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PREHOSPITAL PAIN MANAGEMENT FOR INJURED PATIENTS AT THE INTERSECTION OF SEX AND OBESITY: A RETROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Objectives: We investigated the association of obesity with analgesia administration and pain reduction for prehospital patients with traumatic injuries.

Methods: Using the 2022 ESO Data Collaborative, we analyzed emergency medical services (EMS) records for 9-1-1 transports of adult patients with injuries. Patients with primary impressions related to behavioral, neurologic, respiratory, and cardiac emergencies, Glasgow Coma Scale of < 15, non-alert on AVPU scale, or no race/weight documented were excluded. Weight status was categorized using the Center for Disease Control (CDC) Body Mass Index (BMI) thresholds, with BMI calculated from documented weight, race/ethnicity, and gender using CDC height averages. We analyzed the relationship between BMI category, analgesia administration, and pain reduction using bivariate and multivariable logistic regression.

Results: Of 482,592 patients in the analysis, 164,175 (34.0%) were classified as obese (BMI ≥ 30 kg/m2). Analgesia administration and pain reduction were more likely for patients with obesity (aOR 1.13, 95% CI: 1.10-1.17; aOR 1.06, 95% CI: 1.02-1.10) than those without obesity. Men with obesity were more likely than men without obesity to receive analgesia (aOR 1.21, 95% CI: 1.17-1.24) but women with obesity were not more likely than women without obesity to receive analgesia (aOR 0.97, 95% CI: 0.95-1.00).

Conclusions: Patients with obesity were more likely to receive analgesia by EMS than those without obesity, but this advantage did not exist for women. Limitations to this study include using a convenience sample and calculating a BMI from epidemiological data on average height. Further research should explore the mechanisms underpinning the treatment advantage for men with obesity that does not extend to not women with obesity.

INTRODUCTION

Background

In the past several decades, the prevalence of obesity in the general population has climbed. Globally, over one-third of patients

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are classified as overweight or obese (Chooi, 2018). In the United States, 73.8% of the population is estimated to be overweight or obese, and recent increases have been noted in adolescent youths, particularly non-Hispanic Black and Mexican American children (Li, 2022; Ogden, 2020).

People with obesity are more likely to face institutional discrimination, discriminatory employment practices, and lower levels of self-acceptance than people without obesity (Carr, 2005; Agerstrom, 2011; Flint, 2016). Even children with obesity experience stigma related to their weight, with lower levels of acceptance in the classroom for larger children (Latner, 2003). Weight bias has been described as the last socially acceptable form of discrimination in modern cultures today, with a profound obesity stigma alienating people and reducing their quality of life (Puhl, 2008).

This bias also extends into the health care setting. Patients with obesity have reported less time with physicians, lower levels of physician respect, negative tones from clinicians (Huizinga, 2009; Stone, 2012), and are less likely to receive colorectal or gynecological cancer screenings despite higher risk for disease (Ferrante, 2006; Amy, 2006). Health care clinicians have been shown to hold negative attitudes towards patients with obesity, holding a belief that patients with obesity are weaker willed than other patients and attributing the condition to a deficiency in their personality (Harvey, 2001; Schwartz, 2003; Brown, 2007; Pantenburg, 2012; Puhl, 2014; Phelan, 2014; Tanneberger, 2018). Despite evidence that willpower-focused approaches to patients with obesity are ineffective, clinicians continue to focus on personal accountability over more effective strategies for weight loss, likely exacerbating disparities (Owen-Smith, 2018).

While there has been significant research demonstrating the impact of obesity stigma and weight bias on employment discrimination, wage disparities, and hospital-based health care clinician bias, there has been less exploration of its role in the prehospital setting. One study found that injured female patients with obesity and severe pain were less likely to receive analgesia than any other demographic, but that male patients with obesity had a treatment advantage in the prehospital setting (Kennel, 2022). This study, however, was limited to a specific geographical region and has not been replicated in a national dataset. Several studies have examined other stigmatized conditions associated with bias in the prehospital setting, including race/ethnicity and socioeconomically disadvantaged patients who experience treatment inequities, but the investigation of patient size or weight bias influencing prehospital treatment remains understudied (Michael, 2007; Hewes, 2018; Crowe, 2023).

