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Pain and itch outcome trajectories differ among European American and African American survivors of major thermal burn injury

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Abstract

Over half of individuals experiencing major thermal burn injury (MThBI) receive an autologous skin graft (autograft), in which skin is removed from a healthy “donor” site and transplanted to the burn site. Persistent pain/itch at the graft site are major causes of suffering and disability in MThBI survivors. African Americans have a higher risk of MThBI, and in other clinical settings African Americans experience a greater burden of pain and itch relative to European Americans. However, to our knowledge, ethnic differences in skin graft site pain/itch outcomes after MThBI have not been assessed. We evaluated skin graft site pain and itch severity (0–10 numeric rating scale (NRS)) over 1 year in a prospective multicenter cohort sample of African Americans and European Americans. In adjusted linear mixed models African Americans experienced a slower rate of pain resolution in the acute phase of recovery ($\beta = -0.05$ versus -0.08 NRS points per day, $p < 0.001$), which resulted in a higher pain severity in the persistent phase of recovery (NRS mean difference = 1.21, 95% CI [0.12, 2.29]), although not statistically significant after correction for multiple comparisons. African Americans also experience greater itch severity in the 6 weeks to 12 months after burn injury compared to European Americans (NRS mean difference = 1.86 [0.80–2.93]), which results from a faster rate of itch development in African Americans in the acute

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recovery phase after burn injury. Future studies may improve outcomes in African Americans and lead to new pathogenic insights that benefit all burn injury survivors.

Keywords

Chronic pain; chronic itch; skin graft; ethnic differences; persistent pain; persistent itch; burn injury

1. Introduction

Burn injuries affect 11 million people annually worldwide [45]. In the United States, over 700,000 patients seek care for burn injuries each year and more than 50,000 are hospitalized for major burn injury [33]. More than half of these individuals receive an autologous skin graft (autograft), in which skin is removed from a healthy “donor” site and transplanted to the burn site [9; 28; 53]. Among major thermal burn injury (MThBI) survivors who receive tissue autograft, pain and itch at the autograft site are common and highly morbid [10; 12; 44; 58].

Based on data from the National Burn Registry and the US Census data, African Americans are 1.5 times as likely to experience burn injury compared to European Americans [2; 8], and in other clinical settings African Americans have been shown to experience a greater burden of pain and itch relative to European Americans [14; 17; 50; 56]. Some of this disparity in pain and itch outcomes is likely due to the markedly greater socioeconomic disadvantage experienced by African Americans [25; 41; 64]; however, evidence from other health conditions characterized by chronic pain and/or itch suggests that differences in health outcomes between African Americans and European Americans may not be due to socioeconomic differences alone [46; 52; 56; 64].

To our knowledge, pain and itch outcomes in African American vs. European American survivors of major thermal burn injury (MThBI) have not previously been compared. In this study we evaluated pain and itch outcomes from the time of hospitalization through 1 year in these two groups. We hypothesized that acute and chronic pain and itch at the site of tissue autograft would be more common in African Americans, even after adjusting for socioeconomic status. In addition, we hypothesized that these differences would not be due to ethnic differences [13; 23; 42] in receipt of opioid medications.

2. Methods

2.1 Design, setting, participant eligibility criteria

European American and African American patients undergoing tissue autograft after major thermal burn injury between February 2012 and June 2015 at one of three burn centers (University of North Carolina, Chapel Hill, NC; MedStar Washington Hospital Center, Washington, DC, and University of South Florida, Tampa, FL) were enrolled. We assessed ethnicity by self-report during screening, and again during abstraction of the medical record at the time of admission and exclusively enrolled European Americans and African Americans. Exclusion criteria included age <18 or >65, admission >72 hours after major

thermal burn injury, estimated total body surface area burn >30%, intentional, electrical or a chemical mechanism, autograft performed >14 days after admission to burn center or autograft decision made >7 days after admission, Childs-Pugh liver failure stage B or C, burn that required escharotomy, end-stage renal disease, chronic opioid use >20 morphine equivalents per day prior to burn, pre-burn skin disorder causing pruritus, substantial comorbid traumatic injury, pregnancy or breastfeeding, and residing greater than 100 miles from enrollment site. In addition, individuals unwilling to provide a blood sample, prisoners, suicidal, homicidal, and/or psychotic individuals, and individuals who did not read and speak English were excluded. There was no patient in the sample who self reported a mast cell disorder. Individuals with <30% total body surface area burn were enrolled because such individuals constitute the great majority of burns that present to a burn center [2] and are able to provide pain scores (e.g., are not intubated). Other exclusion criteria were chosen to remove heterogeneous populations (e.g., children, electrical burns, individuals presenting long after injury). Participants were compensated \$70, \$50, \$30 and \$70 for completion of the initial, 6 week, 6 month and 1 year assessments, respectively.

