


## ORIGINAL RESEARCH

## Emergency Medical Services

# Epidemiology and outcome of out-of-hospital cardiac arrest in Salt Lake City: Sex-based investigations

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**Abstract**

**Objectives:** Prior research indicates sex disparities in the incidence and outcomes of out-of-hospital cardiac arrest (OHCA). This study investigates the presence of such differences in Salt Lake City, Utah.

**Methods:** We analyzed data from the Salt Lake City Fire Department (2008–2023). We included adults with non-traumatic OHCA. We calculated the annual incidence of OHCA and examined sex-specific survival outcomes using multivariable logistic regression, adjusting for OHCA characteristics known to be associated with survival.

**Results:** The annual incidence of OHCA was 76 per 100,000 person-years. Among the 894 OHCA cases included in the analysis, 67.5% were males, 37.3% achieved return of spontaneous circulation (ROSC), and 13.6% survived hospital discharge. Unadjusted analysis revealed that males had significantly higher OHCA in public locations (43.9% vs. 28.6%), witnessed arrests (54.5% vs. 47.8%), and shockable rhythms (33.3% vs. 22.9%). Males also showed higher rates of ROSC (37.5% vs. 36.9%), hospital discharge survival (14.5% vs. 11.7%), and neurologically intact survival. After adjusting for the OHCA characteristics, there was no significant differences between males and females in ROSC, survival to hospital discharge, and favorable neurological function with adjusted odds ratios (male vs. female) of 0.92 (95% confidence interval [CI] 0.73–1.16), 0.85 (95% CI 0.59–1.22), and 0.92 (95% CI 0.62–1.40), respectively.

**Conclusion:** Approximately, 128 adults suffer OHCA in Salt Lake City annually. Males initially showed higher crude survival rates, but after adjusting for OHCA characteristics, no significant sex differences in survival outcomes were found. Enhancing OHCA characteristics could benefit both sexes. Investigations into the relationship between sex- and region-specific factors influencing OHCA outcomes are needed.

**KEYWORDS**

incidence, OHCA, Salt Lake City, sex, survival

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## 1 | INTRODUCTION

### 1.1 | Background

Out-of-hospital cardiac arrest (OHCA) is a life-threatening emergency and remains one of the leading causes of mortality globally.<sup>1</sup> In the United States alone, more than 355,000 individuals suffer OHCA yearly, with a mortality rate of approximately 90%.<sup>2,3</sup> Significant regional variations in OHCA incidence and outcomes exist internationally.<sup>4-7</sup> These differences extend not only across countries but also within North American regions and cities.<sup>8</sup> Seattle has an incidence of 144 cases per 100,000 person-years and a survival rate of 8%. Portland has an incidence of 78 cases per 100,000 person-years, with a lower survival rate of 6.5%.<sup>9</sup> A recent study in Vancouver reported an improved survival rate over the last decade, ranging from 14% to 16%.<sup>10</sup> It is crucial to acknowledge the limited studies quantifying OHCA incidence and survival outcomes in Salt Lake City (SLC), Utah, demanding further investigation in this region.

Discrepancies in incidence and survival rates exist within entire cohorts and sex-based subgroups. Studies examining sex disparities in survival outcomes have produced conflicting findings.<sup>11-19</sup> Sex-based disparities in OHCA incidence and survival rates may be linked to biological factors. Higher levels of estrogen in females could influence cardiovascular health, potentially resulting in lower OHCA incidence and improved survival rates.<sup>20</sup> In contrast, males often present with a higher occurrence of cardiovascular risk factors, such as hypertension, smoking, and obesity, which elevate their risk of cardiac events.<sup>21</sup> Moreover, other factors such as demographic characteristics, resuscitation protocols, and in-hospital interventions may also contribute to the reported variations in OHCA outcomes between males and females. While extensive research on sex differences in OHCA interventions and survival outcomes exists for some North American cities,<sup>13,15,16,22,23</sup> the same is lacking in other US cities, particularly in SLC. This study aims to fill this gap, quantifying and evaluating potential sex differences in OHCA incidence and survival outcomes, including achieving return of spontaneous circulation (ROSC), survival to hospital discharge, and survival with favorable neurological function in an OHCA patient cohort in the SLC region.

### 1.2 | Importance

This study assesses the incidence, interventions, and outcomes of OHCA, focusing on sex differences in outcomes within the SLC area. The findings aim to enhance our understanding of sex-specific OHCA resuscitation and outcomes, which could guide interventions targeted to improve outcomes.