Aims

This study evaluated the association between a patient's weight status and the administration of analgesia and reduction of pain in the setting of a traumatic injury. Secondarily, it assessed whether this association is impacted by the intersection of race/ethnicity and gender.

METHODS

Study Design and Setting

This was a retrospective observation study using a large dataset (ESO Data Collaborative, Austin, TX) that has de-identified prehospital encounter data with hospital outcome information available that conforms to the National EMS Information System 3.4 standard (National EMS Information System, 2009). We report findings in alignment with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines (von Elm, 2007). This study was deemed exempt by an institutional review board with a waiver of informed consent.

Selection of Participants

All prehospital patient encounters originating from a 9-1-1 call involving patients 18 years and older with a documented injury were included. Any encounters without patient transport to a hospital were excluded. Any patient with a primary or secondary impression related to behavioral health emergencies, shock, cardiac arrest, and obstetric emergencies were excluded because these conditions can be contraindications or may affect patterns of analgesia administration. Patients with an initial Glasgow Coma Scale score less than 14 or an initial A-V-P-U (alert - verbal - pain - unresponsive) assessment of responsive to verbal stimuli, responsive to painful stimuli, or unresponsive were also excluded as these patients may have a limited ability to communicate their pain or have experienced more serious injuries that required prioritization of life-saving interventions over analgesic administration. Prehospital encounters provided by basic life support (BLS) clinicians were excluded to limit the influence of scope of practice restrictions on analgesic administration. Lastly, patients without documented race and ethnicity and those without a documented weight were excluded as this was a factor in our BMI categorization.

Exposures

Our primary exposure was weight status defined using the Center for Disease Control (CDC) Body Mass Index (BMI) categories that identify patients with a BMI of <30 as underweight, healthy weight, or overweight and those with a BMI of 30+ as obese. BMI was calculated for each patient using data available from the EMS record coupled with the CDC height average following methodology established in previous work (Kennel, 2022; Centers for Disease Control and Prevention). First, we assigned each patient an approximate height based on their documented race/ethnicity and gender and then used the assigned height and the recorded weight to calculate an approximate BMI. We acknowledge that BMI is a poor indicator of health and use this solely as a proxy of patient size to determine the potential impact of weight bias on pain management. In analyzing disparities of care, we felt that the approximate weight listed by prehospital clinicians was a valid proxy to determining whether their perception led to a disparity in care. Patient race and ethnicity have been shown to influence EMS pain management practices (Hewes, 2018; Kennel, 2019; Crowe, 2023), so we included EMS-documented patient race and ethnicity into our analysis using the method and definition described by Crowe et al (2023). To better understand and isolate the impact of patient size in the context of social determinants of health, we included socioeconomic status (SES) of the geographic area where the EMS encounter occurred as a proxy for patient access to financial resources.

Socioeconomic status was measured using the CDC's Social Vulnerability Index for the EMS encounter scene location at the Census tract level (Agency for Toxic Substances and Disease Registry). Specifically, we used the CDC's socioeconomic status theme, which is computed using several measures including: the population below poverty, unemployment, income, and the proportion of the population without a high school diploma for each US Census tract. Socioeconomic status rankings were based on percentiles with values ranging from 0 to 1. Higher values indicate greater socioeconomic vulnerability. Previous work has linked higher values from the socioeconomic status theme to increased health conditions, treatment inequities, and worse health outcomes for individual patients (Crowe, 2023; Bevan, 2023; Herra-Escobar, 2022). For analysis, we classified encounters in the 1 to 25th percentile as Q1 (least vulnerable), 26 to 50th percentile Q2, 51 to 75th percentile Q3, and >75th percentile as Q4 (most vulnerable). We defined urbanicity using urban, rural, and super-rural distinctions linking patients to urbanicity by zip code.