2.2 Study procedures

The institutional review board at each burn center approved the study protocol and each participant provided written informed consent. Enrollment flow chart shown in Figure 1. Retaining a low percentage of screened patients in a study is common among trauma populations including previously collected cohorts in motor vehicle collision [29], critical illness [43], burn injury [15; 59] and traumatic brain injury [57]. Of note, of our sample who was approached, 21% refused enrollment, which is consistent with other studies in burn injury [22; 24]. The most common reasons participants were excluded from the study was being <18 or >59 years of age (20%), delayed presentation for treatment (10%), burn not severe enough to require tissue autograft (16%), non-thermal burn (12%), and reside greater than 100 miles from burn center (10%). Structured in-person interviews were conducted by research assistants at the time of enrollment. Follow-up interviews were conducted daily through Day 7, weekly through Day 21, at 6 weeks, and then monthly thereafter. Data regarding burn injury characteristics, including estimated burn total body surface area and mechanism, were extracted from the medical record.

2.3 Measures

2.3.1. Pain assessments—Verbal rating scales are strongly correlated with visual analogue scales [20; 27; 40] and are optimal in populations with injuries that may impair arm or hand use. A 0–10 verbal NRS score was used to assess the severity of both graft site pain and graft site itch during the past 24 hours [3]. Specifically, patients were asked on enrollment “on a scale of 0 to 10, where “0” means no pain/itch and “10” means pain/itch as severe as it could possibly be, what was the usual intensity of your pain/itch during the past 24 hours, considering any or all of your burn pain/itch together?” Daily inpatient/outpatient follow-up patients were asked, “on a scale of 0 to 10, where “0” means no pain/itch and “10” means pain/itch as severe as it could possibly be, what was the usual intensity of your pain/itch during the past 24 hours, considering only the pain/itch from your graft site?” Monthly follow-up patients were asked, “on a scale of 0 to 10, where “0” means no pain/itch and “10” means pain/itch as severe as it could possibly be, what was the usual intensity of

your pain/itch during the past week, considering only the pain/itch from your graft site?” Initial survey and inpatient follow-up over the first three weeks following burn injury occurred via in-person interviews, while outpatient follow-up occurred via structured telephone interview. Pain and itch severity were assessed daily for the first seven days following injury, at weeks 2, 3, and 4, and then monthly during months 3 through 12. An NRS score of 4 was used to define moderate or severe symptom severity. A change in NRS of 15% has been associated with a clinically meaningful difference in pain experience [51].

2.3.2. General health status prior to burn injury—The SF-12 was administered at the time of enrollment to assess general mental health (mental component score, MCS) and general physical health (physical component score, PCS) during the month prior to burn injury [61]. Higher scores on these scales correspond to better health status [61].

2.3.3. Post-traumatic stress disorder (PTSD) symptom severity—PTSD symptom severity in the immediate aftermath of burn injury was assessed using the PTSD Symptom Scale – Interview (PSSI) [19].

2.3.4. Depression and Anxiety assessment—Depression and anxiety severity was assessed over the week prior to burn injury with subscales of the Depression, Anxiety, and Stress Scale (DASS)-21 [35; 36] The DASS-21 has been previously validated in survivors of trauma [65].

2.3.5. Pain catastrophizing assessment—The Pain Catastrophizing Scale (PCS) was used to assess the influence of catastrophizing on pain severity in the immediate aftermath of burn injury at the time of study enrollment [55]. The PCS is a validated, 13-item assessment, which measures the tendency for catastrophizing ideation in pain experiences [55]. This scale has previously been used and validated in populations of trauma survivors [30].

