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SYSTEMATIC REVIEW OPEN ACCESS

Evidence for Decreasing the Age of Atrial Fibrillation Screening for Indigenous People in Australia: A Systematic Review With Meta-Analysis

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ABSTRACT

Objective: To determine whether the screening age for atrial fibrillation (AF) should be lowered for Indigenous Australians with the goal of reducing risk of stroke and other health burdens.

Study Design: Systematic review of medical databases identified 24 studies reporting outcome measures: AF incidence/prevalence, age of AF occurrence/diagnosis, cardiovascular risk factors and stroke risk. Risk of bias was evaluated using the Joanna Briggs Institute quality appraisal tools. Meta-analysis of mean age of AF onset was performed. An expert panel reviewed the evidence and formed consensus recommendations regarding screening for AF for Indigenous Australians.

Data Sources: MEDLINE, Embase, Scopus, Cochrane, CINAHL, Australian Indigenous HealthInfoNet and grey literature.

Data Synthesis: The review yielded five key findings. Indigenous Australians when compared with non-Indigenous Australians have: (i) higher AF rates at every age group, and meta-analysis showed onset of AF for Indigenous people at 15.9 years (95% CI, 11.5–20.4), younger than for other Australians; (ii) higher prevalence of cardiovascular risk factors; (iii) higher stroke rates (38%–47% vs. 10%–15% of all strokes occur before age of 55 years), higher mortality and other adverse outcomes after stroke and the nationally age standardised risk ratio of death from AF was 1.8 for 1997–2022; (iv) less likelihood of receiving optimal treatment; and (v) greater cost of care for stroke rehabilitation.

Conclusions: The evidence supports an amendment to the AF guideline to opportunistically screen Indigenous Australians from at least age 55 years, and when AF is found, follow guideline recommendations for management of rate, rhythm, stroke prevention and concomitant risk factors/comorbidities. Further, the logistics of care should be considered when deciding on

the localised care pathway. National implementation of these recommendations should minimise missed diagnoses and ensure timely, accessible and appropriate care/treatment.

Registration: Prospective registration with PROSPERO (CRD42024514586) on 13 May 2024.

JEL Classification: Indigenous health, Cardiovascular diseases, Environment and public health, Nervous system diseases, General medicine

1 | Introduction

More than half a million Australians live with atrial fibrillation (AF), though this is likely an underestimate considering about one-third of patients are asymptomatic or do not seek medical assessment [1, 2]. Left undiagnosed and untreated, episodic AF significantly increases the risk of stroke [1]. AF-related strokes tend to be more serious, with more damage to the brain, and worse long-term outcomes than for other ischaemic strokes [3, 4]. Strokes due to AF are largely preventable, with a 65% reduction in risk associated with anticoagulant therapy [3]. Early detection of AF is pivotal for reducing stroke risk.

Aboriginal and Torres Strait Islander people (hereafter respectfully referred to as Indigenous Australians) experience earlier onset of AF than non-Indigenous Australians [5, 6]. The incidence of stroke among Indigenous Australians under 60 years of age is three times as high as that among non-Indigenous Australians, with the risk of fatal stroke almost six times as high [6, 7]. Research suggests that Indigenous Australians experience more AF risk factors and associated comorbidities (including rheumatic heart disease at < 55 years) at a younger age than non-Indigenous Australians [8–11], and are more likely to delay seeking access to the healthcare system until late stages of disease progression [6] due to racism in the healthcare system, limited culturally relevant health information and less access to healthcare services [12].

It is important to acknowledge and understand the profound impact that colonisation has had on the health of Indigenous Australians. The intergenerational effects of colonisation and the denial of access to healthcare are likely linked to the precursors and earlier development of risk factors for AF [13–15].

Current National Heart Foundation of Australia and Cardiac Society of Australia and New Zealand guidelines recommend that screening for AF should commence from age 65 years [4]. This emphasis on screening of older individuals is based on an increase in attributable risk of AF-related stroke with increasing age [16], and an age-related increase in AF detection rate with screening [17]. However, the evidence precludes Indigenous Australians [4, 18]. Our aim is to determine whether the screening age for AF should be lowered for Indigenous Australians, with the goal of reducing risk of stroke and other health burdens. We performed a systematic review to understand if the current guideline recommendations for AF screening are relevant for Indigenous Australians, specifically investigating the following, all with a focus on age: (i) incidence/prevalence of AF; (ii) related cardiovascular risk factors; (iii) AF-related stroke risk; (iv) levels of treatment; and (v) cost of stroke rehabilitation.

2 | Methods

2.1 | Study Design

We conducted this systematic review of literature using the Joanna Briggs Institute (JBI) framework for systematic reviews and reported the results according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [19]. This study was registered on 13 May 2024 with the PROSPERO international prospective register of systematic reviews (CRD42024514586).

2.2 | Expert Panel

An expert panel was established to advise on the review end-to-end, including the research question, the search terms, quality appraisal, data analysis, categorisation of evidence, and recommendations and conclusions. The expert panel consisted of cardiologists, epidemiologists, industry specialists, Indigenous health researchers and guideline committee members (including the chair) of the National Heart Foundation of Australia and Cardiac Society of Australia and New Zealand 2018 guideline on AF [4].

The panel was assembled by two authors (KG, BF) and the study question was designed using the population exposure outcome framework via a collaborative approach. Study inclusion and exclusion criteria were considered by the expert panel and those criteria were further refined. Following panel discussions, the protocol was amended as outlined in Table S1. Panel members independently reviewed design, process and findings of the systematic review and subsequently met face-to-face to discuss in August 2024. This discussion considered what recommendations for guideline change should be, and how recommendations should be worded.

2.3 | Search Terms

"Aboriginal/Torres Strait Islander/First Nations/Native/Oceanic Ancestry/Indigenous peoples"; AND "Mass screening/multiphasic screening/early diagnosis/early detection/early evaluation/monitoring/routine evaluation, risk assessment/risk factor/heart disease risk factor/cardiac risk factor, prevalence/incidence"; AND "Atrial fibrillation/valvular atrial fibrillation/cardiac fibrillation/atrium fibrillation/auricular fibrillation/heart palpitation/heart rhythm disorder/irregular heart beat/atrial flutter/arrhythmia/stroke/treatment adherence and compliance/culturally competent care/patient acceptance of health care".

2.4 | Search Strategy

The initial search was supported by expert librarian guidance, followed by a cross-check against known literature and modification for databases. Data sources used included the databases MEDLINE, Embase, Scopus, Cochrane, CINAHL and Australian Indigenous HealthInfoNet, and the grey literature. The full search strategy is provided in the Supporting Information section.

2.4.1 | Selection Criteria

Studies were included if they met the following cumulative criteria:

- Population: studies conducted with either Indigenous Australians, or if Indigenous Australians were included in the sample and data reported separately.
- Disease: studies examining AF (valvular or non-valvular), arrhythmia, cardiovascular disease or stroke (cerebrovascular accident, infarction or embolism).

