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Cardiovascular and all-cause mortality following acute coronary syndromes in mental health service users.

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A B S T R A C T

Background: People with mental health (MH) conditions experience increased rates of acute coronary syndromes (ACS) and post-ACS mortality. The contribution of cardiac and other causes to excess mortality is unclear.
Methods: Using linked data, we identified all ACS admissions in New South Wales (NSW), Australia, from 2017 to 2021, and people with acute or severe mental illness using state-operated MH services. We examined 30-day and 12-month cardiovascular and all-cause mortality, and cardiovascular complications using binary logistic and competing-risks regressions, adjusting for demographics, socioeconomic disadvantage, comorbidities, ACS type and revascularisation. Subgroup analyses examined age, Indigenous Australians and severe or persistent mental illness.
Results: Of 65,814 ACS admissions, 4 % occurred in MH service users. MH service users had increased 30-day (all-cause OR 1.70, 95 %CI 1.46–1.97; cardiovascular-specific OR 1.60, 95 %CI 1.31–1.96) and 12-month mortality (all-cause OR 1.78, 95 %CI 1.59–2.00; cardiovascular-specific OR 1.54, 95 %CI 1.33–1.78). Risks were greater in younger service users and persisted in adjusted regression models. MH service users experienced higher rates of heart failure and stroke but not reinfarction.
Conclusions: Increased all-cause mortality after ACS in MH service users is mainly due to cardiac causes. Strategies should target broad risk factors in the post-hospital period, particularly in younger and Indigenous MH service users.

1. Introduction

Cardiovascular disease is a major cause of reduced life expectancy in people with mental illness [1–6], and hospitalisations for acute coronary syndromes (ACS) such as myocardial infarction (MI) and unstable angina are a critical point for intervention. Ideal care following ACS hospitalisation includes revascularization, cardiac rehabilitation and addressing risk factors such as smoking or hypertension to reduce recurrence risk [7].

People with MH conditions have increased risk of post-ACS mortality [8] both acutely [9–13] and in the following five years [9,10,14–16]. Risk factors such as socio-economic disadvantage and greater risk of smoking or obesity [6] are likely to interact with health system factors: following ACS, people with schizophrenia or major mood disorders are less likely to receive guideline-adherent medication [16] or revascularisation surgery [4,8,10,12–14] and more likely to receive coronary artery surgery as an emergency rather than planned procedure [17]. These findings suggest that ineffective post-ACS care may contribute to elevated mortality in people with mental illness by increasing the risk of recurrent cardiac events.

However, several studies have found no increase in recurrent myocardial infarction in this group [11,15,16]. Furthermore, studies of post-ACS outcome have examined all-cause mortality rather than cardiac-specific mortality. People with mental illness also have increased risk of non-cardiac death due to medical conditions or suicide, which may explain some of the excess post-ACS mortality [18–20],

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particularly over longer follow-up periods.

1.1. Aim and objectives

To describe cardiovascular and all-cause mortality following ACS in a cohort of people with acute or severe mental health (MH) conditions using state-operated mental health services. Using population-wide linked health data in New South Wales (NSW), Australia, we examine:

(i) 30-day and 12-month cardiovascular and all-cause mortality after a first hospitalisation for an ACS
(ii) Rehospitalisation with cardiovascular complications (subsequent ACS, cardiac failure, stroke)

We compare MH service users and the broader population, adjusting for age, sex, socio-economic disadvantage, comorbidity and attributes of the ACS condition and care. We estimate cardiac-specific mortality adjusting for the competing risk of other causes of death.

A second aim is to describe post-ACS mortality in Indigenous Australians who use MH services. Indigenous people may face compounded health risks due to systemic inequities, leading to overrepresentation in populations with physical health problems such as ACS, as well as greater risk of MH conditions. In NSW, Indigenous Australian people report higher levels of psychological distress, and experience more frequent hospitalisation for self-harm and for cardiovascular disease [21]. Understanding outcomes for Indigenous Australian MH service users is essential for developing targeted and culturally appropriate interventions.

