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Clinical Paper

Trends in the incidence of presumed cardiac out-of-hospital cardiac arrest in Perth, Western Australia, 1997–2010☆

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ABSTRACT

Aim: This study investigated temporal trends in the incidence of out-of-hospital cardiac arrests (OHCA) in metropolitan Perth (Western Australia) between 1997 and 2010.
Methods: We calculated crude and age-and-sex-standardised incidence rates (ASIRs) using the 2011 Australian population as the standard population. Incidence rates are reported per 100,000 population, and for eight age categories (0–14, 15–34, 35–64, 65–69, 70–74, 75–79, 80–84, ≥85). Temporal trends were analysed with linear regression.
Results: Over the 14-years, 12,421 OHCAs of presumed cardiac aetiology were attended by St John Ambulance Western Australia paramedics. The overall ASIR per 100,000 population decreased significantly over this time (75.7–70.6, $p < 0.001$), but predominantly between 1997 and 2002 (75.7–65.9) and in those aged ≥65 years (410.2–336.7, $p < 0.001$). This trend was observed for both males and females and across all five-year age-groups between 65 and 84 years, but not in those ≥85 years – whom by 2010 represented 30% of the older adult (65+ years) OHCAs attended, up from 16% in 1997 ($p < 0.001$).
Conclusions: Over the study period, a decline in the ASIR for OHCAs of presumed cardiac aetiology in Perth was observed. This is largely attributed to a decreasing incidence in the population aged 65–84 years between 1997 and 2002, and is likely the result of improvements in cardiovascular risk profiles that have previously been reported among Western Australian adults. Future studies of the impact of the ageing population are required.

1. Introduction

Monitoring trends in the incidence of out-of-hospital cardiac arrest (OHCA) in a population is important to determine the impact of prevention strategies, OHCA's health care burden, and planning for future emergency medical service (EMS) requirements. A recent systematic review found wide variation in reported OHCA incidence rates,[1] which was seen both between and within countries.

In Australia the crude incidence rate for adult OHCAs attended by Emergency Medical Services (EMS) was the highest of any continent[1] and reported rates varied between cities – Perth (89.1 per 100,000 population in 1996–1999)[2] and Melbourne (149.3 per 100,000 population in 2002–2003).[3] This wide variation could reflect: differences in the age structure of the populations,[4] as these rates were not age- or sex-standardised; differences in the underlying health status of populations[5]; differences in environmental risk factors[6,7]; and/or differences in ambulance use. However, this difference could also suggest an increase in the incidence of OHCA over the two periods studied. This latter hypothesis requires further exploration as there is little data about temporal trends in the incidence of OHCA in an Australian population, and overseas evidence suggests a decline.[8,9] Therefore, this study aims to investigate temporal trends in the incidence of presumed cardiac OHCA in metropolitan Perth (Western Australia) between 1997 and 2010.

2. Methods

2.1. Setting and population

Perth is the capital city of the state of Western Australia, and over the last decade has been Australia's fastest growing capital

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city. Between 1997 and 2010, Perth's population increased from 1.31 million to 1.83 million, representing 78% of the state's population and 8% of the total population of Australia.[4] Over this time the median age of the population has decreased from 44 years to 36 years; however, the proportion of residents aged over 65 years (~11%) and the population percentage of men (49%) have remained stable.[10,11]

2.2. EMS system

St John Ambulance Western Australia Ltd. (SJA-WA) is the sole provider of EMS in the Perth region, covering an area of over 5300 km^2. A detailed description of SJA-WA is reported elsewhere[12]; briefly they provide a single tiered service of advanced life support paramedics and resuscitation protocols follow the Australian Resuscitation Council guidelines.[13]

2.3. Data collection

Cases were identified and data provided by the SJA-WA OHCA dataset – an Utstein-based[14] cardiac arrest registry maintained by the Prehospital, Resuscitation and Emergency Care Research Unit located at Curtin University. All cases identified by paramedics on the patient care record (PCR) as 'cardiac arrest' were included in the study. These SJA-WA paramedic defined 'OHCAs' approximate OHCAs due to 'presumed cardiac aetiology' – since OHCAs due to other 'obvious' causes such as trauma, hanging, drowning, drug overdose, respiratory arrest are routinely differentiated. All patient care records of suspected OHCAs attended by SJA-WA paramedics in Perth have been reviewed by one author (IJ) and independently assessed with respect to likely aetiology, with an agreement of 'presumed cardiac aetiology' in over 95% of the cases. Paramedic industrial action during 2008 resulted in missing cases for that year; therefore cardiac arrest rates for 2008 were estimated by averaging all calculated rates for 2007 and 2009.