The outcomes of interest were studies related to screening, detection, diagnosis, routine monitoring, routine evaluation, prevalence or incidence, treatment adherence, acceptance, compliance and success, or risk factors specifically related to AF.

Studies were excluded if they were: conference abstracts; not in English language; reports on non-Australian data; about the development of screening technology; reports on non-human subjects; protocol papers; conducted on children; related to surgical outcomes or interventions.

Titles and abstracts were independently screened by two authors (AH, RK) and independently verified by three authors (VC, JDG, KG). Full-text screens were independently conducted by two authors (AH, RK). Conflicts were resolved by three authors (VC, JDG, KG). Reference lists of all included texts were searched for relevant articles.

2.5 | Data Extraction

Data extraction was undertaken using a modified template from a previous systematic review in Indigenous health [20]. Outcomes of interest were the following factors related to AF and stroke: mortality, age, incidence, prevalence, risk, treatment, risk, comorbidities, risk factors, recurrence burden, survival and lifetime health costs. Statistics were reported according to sex (a set of biological attributes in association with physical and physiological features)—specifically, what percentage of participants reported as male. Gender (socially constructed roles, behaviours and identities) was not reported.

2.5.1 | Meta-Analysis

There was high heterogeneity across the studies, in part due to disparities in study designs and age of populations. Meta-analysis of all data was not possible due to the varied outcome measures reported for each outcome, and the disparities in study designs and age of populations. Meta-analysis was only possible for mean age of AF onset, reported in four independent studies [21–24].

Meta-analysis of mean age was carried out in RevMan 9.11.0 following guidelines from the *Cochrane Handbook for Systematic Reviews of Interventions* [25]. Data were presented as mean ± standard deviation (SD). When data were presented as median and interquartile range, appropriate transformations to mean ± SD were made [25]. When appropriate, Cochrane formulas were used to combine means and SDs from subgroups into a single group. Meta-analysis of mean age was reported as mean difference. Results were pooled using an inverse variance weighted random effects model. A random effects model was used given the variation in participant characteristics across studies. Heterogeneity was assessed using restricted maximum likelihood and I^2 statistics. I^2 values were interpreted as low (< 25%), medium (25%–50%) or high (> 50%).

2.6 | Risk of Bias

The methodological qualities of studies were appraised (VC, KG) using JBI critical appraisal tools [26], which are well established and suited to the types of evidence included, and provide a transparent and rigorous assessment of study quality [26].

2.7 | Critical Appraisal

Consensus recommendations were informed by the expert panel members, with consideration of the evidence, values, preferences and resource use at the time of writing. Recommendations are categorised as 'consensus' where there is high certainty that the desirable effects of an intervention clearly outweigh its undesirable effects, but the body of supportive evidence is indirect. Consensus was established when the expert panel supported the statement.

3 | Results

3.1 | Search Results

The initial search yielded 3415 results (Figure 1). After removing duplicates ($n = 1459$), 1956 papers underwent a title and abstract screening. Full texts were retrieved for 57 papers. From this set, 33 papers were excluded for the reasons set out in Figure 1. A final dataset of 24 studies was included in the systematic review.

The characteristics of the 24 studies included in the review are summarised in Table 1. There were 11 AF studies and 13 stroke studies (Table 1). Two of the AF studies reported data from the same cohort [24, 31], so these studies are presented together, and only unique data from each study are reported in the analysis. A further three studies [22, 29, 30] reported data from overlapping cohorts, so only one [22] was included in the meta-analysis. Four studies limited the age of participants to 20–84 years

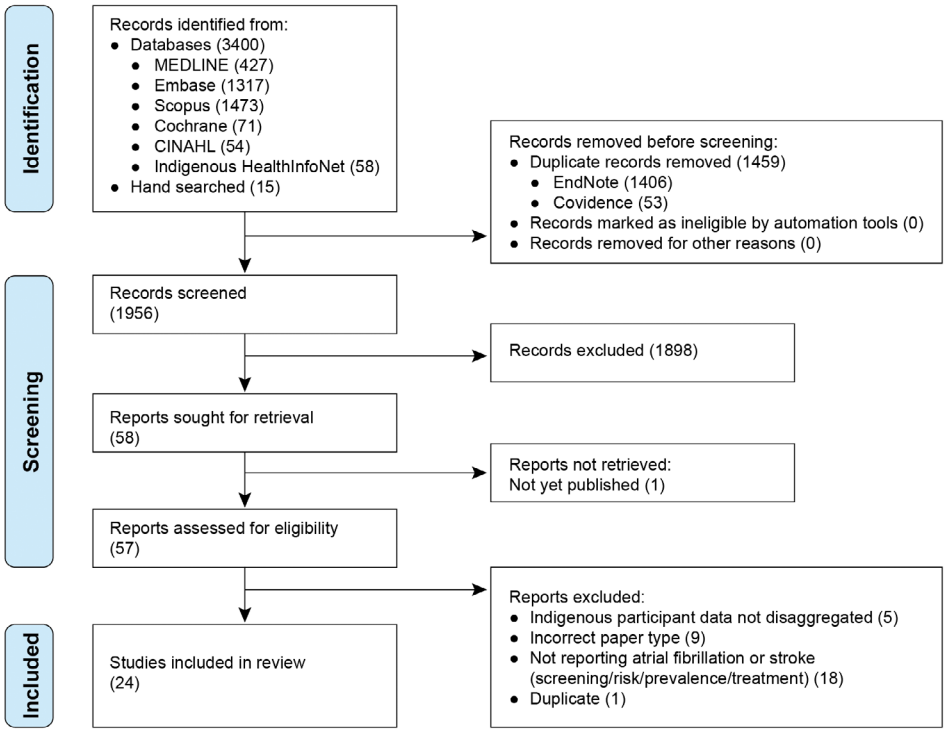

FIGURE 1 | Flow chart of search results.

[22, 29, 30, 34] and one study limited age to 25–84 years [39]. Twenty-one of the included studies were based on retrospective hospital, registry and/or linkage data and the remaining three studies used prospectively collected data from community populations [6, 28, 32].

3.2 | Quality Appraisal

The majority of studies ($n = 22/23$) scored strongly on the JBI critical appraisal tools (18 cohort; 3 cross-sectional; 1 prevalence; 1 economic evaluation), indicating a low risk of bias (Supporting Information). One paper received a medium score due to paucity of details regarding confounding factors and follow-up measures [35]. The Australian Institute of Health and Welfare report [45] was not scored as it reports Australian health statistics. For itemised scoring, see the Tables S2–S5.

3.3 | Findings

There were five key findings arising from the review.