2. Methods

2.1. Service setting and context

Around one-third of Australians live in NSW, with an average adult population of 6.3 million during this study. Hospital care is provided by more than 220 state-government ("public") and more than 100 private hospitals [22,23]. Public hospitals provide most acute and emergency care, including 75 % of admissions for cardiac and circulatory conditions [23], and all involuntary MH care. MH services are funded by national and state governments, and public community MH services primarily care for people with acute or severe mental illness. They provide acute and emergency mental health care, and long-term care for people with severe or enduring mental illness, seeing approximately 2 % of the NSW population each year. The study did not have data from office-based private or primary care mental health services, where most care for common or less serious mental health conditions occurs.

2.2. Data linkage

NSW Hospital, Community MH and Deaths Register data were linked by the NSW Centre for Health Record Linkage (CHeReL) [24], using names, birth-dates, addresses and health-service identifiers. The method has a false-positive rate of around 0.5 %. Additional details are provided elsewhere [25].

2.3. Cohort definition

We identified all admissions with a primary diagnosis of an ACS to NSW public and private hospitals from January 2017 to December 2021. Hospital diagnoses coded by Health Information Managers from clinical records and discharge summaries are recorded using the International Classification of Diseases Australian Modification (ICD10AM) [26]. We defined ACS as myocardial infarction with ST-segment elevation (STEMI) (ICD10-AM codes I21, I21.0, I21.1, I21.2, I21.3), myocardial infarction without ST-segment elevation (non-STEMI) (I21.4, I21.9) or unstable angina (I20.0). Only the first (index) admission per person in the study period for an ACS was identified. A two-year look-back (2015–2016) was used to exclude people with recent prior ACS. People under 18 and interstate or overseas residents were excluded.

ACS events were defined as occurring in MH service users if there was an in-scope MH service contact in the preceding two years. These included any of: (i) public or private hospital admission with a primary diagnosis of a non-organic MH condition (ICD-10 codes F20-F99) or care in a designated MH unit, or; (ii) any face-to-face or telehealth contact with a NSW public community MH service. Non-NSW residents, administrative contacts, case conferences and MH contacts with hospital inpatients were excluded. Primary diagnoses of substance use disorders were excluded, but substance-induced psychoses (F1x.5) were included because they are typically treated by specialist mental health services in NSW. The two-year lookback period (2015 to 2016) was used to define duration of MH care for all participants.

2.4. Primary and secondary outcomes

The primary outcome was death recorded in the NSW Register of Births Deaths and Marriages (RBDM) within 12 months of the date of admission for the index ACS admission. Cardiovascular deaths were identified as ischaemic heart disease (ICD-10AM codes I20.0 – I25.9), other heart disease (I30.0 – I40.9, I50.0, I52.9), cerebrovascular disease (I60.0 – I60.9) or other circulatory disease (other codes I00-I99).

Secondary outcomes were rehospitalisation with unstable angina, acute myocardial infarction (codes as above), subsequent myocardial infarction (I22.0, I22.1, I22.8, I22.9), cerebrovascular event (I61.0 – I64.9, I69.3,I69.4), or congestive cardiac failure (I50.0-I50.9, I11.0, I13.0, I13.2, I97.1, K76.1, P29.0).

2.5. Other variables

Age, sex, Indigenous Australian status and area of residence were defined at the index admission. People identifying as Aboriginal, Torres Strait Islander, or both Aboriginal and Torres Strait Islander were grouped as Indigenous Australian people for analysis. Socioeconomic disadvantage was estimated from the person's area of residence using the Australian Bureau of Statistics *Index of Relative Socioeconomic Disadvantage (IRSD)* [27], which scores geographical areas using census measures of income, welfare support, education, home ownership, employment, household structure and English language proficiency. Scores were divided to create quintiles of roughly equal population size.

The Charlson Comorbidity Index (CCI) was calculated at the index admission. Prior comorbidities (diabetes, hypertension, congestive cardiac failure, cerebrovascular disease, peripheral vascular disease, chronic obstructive lung disease) were defined from hospital admissions from the start of the look-back period up to but not including the index admission, using diagnosis codes from the CCI.

Interventions during the index admission were examined using procedure codes from the Australian Classification of Health Interventions [26], including angiography with or without percutaneous revascularisation (PCI) and coronary artery bypass grafting (CABG) (Supplementary Table 1).

2.6. Statistical analysis

Data assembly was conducted in SAS Enterprise Guide v7.15 and statistical analyses in Stata SE V15.1.