2.3.6. Assessment of analgesic medication usage—Information regarding inpatient medications received was extracted from the medical record. At each follow-up assessment, participants were asked about use (yes/no) of medication in the past week, including medications that were taken “over the counter” and medications that were prescribed. Two licensed physicians independently categorized the medication by class, differences were adjudicated, and this data was recorded in binary variables for analysis.

2.4 Statistical analyses

Student’s t-test was used to assess significance of the differences in continuous independent variables, and Chi-square tests were used to evaluate associations between categorical variables (SPSS Statistics version 23; IBM Corporation, Armonk, NY). Difference in proportions were determined with a two-proportion z-test).

Mixed models (as implemented in PROC MIXED, SAS 9.4, SAS Institute Inc., Cary, NC) were used to model repeated pain or itch outcome measures (0–10 NRS). Each model contained a binary indicator variable for race and a continuous variable denoting the number of days since trauma, as well as the interaction between time since burn injury and ethnicity.

Correlations between measurements within each subject were taken into account by specifying an unstructured covariance matrix for model residuals. A piecewise mixed linear model with random slopes and intercepts and a node at 6 weeks was used to model the biphasic nature of the acute versus persistent changes in pain and itch severity. Random slopes and intercepts were allowed to correlate in these models. Each model was adjusted for patient age, sex, percent total body surface area (TBSA) and ranks for patient education, income, and type of burn injury categories. Given that the difference in acute pain, acute itch, persistent pain and persistent itch (4 outcomes) were examined, p-value of 0.0125 was considered statistically significant. Six patient characteristics at baseline were examined (SF-12 MCS, SF-12 PCS, PTSD severity score, depression scale and anxiety scale), and therefore, a p-value of less than 0.008 was considered significant. P-values were reported for testing the null hypothesis that no differences exist in mean outcomes between the two race groups.

3. Results

3.1. Participants

3.1.1 Demographic characteristics and follow-up—Participant characteristics are presented in Table 1. Most study participants (n=96) were males less than 40 years of age with some education past high school. Nearly half were African American (48%, 46/96). The proportion of males and mean age of European Americans and African Americans were very similar; a greater proportion of European American participants earned more than \$60,000 annually. Overall follow-up was 90/96 (94%) participants at 6 weeks, 77/96 (80%) at 3 months, 82/96 (85%) at 6 months, and 77/96 (80%) at 12 months; similar follow-up rates were observed between European American and African American participants. Throughout the follow-up period, at major time points (day 1, week 6, month 6, and month 12), nearly 7 in 10 patients had data available at all major timepoints [69% (66/96)].

3.1.2 Burn characteristics—The majority of enrolled participants had a burn that was < 10% of their total body surface area, with approximately 3% TBSA affected by a full-thickness injury. Almost three quarters of patients sustained a burn in only one anatomical region (68/95, 72%). The most common locations of burn injury were the upper extremity (72/95, 76%) followed by lower extremities (33/95, 35%). Approximately half of burn injuries were due to flame and half were due to scald.

3.1.3 Reported pre-burn health status and peritraumatic symptoms—Reported pre-burn physical health was similar in the two groups (Table 2). African Americans reported better pre-burn mental health than European Americans; however, after adjusting for multiple comparisons this result did not reach statistical significance based on bonferroni corrected p-value. There were no significant differences reported in pre-burn depressive or anxiety symptoms between groups (Table 2), and there was no difference in peritraumatic pain catastrophizing between European American and African American patients.

3.2. Burn autograft pain resolution in African Americans vs. European Americans experiencing MThBI

In an initial linear mixed model, a significant interaction was observed between ethnicity and time since burn injury ($\beta = 0.004$, $p = 0.04$, Supplemental Tables 1 and 2). Therefore a linear mixed model was fit in which acute pain (≤ 6 weeks, corresponding to the inflammatory and proliferative phase of wound healing [11; 54]) and persistent pain (> 6 weeks, corresponding to the maturation phase of wound healing [11; 18]) were represented by separate linear components conjoined at a node 6 weeks after injury (Figure 2a).

During the 6 weeks following MThBI, European American burn survivors' pain resolved at a faster rate (NRS points per day) than African Americans ($\beta = -0.08$ versus -0.05 , $p < 0.001$, Table 3). Thereafter, the rate of pain resolution between European American and African American participants was similar (difference in slope $= 0.001$, $p = 0.60$, Table 3). Because of their reduced early recovery, and similar subsequent recovery rate, African Americans had a trend towards higher pain severity than European Americans from 6 weeks through 1 year (NRS mean difference $= 1.21$, $p = 0.03$). This result did not change substantially when itch was included as a covariate (data not shown).