2.4. Data analysis

Annual crude, age-specific and age-sex-standardised incidence rates (ASIRs) were calculated. Annual rates were calculated using the Australian Bureau of Statistics population numbers for each year for the Perth Statistical Division[11] as denominators. To calculate ASIR we used the direct method.[15] First we calculated the annual age-sex specific incidence rates across 5-year age-groups by sex using the number of paramedic defined OHCAs for each age-group and sex as numerators. Rates were then standardised by 5-year age groups using the 2011 Australian population as the population standard.[16] Incidence rates are reported per 100,000 population overall and for four predetermined age-groups (paediatric = 0–14 years, young adult = 15–34 years, adult = 35–64 years, older adults = ≥65 years). Older adults were further subdivided (65–69 years, 70–74 years, 75–79 years, 80–84 years, ≥85 years).

Temporal trends in crude and ASIRs overall and for each age-group were assessed with linear regression using the calendar year as the independent variable. A sensitivity analysis was performed excluding data from 2008, when the number of OHCA was estimated, using segmented regression to adjust for the interruption.[17] Data analysis was performed using Stata (Version 11.2). *p*-Values <0.05 were considered statistically significant.

2.5. Ethics approval

The analysis of SJA-WA cardiac arrest data during the study period was covered by the University of Western Australia Human Research Ethics Committee Approval #RA/4/1/1004; which has recently been replaced by Curtin University Approval #128/2013.

Table 1
Mean and average difference (95% confidence intervals) in annual incidence rates (of presumed cardiac aetiology) attended by EMS over the study period (per 100,000).

	Mean annual incidence	Annual difference	95% CI
All cases			
ASIR	69.8	−0.81	−1.28 to −0.33*
Crude	60.2	−0.14	−0.49 to +0.22
Paediatrics ASIR (0–14 y)	6.5	−0.08	−0.24 to +0.09
Young adults ASIR (15–34 y)	7.5	+0.05	−0.15 to +0.24
Adults ASIR (35–64 y)	49.2	+0.10	−0.30 to +0.51
Older adults ASIR (65+ y)	355.1	−8.75	−11.67 to −5.82*
Males ASIR	494.8	−14.03	−18.76 to −9.30*
Females ASIR	237.2	−4.28	−6.78 to −1.79*
65–69 y crude	154.4	−6.11	−8.95 to −3.29*
70–74 y crude	203.9	−11.66	−15.42 to −7.90*
75–79 y crude	311.8	−11.50	−16.04 to −6.96*
80–84 y crude	563.7	−10.18	−20.03 to −0.33*
85+ y crude	763.1	−3.89	−0.75 to +11.54

* $p < 0.005$.

3. Results

Over the 14-year period, there were 16,425 OHCAs attended by SJA-WA in Perth. Of these 12,421 (76%) were identified by the SJA-WA paramedics as cardiac arrest (i.e. of presumed cardiac aetiology) and included in the study (including 12,232 identified cases and 189 estimated cases because of industrial action in 2008). For the 12,232 OHCA entered into the OHCA database, the median age was 71 years (IQR = 58–81 years) and 66% were male. Of the 5255 (43%) cases where resuscitation was attempted, the first monitored rhythm was ventricular fibrillation/tachycardia for 41% ($n = 2122$), asystole for 37% ($n = 1962$), pulseless electrical activity for 19% ($n = 997$), and unknown for 3% ($n = 174$). Survival to hospital discharge was 3.4% overall (3.4% in 1997 and 4.8% in 2010) and 8% in patients whom received attempted resuscitation by EMS (7.3% in 1997 to 12.0% in 2010).

The mean annual crude incidence rate of presumed cardiac OHCA attended by EMS was 60.2 per 100,000 with no significant trend seen over the study period (Table 1). However, a significant decrease was seen when standardised, with an average decline of 0.81 per 100,000 (95% CI: −1.28 to −0.33). As seen in Fig. 1, a stark decline in the ASIR was observed between 1996 and 2002, when the ASIR decreased from 75.7 to 65.9 per 100,000 per year.

For the four main age-groups (<15 years, 15–34 years, 35–64 years, and >65 years), the mean annual ASIRs were 6.5, 7.5, 49.2, 355.1 per 100,000 population respectively. A statistically significant trend in the ASIR was only observed among adults aged 65 years or older; declining from 410.2 in 1997 to 336.7 in 2010 (Figs. 2 and 3). This was observed in both males (593.1–467.1, $p < 0.001$) and females (255.9–226.7, $p = 0.001$).

3.1. Older adult subgroup analysis

When older adults were examined in smaller 5-year age categories, a decreasing temporal trend in age-specific incidence was seen for all age categories (Fig. 4), except for adults aged ≥85 years, among whom no significant change was observed (493.2 in 1997 to 683.9 in 2010, $p = 0.29$). In 2010, adults aged ≥85 years represented 30% of the older adult OHCAs attended, up from 16% in 1997.