Association of MH status with outcomes was examined separately for each outcome using binary logistic regression to estimate Odds Ratios and 95 % confidence intervals, using Stata's *logistic* function. We calculated (a) a simple univariate OR, (b) "Model 1" OR adjusted for demographic factors likely to be associated with differences in outcome, (c) "Model 2" OR, which includes all variables in model 1, additionally adjusting for comorbidities, and (d) a "Model 3" OR which includes all variables in model 2, additionally adjusting for measures of the severity

of the ACS (ACS type, any time spent in ICU) and whether the person received any revascularisation procedure (PCI or CABG). Comorbidity, ACS severity and intervention variables were introduced separately to allow examination of the extent to which they acted as a mediator of possible association between mental health status and outcomes. Candidate variables were examined for multi-collinearity (Stata's *coldiag2* function) and excluded to provide models with a condition number of less than 30 (Belsley 1991) and no individual variable loading above 0.3 on more than one condition index.

To account for possible censoring effects of non-cardiac deaths we examined cardiac-specific 12-month mortality using the same covariates in a maximum likelihood competing-risks regression [28] (Stata *stcrreg* function) with cardiovascular death as the primary outcome and death from any other cause as the competing risk.

2.7. Subgroup analyses

We examined for interactions between sex, age, mental health status and primary outcomes by testing the significance of interaction terms for MH service user status by sex and by age (Stata's *Testparm* function).

We examined outcomes for Indigenous Australian people by repeating main analyses comparing Indigenous mental health service users to other Indigenous Australian people admitted with ACS.

We examined differences between mental health service users by splitting the mental health service user cohort into those with and without *"severe or persistent mental illness" (SPMI)* [29], defined as either (i) any recorded diagnosis of psychosis (including Schizophrenia, Schizoaffective Disorder, Mania or Depression with psychosis specified, or other or atypical psychoses), or (ii) more than two years of contact with mental health services. We combined diagnosis and length of care because of a high rate of missing or non-specific psychiatric diagnosis in NSW community mental health data [25] and because in the Australian health system, long-term contact with public mental health services typically indicates a more complex or severe condition regardless of diagnosis.

3. Results

3.1. Cohort description

We identified 65,814 in-scope index ACS admissions. Of these, 37299 (57 %) were non-STEMI, 23 % were STEMI and 21 % unstable angina. Nearly two-thirds (65 %) were male and 5 % identified as Indigenous Australians. Most admissions (90 %) were to public hospitals, more than a third (37 %) had a revascularisation procedure, and 7 % included admission to an ICU.

MH service users made up 4 % of all index ACS admissions. Compared to other NSW residents (Table 1), MH service users were younger and more likely to live in socioeconomically disadvantaged areas. MH service users were more likely to have prior diabetes, congestive cardiac failure, stroke or chronic obstructive pulmonary disease. One-third (34 %) of MH service users met criteria for severe or persistent mental illness (SPMI), including 15 % with a diagnosis of a psychotic disorder. At index admission, MH service users had higher CCI scores and smoking rates, were more likely to be admitted to a public hospital, to have a STEMI event or to die in hospital. MH service users

Table 1
Characteristics of people with Acute Coronary Syndromes (ACS), NSW mental health service users compared to other NSW residents.