Pain and itch are significantly correlated in both European Americans and African Americans at Month 6 and Month 12 following MThBI (Supplemental Table 3), however at Week 6, pain and itch were correlated in European Americans but not African Americans ($r = 0.32$, $p = 0.028$ in European Americans and $r = 0.23$, $p = 0.140$ in African Americans).

3.3. Burn autograft itch resolution in African Americans vs. European Americans experiencing MThBI

As with burn autograft pain, in an initial mixed linear model, a significant interaction was observed between ethnicity and time since burn injury ($\beta = 0.007$, $p = 0.03$, Supplemental Tables 4 and 5). A linear mixed model was therefore fit in which acute and persistent itch were represented by separate linear components, according to the wound healing phases described above (Figure 2b). While European Americans experienced stable itch intensity during the first 6 weeks after burn injury ($\beta = -0.003$, $p = 0.66$, Table 3), African Americans experienced progressively increasing itch severity during this time ($\beta = 0.05$, $p < 0.001$, Table 3). After 6 weeks, itch intensity decreased among European Americans and African Americans at a similar rate. Because of their much higher average itch severity at 6 weeks, and similar rate of itch recovery after 6 weeks, African Americans experienced more severe persistent itch symptoms than European Americans (average severity almost 2 points higher on a 0–10 NRS, $p < 0.001$).

3.4. Moderate or severe burn autograft pain outcomes in African Americans and European Americans

In addition to evaluating pain as a continuous outcome, we also compared the proportion of African American and European American participants with moderate or severe pain at each follow-up timepoint (Figure 3). Approximately 90% of African American and European American participants experienced moderate or severe acute pain. Differences in the proportion of African American vs. European American with moderate or severe pain

generally increased after the six week timepoint, but at no time did the difference in the proportion of African American vs. European American participants with moderate or severe pain meet statistical significance.

3.5. Moderate or severe autograft itch outcomes in African Americans and European Americans

In addition to evaluating itch as a continuous outcome, we also compared the proportion of African American and European American MThBI survivors with moderate or severe itch at each follow-up timepoint (Figure 4). Approximately 20–30% of African American and European American MThBI survivors experienced moderate or severe acute itch, and the prevalence of moderate or severe itch in these groups gradually increased in the initial weeks after MThBI. Differences in point prevalence of moderate or severe itch between African Americans and European Americans were most pronounced at week six (Figure 4). The proportion of African American participants with moderate or severe itch was significantly higher than European Americans at month 6 ($p=0.02$), month 9 (0.0004), and month 12 ($p=0.02$) (Figure 4) and at month 4 ($p=0.03$), month 5 ($p=0.02$), month 7 ($p=0.0007$), 8 ($p=0.0004$), month 10 ($p=0.0001$), and month 11 ($p=0.002$) (data not shown).

3.6 Analgesic consumption by drug class and ethnicity after discharge from burn center

Opioid analgesic use (yes/no) did not differ significantly between European American and African Americans at the time of discharge ($p=0.5$) and was very similar in the two groups across medication class and timepoints (Table 4). For example, 76% of both European Americans and African Americans were prescribed opioids upon discharge from the burn unit. Although a significantly higher proportion of European Americans were taking acetaminophen at the month 6 timepoint (19% versus 2%, $p=0.01$), there were, overall no other statistically significant differences between ethnicities across other medication classes including anticonvulsants, antidepressants, non-steroidal anti-inflammatory drugs, and acetaminophen at other timepoints.

4. Discussion

Moderate or severe pain and itch are common, morbid sequelae of MThBI that result in substantial losses in mental and physical health [39]. Results of this prospective multicenter study suggest that African American survivors of MThBI experience a more gradual reduction in pain during the initial six weeks after injury vs. European Americans, resulting in a trend towards more severe persistent pain in the year following MThBI. In addition, because African American survivors of MThBI experience a progressive increase in itch severity during the initial six weeks after injury, African Americans MThBI survivors experienced a greater severity of chronic itch over time. These differences were not due to ethnic differences in use of an opioid (yes/no) or to differences in age, sex, education, TBSA, type of burn or income. Although European Americans had lower aggregate mental health functioning (assessed via the SF-12) prior to MThBI, adjusting for this did not significantly influence the results that African American's experience greater pain and itch severity following MThBI. These study results are important, given that African Americans

are at 50% higher risk of sustaining a burn injury based on estimated from the National Burn Registry and US Census data [2; 8].