### 1.3 | Goal of this investigation

The main objectives of this study were to:

#### The Bottom Line

This retrospective analysis of 15 years of adult out of hospital cardiac arrest (OHCA) data from Salt Lake City found that when compared to women, men have a higher incidence of OHCA, higher rates of characteristics associated with improved survival, and higher unadjusted survival. However, adjusted analysis showed no difference in survival between men and women.

1. Evaluate and quantify the incidence of OHCA in the adult population of SLC, stratified by sex.
2. Evaluate sex disparities in OHCA survival outcomes, including achieving ROSC, survival to hospital discharge, and survival with favorable neurological function.

## 2 | METHODS

### 2.1 | Design and setting

This study was a retrospective analysis of prospectively collected data from the Salt Lake City Fire Department (SLCFD) cardiac arrest registry in SLC, Utah. SLCFD provides Emergency Medical Services (EMS) to 111-mile<sup>2</sup> urban area, handling around 34,000 emergency calls annually. The department comprises roughly 200 basic life support (BLS) and 140 advanced life support (ALS) providers, distributed across nine ALS and 11 BLS units, in addition to three non-stationed mobile response units. The local 911 dispatch center employs a tiered dispatch response matrix guided by the Medical Priority Dispatch System protocols (Priority Dispatch Corp.). Dispatchers instruct callers on bystander cardiopulmonary resuscitation (CPR). If patients exhibit uncertain breathing, dispatchers send the nearest ALS or BLS unit. Additional providers are frequently called upon to deliver ALS-level care and aid in chest compressions.<sup>24</sup>

This research study was granted exemption by the University of Utah's Institutional Review Board (IRB) based on the minimal or no risk associated with the study, as it involved a secondary analysis of de-identified data (University of Utah, IRB #00097611).

### 2.2 | Study population

We included adults, EMS-treated OHCA from June 2008 to June 2023. Exclusions included patients under 18 years, those with traumatic cause of arrest, drowning, strangulation, individuals with a valid do-not-resuscitate (DNR) order, and those lacking data on key variables.

### 2.3 | Data source

To accomplish the study's objective, we examined data gathered by SLCFD from patients across all SLC regions between 2008 and

2023. The database contains valuable information, including patient demographics, arrest date, arrest location, bystander CPR, initial rhythm, and other prehospital interventions. Data on OHCA interventions have been entered either by the EMS medical director or the associate medical director as part of a long-term quality assurance process. The medical directors review electronic patient care reports, listen to dispatch recordings of the call, and process CPR quality data from defibrillator files. The outcomes data were initially obtained through records requests to a hospital nurse liaison and later via an online portal serving as a repository for medical records across Utah.

## 2.4 | Variable of interest

The independent variable is sex. Sex data were collected from hospital records. The outcomes of interest included achieving ROSC (yes vs. no), survival to hospital discharge (yes vs. no), and survival with good neurological outcome at hospital discharge. According to the standardized Utstein definitions,<sup>25</sup> ROSC was defined as “the restoration of a spontaneous perfusing rhythm, resulting in a palpable pulse.” Neurological outcome at hospital discharge was measured using a modified Rankin scale (mRS),<sup>26</sup> which score neurological function on a scale from 0 to 6. A “0” represents no neurological deficit and a scale of “6” represents death.<sup>26,27</sup> We defined favorable neurological function as an mRS of  $\leq 3$  and an unfavorable neurological function as an mRS of 4–6.

OHCA characteristics included age per year at time of arrest, arrest location (public vs. private), witnessed status (unwitnessed vs. witnessed), provision of bystander cardiopulmonary resuscitation (CPR), initial heart rhythm (shockable vs. no shockable), application of automated external defibrillator (AED) (yes vs. no), administration of epinephrine (yes vs. no), administration of antiarrhythmic drugs (yes vs. no), ethnicity (Caucasian vs. non-Caucasian), and placement of an advanced airway (yes vs. no).

## 2.5 | Data analysis

We utilized data from January 1, 2014, to January 1, 2023, to compute the annual incidence of adult non-traumatic OHCA for the entire population, and independently for each sex. The calculation employed the following formula: incidence rate = (number of new cases of adults OHCA/total populations at risk)  $\times$  100,000. Then, we estimated the average annual incidence by summing the annual incidences for each year and dividing by the total number of years within the period.

