ORIGINAL RESEARCH

Clinical characteristics of Aboriginal and Torres Strait Islander emergency department patients with suspected acute coronary syndrome

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Abstract

Objectives: To describe the demographics, presentation characteristics, clinical features and cardiac outcomes for Aboriginal and Torres Strait Islander patients who present to a regional cardiac referral centre ED with suspected acute coronary syndrome (ACS).
Methods: This was a single-centre observational study conducted at a regional referral hospital in Far North Queensland, Australia from November 2017 to September 2018 and January 2019 to December 2019. Study participants were 278 Aboriginal and Torres Strait Islander people presenting to an ED and investigated for suspected ACS. The main outcome measure was the proportion of patients with ACS at index presentation and differences in characteristics between those with and without ACS.
Results: ACS at presentation was diagnosed in 38.1% of patients ($n = 106$). The mean age of patients with ACS was 53.5 years (SD 9.5) compared with 48.7 years (SD 12.1) in those without

Key findings

- ED Aboriginal and Torres Strait Islander patients being investigated for ACS have a high burden of traditional cardiac risk factors.
- Aboriginal and Torres Strait Islander patients diagnosed with ACS were 10 years younger in age than non-Indigenous patients.
- A diagnosis of ACS was more likely for men, smokers, and patients with diabetes or renal impairment.

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Results: ACS at presentation was diagnosed in 38.1% of patients ($n = 106$). The mean age of patients with ACS was 53.5 years (SD 9.5) compared with 48.7 years (SD 12.1) in those without

ACS ($P = 0.001$). Patients with ACS were more likely to be male (63.2% *vs* 39.0%, $P < 0.001$), smokers (70.6% *vs* 52.3%, $P = 0.002$), have diabetes (56.6% *vs* 38.4%, $P = 0.003$) and have renal impairment (24.5% *vs* 10.5%, $P = 0.002$).

Conclusions: Aboriginal and Torres Strait Islander patients with suspected ACS have a high burden of traditional cardiac risk factors, regardless of whether they are eventually diagnosed with ACS. These patients may benefit from assessment for coronary artery disease regardless of age at presentation.

Key words: *acute coronary syndrome, chest pain, emergency service, hospital, heart disease risk factors, oceanic ancestry group.*

Introduction

ED risk stratification pathways for suspected acute coronary syndrome (ACS) are informed by findings from large, prospective, multi-centre trials, which have identified that age, diabetes and prior cardiac history, increase the probability of having ACS.[1–5] Aboriginal and Torres Strait Islander people have been underrepresented in these trials, despite population-level data demonstrating higher cardiac event rates.[6–9] The characteristics and outcomes of Aboriginal and Torres Strait Islander patients who present to the ED with suspected ACS are unknown.

Although Aboriginal and Torres Strait Islander patients with chest pain have been shown to have a higher burden of cardiovascular risk factors than non-Indigenous patients,[10] current national guidelines intended for ED risk stratification of suspected ACS are not informed by evidence that considers Aboriginal and Torres Strait Islander people.[11] A 20-year-old study of retrospectively collected data showed Aboriginal and Torres Strait Islander patients were younger and more likely than non-Indigenous Australians to be diagnosed with a major adverse cardiac event (MACE) following ED presentation for suspected ACS (28% *vs* 19%).[12] A MACE included either acute myocardial infarction (AMI), percutaneous cutaneous intervention (PCI), coronary artery bypass graft (CABG) or death. However, the cardiac risk factor profile for Aboriginal and Torres Strait Islander patients with and without MACE is unknown. A retrospective clinical registry audit found that hospitalised Aboriginal and Torres Strait Islander patients with ACS were more likely to have a higher cardiac risk-factor burden than non-Indigenous Australians,[13] but patients with and without ACS were not compared. A better understanding of features unique to Aboriginal and Torres Strait Islander patients with ACS will enable ED clinicians to assess risk more accurately in that population.

The aims of the present study were to determine the demographic and clinical characteristics, and outcomes for Aboriginal and Torres Strait Islander people presenting to a regional cardiac referral ED with suspected ACS, and to compare the characteristics and cardiac risk factor burden between patients with and without an ACS diagnosis.

Methods

Study design and setting

This was a pre-planned analysis of data from a prospective observational study of consenting patients presenting to the Cairns ED. Cairns hospital provides cardiac referral services to North Queensland, Australia: a geographical area of 272 215 km². Details of the original study have been previously published.[14] Patient recruitment occurred in two periods: November 2017 to September 2018; and January 2019 to December 2019. Consenting patients who presented after-hours were recruited by a research nurse as soon as possible during standard office-hours.