We identified additional potentially confounding variables: age in years, sex, race/ethnicity, SES, urbanicity, initial pain score, and EMS transport interval. As shorter EMS transport times may be associated with clinician decision-making and choice to withhold analgesic administration in the prehospital setting and are also associated with urban settings where racial and ethnic diversity is increased, we included EMS transport interval as a potential confounder in our models. We defined EMS transport interval as the difference in minutes from the time the ambulance departed the scene of the encounter and arrival at the hospital (Browne, 2016).

Outcomes

Our primary outcome measure included any analgesic medication administered in the out-of-hospital setting by any route. Analgesic medications used by EMS clinicians in this dataset included opioids (fentanyl, morphine, hydromorphone), ketamine, nonsteroidal anti-inflammatory drugs (ketorolac, ibuprofen), and acetaminophen. Secondarily, in alignment with existing out-of-hospital pain management research, we analyzed a secondary outcome of a clinically meaningful pain reduction as a decrease of 2 or more points on the 0 to 10 pain scale between the final and initial EMS pain assessments (Crowe, 2023).

Statistical Analysis

To evaluate potential systematic differences in patient and encounter characteristics, we first described patients based on weight status according to BMI category calculated using race/ethnicity, documented weight, and gender. Then, we compared unadjusted rates of analgesia and pain reduction by BMI category. We then performed a multivariable logistic regression model to calculate adjusted odds ratios (aOR) and 95% confidence intervals (CI) for analgesia administration by weight category adjusting for race/ethnicity, gender, socioeconomic status, rurality, and pain score. We performed this same analysis for pain reduction. We excluded patients with missing data from the multivariable analyses. We also performed a sub analysis at the intersection of obesity with race/ethnicity and another sub analysis at the intersection of obesity with gender. We used Stata v15.1 (College Station, TX) for all analyses (Stata).

RESULTS

Characteristics of Study Subjects

We included 482,592 patients in the analysis (Figure 1). 34.0% (n=164,175) of patients were classified as obese. The mean age was 60 years (IQR 41, 79) and patients were 53.9% (n=260,108) female. Patients were 28.1% non-White (n=135,695). Nineteen percent (n=96,351) of patients were classified as living in rural or super-rural areas and 23.1% (n=111,357) were classified as living in areas in the most socioeconomically vulnerable quartile. 21.0% (n=101,101) received analgesia and of those with multiple pain scores (n=278,266), 27.7% (n=77,083) experienced a reduction in pain of at least 2 points. Descriptive statistics stratified by primary exposure can be seen in Table 1.

Main Results

When accounting for age, gender, urbanicity, socioeconomic status, EMS transport time, and initial pain score, patients with obesity were more likely to receive pain medication (aOR 1.13, 95% CI: 1.10-1.17) and pain reduction (aOR 1.06, 95% CI: 1.02-1.10) than those without obesity. Black non-Hispanic patients were less likely than White non-Hispanic patients to receive analgesia (aOR 0.57, 95% CI: 0.55-0.59) and experience a reduction in pain (aOR 0.70, 95: CI: 0.68-0.72).

Statistical models were also performed at the intersection of race/ethnicity and obesity. White patients with obesity were more likely to receive analgesia than White patients without obesity (aOR 1.04, 95% CI: 1.02-1.07), and Black non-Hispanic patients with obesity were more likely to receive analgesia than Black non-Hispanic patients without obesity (aOR 1.14, 95% CI: 1.09-1.20).

At the intersection of gender and obesity, men with obesity were more likely to receive analgesia (aOR 1.21, 95% CI: 1.17-1.24) than men without obesity. There was no difference