		Mental health care	Other NSW residents	p
		Number (%)	Number (%)	
Acute coronary syndrome events		2616 (100 %)	63,198 (100 %)	
Demographics				
Sex	Female	1007 (38.5 %)	21,740 (34.4 %)	<0.001
	Male	1609 (61.5 %)	41,458 (65.6 %)	
Age	Mean (SD)	66.6 (16.0)	68.6 (13.7)	<0.001
Indigenous status	Indigenous Australian	325 (12.4 %)	2648 (4.2 %)	<0.001
	Not Indigenous Australian	2291 (87.6 %)	60,544 (95.8 %)	
Socioeconomic Disadvantage	1 (Most disadvantaged quintile)	763 (29.2 %)	15,598 (24.7 %)	<0.001
	2	641 (24.5 %)	14,998 (23.7 %)	
	3	488 (18.7 %)	12,696 (20.1 %)	
	4	416 (15.9 %)	10,916 (17.3 %)	
	5 (Most advantaged quintile)	307 (11.7 %)	8973 (14.2 %)	
Pre-ACS comorbid conditions	Diabetes	814 (31.1 %)	17,095 (27.0 %)	<0.001
	Hypertension	280 (10.7 %)	6952 (11.0 %)	0.63
	Congestive cardiac failure	393 (15.0 %)	6834 (10.8 %)	<0.001
	Chronic obstructive lung disease	134 (5.1 %)	1907 (3.0 %)	<0.001
	Stroke	54 (2.1 %)	816 (1.3 %)	<0.001
	Peripheral vascular disease	20 (0.8 %)	530 (0.8 %)	0.68
Index ACS admission				
Hospital type	Public	2385 (91.2 %)	56,539 (89.5 %)	0.005
	Private	231 (8.8 %)	6659 (10.5 %)	
Charlson comorbidity score	Mean (SD)	1.60 (1.09)	1.36 (0.96)	<0.001
Smoking diagnosis recorded		794 (30.4 %)	12,481 (19.7 %)	<0.001
Index ACS Type	Non-STEMI	35,711 (56.5 %)	1588 (60.7 %)	<0.001
	STEMI	14,397 (22.8 %)	539 (20.6 %)	
	Unstable Angina	13,090 (20.7 %)	489 (18.7 %)	
Admitted to ICU		168 (6.4 %)	4474 (7.1 %)	0.20
Angiography		1344 (51.4 %)	38,519 (60.9 %)	<0.001
Percutaneous revascularisation		647 (24.7 %)	22,285 (35.3 %)	<0.001
CABG		53 (2.0 %)	1769 (2.8 %)	0.018
Any revascularisation		696 (26.6 %)	23,939 (37.9 %)	<0.001
Length of stay (days)	Mean (SD)	5.27 (9.97)	4.42 (12.00)	<0.001
Mode of separation	Discharged	1595 (61.0 %)	41,642 (65.9 %)	<0.001
	Transfer to other hospital care	807 (30.8 %)	19,139 (30.3 %)	
	Transfer to other accommodation	80 (3.1 %)	558 (0.9 %)	
	Death	134 (5.1 %)	1859 (2.9 %)	

SD = Standard Deviation. STEMI = ST elevated myocardial infarction. ICU = Intensive Care Unit. CABG = Coronary Artery Bypass Graph. p = probability: categorical variables compared with Chi Square test, continuous variable with *t*-test.

were less likely to spend time in an ICU or receive a revascularisation procedure.

3.2. All cause and cardiac-specific mortality

Twelve-month all-cause mortality after ACS was 10.8 %, with just over half of deaths (54.3 %) being due to cardiac causes. Twelve-month all-cause mortality among MH service users (18.9 %) was nearly twice that of other NSW residents (10.5 %) (Table 2). Cardiac-specific deaths comprised just under half (49.1 %) of all deaths in MH service users, and 54.3 % in other NSW residents. Adjusting for demographic differences, MH service users had increased risk of all-cause and cardiovascular mortality at 30 days and 12 months (Table 2). Among MH service users, the highest relative risk was for 12-month all-cause mortality (Model 1 OR 2.25, 95 % CI 2.01–2.52). These risks were reduced slightly but not significantly after also adjusting for comorbid medical conditions, ACS type, ICU admission and occurrence of any revascularisation procedure during the index admission (Supplementary Tables 2 and 3). The type of ACS was a strong predictor of cardiovascular mortality, with STEMI associated with a greatly increased risk of cardiovascular death at 30 days (OR 4.43, 95 % CI 4.01–4.89) and 12 months (OR 3.03 95 % CI 2.79–3.30) compared to non-STEMI AMI. Receipt of any revascularisation procedure was associated with a greatly reduced risk of cardiac-specific mortality at 30 days (OR 0.32, 95 % CI 0.29–0.37) and 12 months (OR 0.36 95 % CI 0.33–3.40).

A similar pattern of cardiovascular mortality in MH service users was also seen in survival analysis adjusting for the competing risk of death by non-cardiac causes (Table 3, Fig. 1). Hazard Ratios adjusted for demographics and comorbidity were consistent with the Odds Ratios derived from logistic regression.