Participants

Included patients were aged 18 years or older, identified as Aboriginal and/or Torres Strait Islander, and were evaluated for suspected ACS. Patients presented to the ED either directly or following transfer from smaller rural and remote hospitals or primary healthcare centres without pathology laboratories.

Patients were excluded for any of the following reasons: pregnancy, under 18 years of age, not investigated for ACS, previously enrolled within the last 30 days, deemed inappropriate for recruitment (e.g. terminal illness), unable or unwilling to consent or
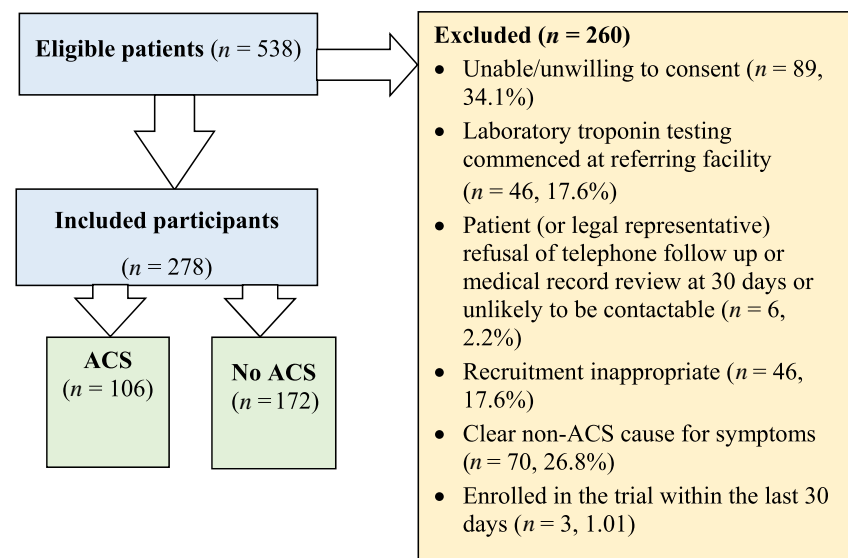

Figure 1. *Participant inclusion.*

refused follow up, or had investigations for ACS commenced using a laboratory-based troponin assay at a transferring hospital (Fig. 1).

Data collection

Data collected included demographics, cardiac risk factors, medical history, symptoms, mode of arrival, healthcare utilisation and cardiac investigations, and 30 days and 12 months telephone follow-up information about primary health provider visitations and hospitalisations. Follow up occurred for 99% and 90% of patients at 30 days and 12 months, respectively. Cardiac outcomes were adjudicated by a cardiologist using the 4th Universal Definition of AMI and standardised data definitions.[15,16] Evidence of death within 12 months of presentation was sourced from hospital medical records.

Postcode and suburb data were matched to 2016 Statistical Area Level 2 (SA2) place names to derive the following socio-economic indexes for Australia (SEIFA):[17] index of relative socio-economic disadvantage (IRSD), index of relative socio-economic advantage and disadvantage (IRSAD), index of education and occupation (IEO), index of economic resources (IER). Socio-economic scores were reported as deciles (from 1 to 10) relative to the general population, where 1 represents the lowest 10% of scores.

Patient reported postcode was used to determine residential status and to assign a remoteness area as either 'major cities of Australia', 'inner regional Australia', 'outer regional Australia', 'remote Australia' or 'very remote Australia'.[18]

Outcomes

The primary outcome was ACS diagnosis at index presentation, inclusive of AMI Type 1 (T1MI) and unstable angina pectoris (UAP).[15] Secondary outcomes included Type 2 MI (T2MI) at index presentation and MACE within 30 days of index presentation. T2MI was defined as infarction secondary to an acute imbalance between oxygen supply/demand (e.g. ventricular arrhythmias). Thirty-day MACE was defined

as T1MI, cardiovascular death, or coronary revascularization (emergency or urgent). 'Other cardiac' condition was defined as an alternative cardiac diagnosis including chronic or acute myocardial injury, arrhythmia, Takutsobo cardiomyopathy, heart failure or myocardial infarction with non-obstructive coronary arteries. 'Non-cardiac' patients had no evidence of a cardiac diagnosis (e.g. normal troponin results and non-ischaemic ECG). All-cause mortality within 30 days and 12 months of index presentation was reported.

