The American Journal of Surgery 218 (2019) 842–846

Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

Racial disparities in post-discharge healthcare utilization after trauma

Shelby Chun Fat [a], Juan P. Herrera-Escobar [a], Anupamaa J. Seshadri [b], Syeda S. Al Rafai [a], Zain G. Hashmi [a], Elzerie de Jager [a], Constantine Velmahos [c], George Kasotakis [d], George Velmahos [c], Ali Salim [b], Adil H. Haider [a, b], Deepika Nehra [b, *]

[a] Center for Surgery and Public Health, Brigham and Women's Hospital, Harvard Medical School and Harvard T.H Chan School of Public Health, Boston, MA, USA
[b] Department of Surgery, Division of Trauma, Burn and Surgical Critical Care, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA
[c] Department of Surgery, Division of Trauma, Emergency Surgery, and Surgical Critical Care, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA
[d] Department of Surgery, Division of Trauma, Acute Care Surgery & Surgical Critical Care, Boston University School of Medicine, Boston, MA, USA

ARTICLE INFO

Article history:
Received 28 February 2019
Received in revised form
18 March 2019
Accepted 23 March 2019

This work was presented at the Academic Surgical Congress on January 30 - February 1, 2018 in Jacksonville, FL.

Keywords:
Trauma
Racial disparities
Long-term outcomes
Rehabilitation utilization
Post-discharge
Patient-reported

ABSTRACT

Background: Racial disparities in trauma outcomes have been documented, but little is known about racial differences in post-discharge healthcare utilization. This study compares the utilization of post-discharge healthcare services by African-American and Caucasian trauma patients.
Methods: Trauma patients with an Injury Severity Score (ISS)≥9 from three Level-I trauma centers were contacted between 6 and 12 months post-injury. Utilization of trauma-related healthcare services was asked. Coarsened exact matching (CEM) was used to match African-American and Caucasian patients. Conditional logistic regression then compared matched patients in terms of post-discharge healthcare utilization.
Results: 182 African-American and 1,117 Caucasian patients were followed. Of these, 141 African-Americans were matched to 628 Caucasians. After CEM, we found that African-American patients were less likely to use rehabilitation services [OR:0.64 (95% CI:0.43–0.95)] and had fewer injury-related outpatient visits [OR:0.59 (95% CI:0.40–0.86)] after discharge.
Conclusions: This study shows the existence of racial disparities in post-discharge healthcare utilization after trauma for otherwise similarly injured, matched patients.

Background

Trauma remains one of the most common causes of long-term functional impairment and disability. Traumatically injured patients commonly suffer from reduced quality of life, poor functional outcomes, psychologic disturbances, chronic pain, social disintegration and the burden of their oftentimes high medical costs.[1,2] The care of these patients does not end on discharge from the hospital and many of these patients require ongoing rehabilitation services after discharge. Post-hospitalization care, especially care provided at a rehabilitation center, has been previously shown to positively contribute to improving long-term outcomes and functional independence after traumatic injury.[3–5]

Disparities in healthcare delivery and outcomes have been shown for many conditions.[6] Trauma has historically been thought to be immune to such disparities given its emergent nature. Unfortunately, this is not the case and racial disparities have been well established even for traumatically injured patients. When compared to Caucasian patients, African American trauma patients have a higher mortality and a higher likelihood of long-term disability.[6–12] Importantly, this relationship between African American race and higher trauma mortality has been shown to be independent of socioeconomic status.[6]

African American patients are also more likely to be discharged home as opposed to rehabilitation centers or skilled nursing facilities compared to Caucasian patients.[13–16] There are likely multiple factors at play other than race, such as insurance and socioeconomic status.[13,14] These previous studies are however limited as they have focused on specific injuries such as spinal cord injury[15] and traumatic brain injury,[16] or are based on data from the National Trauma Data Bank where only information regarding

* Corresponding author. 75 Francis St., Boston, MA, 02215, USA.
E-mail address: dnehra@bwh.harvard.edu (D. Nehra).

https://doi.org/10.1016/j.amjsurg.2019.03.024
0002-9610/

discharge disposition is available.[13,14] As a result, we to date have not been able to capture the long-term contact that these traumatically injured patients have with other types of post-discharge medical care, such as that received in clinic or in the emergency department (ED).

