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Clinical paper

Examining the association between ethnicity and out-of-hospital cardiac arrest interventions in Salt Lake City, Utah

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Abstract

Aims: Previous research has reported racial disparities in out-of-hospital cardiac arrest (OHCA) interventions, including bystander CPR and AED use. However, studies on other prehospital interventions are limited. The primary objective of this study was to investigate race/ethnic disparities in out-of-hospital cardiac arrest (OHCA) interventions: EMS response times, medication administration, and decisions for intra-arrest transport. The secondary objective was to evaluate differences in the provision of Bystander CPR (CPR) and application of AED.

Methods: We retrospectively analyzed data from the Salt Lake City Fire Department (2010–2023). We included adults 18 years or older with EMS-treated OHCA. Race/ethnicity was categorized as White people, Asian people, Black people, Hispanic people, and others. We employed multivariable regression analysis to evaluate the association between race/ethnicity and the outcomes of interest.

Results: Unadjusted analyses revealed no significant differences across ethnic groups in EMS response, medication administration, bystander CPR, or intra-arrest transport decisions. However, significant ethnic disparities were observed in Automated External Defibrillator (AED) utilization, Black people having the lowest rate (6.5%) and Asian people the highest (21.8%). The adjusted analysis found no significant association between race/ethnicity and all OHCA intervention measures, nor between race/ethnicity and survival outcomes.

Conclusions: Our multivariable analysis found no statistically significant association between race/ethnicity and EMS response time, epinephrine administration, antiarrhythmic medication use, bystander CPR, AED intervention, or intra-arrest transport. These results imply regional variations in ethnic disparities in OHCA may not be consistent across all areas, warranting further research into disparities in other regions and additional influential factors like neighborhood conditions and socioeconomic status.

Keywords: Out-of-hospital cardiac arrest (OHCA), Race, Ethnicity, Interventions, Resuscitation

Background

Several studies in the United States () and other countries () consistently reported a significant association between race/ethnicity and out-of-hospital cardiac arrest (OHCA) incidence and survival outcomes. People from racial and ethnic minorities, such as Black people, Asian people, and Hispanic people, have higher incidences of OHCA and lower likelihoods of survival compared to their White counterparts [1–6].

These disparities in survival outcomes may be due to disparities in delivering critical resuscitation interventions. Previous studies in the UK reveal disparities in CPR delivery and AED use based on race, ethnicity, and socioeconomic status [7–9]. Similarly, several large national database studies encompassing patients from diverse regions and states have indicated that patients from racial/ethnic groups such as Black, Asian, and Hispanic people are less likely than White patients to receive bystander cardiopulmonary resuscitation (CPR) and automated external defibrillation (AED) [10,11,6,12–14].

However, the findings from large database studies regarding intervention and survival outcomes did not always align with those from single-region studies. For example, a study conducted in Ventura County, California found no significant difference in survival to hospital discharge among Asian, Hispanic, and non-Hispanic White populations [15]. Similarly, data from New Haven and New York City showed that racial/ethnic background was not associated with sur-

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vival [16,17]. Another study in Texas identified disparities in first responder CPR with lower rates in Black census tract regions [18]. In contrast, a study conducted in North Carolina counties reported that first-responder defibrillation rates were similar between Black and White populations [19]. Additionally, findings from Seattle and King County, Washington, revealed that Black and Asian populations experienced shorter EMS response times than the White population, although there was no significant difference in survival outcomes [20]. In Illinois, Black people were found to be less likely to receive defibrillation or CPR from EMS and had a lower likelihood of achieving return of spontaneous circulation (ROSC) compared to White people [21]. Similarly, a study in Arizona reported significantly lower rates of bystander CPR among Hispanic patients compared to non-Hispanic patients [22].