Analysis

Statistical analysis was conducted using IBM SPSS Statistics for Windows, version 23.0.0.0 (IBM Corp, Armonk, NY, USA). Continuous variables were reported as means and standard deviations (SD) where normally distributed, and medians and interquartile ranges (IQR), otherwise. Frequencies and percentages were used to report categorical variables. Chi-squared tests and t-tests

were used in bivariate comparisons between patients with and without ACS. Levene's test was used to check the equality of variances. The probability distributions between groups were compared using Mann–Whitney U tests.

Ethics approval

Study conduct followed guidance from the National Health and Medical Research Council and Australian Institute of Aboriginal and Torres Strait Islander Studies.[19,20] Ethical approval was granted by Far North Queensland Human Research (HREC/17/QCH/42–1139) and Queensland University of Technology Ethics Committees (Approval number 1900000393).

Results

Demographic characteristics for 278 patients are reported in Table 1. Mean age of patients was 50.5 years (SD 11.4 years) and 51.8% were female ($n = 144$). Most patients identified as Aboriginal ($n = 209$,

TABLE 1. *Demographic characteristics of 278 Aboriginal and Torres Strait Islander ED patients with suspected acute coronary syndrome*

Demographic characteristics	
Age, mean years (SD)	50.5 (11.4)
Sex (female), n (%)	144 (51.8)
Indigenous status, n (%)	
Aboriginal	209 (75.2)
Torres Strait Islander	51 (18.3)
Aboriginal and Torres Strait Islander	18 (6.5)
Socioeconomic scores, median (IQR) (1 = lowest, 10 = highest)	
Index of relative socio-economic disadvantage	1.0 (1.0–3.0)
Index of relative socio-economic advantage and disadvantage	1.0 (1.0–4.0)
Index of education and occupation	1.0 (1.0–4.0)
Index of economic resources	1.0 (1.0–4.0)
Residential status, n (%)	
Major city	1 (0.4)
Inner and outer regional	198 (71.2)
Remote and very remote Australia	79 (28.4)

IQR, interquartile range; SD, standard deviation.

75.2%). All median socioeconomic index scores were in the lowest decile, that is equivalent to the lowest 10% of the general Australian population. Over a quarter of patients resided in remote or very remote areas.

Table 2 shows presentation characteristics according to arrival status. More than two-fifths of patients were transferred to the ED from another hospital. The median (IQR) time between symptom onset and arrival at the ED was longer for transferred patients (10.7: 6.4–22.7 h *vs* 3.5: 1.4–8.8 h; $P < 0.001$; Fig. S1). Most patients ($n = 273$, 98.2%) nominated a primary healthcare provider. Within 30 days of ED presentation, 161 patients (57.9%) had further contact with a healthcare provider, with 60 patients (21.5%) visiting more than one, and 58 patients (20.9%) re-presenting to the cardiac referral hospital for any reason. The median (IQR) time to contact with any health service after ED presentation was 13 (7–22) days.

Half of all patients had a non-cardiac cause of their symptoms (Table 3). One patient died within 30 days of presentation following management for STEMI and 10 (3.6%) patients died within 12 months. These patients were aged between 34 and 77 years old and half were male. The mean (SD) age at death was 54.1 (13.9) years old. Cause of death could not be determined from the available information.

Almost all patients ($n = 263$, 94.6%) had at least one risk factor for underlying coronary artery disease (CAD): hypertension, dyslipidaemia, diabetes, current smoking, self-reported family history of CAD (1st degree relative), or renal impairment (Table 4). Cardiac investigations occurred in 228 (82.0%) patients, with some patients having multiple investigations. Approximately half of all patients underwent angiography ($n = 145$, 52.2%) with most of these patients investigated during their index presentation ($n = 131$, 90.3%). Functional testing, including exercise stress testing (EST) and stress echocardiography, was performed in 28.4% of participants ($n = 79$). The majority of EST ($n = 57$, 96.4%) was performed on an inpatient basis.

Coronary revascularisation was performed in almost a third of patients ($n = 89$, 32.0%) with PCI more common than CABG surgery (27.0% *vs* 5.0%). The median (IQR) time to PCI was 1.6 (0.3–2.6) days. The maximum time to PCI was 46.8 days. Fourteen patients had CABG surgery, which was performed at major referral centres (Townsville or Brisbane). The median (IQR) time to surgery was 13.4 (10.9–21.3) days, with the maximum being 60 days.