3.3. Cardiovascular complications

Around one third (32.0 %) of people were re-hospitalised within 12 months with a cardiovascular complication, primarily reinfarction (27.2 %) or congestive cardiac failure (9.5 %). MH service users had a higher complication rate than other NSW residents (unadjusted OR 1.14, 95 % CI 1.05–1.23) (Table 2), and this persisted after adjusting for demographic differences (model 1) but not after also adjusting for comorbidity, ACS type, ICU admission or revascularisation (models 2 and 3). MH service users had increased risk of stroke (Model 3 OR 1.33, 95 % CI 1.05–1.69) and congestive cardiac failure (Model 3 OR 1.23, 95 %CI 1.08–1.40) but no increase in crude or adjusted rate of re-infarction.

Table 3
Cardiovascular mortality in 12 months following first admission for acute coronary syndrome (ACS). Hazard Ratios and 95 % confidence intervals from competing risk regression, with other causes of death as competing risk.

	Model 1	Model 2
	Demographics	Model 1 + Comorbidity
	Hazard Ratio (95 % CI)	Hazard Ratio (95 % CI)
Sex		
Female	(Ref)	(Ref)
Male	1.10 (1.03–1.18)	1.07 (1.00–1.14)
Age	1.09 (1.08–1.09)	1.08 (1.08–1.09)
Index of Relative Socioeconomic Disadvantage		
1 (Most disadvantaged quintile)	1.33 (1.20–1.48)	1.24 (1.11–1.38)
2	1.29 (1.16–1.43)	1.26 (1.13–1.40)
3	1.14 (1.02–1.28)	1.08 (0.97–1.21)
4	1.16 (1.04–1.31)	1.12 (1.00–1.26)
5 (Most advantaged quintile)	(Ref)	(Ref)
Indigenous status		
Indigenous Australian	1.17 (0.96–1.42)	1.05 (0.86–1.28)
Not Indigenous Australian	(Ref)	(Ref)
Charlson Comorbidity Score		1.54 (1.51–1.58)
MH service use		
MH care	1.66 (1.46–1.89)	1.45 (1.27–1.65)
Other NSW residents	(Ref)	(Ref)

3.4. Subgroup analyses

3.4.1. Age and sex interactions

There was no interaction between mental health service user status and sex for 12-month all-cause mortality (Chi^2 0.74, p 0.391), cardiac-specific mortality (Chi^2 4.51, p 0.061) or cardiovascular complications (Chi^2 0.75, p 0.387). There were significant interactions between mental health status and age for all-cause mortality (Chi^2 19.21, $p < 0.001$) and cardiac-specific mortality (Chi^2 5.89, p 0.015) but not for cardiovascular complications (Chi^2 0.31, p 0.577). The association between mental health service user status and 12-month mortality was stronger in younger service users. Compared to other people with ACS admission, the odds ratio for 12-month all-cause mortality declined from 5.03 (95 % CI 3.47–7.28) in 35-year-old MH service users to 2.12 (95 % CI 1.89–2.32) in 80-year-olds (Supplementary Table 5). A similar gradient was seen for 12-month cardiac-specific mortality, with odds ratios

Table 2
Complications and mortality in 12 months following first admission for acute coronary syndrome (ACS). Odds Ratios and 95 % confidence intervals in mental health service users (MH care) compared to other NSW residents. Unadjusted (univariate) odds ratios compared to Model 1 (age, sex, socioeconomic disadvantage and Aboriginal status), Model 2 (Model 1 plusCharlson Comorbidity Index), and model 3 (Model 2 plus ACS type, ICU admission or receipt of revascularisation procedure).