3.3.1 | Finding 1: Indigenous Australians Have a Higher Prevalence of AF at Every Age Group Compared With Non-Indigenous People

Indigenous Australians at all age groups have a higher prevalence of AF compared with the wider population (Table 2). An AF screening study found a higher prevalence of AF among Indigenous Australians compared with national estimates for those aged 55–64 years (3.8% vs. 1.2%) and 65 years and over (7.2% vs. 5.4%) [6]. Another study, from Central Australia, reported that the prevalence ratio of hospitalised AF for Indigenous versus non-Indigenous Australians aged 45–54 years was 4.3 (95% CI, 3.3–5.6) [21]. In a whole of Western Australia cohort study, Indigenous Australian males under the age of 54 years were more likely to have first ever AF hospitalisation than non-Indigenous males, and the risk was even higher in Indigenous females (incident rate ratio [IRR], 6.4) [30]. Evidence also indicates that among Indigenous Australians aged 20–84 years admitted to hospital with AF, most (58.7%) are aged between 20 and 59 years [22]. Furthermore, Indigenous Australians have higher rates of hospitalisation with AF as a principal or additional diagnosis on admission to hospital compared with non-Indigenous people (Table 2) [6].

Studies reported a mean age ranging from 51 to 56 years for Indigenous Australians with AF compared with 64 to 74 years for non-Indigenous Australians (Table 2), and a meta-analysis indicated that Indigenous people with AF were on average 15.9 [95% CI, 11.5–20.4] years younger than non-Indigenous people (Figure 2).

3.3.2 | Finding 2: Indigenous Australians With AF Have Higher Prevalence of Cardiovascular Risk Factors Compared With Non-Indigenous People

Overall, Indigenous Australians with AF have a greater prevalence of cardiovascular risk factors, including hypertension [29, 30, 37, 46, 47], heart failure [29, 30, 39], coronary and peripheral vascular disease [23, 24], diabetes and kidney disease [23, 29, 30, 33, 35–37, 39, 40, 42, 47], and any chronic disease [33, 35–37, 39] than non-Indigenous Australians and at younger ages (Tables 2 and 3).

TABLE 1 | Study characteristics.

References	Aim	Study design/ Intervention	Sample location	Total sample size; inclusion characteristics	Indigenous sample characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Non- Indigenous characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Outcome measures	Quality: JBI
Atrial fibrillation papers								
AIHW—Atrial fibrillation in Australia 2024 [27]	To provide data on AF-related hospitalisations, procedures and deaths	Descriptive government statistical analyses of administrative data	Australia wide	193,700 AF hospital patients Age ≥ 18 years	NR	NR	AF: mortality hospitalisation	NA
Brown et al. 2014 [28]	To assess burden and determinants of cardiovascular and metabolic risk for Indigenous Australians	Prospective cross-sectional study	Northern Territory	436 Indigenous community sample Age ≥ 18 years	436 (100%) Age: 43.8 (14.2) Male: 157 (36%)	NA	AF: prevalence	Strong
Clarke et al. 2021 [21]	To characterise hospital AF prevalence, AF risk factors and compare stroke risk for Indigenous and non-Indigenous individuals	Retrospective cohort study	Alice Springs, Northern Territory	57,056 Hospital patients Age ≥ 18 years	25,313 (44.4%) Age: 23.8 (20.2) Male: 11,669 (46%)	31,743 (55.6%) Age: 35.2 (21.8) Male: 16,094 (51%)	AF: age prevalence stroke risk	Strong
Gwynn et al. 2021 [6]	To estimate prevalence and age distribution of AF among community-dwelling Aboriginal people aged 45 years and over	Prospective cross-sectional study	New South Wales; Western Australia; Northern Territory	619 Indigenous community sample Age ≥ 45 years	619 (100%) Age: 59 (10) Male: 272 (44%)	NA	AF: age prevalence	Strong

(Continues)

TABLE 1 | (Continued)

References	Aim	Study design/ Intervention	Sample location	Total sample size; inclusion characteristics	Indigenous sample characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Non- Indigenous characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Outcome measures	Quality: JBI
Hung et al. 2021 [29]	To assess applicability of CHA_2DS_2-VA schema for Aboriginal and other Australians with non-valvular AF	Retrospective cohort study	Western Australia	49,114 AF patients Age 20–84 years	1212 (2.5%) Age: 56.9 (13.1) Male: 736 (60.7%)	47,902 (97.5%) Age: 69.5 (11.9) Male: 28,741 (60%)	AF: age comorbidities stroke rate	Strong
Katzenellenbogen et al. 2015 [30]	To compare AF incidence, risk factors and mortality in Aboriginal and non-Aboriginal Australians	Retrospective cohort study	Western Australia	37,097 AF patients Age 20–84 years	923 (2.5%) Age 20–54 years: 43.6 (8.9) Age 55–84 years: 65.4 (7.5) Male: 498 (54%)	36,174 (97.5%) Age 20–54 years: 46.0 (7.8) Age 55–84 years: 72.5 (7.9) Male: 21,451 (59%)	AF: mortality incidence	Strong
Nedkoff et al. 2020 [22]	To compare long-term risk of stroke and the risks of stroke subtypes and cardiovascular mortality after hospitalisation with AF for Aboriginal and non-Aboriginal people	Retrospective cohort study	Western Australia	55,482 AF patients Age 20–84 years	1406 (2.5%) Age: 56.6 (13.4) Male: 801 (57%)	47,902 (97.5%) Age: 69.9 (11.7) Male: 28,741 (60%)	AF: age stroke incidence mortality	Strong

(Continues)

TABLE 1 | (Continued)

References	Aim	Study design/ Intervention	Sample location	Total sample size; inclusion characteristics	Indigenous sample characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Non- Indigenous characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Outcome measures	Quality: JBI
Nguyen et al. 2020 [23]	To characterise quality of warfarin anticoagulation therapy and predictors of time in therapeutic range for Indigenous and non-Indigenous Australians	Retrospective cohort study	South Australia, Royal Adelaide Hospital	512 AF patients on warfarin Age ≥ 18 years	88 (17.2%) Age: 51 (13) Male: 47 (53.4%)	424 (82.8%) Age: 71 (12) Male: 189 (44.6%)	AF: age stroke risk treatment	Strong
Rocheleau et al. 2021 [24]	Determine whether CHA_2DS_2-VA score components were associated with anticoagulation use for Indigenous and non-Indigenous Australians with AF	Retrospective cohort study	South Australia, Royal Adelaide Hospital	19,613 AF patients Age ≥ 18 years	308 (1.6%) Age: 54.2 (13.2) Male: 170 (55.2%)	19,305 (98.4%) Age: 73.9 (13.0) Male: 10,502 (54%)	AF: age treatment	Strong
Wong et al. 2015 [31]	To characterise use of anticoagulation for Indigenous and non-Indigenous Australians with AF						AF: treatment	Strong
Wong et al. 2014 [5]	To examine the prevalence of AF and cardiac structural characteristics for Indigenous and non-Indigenous Australians	Retrospective cross-sectional study	South Australia, Royal Adelaide Hospital	204,668 Hospital patients Age ≥ 18 years	5892 (3%) Age: 42.2 (16.2) Male: 3046 (51.7%)	198,776 (97%) Age: 54.0 (20.9) Male: 106,941 (54%)	AF: prevalence	Strong