Based on the evidence presented above, it appears that the observed disparity may not be consistent or uniform across all regions of the U.S. Additionally, while several studies have investigated racial/ethnic disparities in OHCA intervention measures such as the provision of bystander CPR and AED [3,12–14,23], other measures such as emergency medical services (EMS) response times, the administration of resuscitation medications, and the decision for intra-arrest transport, referring to the initiation of hospital transportation before achieving ROSC, have not been thoroughly investigated. Identifying and addressing health disparities in healthcare and emergency systems' response to OHCA can potentially optimize the overall response to OHCA and improve survival outcomes.

Objectives

The primary objective of this study was to examine racial/ethnic variations in OHCA intervention measures; specifically, evaluating differences in EMS response times, administration of resuscitation medications (epinephrine and antiarrhythmic drugs), and the decision to initiate hospital transport prior to achieving ROSC. The secondary objective was to examine differences in the provision of bystander CPR and bystander use of AED.

Methods

Study design and setting

We conducted a retrospective cohort study utilizing data obtained from the Salt Lake City Fire Department (SLCFD) Utstein-Style Cardiac Arrest Registry in Salt Lake City, Utah. The SLCFD EMS serves a population of approximately 210,000 within a 111-square-mile area, with an annual incidence of 128 OHCA cases [24].The department comprises approximately 340 Basic Life Support (BLS) and Advanced Life Support (ALS) providers, strategically distributed across 14 stations with 22 responding units. The local 911 dispatch center employs a tiered dispatch response matrix, guided by the Medical Priority Dispatch System protocols.

The study received an ethics exemption from the Institutional Review Board (IRB) at the University of Utah (IRB_00138043). This exemption was granted due to the retrospective nature of the analysis, which utilized deidentified data and presented no risk to patients.

Study population

The study enrolled adult patients who suffered from non-traumatic out-of-hospital cardiac arrest (OHCA) and were treated by EMS. Patients must have received either a shock from an AED or CPR performed by EMS to qualify. Patients under 18 years of age, those declared deceased at the scene without EMS intervention, EMS-witnessed arrest, individuals with "Do Not Resuscitate" (DNR) directives, and arrests due to trauma, strangulation, or drowning were excluded.

Data source and variable

The study data were obtained from the SLCFD Cardiac Arrest Registry, covering the period from 2011 to 2023. We abstracted data on patient and event characteristics, prehospital interventions, and survival outcomes. Baseline patient characteristics included sex, age, and racial/ethnic background (Asian, Black, Hispanic, and others). The "others" category included Native American, Alaskan, Hawaiian, and Pacific Islander ethnicities.). OHCA event details included the location of arrest, witness status, provision of Bystander CPR, use of AED, EMS response time (time from 911 call to EMS arrival on scene) (less than 7 min vs. 7 min or more), initial cardiac rhythm (shockable vs. nonshockable), administration of epinephrine, administration of amiodarone and/or lidocaine, and intra-arrest transport (decision to initiate hospital transportation before o ROSC). Survival data consisted of ROSC, survival to hospital discharge, and survival with favorable neurological outcome at hospital discharge (favorable vs. unfavorable), as defined by a Modified Rankin Scale (mRS) of 0–3 [25].

Variables of interest

The independent variable was race/ethnicity, and we represented it with five dummy variables: Asian, Black, Hispanic, and others, using White as the reference group. The primary outcome variables include EMS response time (less than 7 min vs. 7 min or more), epinephrine administration, antiarrhythmic medication (administered vs. not administered), and decision for intra-arrest transport. This involved initiating hospital transportation before achieving ROSC. Patients transported to the hospital with ongoing CPR were coded as (yes), while those pronounced dead in the field without transport were coded as (no). The secondary outcome variable included provision of bystander CPR (Provided vs. not provided) and utilization of an AED (used vs. not used) before EMS arrival.