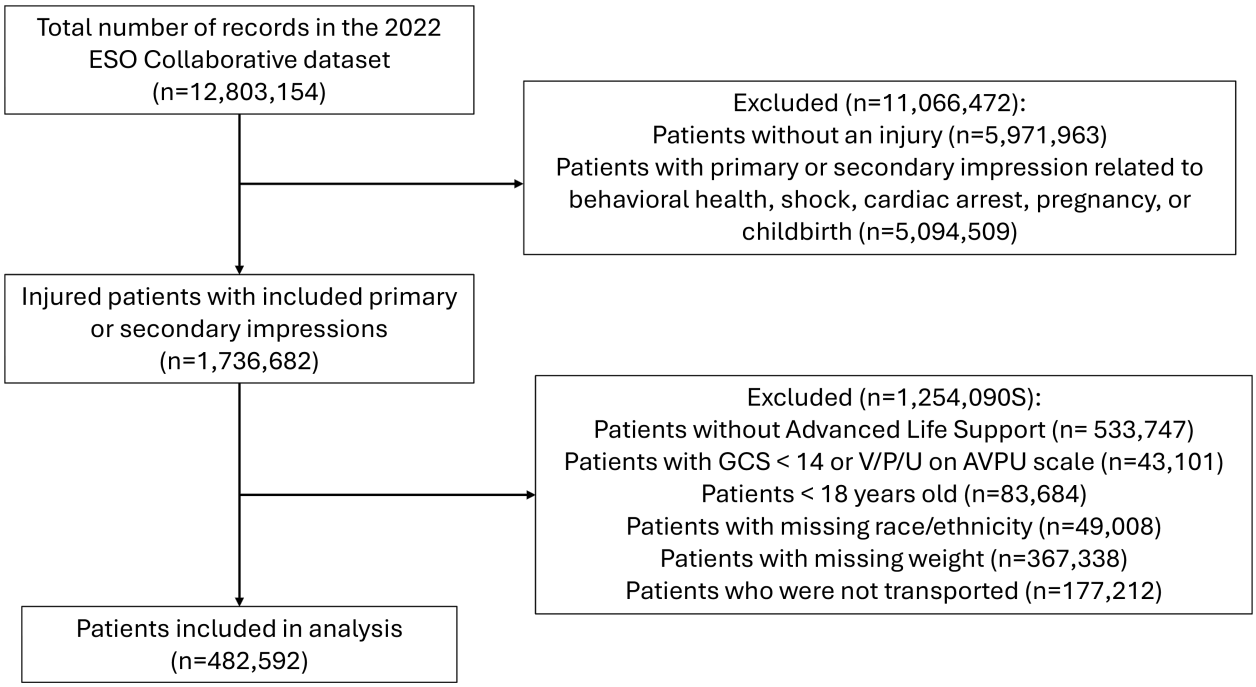

Figure 1. A flow diagram shows how the patient sample was selected for analysis.

Characteristic	Weight Status		
	All patients n=482,592	Patients without Obesity n=318,417 (66%)	Patients with Obesity n=164,175 (34%)
Age			
Median (IQR)	63 (41-79)	67 (41-82)	59 (40-72)
Gender			
Female	54% (260,108)	53% (169,913)	55% (90,195)
Male	46% (222,484)	47% (148,504)	45% (73,980)
Race/Ethnicity			
Black, non-Hispanic	15% (70,744)	13% (41,992)	18% (28,752)
Hispanic	11% (54,168)	10% (33,228)	13% (20,940)
Other	2% (10,783)	2% (7,921)	2% (2,862)
White, non-Hispanic	72% (346,897)	74% (235,276)	68% (111,621)
Census Region			
Northeast	7% (33,131)	8% (23,315)	6% (9,816)
Midwest	27% (117,649)	25% (75,830)	27% (41,819)
South	53% (242,756)	52% (155,800)	55% (86,956)
West	14% (64,945)	15% (45,758)	12% (19,187)
Urbanicity			
Urban	80% (386,079)	81% (257,829)	78% (128,250)
Rural	17% (80,321)	16% (50,263)	18% (30,058)
Super Rural	3% (16,030)	3% (10,216)	4% (5,814)
Scene Socioeconomic Quartile			
Q1	25% (122,460)	27% (86,548)	22% (35,912)
Q2	24% (117,669)	24% (77,589)	24% (40,080)
Q3	27% (130,301)	26% (83,348)	29% (46,953)
Q4	23% (111,357)	22% (70,382)	25% (40,975)
EMS Transport Time, min			
Median(IQR)	13 (8-20)	13 (8-19)	13 (8-20)
First Pain Score Category			
None (0)	16% (62,614)	17% (45,089)	13% (17,525)
Mild (1-3)	17% (69,479)	18% (47,758)	16% (21,721)
Moderate (4-6)	34% (133,615)	33% (86,771)	34% (46,844)
Severe (7-10)	33% (132,610)	31% (80,930)	38% (51,680)