The Functional Outcomes and Recovery after Trauma Emergencies (FORTE) project is a multi-center effort that collects Patient-Reported Outcomes (PROs) from three Boston level 1 trauma centers. In Massachusetts, insurance is significantly expanded via Medicaid, with an extremely high proportion of trauma patients either already insured or able to become insured during their hospitalization. This data, therefore, is uniquely able to evaluate post-discharge service utilization in patients based on race without the confounding effects of insurance status.

The aim of this study was to examine the differences in patient-reported utilization of post-discharge services, including rehabilitation services, outpatient clinics and the ED, between African American and Caucasian patients who have sustained moderate to severe traumatic injuries. We hypothesized that African American patients would utilize rehabilitation services and outpatient clinics less frequently and the ED more frequently as compared to their Caucasian counterparts.

Methods

Data sources and patient population

We used the FORTE project data set for the present study. The FORTE project is a multi-center effort among three Boston level I trauma centers (Brigham and Women's Hospital, Massachusetts General Hospital, and Boston Medical Center), to include long-term functional and PROs measures into trauma registries. These long-term functional and PROs measures are collected via a phone interview conducted at 6 or 12 months after injury for patients who have sustained moderate or severe trauma (Injury Severity Score [ISS] >9). This interview consists of an initial screening and verbal consent followed by a series of survey questions to assess functional and PROs measures, as well as other relevant aspects of the patient recovery experience. This survey includes the following: work and insurance status, education, Trauma Quality of Life Instrument, Short-Form Health Survey Version 2.0, screening for Posttraumatic Stress Disorder and information regarding post-discharge contacts with healthcare. All patients who participated in the FORTE project were either English or Spanish-speaking adults and all interviews in Spanish were performed by a Spanish speaking interviewer. Interviewers were only given the patient name, contact information, date of injury, age, and gender, and were blinded about injury-related characteristics and some patient characteristics such as race or ethnicity. Interview data were collected and managed using REDCap (Research Electronic Data Capture) hosted at Partners Healthcare. Further details regarding the patient recruitment and data collection procedures for the FORTE project have been described previously.[17]

This dataset was then linked with institutional trauma registry data to capture patient demographic and injury-related characteristics. The patients' race was determined using the institutional trauma registry. For the present study, we included African American and Caucasian patients from the FORTE data set from December 2015 through July 2018. Patients whose race was missing or listed as anything other than African American or Caucasian were not included. Other clinical variables extracted from the trauma registry included age, sex, insurance, mechanism of injury, ISS, Abbreviated Injury Scale (AIS) per body region, intensive care unit (ICU) admission, ventilator requirement, length of stay, in-hospital complications and discharge disposition (home, home with health services, rehabilitation facility, nursing home/skilled nursing facility, other.)

Post-discharge contacts with healthcare

Information regarding the patient's post-discharge contact with healthcare was obtained by patient report. Specifically, participants were asked whether they received any rehabilitation services after discharge (i.e. were discharged to a rehabilitation center or skilled nursing facility or received home or outpatient services like physical or occupational therapy), whether they received injury-related outpatient follow-up in the clinic setting and whether they presented to an ED for an injury-related problem after their discharge from the hospital.

Statistical analysis

Patient demographics and clinical characteristics were compared between Caucasian and African American patients. Categorical data was compared using chi-squared tests and continuous data was compared using t-tests or Wilcoxon Rank Sum tests as appropriate. A sensitivity analysis was performed to assess the presence of response bias by comparing baseline characteristics of African American and Caucasian patients who participate in the FORTE study versus those who did not.

The trauma registry discharge disposition was grouped into those who received any rehabilitation services after discharge (rehabilitation, nursing home or skilled nursing facility or home with health services) and those who did not (home). Logistic regression adjusting for age, sex, education, insurance, injury mechanism, ISS, head injury, torso injury, extremity injury, ICU admission, ventilator use, length of stay, and hospital was conducted to compare this between Caucasian and African American patients.