(Continues)

TABLE 1 | (Continued)

References	Aim	Study design/ Intervention	Sample location	Total sample size; inclusion characteristics	Indigenous sample characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Non- Indigenous characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Outcome measures	Quality: JBI
Stroke papers								
Balabanski et al. 2018 [32]	To compare stroke incidence between Aboriginal and non-Aboriginal adults	Prospective cohort study	South Australia	261,403 Community sample Age: all ages	8034 (3%)	253,369 (97%)	Stroke: incidence	Strong
Balabanski et al. 2020 [33]	To compare the incidence of stroke and subtypes, and stroke-related death	Retrospective cohort study	Alice Springs, Northern Territory	121 Stroke patients Age ≥ 18 years	74 (61%) Age, median (IQR): 54 (48–66) Male: 35 (47.3%)	47 (39%) Age, median (IQR): 71 (58–80) Male: 22 (47%)	Stroke: incidence risk factors investigations	Strong
Balabanski et al. 2023 [34]	To measure and compare stroke incidence in Aboriginal and non-Aboriginal residents	Retrospective cohort study with data linkage	South Australia; Northern Territory; Western Australia	11,740 Stroke patients Age 20–84 years	675 (5.7%) Age, median (IQR): 54.5 (45–66) Male: 337 (49.9%) Rural: 497 (74%)	11,065 (94.3%) Age, median (IQR): 70.3 (60–79) Male: 6185 (56%) Rural: 1925 (17%)	Stroke: incidence Fatal stroke	Strong
Crowley et al. 1995 [35]	To understand stroke prevalence, risk factors and outcomes for Indigenous Australians	Retrospective cohort study	Perth, Western Australia	86 Stroke patients Age ≥ 18 years	86 (100%) Age: 53 (16) Male: 43 (50%) Rural: 56 (65%)	NA	Stroke: age risk factors outcomes AF prevalence	Medium
Santos 2022 [36]	To estimate difference in stroke recognition, risk factors, treatment rates and outcomes between Indigenous and non-Indigenous peoples	Prospective descriptive study	Wagga Wagga, New South Wales	1843 Stroke patients Age ≥ 18 years	45 (2.5%) Age: 62 (13.7) Male: 28 (61.5%)	1798 (97.5%) Age: 74.4 (12.5) Male: 1039 (57%)	Stroke: age risk factors AF prevalence	Strong

(Continues)

TABLE 1 | (Continued)

References	Aim	Study design/ Intervention	Sample location	Total sample size; inclusion characteristics	Indigenous sample characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Non- Indigenous characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Outcome measures	Quality: JBI
He et al. 2015 [37]	To investigate stroke recurrence, comorbidities and fatality for Indigenous compared with other Australians	Retrospective cohort study	Northern Territory	2105 Stroke patients Age ≥ 18 years	925 (43.9%) Age: 53 (NR) Male: 462 (49.9%) Remote: 597 (65%)	1180 (56.1%) Age: 64 (NR) Male: 729 (61.8%) Remote: 205 (17%)	Stroke: age risk factors fatality recurrence	Strong
Katzenellenbogen et al. 2011 [38]	To document stroke incidence and burden for Indigenous and non-Indigenous Australians	Retrospective cohort study	Western Australia	11,860 Stroke patients Age ≥ 15 years	419 (3.5%) Age: NR Male: 211 (50.4%)	11,441 (96.5%) Age: NR Male: 5663 (49.5%)	Stroke: incidence burden	Strong
Katzenellenbogen et al. 2014 [39]	To report prevalence of hospitalised stroke and coexistent conditions for Indigenous and non-Indigenous people	Retrospective cohort study	Western Australia	67,956 Stroke patients Age 25–84 years	3184 (5%) Age: NR Male: 1560 (49%)	64,772 (95%) Age: NR Male: 37,568 (58%)	Stroke: prevalence risk factors	Strong
Kilkenny et al. 2013 [40]	To compare in-hospital management and health outcomes of Indigenous and non-Indigenous patients	Retrospective cohort study	Australian National Stroke Audit	3307 Stroke patients Age ≥ 18 years	80 (2.4%) Age: 59 (15) Male: 47 (59%)	3227 (97.6%) Age: 74 (13) Male: 1710 (53%)	Stroke: age risk factors mortality	Strong

(Continues)

TABLE 1 | (Continued)

References	Aim	Study design/ Intervention	Sample location	Total sample size; inclusion characteristics	Indigenous sample characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Non- Indigenous characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Outcome measures	Quality: JBI
Lee et al. 2003 [41]	To determine factors influencing survival for first time stroke or transient ischaemic attack	Retrospective cohort study	Western Australia	7784 Stroke patients Age ≥ 18 years Ischaemic stroke 4681 Age: 73.2 (95% CI 72.8–73.6) Male: 2472 (52.8%) Indigenous: 150 (3.2%) TIA 1974 Age: 72.6 (95% CI 72.0–73.2) Male: 997 (50.5%) Indigenous: 53 (2.7%)	NR	NR	Stroke survival	Strong
Tiedeman et al. 2019 [42]	To compare investigations and management of Indigenous and non-Indigenous patients presenting with an ischaemic stroke	Retrospective cohort study	Tamworth, New South Wales	210 Ischaemic stroke patients Age ≥ 18 years	43 (20.5%) Age: 56.8 (NR) Male: 22 (51.5%)	167 (79.5%) Age: 72.6 (NR) Male: 92 (55.1%)	Stroke: age treatment	Strong

(Continues)

TABLE 1 | (Continued)

References	Aim	Study design/ Intervention	Sample location	Total sample size; inclusion characteristics	Indigenous sample characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Non- Indigenous characteristics Number (% of total sample); age years, mean (SD)[a]; male number (%)	Outcome measures	Quality: JBI
You et al. 2015 [43]	To describe hospital-based stroke incidence and case fatality	Retrospective cohort study	Northern Territory	1962 Hospitalised stroke patients Age ≥ 15 years	872 (44%) Age group 15–39: 179 (20.5%) 40–64: 494 (56.7%) 65+: 199 (22.8%) Male: 425 (48.7%) Remote: 607 (69.6%)	1091 (56%) Age group 15–39: 73 (7%) 40–64: 492 (45%) 65+: 526 (48%) Male: 690 (63.2%) Remote: 178 (16%)	Stroke: incidence	Strong
Zhao et al. 2016 [44]	To estimate lifetime health costs of stroke by comorbidity and Indigenous status in Australia's Northern Territory	Longitudinal cohort study and cost analysis	Northern Territory	3733 Stroke patients Age ≥ 18 years Age, median (IQR): 59 (48–71) Male: 2090 (56%)	1424 (38%) Age, median (IQR): 53 (IQR NR) Male: NR	2309 (62%) Age, median (IQR): 62 (IQR NR) Male: NR	Stroke: age lifetime health costs	Strong

Abbreviations: AF, atrial fibrillation; AIHW, Australian Institute of Health and Welfare; CHA_2DS_2-VA, stroke risk tool; CI, confidence interval; IQR, interquartile range; JBI, Joanna Briggs Institute critical appraisal tools; NA, not applicable; NR, not reported; SD, standard deviation; TIA, transient ischaemic attack.
[a]Unless otherwise stated.