Table 1. Patient and encounter characteristics stratified by weight status.

in analgesia rates between women with obesity and women without obesity (aOR 0.97, 95% CI: 0.95-1.00). Men and women with obesity had higher rates of pain reduction than those without obesity, but the odds ratio was higher for men (aOR 1.25, 95% CI: 1.21-1.28]) than women (aOR 1.1, 95: CI 1.08-1.13). Table 2 shows analgesia and pain reduction rates at the intersection of race and gender with obesity.

Figure 2 shows a panel of forest plots showing the adjusted odds ratios with the multi-variable models for patients with obesity overall and Figure 3 shows them stratified by gender.

DISCUSSION

We found that patients with obesity were more likely to receive analgesia and pain reduction than those without obesity when adjusting for confounders. This did not vary by race and ethnicity, with a persistent advantage for patients with obesity across racial and ethnic categories. At the intersection of gender, however, the treatment advantage of obesity was not present for women. These findings suggest that there is a treatment

Characteristic	Analgesia Administration aOR (95% CI)	Pain Reduction (2+/10) aOR (95% CI)
Weight Status		
Patients with obesity	1.07 [1.05-1.09]	1.16 [1.14-1.18]
Patients without obesity	Referent	Referent
Race and Ethnicity		
Black, non-Hispanic	0.56 [0.55-.58]	0.70 [.0.68-.0.72]
Hispanic	0.84 [0.82-0.87]	1.00 [0.98-1.03]
Other	0.79 [.74-.84]	0.88 [0.83-0.93]
White, non-Hispanic	Referent	Referent
Gender		
Female	0.99 [0.98-1.01]	1.30 [1.28 - 1.32]
Male	Referent	Referent
Obesity Status with Race and Ethnicity		
Black non-Hispanic with obesity	0.62 [0.60-0.65]	0.80 [0.77-0.83]
Hispanic with obesity	0.93 [0.89-0.97]	1.19 [1.14-1.24]
Other with obesity	0.83 [0.74-0.93]	1.10 [0.96-1.19]
White, non-Hispanic with obesity	1.04 [1.02-1.07]	1.16 [1.14-1.19]
Black non-Hispanic without obesity	0.54 [0.53-0.56]	0.72 [0.69-0.75]
Hispanic without obesity	0.82 [0.79-0.85]	0.99 [0.96-1.03]
Other without obesity	0.79 [0.73-0.85]	0.87 [0.81-0.93]
White non-Hispanic without obesity	Referent	Referent
Obesity Status and Gender for Male Patients		
Males with obesity	1.21 [1.17-1.24]	1.25 [1.21-1.28]
Males without obesity	Referent	Referent
Obesity Status and Gender for Female Patients		
Females with obesity	0.97 [0.95-1.00]	1.1 [1.08-1.13]
Females without obesity	Referent	Referent

Table 2. Multivariable generalized estimating equation odds ratios and 95% CI for analgesia administration and pain reduction (defined as a decrease by 2 or greater on documented pain scale) with adjustments for race/ethnicity, gender, rurality, socioeconomic vulnerability, and initial pain score. We did not adjust for initial pain score in the pain reduction model.

advantage for pain management of patients with obesity, but that the advantage is gendered. While men with obesity were nearly 20% more likely to receive analgesia than men without obesity, women with obesity did not receive any advantage or disadvantage based on weight status. We hypothesized that patients with obesity would be less likely to receive analgesia than their not-obese counterparts, but these findings reveal the opposite. Given the large body of research demonstrating discrimination in the hospital setting for patients with obesity, it remains unclear why this did not also translate to prehospital analgesia administration. One potential mechanism for this could be weight concordance between EMS clinician and the patient. Several studies have demonstrated that EMS clinicians have high rates of obesity, cardiac disease, and metabolic syndrome (Tsismenakis, 2009; Hegg-Deloye, 2015; Brice, 2019; Cash, 2019; Supples, 2023). If there is concordance between EMS clinicians and patients with obesity, perhaps it mitigates disparities in treatment, as suggested in previous literature (Kennel 2022). It is unclear whether this weight concordance may be different for men and women.