	Mental health care	Other NSW residents	Odds Ratio (95 % CI)			
	Number (%)	Number (%)	Univariate	Model 1	Model 2	Model 3
Index ACS	2616 (100 %)	63,198 (100 %)				
12-month mortality						
All cause	495 (18.9 %)	6641 (10.5 %)	**1.99 (1.80–2.20)**	**2.25 (2.01–2.52)**	**1.99 (1.77–2.24)**	**1.90 (1.68–2.14)**
Cardiovascular	243 (9.3 %)	3608 (5.7 %)	**1.69 (1.48–1.94)**	**1.76 (1.52–2.04)**	**1.54 (1.33–1.79)**	**1.49 (1.28–1.73)**
Cardiovasc % of total deaths	49.1 %	54.3 %				
30-day mortality						
All cause	228 (8.7 %)	3043 (4.8 %)	**1.89 (1.64–2.17)**	**1.97 (1.70–2.29)**	**1.71 (1.47–2.00)**	**1.66 (1.42–1.95)**
Cardiovascular	142 (5.4 %)	2193 (3.5 %)	**1.60 (1.34–1.90)**	**1.63 (1.36–1.95)**	**1.43 (1.19–1.72)**	**1.40 (1.16–1.69)**
Cardiovasc % of total deaths	62.3 %	72.1 %				
Cardiovascular complications						
Any complication (a)	912 (34.9 %)	20,243 (32.0 %)	**1.14 (1.05–1.23)**	**1.15 (1.06–1.25)**	1.04 (0.95–1.13)	0.97 (0.89–1.06)
Re-infarction	716 (27.4 %)	17,160 (27.2 %)	1.01 (0.93–1.10)	1.01 (0.93–1.11)	0.92 (0.84–1.01)	**0.86 (0.79–0.95)**
Congestive cardiac failure	351 (13.4 %)	5997 (9.5 %)	**1.48 (1.32–1.66)**	**1.52 (1.35–1.71)**	**1.28 (1.13–1.45)**	**1.23 (1.08–1.40)**
Stroke	75 (2.9 %)	1167 (1.8 %)	**1.57 (1.24–1.99)**	**1.57 (1.24–1.99)**	**1.37 (1.08–1.74)**	**1.33 (1.05–1.69)**

Note: MH = mental health. OR = Odds Ratio. Binary logistic regressions conducted separately for each outcome. ORs with 95 % CIs not including 1.00 shown in bold. For ORs for all covariates, see supplementary tables. Pre-ACS comorbidities were excluded from regression models due to collinearity with the index admission comorbidity score (CCI).

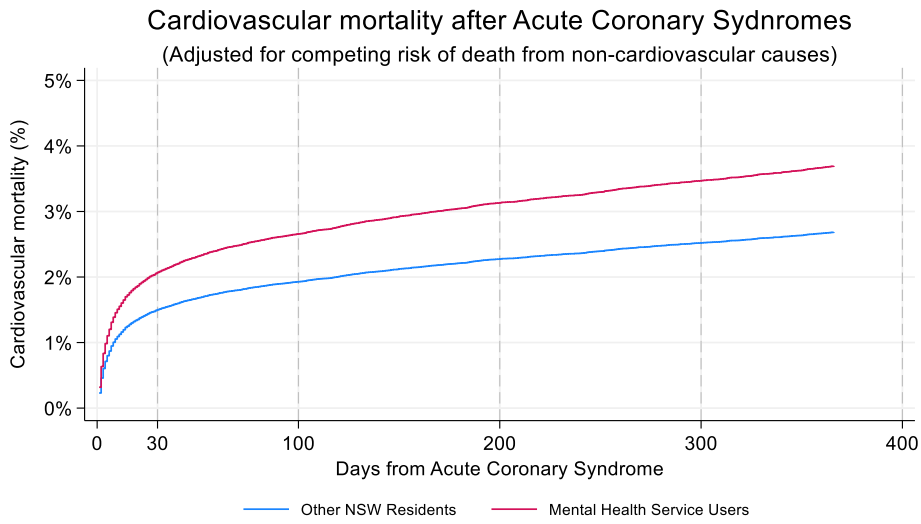

Fig. 1. Cardiovascular mortality in 12 months following first admission for acute coronary syndrome (ACS) in mental health service users compared to other NSW residents. Competing risk regression, with all other non-cardiovascular causes of death as competing risk. Model adjusted for age, sex, socioeconomic disadvantage, Indigenous Australian status, comorbidity score, ACS type, ICU admission and receipt of revascularisation procedures.

declining from 3.37 (95 %CI 1.97–5.77) in 35-year-olds to 1.75 (95 % CI 1.52–2.02) in 80-year-olds.