Coarsened exact matching

The Coarsened Exact Matching (CEM) algorithm[18] was used to match Caucasian patients to African American patients in a 1:many ratio. CEM creates a balance between patients in both groups with slightly different variables while maintaining similarity which allows for higher chances of matching than that of an exact matching algorithm. Matching was used to control for the influence of potential confounding factors: age, gender, injury type (blunt or penetrating) and ISS. CEM categorizes (coarsens) continuous data temporarily into bins with predetermined, appropriate widths to create meaningful groups. The width of these bins allows for control of the amount of imbalance in the matching process. The bin widths used in this study were determined based on the distribution of the data for continuous variables (age and ISS). Conditional logistic regression (CEM weighted) was then used to compare matched patients in terms of post-discharge healthcare utilization. All statistical analyses were performed using Stata Statistical Software Analysis (version 14).

Results

There were 3,431 moderate-to-severely injured patients between December 2015 and July 2018 who were eligible to participate in the FORTE questionnaire, and of these, 2,894 identified as Caucasian (74%) or African American (11%). The remaining 15% corresponded to 8% of patients of other races and 7% of missing data. Of the eligible Caucasian or African American patients, 1,299 completed the FORTE questionnaire; 1,117 (86.0%) identified as Caucasian and 182 identified as African American (Fig. 1).

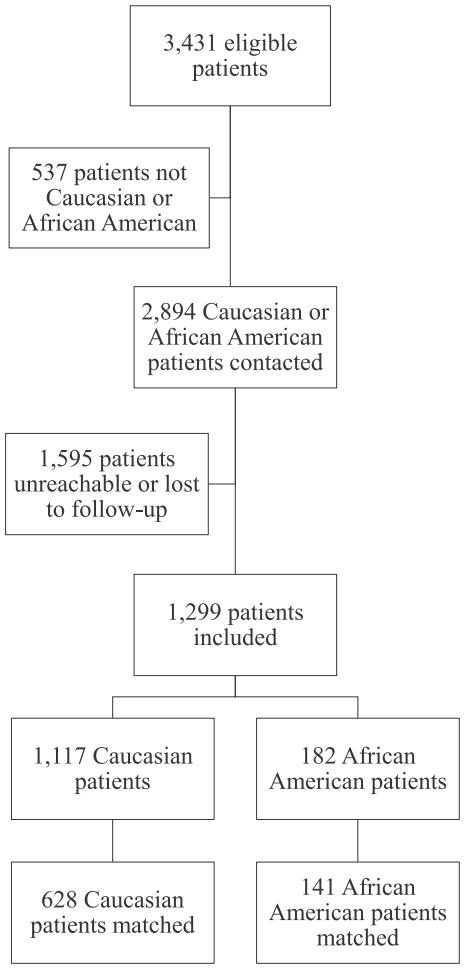

Fig. 1. Study flowchart.

Sensitivity analysis comparing the 1,299 participants to the 1,595 non-participants showed that participants were more likely to have higher mean ISS (14.1 [SD: 7.2] vs 13.55 [SD: 6.7]; p: 0.022) and higher ICU admission rate (38% vs 34%; p: 0.045) compared to non-participants. Participants and non-participants did not differ in age, sex, insurance, injury type, presence of head injury, extremity injury, ventilator use, in-hospital complications, length of stay, or discharge disposition. Additionally, no significant differences in race were found between participants and non-participants, which means that the distribution of Caucasians and African Americans in the study sample reflects the data set in this regard.