Racial disparities were also present in these analyses, further validating previous work demonstrating that non-White patients receive disparate pain management (Hewes, 2018; Kennel, 2019; Crowe, 2023). Patients who were non-White and obese still had a treatment advantage when compared to their non-obese counterparts of the same race and eth-

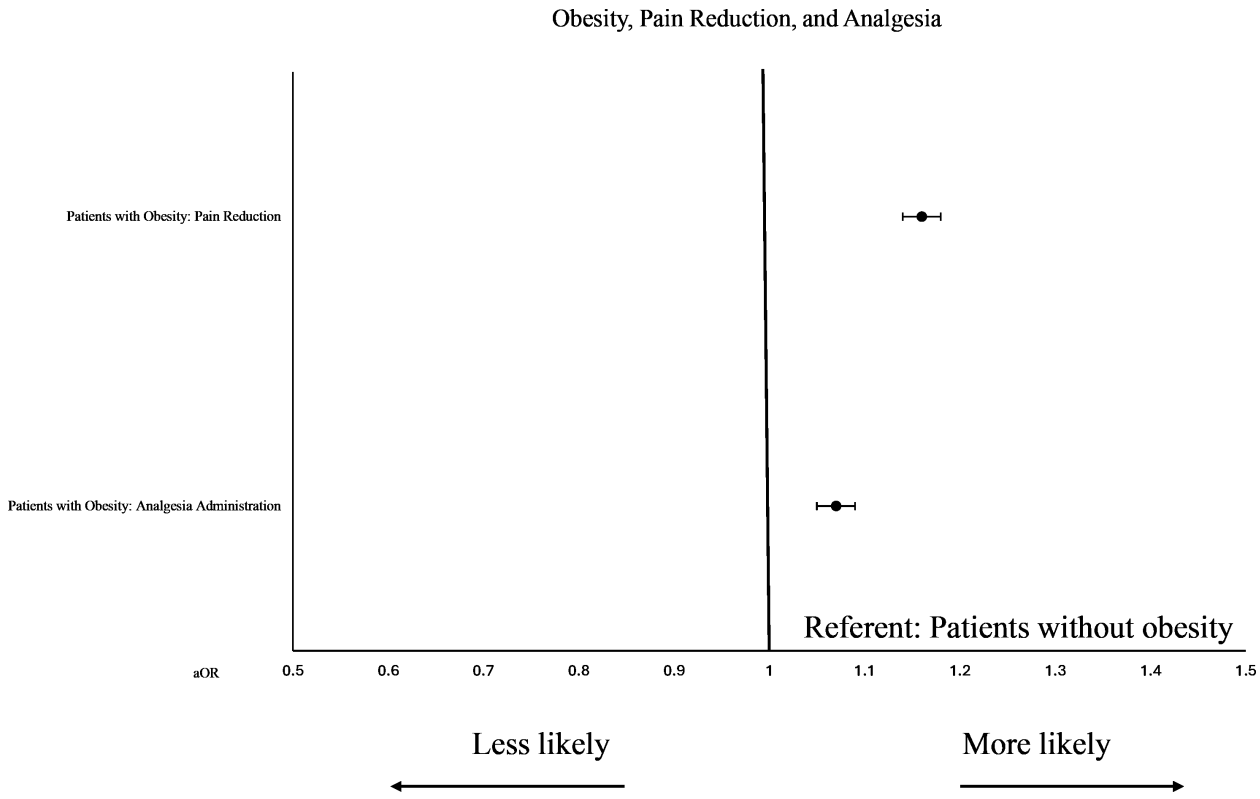

Figure 2. A forest plot represents the primary outcomes stratified by patients with and without obesity. The adjusted odds ratios (aOR) reflect the likelihood of the event on the y axis and the listed referent.

nicity, but the advantage varied more for Black non-Hispanic patients than with White non-Hispanic patients, demonstrating that the intersection of race/ethnicity with obesity had a different impact on our outcome variables. Further research in health care inequities should more consistently explore the intersections of race, ethnicity, gender, and SES when evaluating treatment disparities.