Statistical analysis

First, we calculated summary statistics for each baseline characteristic. We summarized continuous variables using mean and standard deviation or median and interquartile range (IQR) based on the distribution and categorical variables using frequencies and percentages. We used Kruskal-Wallis tests to compare the continuous variables across ethnic groups. Additionally, we used Chi-square tests to compare the categorical variables among ethnic groups. Third, to further examine the association between race/ethnicity and the outcomes of interest, we conducted multivariable logistic regression for all binary outcomes, including EMS response time, the administration of epinephrine and antiarrhythmic medication, the decision for intra-arrest transport, provision of bystander CPR, and utilization of AED. We used the forward variable selection technique as a model-building strategy. We initially entered the race/ethnicity variable and then incrementally added one variable at a time. The final models were considered definitive if they included statistically significant, clinically important variables and clinically important and if they demonstrated a good fit with the observed data as assessed by Hosmer-Lemeshow tests.

We assessed the assumptions of logistic regression models, including normality, linearity, and homoscedasticity, using the Normal Probability Plot of the Regression Standardized Residual and Residual Scatterplot [26]. We also examined multicollinearity by calculating the Variance Inflation Factor [27]. All tests were assessed at a 5% level of significance. All analyses were performed using IBM SPSS version 29, Armonk, NY.

Results

Study cohort

We initially identified 1873 cases of OHCA. Of these, we excluded 54 patients under 18 years of age and 6 cases with a DNR order. We also excluded an additional 51 cases due to missing data on one or more key variables and 98 cases with missing or unknown race/ethnicity data. After applying these exclusions, a total of 1,586 cases remained and were included in the analysis (Fig. 1).

Descriptive analysis results

Out of 1586 adults with OHCA analyzed, 1150 were White patients (72.5%), 198 Hispanic patients (12.5%), 76 Black individuals (4.8%), and 55 Asian individuals (3.5%). Males constituted 1089 (68.7%) and females 497 (31.3%). The second column of Table 1 presents the descriptive statistics on baseline characteristics for the entire cohort. Out of the total cohort, 685 (43.2%) patients had an EMS response time of less than 7 min, 904 (57.0%) received bystander CPR, and 217 (13.7%) had an AED applied. Additionally, 498 (31.4%) had initial shockable rhythms, 1,390 (87.6%) received IV or IO epinephrine, and 185 (11.7%) received IV or IO antiarrhythmic medications (amiodarone and/or lidocaine). Regarding survival outcomes, 567 (35.8%) achieved ROSC, 207 (13.1%) were discharged alive from the hospital, and 195 (12.3%) had favorable neurological function at discharge (Table 1).

Unadjusted ethnic groups comparison

The unadjusted comparison revealed no significant differences in baseline characteristics except for age. Asians were the oldest group at 63.0 years (IQR 47–80), followed by Whites at 62.0 years (IQR 50–72), while Hispanics were the youngest at 54.0 years (IQR 40–63).

Regarding the study outcome variables, the unadjusted analyses showed small variations across racial/ethnic groups in EMS response, epinephrine administration, and antiarrhythmic medication administration. However, these variations were not statistically significant. The results showed no significant differences in bystander CPR by race/ethnicity. However, there were significant disparities by race/ethnicity in the utilization of AEDs. Black people had the lowest rate of having an AED (6.5%) applied prior to EMS arrival, compared to White group (13.7%) and Hispanic group (11.1%). Asian people recorded the highest rate of receiving AED intervention (21.8%) (Table 1). Regarding survival outcomes, the analysis revealed a significant difference in crude ROSC rates. Asian group had the highest ROSC rate (40.0%), followed by White group (37.6%), Hispanic group (36.4%), then the Black and "others" groups, each had rates of 22.4% (p = 0.04) (Table 1).