Patient demographics are summarized in Table 1. The Caucasian patients were significantly older (mean age 65 [SD 19.7] years) with fewer males (51% male) compared to the African American patients (mean age 45 [SD 20] years; 67% male). There was no significant difference in insurance status between groups with only 6 total patients (<1%) being uninsured. Blunt mechanism of injury was the most common type, with average ISS being slightly higher in the African American as compared to Caucasian group (15.3 [SD 8.4] vs. 14 [SD 7.0] respectively). There was a significant difference in the discharge disposition as reported in the institutional trauma registries, with African American patients being more likely to be discharged to home and home with services and less likely to be discharged to rehabilitation facilities and nursing home/skilled nursing facilities than Caucasians (Table 1). However, after adjusting for potential confounders (age, sex, education, insurance, injury mechanism, ISS, head injury, torso injury, extremity injury, ICU admission, ventilator use, length of stay, and hospital), there was no significant difference in discharge disposition (as reported in the trauma registry) for African American compared to Caucasian patients ($p = 0.408$).

When unadjusted patient-reported post-discharge healthcare utilization outcomes were examined in the unmatched cohort, African Americans were significantly less likely to utilize post-discharge rehabilitation services and more likely to be seen in the ED for an injury-related issue (Table 2).

After CEM, 628 Caucasian patients were matched to 141 African American patients. Overall imbalance, which is measured by the

Table 1
Patient demographic, clinical, and injury-specific characteristics by race.[a]

	Caucasian (n = 1,117)	African American (n = 182)	p-value
Age (years), mean (SD)	65 (19.7)	45 (20.0)	**<0.001**
Male sex	574 (51)	122 (67)	**<0.001**
Education, Greater than high school	635 (58)	44 (25)	**<0.001**
Public Insurance	592 (60)	96 (57)	0.482
Medicare	520 (88)	27 (28)	**<0.001**
Medicaid	42 (7)	61 (64)	
Other	30 (5)	8 (8)	
Mechanism of Injury, Blunt	1094 (98)	137 (76)	**<0.001**
Injury Severity Score (ISS), mean (SD)	14 (7.0)	15.3 (8.4)	**0.021**
Head injury, AIS≥2	433 (39)	57 (31)	0.055
Torso Injury, AIS≥2	250 (22)	71 (39)	**<0.001**
Extremity Injury, AIS≥2	729 (65)	105 (58)	**0.048**
ICU admission	418 (37)	75 (41)	0.329
Ventilator	118 (11)	32 (18)	**0.006**
Complications	229 (21)	47 (26)	0.104
Length of stay (days), median (IQR)	5 (3–7)	5 (3–10)	0.288
Discharge disposition			**<0.001**
Home	270 (24)	78 (43)	
Home with health services	192 (17)	33 (18)	
Rehabilitation facility	421 (38)	49 (27)	
Nursing home/Skilled nursing facility	189 (17)	16 (9)	
Other	43 (4)	4 (2)	

AIS: Abbreviated Injury Scale.
p-values with significant p-value < 0.05 were highlighted in bold.
[a] Data presented as n (%) except as otherwise listed.

Table 2
Unadjusted analysis of patient-reported post-discharge healthcare utilization by race in the unmatched cohort.[a]

	Total (n = 1,299)	Caucasian (n = 1,117)	African American (n = 182)	p-value
Rehabilitation services	1,008 (77.6)	891 (79.8)	117 (64.3)	**<0.001**
Injury- related outpatient visit	598 (46.0)	525 (47.0)	73 (40.0)	0.084
Injury-related ED visit	147 (11.3)	113 (10.1)	34 (18.7)	**0.001**

[a] Data presented as n (%).

multivariable L_1 distance, was initially 0.61. After CEM was performed, overall imbalance dropped to $L_1 = 0.25$. Perfect balance (exact matching) is indicated by $L_1 = 0$ with the largest imbalance being $L_1 = 1$ (complete separation).

In the CEM matched adjusted analysis, African American patients were significantly less likely to report receiving rehabilitation services after discharge and were also less likely to be seen for an injury-related outpatient visit. There was not a statistical significance difference in injury-related ED visits between race groups (Fig. 2).