Our results indicated that obesity provided a treatment advantage for men, but no advantage for women that was consistent with past literature (Kennel, 2022). Several hospital-based studies have also shown that the influence of obesity stigma can be more profound for women, as clinicians are more likely to encourage weight loss at lower BMI scores than men, and women with obesity were more likely to be described as "cold" and "defensive" than men with obesity (Puhl, 2008; Anderson, 2001; Fikkan, 2012). This gendered weight bias also extends outside of health care settings and has been seen in wage disparities, and women with obesity are less likely to be hired for public-interfacing jobs when compared to their male counterparts with obesity (Sinall, 2015).

It may be tempting for EMS clinicians and leaders to review the results of this study, among others, showing disparities in care and not know where to start in effectively addressing the difficult problem of health care inequity. A recent position statement from the National Association of EMS Physicians describes why health equity should be a strategic priority for EMS systems, how to examine quality metrics for disparities, and how to implement improvement strategies to tackle inequities in prehospital care (Farcas, 2024). We urge readers to use these tools to evaluate and combat disparities in their own systems, tackling difficult problems like underperformance in ECG acquisition for women, undertreatment of females with obesity in pain, and underdiagnosis of stroke

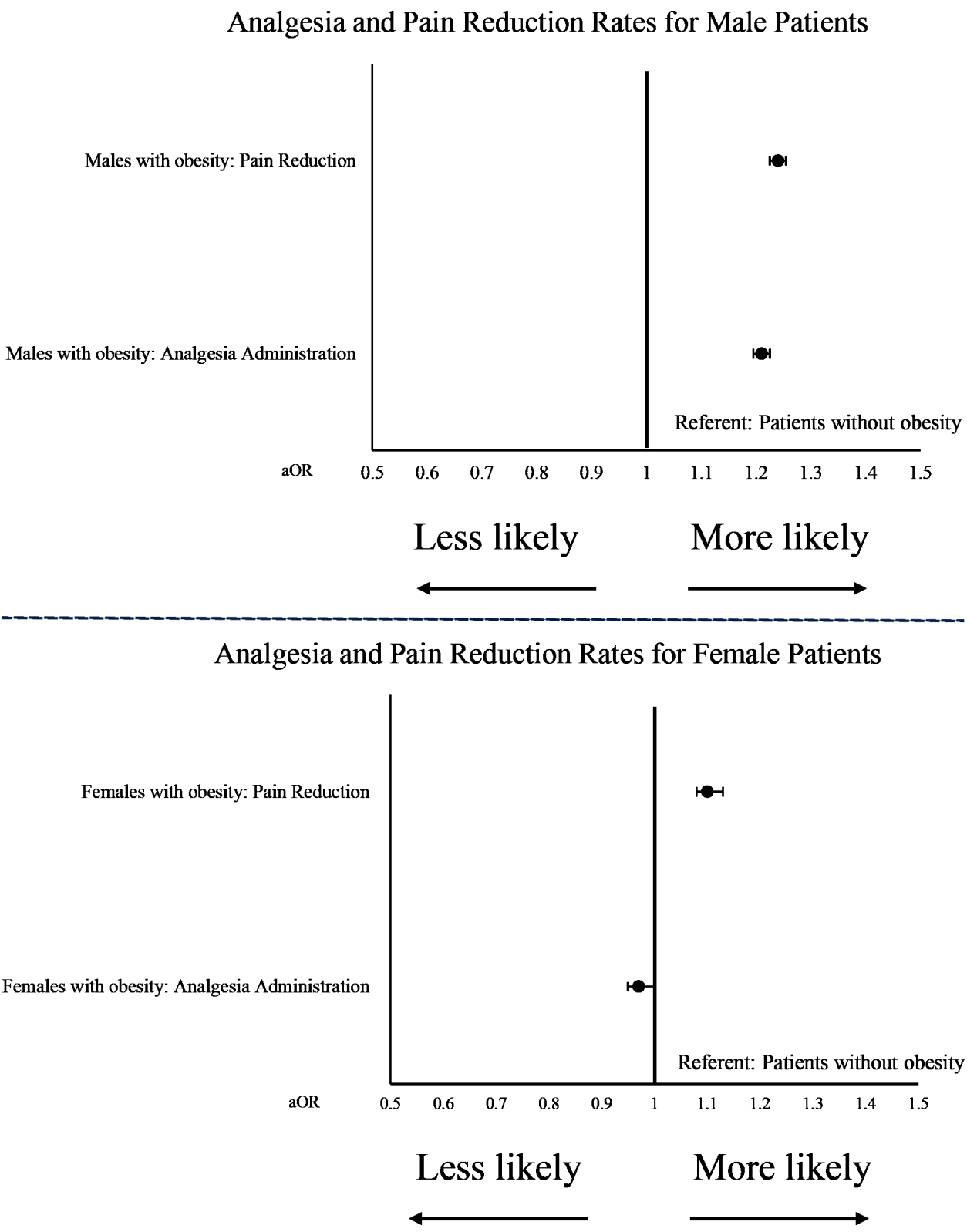

Figure 3. A forest plot represents the primary outcomes stratified by patients with and without obesity for men and then for women in a panel. The adjusted odds ratios (aOR) reflect the likelihood of the event on the y axis and the listed referent.

in female patients the same way they would improve system performance in everyday issues like rapidly decompensating patients, house fires with multiple patients, and patients with difficult airways.

LIMITATIONS

There are several limitations to this study. We used a convenience sample of injured patients in the ESO Collaborative dataset, which does not contain all the EMS responses in a given year and has an uncertain degree of missingness that may bias results and limit generalizability. Additionally, we calculated an approximate BMI by taking the weight in kilograms documented in EMS patient care records and calculating a BMI based on the average height by race and sex. This is not an accurate representation of the patient's health or actual BMI but rather serves as a proxy for the clinician's perception of the patient's weight. The methodology used to