Furthermore, we conducted descriptive statistical analyses on the characteristics of OHCA for the entire study cohort and by sex. We utilized the Mann–Whitney *U*-test for the continuous variable, age, as it was not normally distributed, and the chi-square test for categorical variables to explore the association between sex and OHCA characteristics and outcomes. Subsequently, we fit a series of multivariable

logistic regression models to investigate the relationship between sex and outcomes, while controlling for Utstein variables known to be associated with ROSC.<sup>25</sup> Prior to performing the multivariable analyses, we examined logistic regression assumptions and multicollinearity. A variance inflation factor (VIF) value  $>2.5$  was considered an indicative of collinearity problem.<sup>28</sup> In the initial model, we incorporated only the sex variable and subsequently added other variables one at a time. We used  $-2$  log-likelihood values (deviance) to evaluate competing models. All analyses were conducted using IBM Statistical Package for the Social Sciences software (version 29).

## 3 | RESULTS

### 3.1 | Annual incidence

We identified OHCA cases for each year from January 1, 2014, to January 1, 2023, stratified by sex. The corresponding populations at risk for each year were determined using US census data.<sup>29</sup> The annual incidence of adult non-traumatic OHCA was calculated at 76 per 100,000 person-years, approximately equating to 128 patients annually. Sex-specific analysis revealed a higher annual incidence in males (101 per 100,000 male population) compared to females (53 per 100,000 female population).

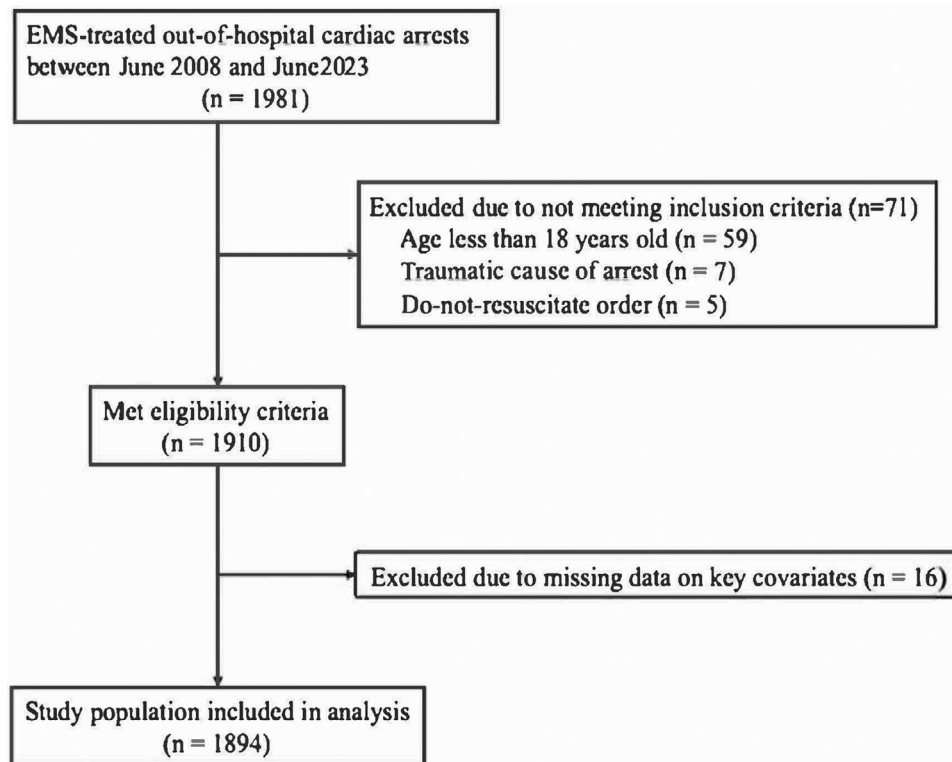
### 3.2 | Baseline characteristics

We initially identified 1981 OHCA cases during the study period. Of those, we excluded 59 cases under 18 years, seven due to traumatic cause of arrest, and five cases due to preexisting DNR order. Additionally, we excluded 16 more cases due to missing data on one or more key variables. After the exclusions, 1894 cases remained and were included in the analysis (Figure 1).