Table 4 compares characteristics of patients with and without ACS. Patients with ACS ranged in age from 28 to 75 years old and, as a group, were older than those without ACS (mean [SD] 53.5 [9.5] *vs* 48.7 [12.1] years, $P < 0.001$). A higher proportion

of males had ACS compared with females (50.0% *vs* 27.1%, respectively, $P < 0.001$). Males and females with ACS were of similar ages. Patients with STEMI ($n = 37$) were more likely to be male ($n = 29$, 78.4%). ACS was more common among transferred patients compared with those presenting directly to the ED (58.9% *vs* 24.4%, respectively, $P < 0.001$). The prevalence of patients with diabetes, smoking and renal impairment were higher in patients with ACS (Table 4 and Fig. 2). Proportions of patients with pre-existing cardiac history were not significantly different between patients with and without ACS, except for prior CABG surgery, which was more common in patients with ACS (11.3% *vs* 4.7%, respectively, $P = 0.037$).

TABLE 2. *Presentation characteristics of Aboriginal and Torres Strait Islander ED patients with suspected acute coronary syndrome by arrival status*

	Transferred from another hospital ($n = 112$)	Direct presentation to ED ($n = 166$)
Mode of arrival, *n* (%)		
Walked in/private transport	0 (0.0%)	58 (34.9%)
Road ambulance	55 (49.1%)	108 (66.3%)
Aeromedical (fixed wing aircraft/helicopter)	57 (50.9%)	0 (0.0%)
Symptom onset, h, median (IQR)		
Time between onset and Cairns ED arrival	10.7 (6.3–22.8)	3.5 (1.4–8.8)
Arrival time, *n* (%)		
In-hours (Monday to Friday 09.00 to 17.00 hours)	35 (31.2%)	80 (48.2%)
After-hours (Weekends, Weekdays 17.01 to 08.59 hours)	77 (68.8%)	86 (51.8%)
Principal nominated primary healthcare provider, *n* (%)		
GP only	17 (15.2)	102 (61.5)
ATSICCHO	45 (40.2)	51 (30.7)
Local hospital/primary care clinic	45 (40.2)	10 (6.0)
RFDS	2 (1.8)	1 (0.6)
No nominated provider	3 (2.7)	2 (1.2)

ATSICCHO, Aboriginal and Torres Strait Islander community-controlled health organisation; GP, general practitioner; IQR, interquartile range; RFDS, Royal Flying Doctor Service.

TABLE 3. *Outcomes and all-cause mortality for 278 Aboriginal and Torres Strait Islander ED patients with suspected acute coronary syndrome*

	All patients
At index presentation, *n* (%)	
Acute coronary syndrome	106 (38.1)
STEMI	37 (13.3)
NSTEMI	61 (21.9)
UAP	8 (2.9)
T2MI	16 (5.8)
Other cardiac diagnosis (e.g. heart failure)	15 (5.4)
Non-cardiac diagnosis	141 (50.7)
Death (all causes)	0 (0.0)
At 30 days, *n* (%)	
MACE	106 (38.1)
T1MI	99 (35.6)
Emergency or urgent revacularisation	90 (32.4)
Death (all causes)	1 (0.4)
At 12 months, *n* (%)	
Death (all causes)	10 (3.6)

MACE, major adverse cardiac event; NSTEMI, non-ST segment elevated myocardial infarction; STEMI, ST segment elevated myocardial infarction; T1MI, Type 1 acute myocardial infarction; T2MI, Type 2 acute myocardial infarction; UAP, unstable angina pectoris.

Discussion

In the present study of Aboriginal and Torres Strait Islander people with suspected ACS presenting to a regional hospital ED with specialist cardiac services, patients with ACS were more likely to be male, have diabetes, smoke and have renal impairment compared with those without ACS. Compared with previous studies of predominantly non-Indigenous Australian ED patients with suspected ACS,[4,5] the rate of ACS in the present study (38.1%) was over three times higher and, as a group, the patients with ACS were approximately 10 years younger (53.5 *vs* 64.5 years, respectively).

To our knowledge, this is the first study of its kind in Aboriginal and Torres Strait Islander people. In this prospective study with high follow-up rates (>99% at 30 days) the investigator team had high levels of engagement with local ATSICCHOs with whom the interim and final analyses were shared prior to publication. These findings will inform the design of future studies to determine risk factors for ACS in Aboriginal and Torres Strait Islander people who present to the EDs with symptoms requiring investigation.

