective study on differences between genders in the provision of adequate analgesics to patients with the diagnosis of abdominal pain. The study enrolled 981 patients who were referred to the ED for nontraumatic abdominal pain lasting less than 72 hours. The authors reported that women waited much longer than men to receive their first analgesic. Similar findings were also made by Weimer et al. (2013), who indicated possible discrimination in the treatment of women with chronic and acute pain. Shabbir et al. (2004) conducted a prospective study including 107 patients that evaluated the management of abdominal pain in the ED. They found that women waited longer than men for

Table 1
Pain Scale Measurements and Management of Renal Colic Patients in the ED

Characteristics	Men (410 Patients)	Women (414 Patients)	T Test	*df*	*p*
First VAS (Mean ± SD)	6.43 ± 2.71	5.90 ± 2.75	−1.22	84	.001
Number of VAS measurements (mean ± SD)	1.43 ± 0.7	1.31 ± 0.73	−0.55	92	.006
OTC drugs (n, %) (paracetamol, dipyrone)	76 (18.5%)	86 (20.7%)	0.1	1	.52
NSAID (diclofenac)	118 (28.7%)	123 (29.7%)	0.64	1	.76
Opioids (tramadol, meperidine, oxycodone, morphine)	197 (48.3%)	147 (35.7%)	0.11	1	.001
No medication	128 (31.2%)	157 (37.9%)	0.26	1	.04
No. of drugs given per patient (mean ± SD)	1.06 ± 0.93	0.93 ± 0.89	0.06	91	.03

ED = emergency department; VAS = Visual Analog Scale; SD = standard deviation; OTC = over the counter; NSAID = nonsteroidal anti-inflammatory drugs.

Table 2
Time Gaps Between Different Stations in the ED (Δ in Minutes: Mean ± SD)

Stations in the ED	Men (n = 410)	Women (n = 414)	T Test	*df*	*p*
Δ Admission–nurse examination	20 ± 25	23 ± 38	0.65	91	.10
Δ Admission–medical examination	76 ± 90	94 ± 107	1.36	90	.01
Δ Admission–first order medication	128 ± 133	141 ± 148	−0.46	70	.28
Δ First order–second order medication	147 ± 135	181 ± 164	0.09	32	.08
Δ Nurse examination–first order medication	108 ± 132	117 ± 150	−0.39	72	.023
Δ Nurse–medical examination	56 ± 90	70 ± 113	1.11	89	.04
Δ Medical examination–imaging	199 ± 149	324 ± 165	0.97	87	.60
Δ Admission–discharge	484 ± 181	503 ± 214	1.71	82	.15

ED = emergency department; SD = standard deviation.
All values and SD are in minutes.

analgesia administration (mean of 129 minutes versus 69 minutes; $p = .09$, respectively).

However, other studies have reported no time differences (Patel et al., 2014; Selbst & Clark, 1990). In a prospective study by Uri et al. (2015) including 150 men and 178 women studied for musculoskeletal pain management in the ED, there were no differences reported related to gender as far as analgesia administration, duration time for analgesia, pain relief, and patient satisfaction (Uri, Elias, Behrbalk, & Halpern, 2015). The authors suggested that this could have been due to the strict use of a standardized protocol.

Our study found that women waited longer than men for analgesic treatment (117 ± 150 minutes versus 108 ± 132 minutes, respectively; $p = .023$), but we argue that there might also be a different interpretation than gender discrimination for our findings and those of others concerning prolonged waiting time for women. In general the workup for women may require more time because of additional gynecologic examinations, and many EDs routinely require gynecologic examinations for women with abdominal pain. Our results therefore support the conclusions of the multicenter study by Siddiqui et al. (2015), which included 6,931 patients. Those researchers evaluated the impact of gender bias on abdominal pain or fracture pain in an ED setting. They found that women with abdominal pain waited longer than men for analgesia (women: mean = 112 (65-187) minutes; men: mean = 96 (52-167) minutes; $p < .001$), whereas the waiting time for women with a fracture was equal to that of men. The researchers concluded that abdominal pain in women is more complex to diagnose than in men, and this could partially explain the time disparities found between responding to abdominal pain and fractures. Our study dealt with renal colic, which is also more complex in women because of a more demanding differential diagnosis, including possible coexisting gynecologic problems, and this could explain the prolonged waiting times for women as opposed to putative gender discrimination. The report by Siddiqui et al. (2015) that assessment of somatic pain (fracture) as opposed to visceral pain was not associated with prolonged waiting times for women strongly corroborates our conclusions.