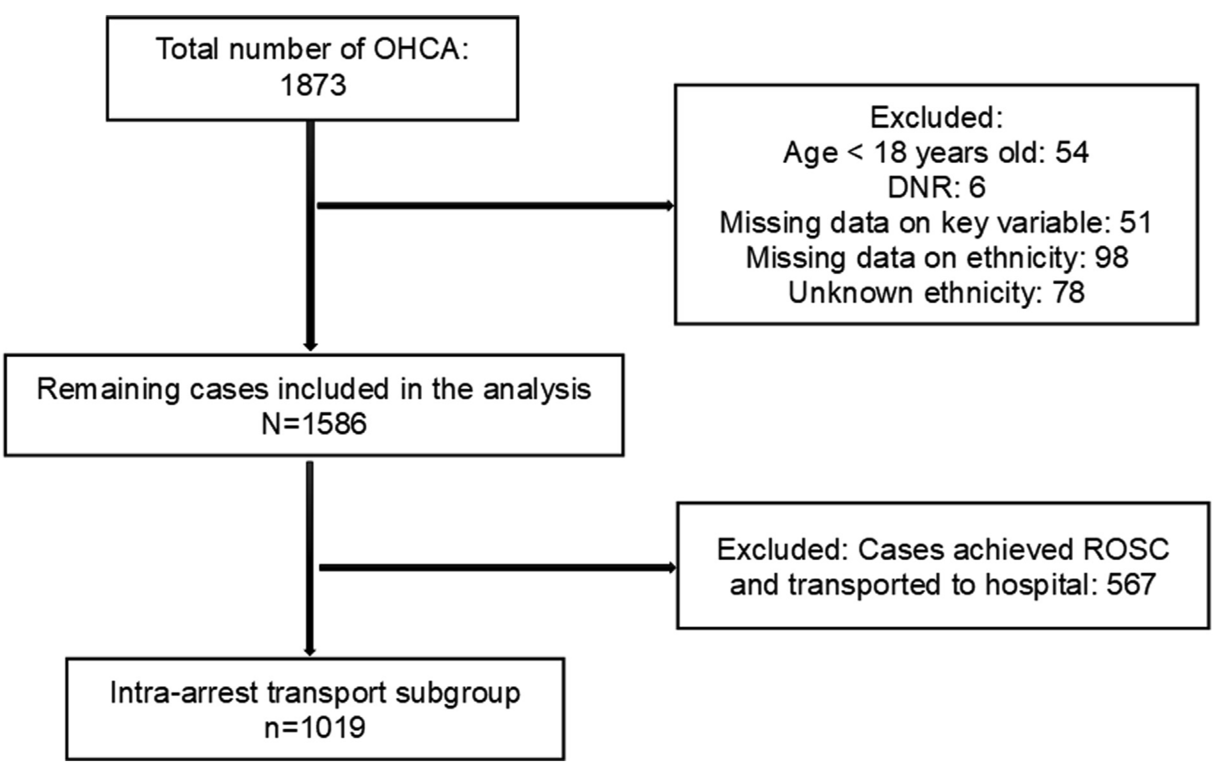

Fig. 1 – Study flow chart.

Table 1 – Baseline characteristics stratified by race/ethnicity.