Of the many patients transferred from other hospitals, over half had ACS. This may in part explain the high overall ACS rate. Although patient transfer from rural or remote EDs to specialist cardiac centres is costly, time and resource intensive, and potentially distressing for patients,[21,22] it can be lifesaving.[23] In practice, ED clinicians transfer patients with evidence of myocardial damage or a high index of suspicion of ACS diagnosis.[11] Thus, the study location will have created a selected sample given patients presenting to smaller hospitals not subsequently transferred are not represented. Excluding transferred patients, the proportion of patients with ACS was 24.1%, which is still more than double that reported previously.[4]

We note a 7 h longer median duration from symptom onset to the ED arrival between transferred patients and those presenting directly to the ED. Although transferred patients may present promptly to local health services, vast distances in the study region leads to delays in accessing specialist care. Timely access to specialist services is critical for patients with ACS, as delays are linked to poor outcomes.[24] Additionally, socioeconomic disadvantage was noted across the entire cohort, consistent with population level data demonstrating many Aboriginal and Torres Strait Islander people live in disadvantaged areas.[25] These observations confirm the inequities of geographical isolation and social determinants of health that Aboriginal and Torres Strait Islander patients face when accessing specialised cardiac services.[26,27]

Eighty-two percent (*n* = 228) of patients received a cardiac investigation for their symptoms and there were no missed events within 30 days of presentation. Despite this, 10 patients died within 12 months, although this was not necessarily because of ACS. Our findings suggest that although current assessment pathways for suspected ACS may be safe at ruling out short-term cardiac events, the longer-term safety for Aboriginal and Torres Strait Islander people at risk of CAD remains unclear. Considering the high proportion of patients (*n* = 263, 94.6%) with at least one cardiovascular risk-factor, we recommend further research on long-term outcomes for this population.

Most patients were linked to a primary healthcare provider and over half visited this provider within 30 days of their ED presentation. Although the reason for the primary care visit is unclear, current recommendations state suspected ACS patients should seek follow up within 1 week of ED presentation for cardiac risk-factor modification.[11] It has recently been recommended that all Aboriginal and Torres Strait Islander adults

TABLE 4. *Clinical characteristics of 278 Aboriginal and Torres Strait Islander people with suspected acute coronary syndrome*

|	All patients ($n = 278$)	ACS ($n = 106$)	No ACS ($n = 172$)	P
Demographics				
Age, years, mean (SD)	50.5 (11.4)	53.5 (9.5)	48.7 (12.1)	0.001
Female, n (%)	144 (51.8)	39 (36.8)	105 (61.0)	<0.001
Male, n (%)	134 (48.2)	67 (63.2)	67 (39.0)	
Arrival status, n (%)				
Transferred from another hospital	112 (40.3)	66 (62.3)	46 (26.7)	<0.001
Cardiac risk factors, n (%)				
Hypertension	176 (63.3)	73 (68.9)	103 (59.9)	0.13
Dyslipidaemia	144 (51.8)	60 (56.6)	84 (48.8)	0.21
Diabetes	126 (45.3)	60 (56.6)	66 (38.4)	0.003
Family history of CAD	165 (59.4)	69 (65.1)	96 (55.8)	0.13
Current or recent smoking	165 (59.4)	75 (70.6)	90 (52.3)	0.002
Renal impairment (eGFR <60)	44 (15.8)	26 (24.5)	18 (10.5)	0.002
Medical history, n (%)				
Myocardial infarction	75 (27.0)	34 (32.1)	41 (23.8)	0.13
Angina	60 (21.6)	29 (27.4)	31 (18.0)	0.07
Coronary artery disease	83 (29.9)	37 (34.9)	46 (26.7)	0.15
CABG (prior)	20 (7.2)	12 (11.3)	8 (4.7)	0.04
Angioplasty	34 (12.2)	18 (17.0)	16 (9.3)	0.06
Rheumatic heart disease	16 (5.8)	5 (4.8)	11 (6.4)	0.56
Investigations, n (%)†				
Exercise stress test	59 (21.2)	1 (0.9)	58 (33.7)	Not applicable
Stress echocardiogram	23 (8.3)	1 (0.9)	22 (12.8)	
Echocardiogram	149 (53.6)	102 (96.2)	47 (27.3)	
CTCA	5 (1.8)	1 (0.9)	4 (2.3)	
Angiography	145 (52.2)	103 (97.2)	44 (25.6)	
Interventions, n (%)				
PCI	75 (27.0)	75 (70.8)	0 (0.0)	Not applicable
CABG	14 (5.0)	14 (13.2)	0 (0.0)	

†Some patients received multiple investigations. CABG, coronary artery bypass grafting; CAD, coronary artery disease; CTCA, computed tomography coronary angiogram; eGFR, estimated glomerular filtration rate; PCI, percutaneous coronary intervention; SD, standard deviation.