Out of 1894 OHCA, 738 (39.0%) occurred in public locations, 991 (52.3%) witnessed arrests, and 567 (29.9%) had an initial shockable rhythm. In total, 707 (37.3%) patients achieved ROSC, 258 (13.6%) were discharged alive from the hospital, and 230 (12.1%) had a favorable neurological outcome at hospital discharge (Table 1).

### 3.3 | Unadjusted males–females comparison

The unadjusted analysis revealed significant differences in baseline characteristics known to be associated with survival. Males exhibited a higher proportion of OHCA in public locations (43.9% vs. 28.6%,  $p < 0.001$ ), witnessed arrest (54.5% vs. 47.8%,  $p = 0.006$ ), bystander CPR (55.7% vs. 52.5%,  $p = 0.33$ ), and shockable rhythm (33.3% vs. 22.9%,  $p < 0.001$ ). Additionally, males had a higher crude rate of ROSC (37.5% vs. 36.9%,  $p = 0.79$ ), survival to hospital discharge (14.5% vs. 11.7%,  $p = 0.09$ ), and neurologically intact survival (13.1% vs. 10.2%,  $p = 0.08$ ). Table 1 presents a detailed description of OHCA characteristics within the study cohort, stratified by sex.



**FIGURE 1** Study flow chart. EMS, Emergency Medical Services.

### 3.4 | Multivariable analysis

#### 3.4.1 | ROSC

In total, 707 patients (37.3% of the cohort) achieved ROSC. Although more males than females attained ROSC (37.5% vs. 36.9%), this difference was not statistically significant (crude odds ratio for males vs. females 1.03, 95% confidence interval [CI] 0.84–1.18,  $p = 0.80$ ). After adjusting for variables associated with improved survival, the odds ratio (OR) was attenuated but remained non-significant (adjusted OR 0.92, 95% CI 0.73–1.16,  $p = 0.39$ ). The final model (Table 2) had a lower  $-2$  log-likelihood value than all other alternative models, indicating a good fit of the model to the data. Additionally, no VIF value exceeding 2.0 was found, suggesting the absence of multicollinearity among the independent variables.

#### 3.4.2 | Survival to hospital discharge

Overall, 258 individuals (13.6% of the cohort) survived to hospital discharge. The survival rate for males was higher than that of females (14.5% and 11.7%). Males had greater crude odds of survival to hospital discharge than females (crude OR 1.28, 95% CI 0.96–1.71,  $p = 0.09$ ) (Table 3). After adjusting for variables associated with improved survival, we observed no significant association between sex and survival to hospital discharge (adjusted OR 0.85, 95% CI

0.59–1.22,  $p = 0.30$ ). The final model (Table 3) demonstrated a superior fit to the data with a lower deviance compared to alternative models.

#### 3.4.3 | Neurological outcome at hospital discharge

Overall, 13.6% of the cohort survived with favorable neurological function. The rates of neurologically intact survival for males and females were 13.1% and 10.2%, respectively (crude OR 1.32, 95% CI 0.97–1.79,  $p = 0.08$ ) (Table 4). After adjustment, we observed no significant association between sex and survival with favorable neurological outcomes at hospital discharge (adjusted OR 0.92, 95% CI 0.62–1.40,  $p = 0.71$ ) (Table 4). Figure 2 displays the crude and adjusted ORs (males compared to females) with 95% CI for the survival outcomes.

## 4 | LIMITATIONS

This study has certain limitations. Our analyses focused exclusively on OHCA data from SLC. Considering the presence of regional variations in OHCA characteristics and outcomes nationally and internationally, our results may exhibit similarity but lack generalizability to other regions. Additionally, the dataset lacked complete information on certain variables, such as comorbidities and post-resuscitation care, which were not included as covariates in the analyses. Further research,