Variables	Total	White	Hispanic	Others*	Black	Asian	P value
	N = 1586	1150 (72.5%)	198 (12.5%)	107 (6.7%)	76 (4.8%)	55 (3.5%)	
Age							
Median (IQR)	60.0 (47–70)	62.0 (50–72)	54.0 (40–63)	55 (39–63)	57.5 (46–63)	63.0 (47–80)	<0.001
Gender							
Males	1089 (68.7%)	796 (69.2%)	128 (64.6%)	70 (65.4%)	54 (71.1%)	41 (74.5%)	0.52
Females	497 (31.3%)	354 (30.8%)	70 (35.4%)	37 (34.6%)	22 (28.9%)	14 (25.5%)	
Location of arrest							
Private	963 (60.7%)	685 (59.6%)	126 (63.6%)	69 (64.5%)	47 (61.8%)	36 (65.5%)	0.62
Public	623 (39.3%)	465 (40.4%)	72 (36.4%)	38 (35.5%)	29 (38.2%)	19 (34.5%)	
EMS-response time							
Less than 7 min	685 (43.2%)	495 (43.0%)	88 (44.4%)	45 (42.1%)	26 (34.2%)	31 (56.4%)	0.16
7 min or more	901 (56.8%)	655 (57.0%)	110 (55.6%)	62 (57.9%)	50 (65.8%)	24 (43.6%)	
Witness Status							
Unwitnessed	737 (46.5%)	524 (45.6%)	98 (49.5%)	49 (45.8%)	39 (51.3%)	27 (49.1%)	0.73
Witnessed	849 (53.5%)	626 (54.4%)	100 (50.5%)	58 (54.2%)	37 (48.7%)	28 (50.9%)	
Bystander CPR							
No CPR	682 (43.0%)	488 (42.4%)	89 (44.9%)	48 (44.9%)	33 (43.4%)	24 (43.6%)	0.96
Bystander CPR	904 (57.0%)	662 (57.6%)	109 (55.1%)	59 (55.1%)	43 (56.6%)	31 (56.4%)	
Use of AED							
No	1369 (86.3%)	984 (85.6%)	176 (88.9%)	100 (93.5%)	66 (86.8%)	43 (78.2%)	0.04
Yes	217 (13.7%)	166 (14.4%)	22 (%11.1)	7 (6.5%)	10 (13.2%)	12 (21.8%)	
Initial rhythm							
Non-shockable	1088 (68.6%)	770 (67.0%)	149 (75.3%)	73 (68.2%)	54 (71.1%)	42 (76.4%)	0.12
Shockable	498 (31.4%)	380 (33.0%)	49 (24.7%)	34 (31.8%)	22 (28.9%)	13 (23.6%)	
Epinephrine							
No	196 (12.4%)	152 (13.2%)	23 (11.6%)	8 (7.5%)	6 (6.8%)	7 (12.7%)	0.22
Yes	1390 (87.6%)	998 (86.8%)	175 (88.4%)	99 (92.5%)	70 (93.2%)	48 (87.3%)	
Antiarrhythmics							
No	1401 (88.4%)	1014(88.2%)	179 (90.4%)	93 (86.9%)	66 (86.8%)	49 (89.1%)	0.51
Yes	185 (11.6%)	136 (11.8%)	19 (9.6%)	14 (13.1%)	10 (13.2%)	6 (10.9%)	
Survival outcomes							
ROSC	567 (35.8%)	432 (37.6%)	72 (36.4%)	24 (22.4%)	17 (22.4%)	22 (40.0%)	0.003
Hospital outcome	207 (13.1%)	160 (13.9%)	21 (10.6%)	8 (7.5%)	9 (11.8%)	9 (16.4%)	0.25
Favorable Neuro outcome	195 (12.3%)	153 (13.3%)	21 (10.6%)	7 (6.5%)	6 (7.9%)	8 (14.5%)	0.16

* Others: Native American/Alaskan/Hawaiian/Pacific Islander.

Multivariable analysis results: Association between race/ethnicity and study variable outcomes

EMS response time

The multivariable logistic regression analysis indicated that there was no statistically significant association between race/ethnicity and EMS response time. (Table 2).

Administration of epinephrine and antiarrhythmic medications

The analysis revealed no statistically significant association between race/ethnicity and the administration of epinephrine during resuscitation. The odds of administering epinephrine for all racial/ethnic groups compared to Whites were not statistically significant, with all other variables held constant (Table 3). No significant association was found in the administration of antiarrhythmic medications either (Table 3).

Provision of bystander CPR and AED intervention

The multivariable analysis found no significant association between race/ethnicity and bystander CPR provision or AED usage when controlling for other variables (Table 4).

Intra-arrest transport

Of the 1,586 adults in this study cohort, 567 patients (35.8%) achieved prehospital ROSC and were subsequently transported to the hospital. These patients were excluded from analysis concerning intra-arrest transport. The remaining 1,019 patients did not achieve prehospital ROSC, with some either having been pronounced dead at the scene or being transported to the hospital while resuscitation efforts continued (intra-arrest transport).

A subgroup analysis was conducted on this subset of patients (n = 1,019) (Fig. 1). Of those, 718 (70.5%) were of White race, 126 (12.4%) were Hispanic, 59 (5.8%) were Black people, 33 (3.2%) were of Asian people, and 83 (8.1%) were of 'others' category. Among this group, 606 (59.5%) were pronounced dead at the

Table 2 – Association between race/ethnicity and EMS response time <7 min: Multivariable analysis.