(18 years and over) with suspected ACS be assessed for future cardiac risk secondary to underlying CAD.[28] In contrast, for non-Indigenous Australians, the suggested age is 50 years and over. The effectiveness of implementing these recommendations across the primary healthcare sector has not been reported. Additionally, standard strategies to assess longer-term cardiac risk have not been validated in Aboriginal and Torres Strait Islander people.[29]

Investigation with computed tomography coronary angiography (CTCA), which has high sensitivity and specificity for CAD, was low in the present study ($n = 5$, 1.8%). Current Australian guidelines do not include CTCA in routine assessment for patients with suspected ACS[11] with access remaining limited. However, a UK study of patients with suspected angina, demonstrated CTCA, in addition to standard care, improved 5-year survival compared with standard care alone.[30] This was not an ED cohort and further research is required to determine if Aboriginal and Torres Strait Islander people with suspected ACS would benefit from CTCA investigation.
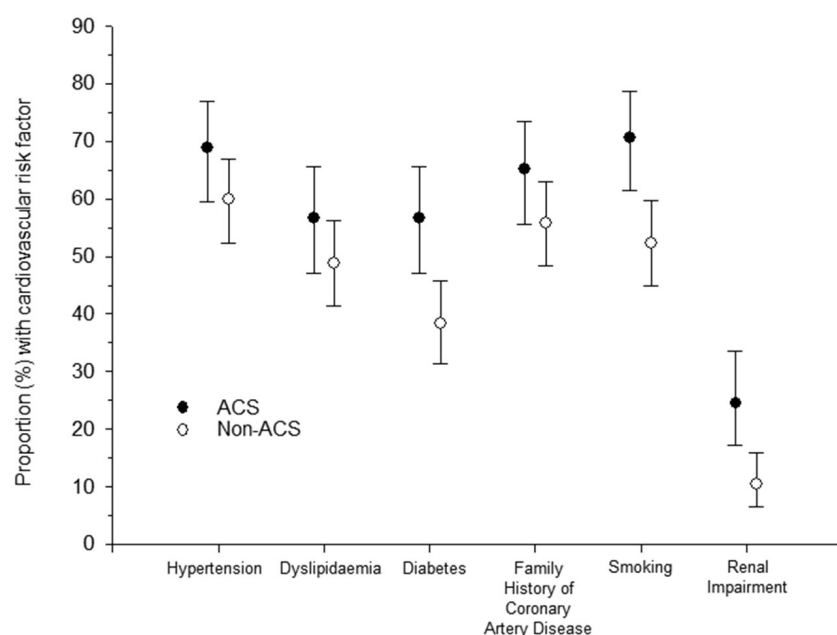
Figure 2. *Proportions of cardiovascular risk factors for Aboriginal and Torres Strait Islander ED patients with and without acute coronary syndrome (error bars are 95% confidence intervals).*

Limitations

The limitations of the present study include observational data were collected from a single site. Although the site provides cardiac referral services for a large geographical area, the data may not truly represent all Aboriginal and Torres Strait Islander people given the diversity of First Nations communities throughout Australia. The original trial included only consenting patients meaning there was potential for selection bias. Both SES and rural status were based on self-reported postcode, which may not be an accurate indicator of cardiac services available close to home nor reflect individual circumstances for this cohort. Time of arrival and other data relating to clinical interventions occurring at patient's local ED prior to transfer was unavailable.

Conclusion

We showed there is a high prevalence of ACS among Aboriginal and Torres Strait Islander people, who present to the ED with possible symptoms. These patients are younger than previously reported cohorts of non-Indigenous Australians with suspected ACS. Smoking, diabetes, renal impairment, and male sex were more common in patients with ACS compared with patients without ACS. These findings will help facilitate targeted, evidenced-based ED assessment for this patient group. Further work is required to ensure early identification of CAD in Aboriginal and Torres Strait Islander people and to strengthen coordinated cardiovascular risk factor assessment and management between the ED and primary healthcare sector.

Acknowledgements

Competing interests

Data availability statement

Due to relevant ethical approvals, research data for this study are not shared.

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Supporting information

Additional supporting information may be found in the online version of this article at the publisher's web site:

Figure S1. Histogram of time in hours between symptom onset and arrival to the Cairns ED by arrival mode.