Like others, we also assessed whether imaging modes may be different between men and women in the course of evaluating abdominal pain. In our study, women underwent more ultrasounds and men underwent CT more often for diagnosis of abdominal pain ($p = .01$). This is in accordance with the findings of Innes et al. (2016), who assessed patient management of renal colic caused by nephrolithiasis stratified by gender. Their study included 1,993 patients (35% women and 65% men) with no epidemiologic difference in other indices. It was found that men were referred to CT

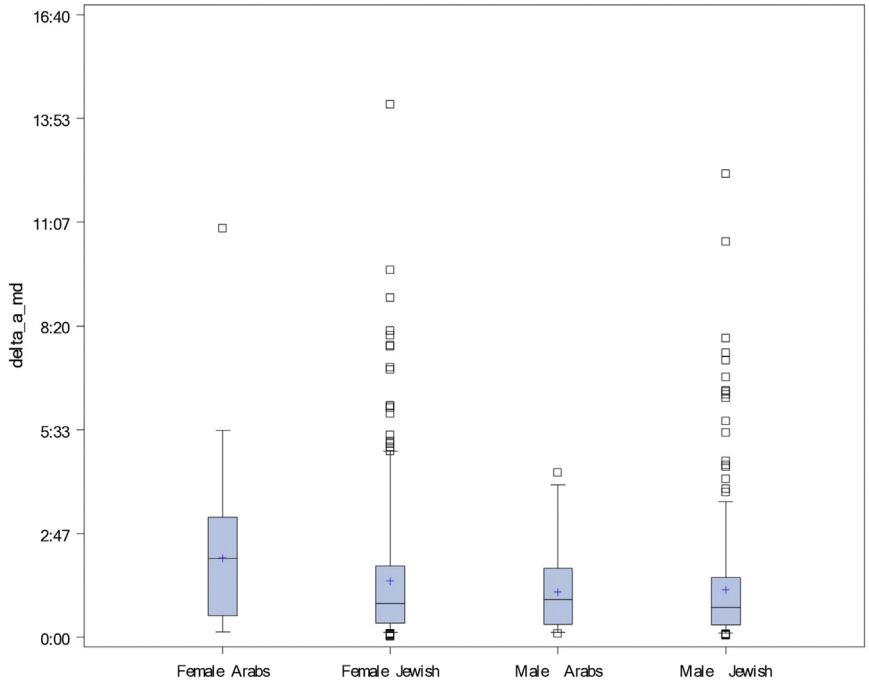

Figure 1. Interaction plot for time gap between admission to medical examination.

more often than women. Because CT is often considered a more reliable, albeit more expensive, imaging modality, one may be inclined to assume that a gender bias was the basis of its more common use in men.

Here too we believe that there might be another explanation for these findings. The reluctance of the medical staff to use radiation-based imaging in women of childbearing age might have simply been because of the concern of exposing ovaries or even a yet undetected early pregnancy to radiation, rather than gender bias.

Finally, it has repeatedly been found that men receive analgesic treatment earlier than women and that treatment is also more intensive in men than in women. Chen et al. (2008) assessed patients who were referred to the ED for nontraumatic abdominal pain lasting less than 72 hours. Although women and men reported the same pain intensity as men, they received significantly less analgesia and were prescribed opioids less often. Banz et al. (2012), examined 150 patients (75 women and 75 men) with nonspecific abdominal pain who were admitted to the ED. More men received a nonsteroidal anti-inflammatory drug and opioids than women.