TABLE 2 | Atrial fibrillation data (Indigenous versus non-Indigenous people).

References	AF age years[a], mean (SD)	AF incidence/ prevalence	AF patients—stroke rate	AF patients—stroke risk factors	AF-related mortality
AIHW—Atrial fibrillation in Australia 2024 report [27]		Hospitalisation rates per 100,000 people: Males 1138 vs. 694 (RR 1.6) Females 853 vs. 438 (RR 1.9)			Age-standardised death RR: 1.8 Death rates per 100,000 people: Males 84.5 vs. 55.7 (RR 1.5) Females 85.6 vs. 41.4 (RR 2.1)
Brown et al. 2014 [28]		3%			
Clarke et al. 2021 [21]	53.5 (15) vs. 64.5 (14) ($p < 0.001$) Proportion of AF cases occurring age less than 55 years: 300/559 (53.7%) vs. 300/651 (20.6%) ($p \leq 0.001$)	Prevalence per 100,000 (95% CI): All ages: 29.6 (27.3–32.2) vs. 25.7 (23.7–27.7) RR: 1.16 (1.03–1.29) $p = 0.01$ Age 45–54: 838 (711–978) vs. 196 (156–242) RR: 4.28 (3.29–5.58) ($p < 0.001$)		CHA_2DS_2-VASc score, mean (SD): 3.4 (1.6) vs. 2.5 (1.9) ($p < 0.001$) Age ≤45 years: 2.5 (1.5) vs. 0.7 (1.1) ($p < 0.001$) Age 45–54 years: 3.1 (1.4) vs. 1.1 (1.1) ($p < 0.001$)	
Gwynn et al. 2021 [6]	69 (10)	All ages: 4.7% (95% CI 3.0–6.4) Age 55–64: 3.8% vs. 1.2%			
Hung et al. 2021 [29]	56.9 (13) vs. 69.5 (12) ($p < 0.001$) Proportion of AF cases occurring age 20–64 years: 868/1212 (71.6%) vs. 14,157/47902 (29.6%) ($p < 0.001$)		Incidence rate per 100 per year (95% CI): CHA_2DS_2-VA score = 0 0.92 (0.49–1.70) vs. 0.42 (0.36–0.48) ($p = 0.03$) CHA_2DS_2-VA score = 1 1.45 (0.85–1.03) vs. 1.45 (0.89–2.37) ($p = 0.09$) CHA_2DS_2-VA score = 2–3 2.07 (1.56–2.73) vs. 2.17 (2.08–2.27) (p = ns) CHA_2DS_2-VA score = 4+ 8.41 (6.60–10.73) vs. 5.65 (5.43–5.87) ($p < 0.001$)	Heart failure: 406/1212 (33.5%) vs. 9067/47902 (18.9%) ($p < 0.001$) Hypertension: 745/1212 (61.5%) vs. 21,313/47902 (44.5%) ($p < 0.001$) Diabetes: 662/1212 (54.6%) vs. 8767/47902 (18.3%) ($p < 0.001$) Similar proportions of Indigenous vs. non-Indigenous people in each CHA_2DS_2-VA category Stroke HR (95% CI) per 1-unit increase in CHA_2DS_2-VA score: 2.33 (1.88–2.9) vs. 2.44 (2.36–2.53) ($p < 0.001$)	

(Continues)

TABLE 2 | (Continued)

References	AF age years[a], mean (SD)	AF incidence/ prevalence	AF patients—stroke rate	AF patients—stroke risk factors	AF-related mortality
Katzenellenbogen et al. 2015 [30]	Age 20–54: 43.6 (8.9) vs. 46.0 (7.8) ($p < 0.001$) Age 55–84: 65.4 (7.5) vs. 72.5 (7.9) ($p < 0.001$) Proportion of AF cases occurring age 20–54: 441/923 (47.8%) vs. 4129/36174 (11.4%) ($p < 0.001$)	Age-standardised incidence rates per 100,000 person years (95% CI): Age 20–54 years Male: 197 (174 to 221) vs. 55 (53–57) IRR 3.6 (2.4–5.5) Female: 122 (104 to 141) vs. 19 (18–20) IRR 6.4 (3.3–12.4) Age 55–84 years Male: 1151 (993–1308) vs. 888 (875–901) IRR 1.3 (0.95–1.8) Female: 1050 (917–1184) vs. 571 (561–581) IRR 1.8 (1.3–2.6)		Female Age 20–54 years 171/441 (38.8%) vs. 1062/4129 (25.7%) ($p < 0.001$) Age 55–84 years 253/482 (52.5%) vs. 13,683/32527 (42.7%) ($p < 0.001$) Age 20–54 YEARS: CHA_2DS_2-VA score ≥ 2: 199/379 (52.5%) vs. 565/4051 (14%) ($p < 0.001$) Ischaemic heart disease: 109/441 (24.7%) vs. 373/4129 (9%) ($p < 0.001$) Rheumatic heart disease: 79/441 (17.9%) vs. 168/4129 (4.1%) ($p < 0.001$) Hypertension: 178/441 (40.4%) vs. 448/4129 (10.9%) ($p < 0.001$) Heart failure: 36/441 (39%) vs. 585/4129 (12%) ($p < 0.001$) Myocardial infarction: 53/441 (11.8%) vs. 137/4129 (3.3%) ($p < 0.001$) Diabetes: 203/441 (46%) vs. 385/4129 (9.3%) ($p < 0.001$) Chronic kidney disease: 111/441 (25.2%) vs. 173/4129 (4.2%) ($p < 0.001$) Smoking: 271/441 (61.5%) vs. 1743/4129 (42%) ($p < 0.001$) Alcohol-related admissions: 211/441 (47.9%) vs. 345/4129 (8.4%) ($p < 0.001$)	Cumulative 1-year death: Age 20–54 years: 15.1% vs. 5.3% ($p < 0.001$) Age 55–84 years: 25.6% vs. 17.7% ($p < 0.001$) 1-year mortality HR (95% CI): 1.24 (1.03–1.48) ($p = 0.022$)