Variable	OR	95% CI	P value
White (ref)			
Hispanic	1.53	0.78–2.99	0.21
Black	1.04	0.64–1.69	0.86
Others*	0.64	0.35–1.20	0.16
Asian	0.97	0.64–1.46	0.88
Age	0.99	0.99–1.01	0.32
Male sex	0.76	0.61–0.95	0.01
Public location	1.02	0.81–1.29	0.85
Bystander CPR	0.95	0.77–1.17	0.62
Use of AED	2.82	2.03–3.92	<0.001

The Hosmer-Lemeshow test P value 0.75.

Table 3 – Association between race/ethnicity and administration of resuscitation medications: Multivariable analysis.

	Administration of epinephrine			Administration of anti-arrhythmia		
Variable	OR	95% CI	P value	OR	95% CI	P value
White (reference)			.			.
Hispanic	0.65	0.21–2.04	0.46	0.41	0.11–1.61	0.20
Black	0.58	0.25–1.37	0.21	0.81	0.37–1.79	0.61
Others	1.11	0.34–3.63	0.86	1.09	0.42–2.81	0.86
Asian	0.55	0.26–1.17	0.12	0.83	0.44–1.57	0.82
Age	1.00	0.99–1.01	0.87	1.00	0.99–1.01	0.64
Male sex	0.90	0.64–1.28	0.56	0.85	0.58–1.24	0.40
Public location	1.70	1.20–2.40	0.003	1.42	0.97–2.09	0.07
Bystander CPR	0.56	0.40–0.78	<0.001	0.70	0.49–1.00	0.05
Use of AED	1.53	0.98–2.38	0.06	1.02	0.61–1.72	0.90
EMS response < 7 min	0.88	0.64–1.22	0.45	0.61	0.77–1.55	0.61
Witnessed arrest	1.92	1.35–2.73	<0.001	1.06	0.73–1.53	0.77
Shockable rhythm	1.91	1.36–2.67	<0.001	0.10	0.07–0.15	<0.001

The Hosmer-Lemeshow test P value 0.51 The Hosmer-Lemeshow P value 0.25.

Table 4 – Association between race/ethnicity and bystander interventions: Multivariable analysis.

Bystander CPR				Bystander AED			
Variable	OR	95% CI	P value	Variable	OR	95% CI	P value
White (ref)			.	White (ref)			.
Hispanic	0.89	0.45–1.67	0.74	Hispanic	2.57	0.71–7.41	0.15
Black	0.93	0.56–1.52	0.79	Black	1.88	0.72–4.89	0.20
Others	0.98	0.54–1.80	0.94	Native/Alas/Haw/PI	2.00	0.67–6.36	0.19
Asian	1.01	0.68–1.52	0.93	Asian	2.00	0.86–4.66	0.11
Age	0.99	0.99–1.01	0.39	Age	1.01	1.01–1.02	0.01
Male sex	1.04	0.84–1.31	0.70	Male sex	1.03	0.70–1.49	0.88
Public location	1.79	1.45–2.22	<0.001	Public location	10.1	5.56– 17.02	<0.001
Use of AED	5.17	3.50–7.56	<0.001	BCPR	4.38	2.90–6.60	<0.001
Witnessed arrest	0.95	0.85–1.09	0.10	Witnessed arrest	1.22	0.87–1.71	0.25

The Hosmer-Lemeshow test P value 0.21 The Hosmer-Lemeshow test P value 0.09.

scene and 413 (40.5%) were transported to the hospital prior to ROSC (resuscitation continued during transport).

Unadjusted analysis revealed that individuals of the "others" category (Native American/ Alaskan/ Hawaiian/Pacific Islander patients) were comparatively more likely than those from other racial/ethnic groups to undergo intra-arrest transport to the hospital before achieving ROSC (41 (49.0%), compared to Whites 278 (38.7%), Hispanics 54 (42.9%), Blacks24 (40.7%), and Asian patients 13 (39.4%).

Table 5 – Association between race/ethnicity and intra-arrest transport: Multivariable analysis.