Our results corroborate the reports and indicate that men received analgesic treatment earlier that women and were also given more intensive treatment than women. We believe that this was related to the first pain assessment at admission: Men reported significantly higher VAS scores, and this may have led to earlier provision of analgesic and also to more intensive treatment (Table 2).

The main way our research differs from most studies is the emphasis we placed on VAS data and the analysis of various time intervals for access events. Pain in women and men was assessed using VAS at admission, where men reported significantly higher scores than women. Men also subsequently underwent more VAS tests than women. Because one of the first decisions required by the medical staff, related to a patient visiting an ED with a complaint of pain, is to assess the level and intensity of pain, we believe that the management cascade was trigged earlier and differently in men than in women. We are aware that this might be in contrast to many studies in which no difference in VAS scores between genders was identified for a particular diagnosis (Chen et al., 2008; Patel et al., 2014; Uri et al., 2015). Moreover, there are reports of higher VAS in women (mostly in trauma and musculoskeletal pain), interpreted as probably being a result of higher anxiety levels and cultural aspects (Raftery, Smith-Coggins, & Chen, 1995). This suggests that cultural differences, including different gender roles in ethnic populations, might play a role.

An unexpected finding in our study is related to an apparent bias toward women of a minority group: Arab women (who belong to the largest minority group in Israel) waited longer than Jewish women before receiving analgesia or undergoing medical examination by a nurse or physician. This observation may be in agreement with the findings of other studies that have reported a racial disparity in analgesia and opioid administration in the ED (Choi, Yate, Coats, Kalinda, & Paul, 2000; Pletcher et al., 2008; Tamayo-Sarver, Hinze, Cydulka, & Baker, 2003). The most recent study regarding racial disparity was conducted in California by Young et al. (2013), who retrospectively evaluated 2,461 patients (Young, Hern, Alter, Barger, & Vahidnia, 2013). A multivariate analysis, adjusted for race, sex, age, time with patient, and pain score, found that African-American and Hispanic patients were less likely than Caucasian patients to receive analgesia and waited a longer time before its administration. But given the fact there were no differences in pain management for Jewish and non-Jewish male patients in our study, and taking into account the ethnic heterogeneity of our medical staff, we have no explanation for this finding and are currently planning a study to gain further insight.

Limitations

This study is limited by its retrospective nature. The medical records provide only a limited understanding of the clinical decision making and nonverbal communication or discussion regarding the type of analgesia, such as patients' preferences regarding receiving opioids. Moreover, data on socioeconomic status and educational level, which could play a role in deciding on the analgesia treatment, are not recorded in the patients' charts. There is a statistical difference in the original VAS between men and women (men had higher VAS scores at presentation). Although this finding could explain the increased incidence of analgesic treatments and the use of opioids among men, it is not clear to us whether it is so because women present their pain differently from men and are undertreated or because experience renal colic pain differently than men. Finally, because this study is based on patients' charts, it is possible that there were errors in the data entries. However, it is unlikely that such errors would occur more often in any particular group.

The strength of the study is in its relatively large number of patients who were treated in a single tertiary health care center within a relatively short period and according to a similar protocol.

Nursing Implications

We found that there are gender differences in VAS scores, which were significantly higher in men than in women. Moreover, the higher VAS in men could have been the trigger for the subsequent disparity in pain management between men and women. Specifically, the greater number of VAS tests performed in men, the shorter time intervals between admissions and medical examinations, the increased incidence of analgesic treatments, and the use of opioids in men may all be derivatives of the initially higher VAS reported by men and not necessarily a result of gender discrimination. The preference for ultrasound examinations in women as opposed to CT scans in men might have been due to the reluctance of the staff to perform ionizing radiation imaging studies on women for fear of exposing the ovaries or an undocumented early pregnancy, not necessarily a result of gender discrimination. The remaining question is whether men are overtreated or women are undertreated for pain in an ED setting. Both may be true, but an important conclusion is that gender differences need to be acknowledged in order to provide appropriate care for both men and women. Specifically, educating the medical, nursing, and paramedical staff that women may experience and may express pain differently than men is a marked step toward gender- and sex-conscious medicine.