Previous studies have shown that mental health characteristics predict poor pain and itch outcomes after injury, [1; 5; 21; 58] thus we explored whether ethnic differences in baseline mental health might account for worse pain and itch outcomes in African Americans in the present study. Among the six pre- and periburn mental health characteristics evaluated, function/symptom levels were similar, with the exception of SF-12 mental component score, which had trend-level significance at our multiple testing-adjusted significance threshold. However, despite this, African Americans continued to experience significantly worse itch outcomes and a greater proportion of African Americans experience persistent moderate or severe pain following MThBI.

Prior studies have found that African Americans are sometimes prescribed fewer opioid analgesics than European Americans [13; 42; 47], thus we explored whether ethnic differences in receipt of opioid analgesics might account for worse pain and itch outcomes in African Americans in the present study. However, no significant differences in the proportion of European American vs. African American MThBI survivors receiving opioid prescriptions was observed, and the proportion of participants taking common adjunctive medications in the two groups was very similar. Based on this data, observed ethnic differences are not likely related to differences in receipt of an opioid prescription. Acetaminophen was more likely to be used/self reported by European Americans 6 months following MThBI. We believe that this difference at 6 months is unlikely to be driving the difference seen in pain outcomes between ethnicities, for the following reasons: 1) adjusting for whether patients were taking acetaminophen at 6 months did not reduce differences in chronic pain/itch between ethnicities; 2) pain outcomes were assessed using data from 20 timepoints, and analgesic differences were only reported at one of these timepoints (6 months); and 3) acetaminophen is a weak analgesic and has not shown efficacy to treat chronic pain (eg. osteoarthritis and spine pain [31; 37]). Of note, 75% (53/71) of study participants received opioids without any other adjunctive analgesic medications. Multimodal analgesia has been shown to reduce opioid use and improve pain and functional outcomes in other settings [6; 16], has been advocated for MThBI survivors[49]. Further studies are needed to evaluate the utility of multimodal analgesia and identify novel non-opioid treatment options for MThBI survivors experiencing moderate or severe pain.

To our knowledge, this is the first study to evaluate acute and chronic pain and itch outcomes in African Americans vs. European Americans experiencing MThBI. Our study results show that a greater proportion of African Americans experience persistent moderate or severe pain. This finding is consistent with data that African Americans experience worse pain outcomes after other types of trauma/stress exposure (e.g., bone fracture, post-surgical) [17; 34; 60; 63]. These data are also consistent with evidence that African Americans experience increased pain sensitivity in experimental settings [7; 26; 48]. At 6 weeks, the model estimate of 1.21 (95% CI [0.12, 2.29]) represents a 46% (1.21/2.6) difference in NRS (African Americans have an average pain NRS of 2.6 at 6 weeks) which is clinically meaningful based on our cut-off of 15%, but this result does not reach statistical significance after adjusting for multiple comparisons. Our finding that African Americans experience an

increased burden of itch after MThBI is consistent with data that African Americans experience an increased burden of itch in conditions in which itch is prevalent (e.g. primary biliary cirrhosis[46], eczema[52]). If confirmed by future studies, an increased burden of pain and itch experienced by African American MThBI survivors is of particular importance as African Americans are at higher risk of MThBI [2].