**TABLE 1** Baseline characteristics of the out-of-hospital cardiac arrest cohort, stratified by sex.

Variable	Total (N = 1894)	Female (615 [32.5%])	Male (1279 [67.5%])	p-Value <sup>a</sup>
Age, median (IQR)	60 (48–71)	(48–70)	60 (47–74)	0.23
Time to EMS arrival				
7 min or less	942 (49.7%)	324 (52.7%)	618 (48.3%)	0.07
More than 7 min	952 (50.3%)	291 (47.3%)	661 (51.7%)	
Arrest location				
Private	1156 (61.0%)	439 (71.4%)	717 (56.1%)	<0.001
Public	738 (39.0%)	176 (28.6%)	562 (43.9%)	
Ethnicity				
Non-Caucasian	724 (38.2%)	254 (41.3%)	470 (36.7%)	0.06
Caucasian	1170 (61.8%)	361 (58.7%)	809 (63.3%)	
Witnessed status				
Unwitnessed	903 (47.7%)	321 (52.2%)	582 (45.5%)	0.006
Witnessed	991 (52.3%)	294 (47.8%)	697 (54.5%)	
Immediate CPR				
None	697 (36.8%)	233 (37.9%)	464 (36.3%)	0.33
Bystander initiated	1035 (54.6%)	323 (52.5%)	712 (55.7%)	
EMS initiated	162 (8.6%)	59 (9.6%)	103 (8.1%)	
Initial rhythm				
Non-shockable	1327 (70.1%)	474 (77.1%)	853 (66.7%)	<0.001
Shockable	567 (29.9%)	141 (22.9%)	426 (33.3%)	
AED application and use				
No	1646 (86.9%)	553 (89.9%)	1093 (85.5%)	0.002
Yes, without defibrillation	148 (7.8%)	45 (7.3%)	103 (8.1%)	
Yes, with defibrillation	100 (5.3%)	17 (2.8%)	83 (6.5%)	
Administration of epinephrine				
No	274 (14.5%)	91 (14.8%)	183 (14.3%)	0.78
Yes	1620 (85.5%)	524 (85.2%)	1096 (85.7%)	
Antiarrhythmic drugs				
No	1630 (86.1%)	550 (89.4%)	1080 (84.4%)	0.003
Yes	264 (13.9%)	65 (10.6%)	199 (15.6%)	
Advanced airway				
No	521 (27.5%)	175 (28.5%)	346 (27.1%)	0.52
Yes	1373 (72.5%)	440 (71.5%)	933 (72.9%)	
ROSC				
Not achieved	1187 (62.7%)	388 (63.1%)	799 (62.5%)	0.79
Achieved	707 (37.3%)	227 (36.9%)	480 (37.5%)	
Hospital discharge				
Died	1636 (86.4%)	543 (88.3%)	1093 (85.5%)	0.09
Alive	258 (13.6%)	72 (11.7%)	186 (14.5%)	
Neurological outcome				
Unfavorable	1664 (87.9%)	552 (89.8%)	1112 (86.9%)	0.08
Favorable	230 (12.1%)	63 (10.2%)	167 (13.1%)	

Abbreviations: EMS, Emergency Medical Services; IQR, interquartile range; ROSC, return of spontaneous circulation.

<sup>a</sup>p-Value assessed at 5% level of confidence.

**TABLE 2** Association between gender and return of spontaneous circulation: logistic regression analysis (N = 1856).

Variable	OR	95% CI
Sex		
Female		
Male (crude)	1.03	0.84–1.18
Sex		
Female		
Male (adjusted)	0.92	0.73–1.16
Age	0.99	0.98–1.0
Time to EMS arrival		
More than 7 min		
7 min or less	4.89	3.42–7.02
Location		
Private		
Public	1.04	0.88–1.35
Witnessed status		
Unwitnessed		
Witnessed	4.61	3.51–5.95
CPR initiation		
No CPR initiated <sup>a</sup>		
Bystander-initiated CPR	3.72	3.14–6.10
EMS-initiated CPR <sup>b</sup>	4.15	2.35–5.93
Initial rhythm		
Non-shockable		
Shockable	2.22	1.74–2.81
Epinephrine administration		
No		
Yes	0.37	0.26–0.53
Ethnicity		
Non-Caucasian		
Caucasian	1.02	0.82–1.27

Abbreviations: CI, confidence interval; EMS, Emergency Medical Services; OR, odds ratio.

<sup>a</sup>No CPR initiated until EMS arrival.

<sup>b</sup>Out-of-hospital cardiac arrest witnessed by EMS and immediate CPR was initiated by EMS.

dedicated explicitly to exploring sex differences in post-resuscitation care, is required.