3.4.2. Indigenous Australian peoples

Indigenous Australians admitted with ACS were younger, more likely to be male, to live in the most disadvantaged population quintile, to have pre-ACS diabetes and chronic lung disease, and to be MH service users compared to non-Indigenous people admitted with ACS (Supplementary Table 6). Despite a similar mix of ACS types, Indigenous Australians were also less likely to receive any revascularisation procedure after ACS than non-Indigenous Australians. Indigenous Australian MH service users had higher 12-month all-cause mortality (Model 1 OR 1.66, 95 % CI 1.08–2.55) and cardiovascular mortality (Model 1 OR 1.87, 95 % CI 1.03–3.38) than other Indigenous Australian people (Supplementary Table 7) but these increases were not significant when adjusting for comorbidity, ACS type, ICU admission and revascularisation (Models 2 and 3). Compared to other Indigenous Australians, Indigenous MH service users had fewer recurrent major adverse cardiac events at 12 months (29 % compared to 36 %): this difference was not significant after adjusting for differences in age, socioeconomic disadvantage or comorbidity, but was significant when also adjusting for ACS type and interventions (Model 3 OR 0.72 95 % CI 0.54–0.94).

3.4.3. Serious or persistent mental illness (SPMI)

People with SPMI were younger than other MH service users (SPMI mean age 61.5 years SD 14.4, Other MH 69.2 years SD 16.2) but did not differ by gender, socioeconomic disadvantage or rates of most prior comorbid conditions (Supplementary Table 8). They were more likely to have STEMI episodes, to receive revascularisation and to be admitted to ICU.

Both subgroups of MH service users had a similar increases in all-cause and cardiac mortality in all regression models (Supplementary Table 9). These risks were attenuated slightly in adjusted models but remained significantly increased in all models. Model 3 estimates overlapped univariate estimates for both causes of mortality and both time periods (30 days and 2 months). For all mortality measures the corresponding estimates for the Other-MH service user group overlapped those of the SPMI group: 12-month cardiac specific mortality univariate OR 2.28 (95 %CI 1.96–2.64), Model 3 OR 1.67 (95 % CI 1.41–1.97). For both MH service user subgroups, rates of complications were increased in unadjusted models but not significant elevated when adjusting for comorbidity, ACS severity or procedures (Model 2 and Model 3).

4. Discussion

We examined 65,814 hospital admissions for acute coronary syndromes in NSW, Australia. Four percent of people had previously used public mental health services, and they experienced substantially higher cardiovascular and all-cause mortality at 30-days and 12-months. They also had increased rates of rehospitalization for congestive heart failure and stroke, but not for recurrent myocardial infarction.

Our finding of increased all-cause mortality is consistent with previous findings of 1.4 to 2.2-fold increases in 12-month post-ACS mortality in MH cohorts [9,10,12–14]. In our data, nearly 11 % of people with a first ACS hospitalisation died within 12 months, and nearly half of those deaths occurred in the first 30 days. Despite being younger at index ACS admission, MH service users were approximately twice as likely to die from any cause within 12 months (crude OR 1.99, age-, sex-, and disadvantage-adjusted OR 2.25).

Cardiac deaths, rather than suicide or other medical causes, were the major reason for this increased mortality. MH service users had greater risk of cardiac-specific death in unadjusted analyses and after adjusting for demographic factors, comorbid conditions or competing risk of other causes of death. To our knowledge, this is the first population-based study to examine cardiovascular-specific mortality after ACS in mental health service users. The period following an ACS is an important window for intervention, and many factors may have contributed to these findings. MH service users may face additional risk factors and systemic barriers to effective care, with previous studies reporting reduced rates of revascularization or reperfusion procedures [4,8,30]. We found that only 27 % of MH service users received any revascularisation procedure at their index ACS, compared to 35 % of other NSW residents. However increased mortality risk for MH service users persisted after adjusting for ACS type and revascularisation, suggesting that increased risk was not mediated by those factors alone. Other possible causes include reduced use of guideline-adherent pharmacotherapy [30–32], and socioeconomic circumstances, mental health conditions or mental health treatments which impede preventative lifestyle modifications such as smoking cessation, dietary changes and regular exercise [6,33–35].

We found strong interactions between excess mortality risk and age in MH service users, with greatly increased relative risk in younger mental health service users. This highlights the need for screening of younger mental health service users and early initiation of pharmacological treatment of cardiac risk factors [6]. Assertive efforts are needed to support post-ACS care in people in their 40s, 50s and 60s who may also have comorbid mental health conditions. We also found

unexpectedly small differences between MH health service users with severe or persistent mental disorders and other MH service users. This may reflect imprecision in our measure of severe illness, or that people using Australian public mental health services typically have complex conditions regardless of primary diagnosis. However, it is also consistent with findings of increased risk of medical mortality across the broad range of mental health diagnoses [36]. Strategies to improve ACS prevention or care may need to target mental health conditions as a broad risk factor, and not only focus on people living with psychotic disorders.