4.1 Limitations

Several limitations should be considered when interpreting our study results. First, our sample size (n=96) was small and included 39 African Americans, 43 European Americans at the 6 months follow-up. However, unlike many prior studies of this difficult to recruit population, our follow-up rates were excellent, increasing internal validity [32; 38]. Additionally, no studies have examined ethnic differences in pain/itch outcomes among MThBI survivors. Further prospective studies are needed to reproduce/confirm our findings given the small sample size. Second, our study was limited to only patients who presented to major burn centers. However, the great majority of MThBI survivors receiving tissue autograft are treated at such centers [4]. Another potential limitation is the influence of peri-assessment activities (occupational therapy, dressing changes, etc.) on pain/itch reporting. However, the affect of these activities would be random, increasing noise, and biasing findings toward the null. Our study evaluated the class of medication that was prescribed for each patient; however, analgesic consumptions was not quantitatively reported. In future studies, this would allow the contribution of analgesic consumption on persistent pain and itch pathogenesis to be further evaluated. Another limitation is that the ethnicity of the interviewer/assessor, which may potentially confound the results, was not recorded. Although racial concordance was not found to influence pain reporting in experimental pain conditions [62], future studies quantifying the effect of assessor ethnicity of pain reporting are needed. Finally, our study only included one common population of burn patients. Other studies are needed which evaluate pain and itch outcome disparities in other burn populations (e.g., pediatric populations, those with electrical or chemical burns).

4.1 Conclusions

In this prospective study of MThBI patients receiving tissue autograft, African Americans experienced significant, clinically relevant increases in pain and itch severity outcomes in comparison to European Americans. These differences were not explained by differences in baseline mental health or whether individuals reported taking an opioid. Future studies evaluating differences in pain and itch outcomes between African Americans and European Americans experiencing major thermal burn injury may both improve outcomes in African American patients and lead to new pathogenic insights that benefit all burn injury survivors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Study enrollment flowchart.

Figure 2.

Piecewise linear model of pain and itch recovery in survivors of major thermal burn injury (MThBI). Figure 2a shows unadjusted mean pain severity scores (0–10 NRS) for European Americans (open circles) and African Americans (closed circles) over time (in days) following enrollment in the study which occurred shortly after MThBI, plotted with error bars representing standard error of the mean. The solid and dashed lines show the piecewise linear mixed model for pain recovery in African Americans and European Americans, respectively. The shaded bands represent the standard error of the mixed model estimates. Figure 2b shows unadjusted mean itch severity scores (0–10 NRS) for European American (open circles) and African American (closed circles) participants over time (in days) following enrollment in the study which occurred shortly after MThBI. The solid and dashed lines show the piecewise linear mixed model for itch recovery in African Americans and European Americans, respectively with the shaded band representing the standard error of the model estimates.

Figure 3.

Graft site pain outcomes in European American and African Americans. Each point represents the percentage of European American (open circles) and African American (closed circles) participants with moderate to severe graft site pain (NRS (numeric rating scale) ≥ 4) following of major thermal burn injury. Error bars represent the pointwise 95% confidence intervals calculated for proportions. At no point was there a statistically significant difference between proportion of participants with moderate or severe pain.

Figure 4.

Graft site itch outcomes in European American and African Americans. Each point represents the percentage of European American (open circles) and African American (closed circles) with moderate to severe graft site itch (NRS (numeric rating scale ≥ 4) following of major thermal burn injury. Error bars represent the pointwise 95% confidence intervals calculated for proportions. *Indicates statistical significance (non-overlapping 95% confidence intervals).

Table 1

Participant Characteristics

	All	European American	African American	p-value
Male Sex (%)	72 (75)	38 (76)	34 (74)	0.81
Mean Age (SD)	38.0 (13)	39.6 (14)	36.2 (12)	0.21
Income (%)				
\$0–\$19,999	13 (17)	5 (11)	8 (24)	0.4
\$20,000–\$39,999	24 (31)	14 (31)	10 (30)	
\$40,000–\$59,999	17 (22)	10 (22)	7 (21)	
\$60,000 or higher	24 (31)	16 (36)	8 (24)	
Education (%)				
8–11 years	10 (11)	5 (10)	5 (11)	0.4
12 years	30 (32)	13 (26)	17 (38)	
Post-high school	55 (58)	32 (64)	23 (51)	
% TBSA burn (SD)	5 (3)	5 (4)	4 (3)	0.08
% TBSA Full Thickness Burn (SD)	3 (2)	3 (3)	3 (2)	0.61
Type of burn injury (%)				
Contact	5 (5)	3 (6)	2 (4)	0.02
Flame	43 (48)	28 (60)	15 (33)	
Scald	42 (46)	14 (30)	28 (62)	
Length of stay, days (SD)	9.8 (3)	10 (3)	10 (4)	0.88

TBSA: total body surface area, SD: standard deviation, ED: emergency department, t-tests were used to calculate p-values for continuous measures, and χ^2 tests were used for categorical variables.