(Continues)

TABLE 2 | (Continued)

References	AF age years[a], mean (SD)	AF incidence/ prevalence	AF patients—stroke rate	AF patients—stroke risk factors	AF-related mortality
Nedkoff et al. 2020 [22]	56.6 (13) vs. 69.9 (12)		IRR (95% CI): <60 years 3.2 (2.5–4.1) (all stroke) 5.7 (3.9–8.9) (fatal stroke) ≥60 years 1.6 (1.3–2.0) (all stroke) 1.5 (1.2–2.0) (fatal stroke) All stroke aHR (95% CI): <60 years 1.67 (1.22–2.28) ≥60 years 1.64 (1.32–2.03)	Age 20–59 years: CHA_2DS_2-VASc score ≥2: 493/825 (60%) vs. 1308/9862 (22%) ($p<0.001$) Hypertension: 466/825 (56.5%) vs. 2308/9862 (23.4%) ($p<0.001$) Heart failure: 288/825 (34.9%) vs. 1101/9862 (11.2%) ($p<0.001$) Valvular heart disease: 124/825 (15.0%) vs. 717/9862 (7.3%) ($p<0.001$) Chronic kidney disease: 257/825 (31.2%) vs. 543/9862 (5.5%) ($p<0.001$) Diabetes: 412/825 (49.9%) vs. 1019/9862 (10.3%) ($p<0.001$) Alcohol and illicit drugs: 369/825 (44.7%) vs. 863/9862 (8.8%) ($p<0.001$)	Cardiovascular mortality aHR (95% CI): <60 years: 1.47 (1.18–1.83) ≥60 years: 1.45 (1.26–1.67)
Nguyen et al. 2020 [23]	51 (13) vs. 71 (12) ($p<0.001$)			Past history of stroke: 5/88 (5.7%) vs. 70/424 (16.5%) ($p=0.009$) Valvular heart disease: 26/88 (29.6%) vs. 34/424 (8.0%) ($p<0.001$) Diabetes: 49/88 (55.7%) vs. 184/424 (43.4%) ($p=0.035$) Alcoholism: 9/88 (10.2%) vs. 13/424 (3.1%) ($p=0.003$)	

(Continues)

TABLE 2 | (Continued)

References	AF age years[a], mean (SD)	AF incidence/ prevalence	AF patients—stroke rate	AF patients—stroke risk factors	AF-related mortality
Rocheleau et al. 2021 [24]	54.2 (13) vs. 73.9 (13) ($p < 0.001$)			Past history of stroke: 8/308 (2.6%) vs. 304/19304 (6.8%) ($p = 0.004$) Diabetes: 130/308 (42.2%) vs. 3353/19305 (17.4%) ($p < 0.001$) Vascular disease: 44/308 (14.3%) vs. 2013/19305 (10.4%) ($p = 0.03$)	
Wong et al. 2015 [31]				CHA_2DS_2-VA score, mean (SD): 1.47 (0.03) vs. 2.82 (0.08) ($p < 0.001$) CHA_2DS_2-VA score ≥ 2: 194/308 (62.9%) vs. 15,212/19305 (78.8%) ($p < 0.0001$)	
Wong et al. 2014 [5]	55.4 (13) vs. 74.5 (13) ($p < 0.001$)	< 60 years: 2.57% vs. 1.73% ($p < 0.0001$)		Similar cardiovascular comorbidities	

Abbreviations: AF, atrial fibrillation; aHR, adjusted hazard ratio; AIHW, Australian Institute of Health and Welfare; CHA_2DS_2-VA and CHA_2DS_2-VASc, stroke risk tools; CI, confidence interval; HR, hazard ratio; IRR, incidence rate ratio; NS, not significant; SD, standard deviation; RR, risk ratio.
[a]Unless otherwise stated.

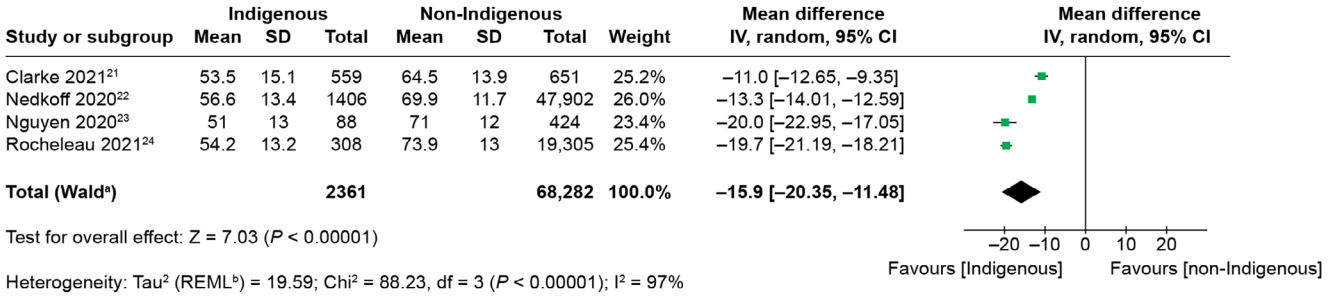

FIGURE 2 | Meta analysis of mean age of AF onset. AF, atrial fibrillation; CI, confidence interval; df, degrees of freedom; I^2, *I*-squared statistic measuring statistical heterogeneity; IV, independent variable; REML, restricted maximum likelihood; SD, standard deviation; *Z*, *z*-score measuring standard deviations. [a]Confidence interval calculated by the Wald-type method. [b]Tau^2 calculated by restricted maximum-likelihood method.

3.3.3 | Finding 3: Indigenous Australians Have a Higher Incidence of Stroke, and Higher Mortality and Other Adverse Outcomes After Stroke, Compared With Non-Indigenous Australians

The mean age of stroke reported in the studies ranged from 51 to 62 years for Indigenous Australians compared with 62 to 78 years for non-Indigenous Australians (Table 3). Furthermore, 38%–47% of all strokes in Indigenous people occur below age 55 years, compared with 10%–15% in non-Indigenous people (Table 3).

Across studies, incidence of stroke among Indigenous Australians was consistently higher than among non-Indigenous Australians (Table 3). When age is limited to < 55 years, the relative risk of stroke increases substantially, ranging from IRR 3.5 ([95% CI, 2–7] to 17.9 [95% CI, 7–45]) (Table 3). The Australian Institute of Health and Welfare indicates that the death rate from AF was 1.8 times higher for Indigenous than non-Indigenous Australians across all ages during the period 1997–2022 [27].