approximate BMI has been established in previous studies on disparities in patients with obesity (Kennel, 2022; Kennel, 2018). The weight recorded in the EMS records are rarely taken from a recent weight and are likely crude approximations based on EMS clinician judgment. While documented weights may be inaccurate, the focus of our study was on the potential disparity in care based upon the clinician's perception of patient weight, not the literal weight of the patient. To validate this proxy for weight status, we analyzed ICD-10 codes for patients with discharge information available in the dataset for diagnoses related to obesity. We found that 74% of patients with this diagnosis (n=1,340) were classified as obese by our inferred BMI. Furthermore, we compared our calculated rate of obesity at 34% to 42% in national CDC data, showing that our sample was a conservative estimate of the national population (Stierman, 2021).

Another limitation of this study and prehospital research more broadly is data quality. We could not know precisely the weight or height of the patient but instead rely on approximate weights recorded by prehospital clinicians. Future efforts should be made to improve the quality of EMS data by using stretchers with the ability to assess weight, direct analysis of defibrillator files to assess resuscitation quality, and more.

Additionally, the race and ethnicity designation in the prehospital records are also based on EMS clinician perception, not the patient's reported identity, and are subject to missingness and error. Refusals of pain management were unable to be distinguished due to feasibility, but previous literature demonstrates that refusal of care does not appear to be a mediating variable for disparities in prehospital pain management (Crowe, 2023).

CONCLUSIONS

In summary, these findings show that patients with obesity were more likely to receive analgesia and have a reduction in pain than those without obesity. When looking at the intersection with gender, men with obesity received this treatment advantage but women with obesity did not. Further research in health disparities should examine the intersections of race, gender, and other identities subject to bias and the possible role of clinician concordance in mitigating disparities. EMS leaders should gain visibility to and address inequities in their own systems for patients with obesity.

DECLARATION OF GENERATIVE AI IN SCIENTIFIC WRITING

We did not use a generative artificial intelligence (AI) tool or service to assist with preparation or editing of this work. We take full responsibility for the content of this publication.

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