Table 2

Mental health characteristics by ethnicity surrounding burn injury

	European AmericanMean (SD)	African AmericanMean (SD)	p-value
<i>Reported pre-burn health*</i>			
SF-12 Physical Component Score	53 (10)	54 (6)	0.46
SF-12 Mental Component Score	50 (12)	55 (7)	0.01
Depressive symptoms, DASS	4 (9)	2 (5)	0.23
Anxiety symptoms, DASS	3 (7)	3 (5)	0.92
<i>Periburn symptoms[§]</i>			
Pain Catastrophizing	21 (13)	22 (14)	0.97
PTSD Severity Score, PSSI	11 (10)	14 (13)	0.22

* SF-12 assessed general health over the month prior to MThBI, DASS assessed symptoms of depression and anxiety over the week prior to MThBI.

[§] Pain catastrophizing was assessed at the time of study enrollment in the immediate aftermath of MThBI, PSSI was assessed at the time of study enrollment measuring PTSD symptoms in the early aftermath of MThBI. SD: standard deviation, DASS: depression anxiety stress scale, PSSI: PTSD Symptom Scale – Interview. Given multiple comparisons (6), a $p < 0.008$ was considered statistically significant.

Table 3

Effect estimates from multivariate piecewise linear mixed model of graft site pain and itch following major thermal burn injury.

	Graft Site Pain			Graft Site Itch		
	Estimate	SE	p-value	Estimate	SE	p-value
Slope for AA in Acute Phase	-0.05	0.008	<0.001	0.05	0.01	<0.001
Slope for EA in Acute Phase	-0.08	0.007	<0.001	-0.003	0.01	0.66
Slope difference for Acute Phase	0.04	0.01	<0.001	0.05	0.01	<0.001
Model-estimated mean difference across all visits in Acute Phase						
	-0.05	0.51	0.92	0.09	0.50	0.86
Slope for AA in Persistent Phase						
	-0.003	0.002	0.06	-0.005	0.002	0.004
Slope for EA in Persistent Phase	-0.002	0.001	0.13	-0.006	0.002	<0.001
Slope difference for Persistent Phase	-0.001	0.002	0.60	0.001	0.003	0.66
Model-estimated mean difference across all visits in Persistent Phase						
	1.21	0.55	0.03	1.86	0.54	<0.001

Model has been adjusted for sex, age, income, total body surface area burn, type of burn injury, and education level. The slope unit is pain NRS (numeric rating scale change per day). Slope difference is the difference in slope between European American (EA) and African American (AA) participants. Acute phase includes Day 1–Week 6 timepoints, persistent phase includes Week 6–Year 1 timepoints. EA: European American. AA: African American; SE: standard error.

Table 4

Proportion of participants receiving analgesic medications by ethnicity*

	Discharge				6 Weeks			
	European American		African American		European American		African American	
				p-value				p-value
Opioid N (%)	38 (81)	34 (76)		.53	15 (31)	13 (28)		.76
NSAID	2 (4)	1 (2)		.57	13 (27)	13 (28)		.90
Antiepileptic	11 (23)	8 (17)		.47	8 (17)	2 (4)		.06
Antidepressant	2 (6)	1 (2)		.61	3 (7)	0 (0)		.10
Acetaminophen	3 (6)	4 (9)		.67	5 (10)	1 (2)		.11
6 Months								
12 Months								
	European American		African American		European American		African American	
				p-value				p-value
Opioid N (%)	11 (26)	9 (20)		.51	3 (8)	3 (7)		.84
NSAID	7 (16)	10 (22)		.52	5 (13)	4 (9)		.56
Antiepileptic	5 (12)	5 (11)		.91	2 (5)	3 (7)		.80
Antidepressant	1 (4)	1 (2)		.96	0 (0)	1 (2)		.35
Acetaminophen*	8 (19)	1 (2)		.01	2 (5)	2 (4)		.87

* N: number of participants reporting taking medication yes/no; NSAID: Non-steroidal anti-inflammatory drug; Antidepressants included tricyclic antidepressants and selective norepinephrine reuptake inhibitors;

* There was a significantly higher proportion of European Americans reporting acetaminophen use relative to African Americans at Month 6 (19% versus 2%, p=0.01).