## 5 | DISCUSSION

We analyzed data from January 2014 to January 2023 to determine the annual incidence of adult non-traumatic OHCA in SLC, Utah. We identified an annual incidence at 76 per 100,000 person-years, corresponding to 128 cases annually. This incidence was slightly lower than the overall incidence (93.2 per 100,000) reported in 2021 by the

**TABLE 3** Association between gender and hospital discharge: logistic regression analysis (N = 1856).

Variable	OR	95% CI
Sex		
Female		
Male (crude)	1.28	0.96–1.71
Sex		
Female		
Male (adjusted)	0.85	0.59–1.22
Age	0.97	0.96–0.98
Time to EMS arrival		
More than 7 min		
7 min or less	2.72	1.90–3.89
Location		
Private		
Public	1.50	1.07–2.11
Witnessed status		
Unwitnessed		
Witnessed	4.61	1.96–5.80
CPR initiation		
No CPR initiated <sup>a</sup>		
Bystander-initiated CPR	0.73	0.45–2.34
EMS-initiated CPR <sup>b</sup>	1.87	1.10–3.18
Initial rhythm		
Non-shockable		
Shockable	7.78	5.44–11.03
Epinephrine administration		
No		
Yes	0.11	0.07–0.17
Ethnicity		
Non-Caucasian		
Caucasian	1.08	0.77–1.53

Abbreviations: CI, confidence interval; EMS, Emergency Medical Services; OR, odds ratio.

<sup>a</sup>No CPR initiated until EMS arrival.

<sup>b</sup>Out-of-hospital cardiac arrest witnessed by EMS and immediate CPR was initiated by EMS.

national Cardiac Arrest Registry to Enhance Survival (CARES), which analyzed data on OHCA in regions representing almost half of the US population.<sup>30</sup> Additionally, our findings indicate a higher incidence in males than females, aligning with consistent patterns observed in previous studies.<sup>31,32</sup>

Furthermore, we used SLCFD data on non-traumatic OHCA to examine the crude survival rate for the study cohort, overall and stratified by sex and to investigate sex differences in survival outcomes. The crude survival to hospital discharge was 13.6%, slightly lower than the national average (15.6%) reported by CARES in 2021.<sup>30</sup>

**TABLE 4** Association between gender and neurological outcome: logistic regression analysis ( $N = 1856$ ).

Variable	OR	95% CI
Sex		
Female		
Male (crude)	1.32	0.97–1.79
Sex		
Female		
Male (adjusted)	0.92	0.62–1.40
Age	0.97	0.96–0.98
Time to EMS arrival		
More than 7 min		
7 min or less	2.29	1.53–3.44
Location		
Private		
Public	1.46	1.00–2.12
Witnessed status		
Unwitnessed		
Witnessed	5.47	2.74–8.98
CPR initiation		
No CPR initiated <sup>a</sup>		
Bystander-initiated CPR	0.55	0.41–1.62
EMS-initiated CPR <sup>b</sup>	2.40	1.31–4.40
Initial rhythm		
Non-shockable		
Shockable	8.17	5.37–11.97
Epinephrine administration		
No		
Yes	0.11	0.07–0.18
Ethnicity		
Non-Caucasian		
Caucasian	1.16	0.78–1.72

Abbreviations: CI, confidence interval; EMS, Emergency Medical Services; OR, odds ratio.

<sup>a</sup>No CPR initiated until EMS arrival.

<sup>b</sup>Out-of-hospital cardiac arrest witnessed by EMS and immediate CPR was initiated by EMS.

When comparing males to females, our unadjusted analysis showed higher crude rates of ROSC, survival to hospital discharge, and favorable neurological function in males. Our analysis also indicated notable differences in OHCA characteristics known to be associated with survival, favoring males. Specifically, males experienced a higher incidence of OHCA in public locations and a greater proportion of witnessed arrests and shockable rhythms compared to females. Previous studies, including systematic reviews and meta-analyses,<sup>23,33–35</sup> have consistently reported similar advantages in baseline characteristics for males. This may explain the higher crude survival rates observed in males. Developing strategies to enhance the early detection of unwit-