A higher proportion of Indigenous Australians had one or more comorbidities compared with non-Indigenous Australians [44]. Risk of AF-related stroke is commonly determined using the CHA_2DS_2-VASc score [48]. A CHA_2DS_2-VASc score ≥ 2 indicates a high stroke risk, with recommendation for oral anticoagulation [49]. Of note, 53% of Indigenous Australians with AF under age 55 years have a CHA_2DS_2-VASc score ≥ 2 compared with only 14% of others at the same age [30], while Indigenous Australians with a CHA_2DS_2-VASc of 0 or 1 had an overall annual stroke rate of 0.9% to 1.5% compared with < 0.5% to 0.9% for non-Indigenous people [30], indicating elevated risk even among lower-risk groups.

Indigenous Australians aged 20–55 years with AF have a higher fatal stroke risk than non-Indigenous Australians (IRR, 5.5 [95% CI, 1.2–51.1]) [22]. Indigeneity and residing in a rural/remote area were additional predictors of death following stroke [41]. The burden of disease due to stroke, when measured using the age-standardised disability-adjusted life year—a measure combining morbidity and mortality [50]—is higher for Indigenous Australians at all ages up to 75 years, particularly within the 15–64-year age bracket, compared with non-Indigenous Australians (Table 3) [38].

3.3.4 | Finding 4: Indigenous Australians With AF Are Less Likely to Receive Optimal Treatment Compared With Non-Indigenous Australians

Indigenous Australians with AF and high stroke risk are less likely to receive guideline-recommended anticoagulation therapy (Table 4). A study of 19,613 individuals with AF over a 14-year period (1999–2012) found that 76.3% of Indigenous participants with CHA_2DS_2VAScs ≥ 2 were under-anticoagulated, compared with 71.3% of non-Indigenous participants [31]. Furthermore, Indigenous status was an independent predictor of over- or under-anticoagulation in multivariate analyses according to the $CHADS_2$- or CHA_2DS_2VASc [31]. While under-use of anticoagulation is recognised as a widespread clinical issue, the available evidence indicates that it occurs more frequently among Indigenous Australians. This disparity may reflect under-recognition of stroke risk as well as structural, health system and sociodemographic barriers to treatment access (Table 4). Under-use may also result from delayed or missed AF diagnosis, with some individuals first identified following a stroke or other cardiac event.

3.3.5 | Finding 5: The Cost of Care for Stroke Rehabilitation Is Greater for Indigenous Australians Compared With Non-Indigenous Australians

Overall, the cost of care for stroke rehabilitation is much greater for Indigenous patients [44] as AF is more likely an emergency admission and a secondary diagnosis for Indigenous Australians and there is increased likelihood of a more complex comorbidity profile than for non-Indigenous Australians [46].

3.4 | Expert Panel Consensus Recommendations

The expert panel unanimously recommended that an update to the AF guidelines in Australia is required based on available evidence. Suggested wording for the recommendations was:

3.4.1 | Recommendation #1

It is recommended that Indigenous Australians be screened opportunistically for AF from age 55 years. Consider screening even earlier for Indigenous people with a CHA_2DS_2-VASc of 2 or more.

TABLE 3 | Stroke data (Indigenous vs. non-Indigenous people).

References	Stroke age, years	Stroke incidence/ prevalence (all ages) Age-standardised stroke incidence per 100,000/ year (95% CI)[a]	Stroke incidence/ prevalence (younger age) Age-standardised stroke incidence per 100,000/ year (95% CI)[a]	Ischaemic stroke incidence Age-standardised stroke incidence per 100,000/year (95% CI)[a]	Recurrent stroke	Fatal stroke/ mortality/burden	Stroke risk factors	AF prevalence in stroke
Balabanski et al. 2018 [32]	Median (IQR): 51 vs. 78 (IQR NR) ($p < 0.001$)	116 (95–137) vs. 67 (51–84) ($p < 0.001$)	Age ≤ 55 years: IRR 3.5 (95% CI 2–7)	Age ≤ 55 years: IRR 2.4 (95% CI NR)				Age ≤ 55 years: 2/9 (22%) ($p = 0.02$)
Balabanski et al. 2020 [33]	Median (IQR): 54 (48–66) vs. 71 (58–80) ($p < 0.001$)	153 (129–177) vs. 51 (37–65) ($p < 0.001$) IRR 3 (95% CI 2–4)	Age ≤ 55 years: 68 (52–84) vs. 5 (1–10) ($p < 0.001$) IRR 13.6 (95% CI 5–34) Age 45–54 years: IRR 17.6 (95% CI 7–45)	103 (83–123) vs. 42 (30–55) ($p < 0.001$) IRR 2.5 (95% CI 2–4) Age ≤ 55 years: 42 (29–55) vs. 3 (0–7) ($p < 0.001$) IRR 14 (95% CI 4–45)	Age-standardised rate recurrent stroke per 100,000/year: 59 vs. 32 (95% CI NR) IRR 1.8 (95% CI 1.2–2.8)	Age standardised rate of death per 100,000/year: 35 vs. 7 (95% CI NR) ($p < 0.001$)	Diabetes mellitus: 52/74 (70.3%) vs. 16/47 (34.0%) ($p < 0.001$) Hypercholesterolaemia: 51/74 (68.9%) vs. 24/47 (51.1%) ($p = 0.049$)	12/74 (16.2%) vs. 7/47 (14.9%) ($p = 0.845$)
Balabanski et al. 2023 [34]	Median (IQR): 54.5 (45–66) vs. 70.3 (60–79) ($p < 0.001$)	192 (177–208) vs. 66 (65–68) (p-value NR)	Age 20–54 years: 90 (81–100) vs. 21 (20–22) (p-value NR)			Age-standardised incidence of fatal stroke per 100,000/ year (95% CI) All ages: 38 (31–46) vs. 9 (9–10) IRR 4.2 (95% CI 2.1–9.4) Age 20–54 years: 11 (7–15) vs. 2 (1–2) IRR 5.5 (1.2–51.1)	Female: 338/675 (50.1%) vs. 4876/11065 (44.1%) ($p = 0.002$) Age ≤ 55 years: AF: 20/338 (5.9%) vs. 56/1942 (2.9%) ($p = 0.008$) Diabetes: 134/338 (39.6%) vs. 221/1942 (10.9%) ($p < 0.001$) Hypertension: 163/338 (48.2%) vs. 676/1942 (34.8%) ($p < 0.001$) Valvular heart disease: 30/338 (8.9%) vs. 36/1942 (1.9%) ($p < 0.001$) Rheumatic heart disease: 17/338 (5.0%) vs. 12/1942 (0.6%) ($p < 0.001$)	

(Continues)

TABLE 3 | (Continued)