Discussion

The goal of trauma care is not only to reduce injury-related morbidity and mortality, but also to improve long-term outcomes in trauma patients. The impact of traumatic injuries persists far beyond discharge from the hospital. As we better understand the long-term consequences of trauma, we strive to improve both in-hospital and post-hospitalization care and services to mitigate the negative long-term consequences of traumatic injury. Our results suggest that racial disparities exist in the post-discharge utilization of healthcare services, which we know affect long term functional outcomes after injury. While African American patients were found to have no significant difference in discharge disposition as compared to Caucasian patients as reported in the trauma registry, African American patients were less likely to actually receive rehabilitation services after discharge and were less likely to be seen for injury-related outpatient visits. These racial discrepancies in post-discharge health services utilization may contribute to worse long-term trauma outcomes.

This study is unique in that we utilized patient-reported data to assess post-discharge utilization of injury-related outpatient services. Patient-reported information are a way of identifying areas for improvement from a patient's perspective to emphasize efficiency, safety, and high-quality care without bias or interpretation.[19] Symptom severity, treatment impact, outcomes, and identification of areas important to patients can be assessed to further facilitate the patient-provider relationship.[20,21] This makes it especially useful in measuring physical, mental, and social health.[22] Furthermore, it enhances patient engagement in shared decision-making by prompting the patient to assess their experiences, values, preferences, and goals about their healthcare.[20]

Prior studies investigating discharge disposition or post-discharge healthcare utilization have used institutional databases for assessment which do not capture care outside the primary trauma provider site. In contrast to our study results, these previous studies have found that Caucasian patients were less likely to follow-up in outpatient trauma clinics as compared to African American and Hispanic patients.[23,24] Patients may not return to the same trauma center for follow-up care due to insurance restrictions, geographical distance, or personal preference.[23] Using patient-reported information in our study allowed for consideration of the post-discharge healthcare utilization not limited to the primary trauma care provider facility.

An important strength of this study is the fact that less than one percent of patients included were uninsured. There was no

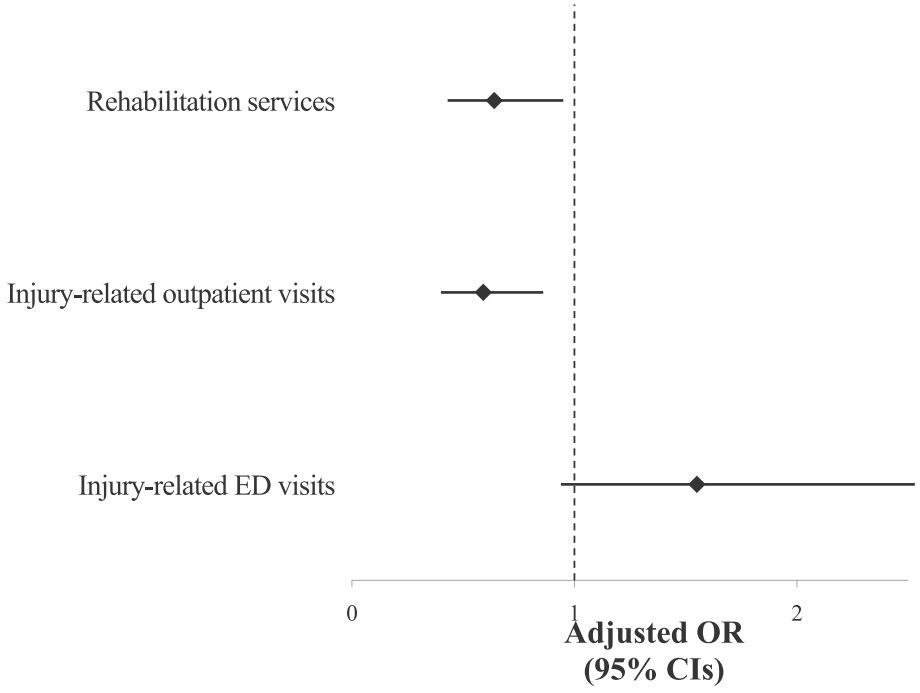

Fig. 2. CEM-weighted analysis comparing the utilization of post-discharge healthcare services between African American and Caucasian (reference) patients.

significant difference in insurance status in our study population, though numerous studies have attributed racial disparities in outcomes to insurance status.[8,23,25] This is likely due to the unique, expanded health insurance coverage via Medicaid in Massachusetts. Having the majority of our patients insured mitigates the effect of insurance in our study. Therefore, our findings of decreased utilization of post-discharge rehabilitation and outpatient services is potentially more attributable to the variable of race, as compared to other studies whose cohorts are not as uniformly insured.