We found that mental health service users showed no increase in the rate of repeat myocardial infarction, but increased risk of congestive heart failure (OR 1.52) and stroke (OR 1.57) in the 12 months after an ACS. A similar pattern has been reported in other studies [11,15,16]. This suggests the importance of broad-based assessment and care, offering specific post-infarct care and rehabilitation but also addressing risk factors for other conditions.

In many countries Indigenous people face shared risk factors for both mental and physical health conditions, and additional barriers to effective prevention and care. In our study, Indigenous Australian peoples were over-represented among both acute coronary syndrome admissions and mental health service users. This highlights the need for systemic change. Indigenous Australian people make up less than 3 % of the NSW population [21] but made up nearly 5 % of index admissions for ACS overall, and more than 12 % of ACS admissions in mental health service users. We found that Indigenous Australian people admitted with ACS experienced higher rates of complications and mortality than non-Indigenous people of the same age, and the scale of this increase was similar in Indigenous MH service-users and other Indigenous Australian people. This may reflect shared social determinants of physical and mental health conditions, such as access to care, social support, and historical trauma [37]. Consistent with this, we found that Indigenous Australian people did not have increased 12-month cardiovascular mortality after adjusting for socioeconomic disadvantage and comorbid medical conditions. Addressing these determinants is therefore critical to improving outcomes. Culturally safe healthcare models and community-led solutions are essential to reducing the burden of disease for Indigenous people. The findings indicate a pressing need to strengthen healthcare systems to not only improve immediate clinical care but also to embed long-term strategies that are culturally responsive and community informed.

4.1. Strengths and limitations

The study examined all private and public hospital admissions for more than 6 million adults over five years, providing a population-wide view of care and outcomes. The study also examined the intersection of mental health and cardiovascular disease among Indigenous Australian people, a previously under-researched area.

We acknowledge several limitations. Our study did not have access to data on some important risk factors (including smoking, weight, blood chemistry or family history) nor data on post-ACS pharmacological or lifestyle treatments. We defined mental health service users via data on contact with state-operated ("public") mental health services, which in the Australian health system mainly includes people experiencing acute or severe mental health conditions. In our study these MH service users made up around 2 % of the adult population. Therefore our results may not generalise to the more than 10 % of the Australian population with milder or more common mental health conditions who receive care in primary health settings each year [38]. High rates of missing diagnoses in the study's community mental health data prevented subgrouping the mental health cohort by diagnosis alone, reducing our ability to understand different risks for clinically relevant subgroups of mental health service users.

Our study has been conducted in a largely government-funded health system, and findings may differ for health systems with other funding models.

5. Conclusions

People living with mental health conditions have substantially increased cardiac-specific mortality in the year after acute coronary syndromes in mental health service users, and this is not explained by differences in demographics or comorbid conditions. Cardiovascular causes appear to be the main cause of increased all-cause mortality after ACS in people living with mental health conditions.

Targeted healthcare initiatives are imperative for addressing the challenges faced by people living with mental illness. These should include strategies to improve access to effective health care, including pharmacotherapy or revascularisation. They should also include strategies to support change in risk factors including diet, exercise or smoking, which are likely to contribute to the risk of mortality through re-infarction, cardiac failure or stroke. We additionally demonstrate a need for culturally appropriate care for Indigenous Australian people, who are disproportionately affected by both mental health conditions and cardiovascular diseases.

CRediT authorship contribution statement

A. Tegg: Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **J. Curtis:** Writing – review & editing, Methodology. **T. O'Brien:** Writing – review & editing. **P. Burgess:** Writing – review & editing, Methodology. **B. Biles:** Writing – review & editing. **F. McMillan:** Writing – review & editing. **G. Sara:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Formal analysis, Data curation, Conceptualization.

Ethics approval

The project is approved by the NSW Population and Health Services Research Ethics Committee (2017/HRE1105, 2019/UMB0208) and the Aboriginal Health and Medical Research Council (Ref 1564/19).

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Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.genhosppsych.2025.11.001.

Data availability

Access to NSW Health unit record data is only available to named researchers within specific approved research projects. Unit record data cannot be shared via public data repositories.

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