Variable	OR	95% CI	P value
White (reference)			.
Hispanic	0.84	0.34–2.10	0.72
Black	0.70	0.41–1.47	0.45
Others	0.69	0.33–1.47	0.35
Asian	0.62	0.37–1.04	0.08
Age	0.99	0.98–1.01	0.22
Male sex	1.05	0.79–1.42	0.72
Public location	0.46	0.34–0.62	<0.001
Use of AED	1.87	1.18–2.96	0.007
EMS response <7 min	0.53	0.39–0.84	0.007
Witnessed arrest	2.25	1.40–4.32	<0.001
Bystander CPR	1.26	0.95–1.66	0.11
Epinephrine	0.92	0.56–1.51	0.75
Antiarrhythmics	0.64	0.40–1.02	0.06
Shockable rhythm	3.62	2.56–5.11	<0.001

The Hosmer-Lemeshow test P value 0.16.

However, this observed difference was not statistically significant ($\chi 2$ (4, N = 1019) = 6.64, p = 0.15). After adjusting for all other confounders, the multivariable regression analysis indicated no significant differences between ethnic groups and the odds of intra-arrest transport (Table 5).

Sensitivity analysis

For all final multivariable regression models, the normal probability plot indicated that the residuals were normally distributed around zero with constant variance, and the residual scatterplot exhibited a random pattern. Furthermore, the variance inflation factor exceeded 2.5. These findings suggest that the assumptions of normality, constant variance, and absence of multicollinearity were satisfied. Moreover, all p-values associated with the Hosmer-Lemeshow tests were greater than 0.05, indicating good fit of the logistic regression models with the data.

As part of a sensitivity analysis, we replicated all regression models, first by altering the reference group from White category to Asian category, then from Whites to Blacks. This allowed us to assess the influence of changing the reference group on the analysis. Across all models examining specific outcome variables, including EMS response time, provision of bystander CPR, administration of epinephrine and antiarrhythmics medications, and intra-arrest transport, the results were consistent with the original analysis reported in this article. These findings confirm the absence of a significant association between race/ethnicity and the study outcome variables.

Discussion

We investigated ethnic disparities in OHCA intervention measures, including EMS response times, administration of resuscitation medications, decisions for intra-arrest transport, provision of bystander CPR, and use of AED within Salt Lake City, Utah, managed by a single EMS system. Our unadjusted analysis revealed no significant differences among racial/ethnic groups in OHCA interventions, including EMS response, administration of epinephrine, administration of antiarrhythmic medication, and provision of bystander CPR. However, there were significant univariate disparities by race/ethnicity in the utilization of AEDs prior to EMS arrival. Black people had the lowest rate of AED application (6.5%), compared to Asian people who recorded the highest rate of receiving AED intervention (21.8%), followed by White group (13.7%) and Hispanic group (11.1%). However, it's essential to recognize that these significant results might be due to sampling variability. To minimize the risk of Type 1 errors, we set our significance level (alpha) to α = 0.05. Our multivariable analysis showed no statistically significant association between race/ethnicity and EMS response time, administration of epinephrine, administration of antiarrhythmic medication, and provision of bystander CPR, and AED intervention.

We also conducted a subgroup analysis of 1,019 patients who did not achieve ROSC to assess racial/ethnic disparities in intra-arrest transport. Our unadjusted analysis showed a higher likelihood of intra-arrest transport among individuals of the "others" category which included Native American/Alaskan/Hawaiian/Pacific Islander patients compared to other races/ethnicities, but this difference was not statistically significant. After adjusting for possible confounders, the association between race/ethnicity and intra-arrest transport remained nonsignificant. When we replicated the regression models, changing the reference group from White to Asian and then to Black categories, the association between race/ethnicity and study outcomes remained non-significant, confirming our original findings. In terms of EMS response time, limited research exists on this topic in the USA. However, a study conducted in South Korea [28] found that OHCA occurring in lower socioeconomic status (SES) areas is associated with longer EMS response times. Our results were not consistent with this study, possibly due to differences in geographical or population characteristics.