References

Alexander, J., & Manno, M. (2003). Underuse of analgesia in very young pediatric patients with isolated painful injuries. *Annals of Emergency Medicine, 41*(5), 617–622.

Bai, X., Zhang, X., Li, Y., Lu, L., Li, B., & He, X. (2015). Sex differences in peripheral mu-opioid receptor mediated analgesia in rat orofacial persistent pain model. *PLoS One, 10*(3), e0122924.

Banz, V. M., Christen, B., Paul, K., Martinolli, L., Candinas, D., Zimmermann, H., & Exadaktylos, A. K. (2012). Gender, age and ethnic aspects of analgesia in acute abdominal pain: is analgesia even across the groups? *Internal Medicine Journal, 42*(3), 281–288.

Barnabe, C., Bessette, L., Flanagan, C., Leclercq, S., Steiman, A., Kalache, F., Kung, T., Pope, J. E., Haraoui, B., Hochman, J., Mosher, D., Thorne, C., & Bykerk, V. (2012). Sex differences in pain scores and localization in inflammatory arthritis: a systematic review and meta analysis. *The Journal of Rheumatology, 39*(6), 1221–1230.

Behzadnia, M. J., Javadzadeh, H. R., & Saboori, F. (2012). Time of admission, gender and age: challenging factors in emergency renal colic—a preliminary study. *Trauma Monthly, 17*(3), 329.

Boissoneault, J., Mundt, J., Bartley, E., Wandner, L., Hirsh, A., & Robinson, M. (2016). Assessment of the influence of demographic and professional characteristics on health care providers' pain management decisions using virtual humans. *Journal of Dental Education, 80*(5), 578–587.

Chen, E. H., Shofer, F. S., Dean, A. J., Hollander, J. E., Baxt, W. G., Robey, J. L., Sease, K. L., & Mills, A. M. (2008). Gender disparity in analgesic treatment of emergency department patients with acute abdominal pain. *Academic Emergency Medicine, 15*(5), 414–418.

Choi, D. M., Yate, P., Coats, T., Kalinda, P., & Paul, E. A. (2000). Ethnicity and prescription of analgesia in an accident and emergency department: cross sectional study. *BMJ, 320*(7240), 980–981.

Ducharme, J., & Barber, C. (1995). A prospective blinded study on emergency pain assessment and therapy. *Journal of Emergency Medicine, 13*(4), 571–575.

Gould, H. J., & Kaye, A. D. (2018). The anatomy of pain and its implications for regional anesthesiology practice. In A. D. Kaye, R. D. Urman, & N. Vadivelu (Eds.), *Essentials of regional anesthesia* (2nd ed., pp. 53–82). Cham, Switzerland: Springer.

Guru, V., & Dubinsky, I. (2000). The patient vs. caregiver perception of acute pain in the emergency department. *The Journal of Emergency Medicine, 18*(1), 7–12.

Hampton, S. B., Cavalier, J., & Langford, R. (2015). The influence of race and gender on pain management: A systematic literature review. *Pain Management Nursing, 16*(6), 968–977.

Hostetler, M. A., Auinger, P., & Szilagyi, P. G. (2002). Parenteral analgesic and sedative use among ED patients in the United States: Combined results from the National Hospital Ambulatory Medical Care Survey (NHAMCS) 1992-1997. *The American Journal of Emergency Medicine, 20*(3), 139–143.

Huskisson, E. C. (1974). Measurement of pain. *The Lancet, 304*(7889), 1127–1131.

Hwang, U., Richardson, L. D., Sonuyi, T. O., & Morrison, R. S. (2006). The effect of emergency department crowding on the management of pain in older adults with hip fracture. *Journal of the American Geriatrics Society, 54*(2), 270–275.