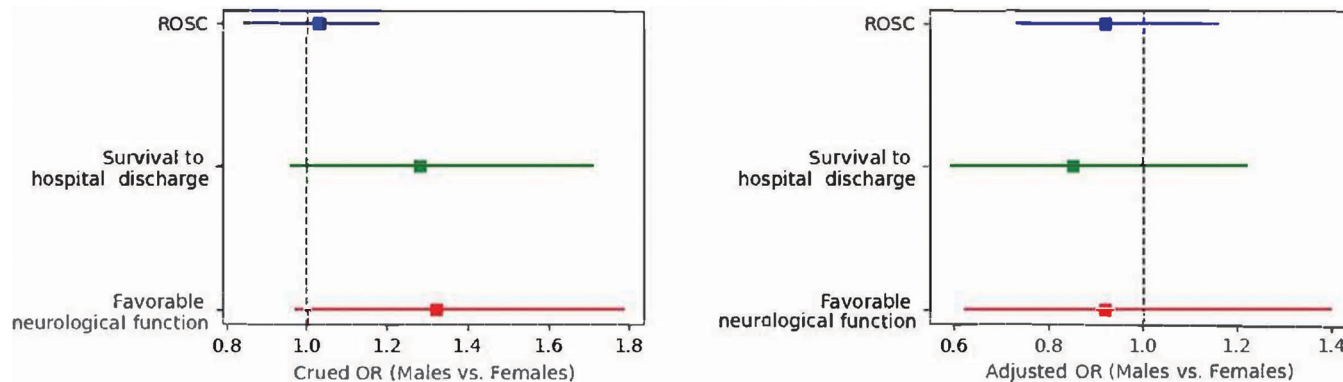
nessed OHCA incidents, particularly in private settings, is crucial for improving survival rates for both males and females. Given the higher proportion of females experiencing unwitnessed OHCA incidents, focusing on tailored interventions to address this disparity may yield more significant improvements in survival outcomes for females.

After adjusting for baseline characteristics associated with survival, our multivariable analysis found no significant differences in ROSC, survival to hospital discharge, or neurological outcomes between males and females. While adjusting for baseline characteristics appeared to balance out the odds of survival between males and females, another plausible explanation may be attributed to the influence of female sex hormones. Emerging evidence suggests that female sex hormones may exert a beneficial effect on OHCA survival. The influence of estrogen may have balanced out the odds of survival between males and females.<sup>36,37</sup>

Our multivariable analysis findings, indicating no significant association between sex and survival outcomes, are consistent with the results of recent systematic reviews and meta-analyses,<sup>34,38</sup> as well as other observational studies.<sup>12,13</sup> However, they are not in line with other studies suggesting an females have higher odds of survival,<sup>23,39</sup> and others indicating females have lower odds of survival.<sup>15,40</sup> The discrepancies between our findings and other studies may have arisen from variations in study populations, comorbidities, and in-hospital interventions. Further research is needed to clarify these discrepancies. Our study's findings indicating no association between sex and OHCA outcomes suggest that while significant sex differences in OHCA outcomes are apparent in specific regions of the United States, it is crucial to recognize that these variations are not uniform across all areas. This highlights the need for a comprehensive assessment of region-specific factors influencing OHCA outcomes, such as socio-economic status and regional disparities in EMS, to fully comprehend the underlying causes of these disparities. Achieving a thorough understanding of regional variations in sex disparities in OHCA outcomes on a national scale requires targeted investigations to guide effective interventions.

This was the first study assessing annual incidence of OHCA and sex differences in incidence and survival outcomes in SLC. The findings illuminate incidence, characteristics, and survival rates specific to the SLC region. It lays the groundwork for future research investigating regional characteristics and outcomes of OHCA in SLC.

In conclusion, this study revealed an annual incidence of adult non-traumatic OHCA at 76 per 100,000 person-years, equating to around 128 patients annually, with a higher occurrence among males. Males had more favorable OHCA characteristics predictive of survival than females. The crude survival rates including ROSC, survival to hospital discharge, and survival with favorable neurological function were slightly higher in males. However, after adjusting for these OHCA characteristics, no significant difference was found between males and females in all survival outcomes. Implementing strategies to enhance OHCA characteristics has the potential to improve outcomes for both sexes. Furthermore, our findings were inconsistent with many other studies in the USA, emphasizing the need for targeted investigations into the relationship between sex- and region-specific factors influencing OHCA outcomes.



**FIGURE 2** Forest plot displaying crude and adjusted odds ratios (ORs) of survival (male vs. female). ROSC, return of spontaneous circulation.

### AUTHOR CONTRIBUTIONS

All authors contributed to the study's conception and design. Data collection and analysis were performed by Emad Awad, Taryn Tenaya Hunt-Smith, and Scott Youngquist. Critical review and evaluation of results were performed by Christy Hopkins, Helen Palatinus, and Scott Youngquist. The first draft of the manuscript was written by Emad Awad and reviewed and revised by Christy Hopkins, Helen Palatinus, Christopher Ryba, and Scott Youngquist. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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### CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

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