Our results align with a study conducted in North Carolina, indicating no difference in first-responder defibrillation rates between White and Black populations [19]. However, they are inconsistent with findings from systematic reviews [10,29,30] and several large database studies [6,12–14,23], which typically involve a large sample size drawn from diverse populations across various regions. These studies often estimate a population average effect or incorporate random effects to address the inherent variability, resulting in more generalizable results. However, it is advisable to interpret their statistical significance in these studies alongside the effect size. In contrast, single-region studies focus on specific populations and settings, potentially yielding findings that may not always align with those from large database studies due to contextual differences. These differences may include variations in healthcare quality and socioeconomic status. Nevertheless, findings from single-region studies tend to be more accurate for that specific area.

Other potential explanations that may account for the discrepancies observed in our results compared to others include variations in geographic location. For instance, Salt Lake City may have a smaller population and less traffic compared to many other US cities, potentially resulting in shorter EMS response times for all patients. Additionally, racial/ethnic differences in OHCA interventions may be influenced by various confounding factors, such as socioeconomic status and comorbidities, which we did not account for in our study. Moreover, temporal trends in OHCA EMS protocols and public awareness campaigns may have evolved over time, leading to improvements in racial/ethnic disparities in OHCA interventions. Further, publication bias may skew the literature, as studies reporting significant results are more likely to be published than those with null findings [31]. Studies reporting significant racial/ethnic differences in OHCA interventions may be overrepresented in the literature compared to studies reporting no significant findings, like our study. Our results may confirm that racial/ethnic disparities in OHCA interventions vary across regions. However, it's important to note that our study had a relatively small sample size of non-white patients. As a result, the statistical power to detect significant associations may have been reduced. Larger sample sizes are recommended for future research. Another significant finding of our study is that the Asian group had a significantly higher crude ROSC rate compared to all other groups. This discrepancy may be attributed to a higher proportion of Asian people receiving AED application. Nonetheless, there were no significant differences in crude survival to hospital discharge or neurologically intact survival. Further research into racial/ethnic differences in in-hospital interventions is required.

Limitations

This study was conducted within a single region, potentially limiting the generalizability of the findings to other regions and settings. Additionally, the use of OHCA registry data may introduce information bias or incomplete data capture. The racial/ethnic makeup of our study region is less diverse than some other major cities, and the distribution of minority groups may not be geographically as homogeneous elsewhere, resulting in less of an impact of social determinants of health. Furthermore, although efforts were made to adjust for potential confounders, data on other important variables such as comorbidities and socioeconomic status were unavailable and thus not included in the analysis. Lastly, we did not include the year in the analysis due to our small sample size. Including year as a variable in the regression model would add complexity and consume degrees of freedom, potentially leading to overfitting.

Conclusion

This study represents the first investigation into racial/ethnic disparities in OHCA interventions within Salt Lake City, Utah. While our unadjusted analysis found no significant differences among racial/ethnic groups in most OHCA interventions, there was a significant difference in AED utilization, with Asian However, our multivariable analysis did not identify any statistically significant association between race/ethnicity and most OHCA intervention measures, including AED use. Subgroup analysis on patients failing to achieve ROSC revealed no significant association between race/ethnicity and intra-arrest transport. Our findings demonstrate that regional variation in racial/ethnic disparities in OHCA may not be uniform across all regions. Additional influential variables such as neighborhood conditions, socioeconomic factors, and in-hospital interventions should also be considered in future studies.

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During the preparation of this work the authors used Chat GPT 3.5 in order to improve grammar and clarity. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

CRediT authorship contribution statement

Emad Awad: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Dilan Al Kurdi:** Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Conceptualization. **M Austin Johnson:** Writing – review & editing, Methodology, Conceptualization. **Jeffrey Druck:** Writing – review & editing, Validation, Methodology, Conceptualization. **Christy Hopkins:** Writing – review & editing, Resources, Methodology, Conceptualization. **Scott T Youngquist:** Writing – review & editing, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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