Innes, G. D., Scheuermeyer, F. X., Law, M. R., McRae, A. D., Weber, B. A., Boyda, H. N., Lonergan, K., & Andruchow, J. E. (2016). Sex-related differences in emergency department renal colic management: Females have fewer computed tomography scans but similar outcomes. *Academic Emergency Medicine, 23*(10), 1153–1160.

Jackson, T., Iezzi, T., Gunderson, J., Nagasaka, T., & Fritch, A. (2002). Gender differences in pain perception: The mediating role of self-efficacy beliefs. *Sex Roles, 47*(11-12), 561–568.

Jensen, I., Nygren, Å., Gamberale, F., Goldie, I., & Westerholm, P. (1994). Coping with long-term musculoskeletal pain and its consequences: is gender a factor? *Pain, 57*(2), 167–172.

Jones, J. S., Johnson, K., & McNinch, M. (1996). Age as a risk factor for inadequate emergency department analgesia. *The American Journal of Emergency Medicine, 14*(2), 157–160.

Keogh, E., & Herdenfeldt, M. (2002). Gender, coping and the perception of pain. *Pain, 97*(3), 195–201.

Levey, A. S., Stevens, L. A., Schmid, C. H., Zhang, Y. L., Castro, A. F., Feldman, H. I., Kusek, J. W., Eggers, P., Van Lente, F., Greene, T., & Coresh, J. (2009). A new equation to estimate glomerular filtration rate. *Annals of Internal Medicine, 150*(9), 604–612.

Litwin, M. S., Saigal, C. S., Yano, E. M., Avila, C., Geschwind, S. A., Hanley, J. M., Joyce, G. F., Madison, R., Pace, J., Polich, S. M., Wang, M., & Urologic Diseases in America Project. (2005). Urologic diseases in America Project: Analytical methods and principal findings. *The Journal of Urology, 173*(3), 933–937.

McDonald, J., & Lambert, D. G. (2015). Opioid receptors. *Continuing Education in Anesthesia Critical Care & Pain, 15*(5), 219–224.

Meints, S. M., Wang, V., & Edwards, R. R. (2018). Sex and race differences in pain sensitization among patients with chronic low back pain. *The Journal of Pain, 19*(12), 1461–1470.

Miller, C., & Newton, S. E. (2006). Pain perception and expression: The influence of gender, personal self-efficacy, and lifespan socialization. *Pain Management Nursing, 7*(4), 148–152.

Miner, J., Biros, M. H., Trainor, A., Hubbard, D., & Beltram, M. (2006). Patient and physician perceptions as risk factors for oligoanalgesia: A prospective observational study of the relief of pain in the emergency department. *Academic Emergency Medicine, 13*(2), 140–146.

Patel, R., Biros, M. H., Moore, J., & Miner, J. R. (2014). Gender differences in patient-described pain, stress, and anxiety among patients undergoing treatment for painful conditions in the emergency department. *Acad Emerg Med, 21*(12), 1478–1484.

Pierik, J. G., Berben, S. A., IJzerman, M. J., Gaakeer, M. I., van Eenennaam, F. L., van Vugt, A. B., & Doggen, C. J. (2016). A nurse-initiated pain protocol in the ED improves pain treatment in patients with acute musculoskeletal pain. *International Emergency Nursing, 27*, 3–10.

Pletcher, M. J., Kertesz, S. G., Kohn, M. A., & Gonzales, R. (2008). Trends in opioid prescribing by race/ethnicity for patients seeking care in US emergency departments. *JAMA, 299*(1), 70–78.

Pretorius, A., Searle, J., & Marshall, B. (2015). Barriers and enablers to emergency department nurses' management of patients' pain. *Pain Management Nursing, 16*(3), 372–379.

Raftery, K. A., Smith-Coggins, R., & Chen, A. H. (1995). Gender-associated differences in emergency department pain management. *Annals of Emergency Medicine, 26*(4), 414–421.