Limitations of this study include a selection bias in that only patients who answered the phone calls and were willing to participate were included. We assessed the potential of selection bias by comparing baseline characteristics of patients who participated to those who did not, and the only significant differences were that responders had a higher ISS and ICU admission rate. The patient-reported nature of our outcome measures also potentially introduces some room for error based upon the patient's recall or understanding of services provided, but is likely still the most accurate way of capturing a patient's actual service utilization. Socioeconomic status has been associated with post-discharge healthcare utilization[13,26–29] and there was a significant difference in the education level between the Caucasian and African American cohort. However, education was not a variable included in the CEM analysis because we do not feel this variable should independently influence the discharge disposition or services provided to a patient. Lastly, the generalizability of this study is uncertain as it was conducted in a single city. However, the study does include data from three level I trauma centers with somewhat different patient populations.

Conclusions

In this multi-institutional study using long-term patient-reported data we demonstrate racial disparities in post-discharge healthcare utilization after trauma for similarly injured, cohort matched patients. African American patients were less likely to use post-discharge rehabilitation services and less likely to be seen in the outpatient setting for injury-related services as compared to Caucasian counterparts. These differences in post-discharge resource utilization may contribute to differences in long-term outcomes. There are likely many factors that contribute to these differences, such as an unconscious provider bias, patient understanding, miscommunication, access to care, and evidence of distrust toward medical providers.[26,28–30] Better understanding the reasons for these differences in post-discharge resource utilization may provide insight into avenues for equalizing long-term outcomes for traumatically injured patients.

Conflicts of interest

The authors of this manuscript have no conflicts of interest.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgements

We acknowledge the entire FORTE project team for their contribution and dedication with data collection as well as their continued support.