Ramírez-Maestre, C., & Esteve, R. (2014). The role of sex/gender in the experience of pain: Resilience, fear, and acceptance as central variables in the adjustment of men and women with chronic pain. *The Journal of Pain, 15*(6), 608–618.

Reed, B., Butelman, E. R., & Kreek, M. J. (2017). Endogenous opioid system in addiction and addiction-related behaviors. *Current Opinion in Behavioral Sciences, 13*, 196–202.

Romero, V., Akpinar, H., & Assimos, D. G. (2010). Kidney stones: A global picture of prevalence, incidence, and associated risk factors. *Reviews in Urology, 12*(2-3), e86.

Scales, C. D., Jr., Smith, A. C., Hanley, J. M., Saigal, C. S., & Urologic Diseases in America Project. (2012). Prevalence of kidney stones in the United States. *European Urology, 62*(1), 160–165.

Selbst, S. M., & Clark, M. (1990). Analgesic use in the emergency department. *Annals of Emergency Medicine, 19*(9), 1010–1013.

Shabbir, J., Ridgway, P. F., Lynch, K., Law, C. E., Evoy, D., O'Mahony, J. B., & Mealy, K. (2004). Administration of analgesia for acute abdominal pain sufferers in the accident and emergency setting. *European Journal of Emergency Medicine, 11*(6), 309–312.

Siddiqui, A., Belland, L., Rivera-Reyes, L., Handel, D., Yadav, K., Heard, K., Yadav, K., Heard, K., Eisenberg, A., & Hwang, U. (2015). A multicenter evaluation of the impact of gender on abdominal and fracture pain care. *Medical Care, 53*(11), 948.

Sullivan, M. J., Thorn, B., Haythornthwaite, J. A., Keefe, F., Martin, M., Bradley, L. A., & Lefebvre, J. C. (2001). Theoretical perspectives on the relation between catastrophizing and pain. *The Clinical Journal of Pain, 17*(1), 52–64.

Tamayo-Sarver, J. H., Hinze, S. W., Cydulka, R. K., & Baker, D. W. (2003). Racial and ethnic disparities in emergency department analgesic prescription. *American Journal of Public Health, 93*(12), 2067–2073.

Uri, O., Elias, S., Behrbalk, E., & Halpern, P. (2015). No gender-related bias in acute musculoskeletal pain management in the emergency department. *Emergency Medicine Journal, 32*(2), 149–152.

Van Woerden, G., Van Den Brand, C. L., Den Hartog, C. F., Idenburg, F. J., Grootendorst, D. C., & Van Der Linden, M. C. (2016). Increased analgesia administration in emergency medicine after implementation of revised guidelines. *International Journal of Emergency Medicine, 9*(1), 4.

Weimer, M. B., Macey, T. A., Nicolaidis, C., Dobscha, S. K., Duckart, J. P., & Morasco, B. J. (2013). Sex differences in the medical care of VA patients with chronic non-cancer pain. *Pain Medicine, 14*(12), 1839–1847.

Young, M. F., Hern, H. G., Alter, H. J., Barger, J., & Vahidnia, F. (2013). Racial differences in receiving morphine among prehospital patients with blunt trauma. *The Journal of Emergency Medicine, 45*(1), 46–52.

Zheng, H., Schnabel, A., Yahiaoui-Doktor, M., Meissner, W., Van Aken, H., Zahn, P., & Pogatzki-Zahn, E. (2017). Age and preoperative pain are major confounders for sex differences in postoperative pain outcome: A prospective database analysis. *PLOS One, 12*(6).

Zubieta, J. K., Smith, Y. R., Bueller, J. A., Xu, Y., Kilbourn, M. R., Jewett, D. M., Meyer, C. R., Koeppe, R. A., & Stohler, C. S. (2002). μ-Opioid receptor-mediated antinociceptive responses differ in men and women. *Journal of Neuroscience, 22*(12), 5100–5107.