References

1. Sleet DA, Dahlberg LL, Basavaraju SV, et al. Injury prevention, violence prevention, and trauma care: building the scientific base. *CDC MMWR*. 2011;60:78–85.
2. Haider AH, Herrera-Escobar JP, Al Rafai SS, et al. Factors associated with long-term outcomes after injury: results of the functional outcomes and recovery after trauma emergencies (FORTE) multi-center cohort study. *Ann Surg*. 2018. Article in press.
3. Nusselder WJ, Looman CWN, Franco OH, et al. The relation between non-occupational physical activity and years lived with and without disability. *J Epidemiol Community Health*. 2008;62:823–828.
4. Jette DU, Warren RL, Wirtalla C. The relation between therapy intensity and outcomes of rehabilitation in skilled nursing facilities. *Arch Phys Med Rehabil*. 2005;86:373–379.
5. Hansen L, Shaheen A, Crandall M. Outpatient follow-up after traumatic injury: challenges and opportunities. *J Emerg Trauma Shock*. 2014;7(4):256–260.
6. Haider AH, Weygandt PL, Bentley JM, et al. Disparities in trauma care and outcomes in the United States: a systematic review and meta-analysis. *J Trauma Acute Care Surg*. 2013;74(5):1195–1205.
7. Glance LG, Osler TM, Mukamel DB, et al. Trends in racial disparities for injured patients admitted to trauma centers. *Health Serv Res*. 2013;48(5):1684–1703.
8. Haider AH, Chang DC, Efron DT, et al. Race and insurance status as risk factors for trauma mortality. *Arch Surg*. 2008;143(10):945–949.
9. Hicks CW, Hashmi ZG, Velopulos C, et al. Association between race and age in survival after trauma. *JAMA Surg*. 2014;149(7):642–647.
10. Strong BL, Torain JM, Greene CR, Smith GS. Outcomes of trauma admission for falls: influence of race and age on in-hospital and post-discharge mortality. *Am J Surg*. 2016;212(4):638–644.
11. Lin S-F, Beck AN, Finch BK. Black–white disparity in disability among U.S. Older adults: age, period, and cohort trends. *J Gerontol B Psychol Sci Soc Sci*. 2014;69(5):784–797.
12. Ng JH, Bierman AS, Elliott MN, et al. Beyond black and white: race/ethnicity and health status among older adults. *Am J Manag Care*. 2014;20(3):239–248.
13. Englum BR, Villegas C, Bolorunduro O, et al. Racial, ethnic, and insurance status disparities in use of posthospitalization care after trauma. *J Am Coll Surg*. 2011;213(6):699–708.
14. Sacks GD, Hill C, Rogers SO. Insurance status and hospital discharge disposition after trauma: inequities in access to postacute care. *J Trauma*. 2011;71:1011–1015.
15. Arango-Lasprilla JC, Ketchum JM, Stevens LF, et al. Ethnicity/racial differences in employment outcomes following spinal cord injury. *NeuroRehabilitation*. 2009;24(1):37–46.
16. Marquez de la Plata C, Hewlitt M, de Oliveira A, et al. Ethnic differences in rehabilitation placement and outcome after TBI. *J Head Trauma Rehabil*. 2007;22(2):113–121.
17. Rios-Diaz AJ, Herrera-Escobar JP, Lilley EJ, et al. Routine inclusion of long-term functional and patient-reported outcomes into trauma registries: the FORTE project. *J Trauma Acute Care Surg*. 2017;83(1):97–104.
18. Blackwell M, Iacus S, King G, Porro G. Cem: coarsened exact matching in Stata. *STATA J*. 2009;9(4):524–546.
19. Botero JP, Thanarajasingam G, Warsame R. Capturing and incorporating patient-reported outcomes into clinical trials: practical considerations for clinicians. *Curr Oncol Rep*. 2016;18:61.
20. Lavallee DC, Chenok KE, Love RM, et al. Incorporating patient-reported outcomes into health care to engage patients and enhance care. *Health Aff*. 2016;35(4):575–582.
21. Jenkinson C, Morley D. Patient reported outcomes. *Eur J Cardiovasc Nurs*. 2015;15(2):112–113.
22. Driban JB, Morgan N, Price LL, et al. Patient-Reported Outcomes Measurement Information System (PROMIS) instruments among individuals with symptomatic knee osteoarthritis: a cross-sectional study of floor/ceiling effects and construct validity. *BMC Musculoskelet Disord*. 2015;16:253.
23. Stone ME, Marsh J, Cucuzzo J, et al. Factors associated with trauma clinic follow-up compliance after discharge: experience at an urban Level I trauma center. *J Trauma Acute Care Surg*. 2014;76(1):185–190.
24. Stewart MG, Chen AY. Factor predictive of poor compliance with follow-up after facial trauma: a prospective study. *Otolaryngol Head Neck Surg*. 1997;117:72–75.
25. Greene WR, Oyetunji TA, Bowers U, et al. Insurance status is a potent predictor of outcomes in both blunt and penetrating trauma. *Am J Surg*. 2010;199:544–557.
26. Brown LE, Burton R, Hixon B, et al. Factors influencing emergency department preference for access to healthcare. *West J Emerg Med*. 2012;13(5):410–415.
27. Leukhardt WH, Golob JF, McCoy AM, et al. Follow-up disparities after trauma: a real problem for outcomes research. *Am J Surg*. 2010;199(3):348–353.
28. Baker DW, Stevens C, Brook R. Determinants of emergency department use: are race and ethnicity important? *Ann Emerg Med*. 1996;28:677–682.
29. Lee JS, Tamayo-Sarver J, Kinneer P, Hobgood C. Association between patient race/ethnicity and perceived interpersonal aspects of care in the emergency department. *J Natl Med Assoc*. 2008;100:79–85.
30. Burgess DJ, Fu SS, van Ryn M. Why do providers contribute to disparities and what can Be done about it? *J Gen Intern Med*. 2004;19(11):1154–1159.