References	Stroke age, years	Stroke incidence/ prevalence (all ages) Age-standardised stroke incidence per 100,000/ year (95% CI)[a]	Stroke incidence/ prevalence (younger age) Age-standardised stroke incidence per 100,000/ year (95% CI)[a]	Ischaemic stroke incidence Age-standardised stroke incidence per 100,000/year (95% CI)[a]	Recurrent stroke	Fatal stroke/ mortality/burden	Stroke risk factors	AF prevalence in stroke
Crowley et al. 1995 [35]	Mean (SD): 53 (16)			Proportion of ischaemic stroke (of all strokes): 58/86 (67%)		In-hospital mortality: 14/86 (16.7%) 43/86 (50%) required assistance for activities of daily living post discharge	Hypertension: 34/86 (40%) Smoking: 58/86 (67%) Hypercholesterolaemia: 52/86 (60%) Diabetes: 35/86 (41%) Excess alcohol: 42/86 (49%)	19/86 (22%)
Santos 2022 [36]	Mean (SD): 62 (13.7) vs. 74.4 (12.5)						Risk difference (95% CI): Diabetes: 22.3% (3–41.7) Dyslipidaemia; 19.4% (21–36.7) Ever smokers: 24.9% (9.5–40.3)	6/26 (23.1%) vs. 359/1163 (30.9%) Risk difference: −7.8% (−24.2–8.6)
He et al. 2015 [37]	Median (IQR): 53 vs. 64 (IQR NR)			Proportion of ischaemic stroke (of all strokes): 308/925 (33.3) vs. 468/1180 (39.7%)	Risk of recurrence Standard HR: 1.82 (95% CI 1.32–2.51) Age-adjusted cumulative incidence: One year: 7.70% vs. 5.73% Five years: 13.43% vs. 10.08%	Case fatality (adjusted for comorbidities) OR: 1.25 (95% CI 0.88–1.78) Risk of long-term death Standard HR: 1.27 (95% CI 1.01–1.61)	Hypertension: 572/925 (61.8%) vs. 618/1180 (52.4%) ($p < 0.001$) Diabetes: 225/925 (24.3%) vs. 135/1180 (11.4%) ($p < 0.001$) Rheumatic heart disease: 94/925 (10.2%) vs. 43/1180 (3.6%) ($p < 0.001$) COPD: 141/925 (15.2%) vs. 138/1180 (11.7%) ($p < 0.001$) Renal failure: 168/925 (18.2%) vs. 68/1180 (5.8%) ($p < 0.001$)	118/925 (12.8%) vs. 206/1180 (17.5%) ($p = 0.5$)

(Continues)

TABLE 3 | (Continued)

References	Stroke age, years	Stroke incidence/ prevalence (all ages) Age-standardised stroke incidence per 100,000/ year (95% CI)[a]	Stroke incidence/ prevalence (younger age) Age-standardised stroke incidence per 100,000/ year (95% CI)[a]	Ischaemic stroke incidence Age-standardised stroke incidence per 100,000/year (95% CI)[a]	Recurrent stroke	Fatal stroke/ mortality/burden	Stroke risk factors	AF prevalence in stroke
Katzenellenbogen et al. 2011 [38]	Distribution of strokes according to age group: Males: Age 15–34: 18/211 (8.5%) vs. 141/5669 (2.4%) Age 35–54: 81/211 (38.4%) vs. 637/5669 (11.2%) Age 55–64: 48/211 (22.7%) vs. 854/5669 (15.1%) Age 65–74: 35/211 (16.6%) vs. 1523/5669 (26.9%) Age ≥ 75: 29/211 (13.7%) vs. 2514/5669 (44.3%) Females: Age 15–34: 21/208 (10.1%) vs. 146/5772 (2.5%) Age 35–54: 75/208 (36.1%) vs. 432/5772 (7.5%) Age 55–64: 44/208 (21.2%) vs. 484/5772 (8.4%) Age 65–74: 40/208 (19.2%) vs. 1091/5772 (18.9%) Age ≥ 75: 28/208 (13.5%) vs. 3620/5772 (62.7%)	Age-standardised stroke IRR (95% CI): Male: 2.6 (2.3–3.0) Female: 3.0 (2.6–3.5)	Total incidence rates per 100,000 (95% CI): Age 35–54: Male: 268 (210–327) vs. 47 (43–51) Female: 236 (183–289) vs. 32 (29–35) Age-standardised stroke IRR (95% CI): Age 15–64: Male: 4.6 (3.9–5.4) Female: 5.8 (4.9–6.9)			Excess mortality rate: Higher for Indigenous people across all age groups Survival age 25–24: Males: 13 years less Females: 7 years less Total burden (DALY): 55,099 vs. 2134 Age standardised rates (DALY) per 100,000 (95% CI): All ages: Male: 2027 (1909–2145) vs. 640 (633–648) Female: 1598 (1499–1697) vs. 573 (567–580) Age 15–64: Males: 1133 (1052–1213) vs. 243 (237–248) Female: 995 (921–1069) vs. 194 (190–199) Fatal stroke contribution to DALYS: Male: 67% vs. 57% Female: 53% vs. 66%		

(Continues)

TABLE 3 | (Continued)

References	Stroke age, years	Stroke incidence/ prevalence (all ages) Age-standardised stroke incidence per 100,000/ year (95% CI)[a]	Stroke incidence/ prevalence (younger age) Age-standardised stroke incidence per 100,000/ year (95% CI)[a]	Ischaemic stroke incidence Age-standardised stroke incidence per 100,000/year (95% CI)[a]	Recurrent stroke	Fatal stroke/ mortality/burden	Stroke risk factors	AF prevalence in stroke
Katzenellenbogen et al. 2014 [39]	Distribution of strokes according to age group: Age 25–34: 147/3184 (5%) vs. 1454/64772 (2%) Age 35–44: 411/3184 (13%) vs. 3263/64772 (5%) Age 45–54: 648/3184 (20%) vs. 6567/64772 (10%) Age 55–64: 850/3184 (27%) vs. 11,749/64772 (18%) Age 65–74: 701/3184 (22%) vs. 17,823/64772 (28%) Age 75–84: 427/3184 (13%) vs. 23,916 (37%)	Age-standardised prevalence per 1000 (95% CI): Male: 33.7 (31.9–35.4) vs. 9.1 (9.0–9.2) Female: 27.1 (25.7–28.4) vs. 6.1 (6.0–6.2)	Prevalence Age < 55 years: 38% vs. 17% ($p < 0.0001$)	Proportion of ischaemic stroke (of all strokes): 1299/3184 (41%) vs. 32,392/64772 (50%)			Female: 1622/3184 (51%) vs. 27,054/64772 (42%) ($p < 0.0001$) Age-specific differentials: Dementia 2.3 Diabetes 2.7 COPD 3.0 Alcohol-related admission 3.4 Chronic kidney disease 3.5 Heart failure 2.3 Ischaemic heart disease 1.4 Rheumatic heart disease 2.5	
Kilkenny et al. 2013 [40]	Mean (SD): 59 (15) vs. 74 (13)			Proportion of ischaemic stroke (of all strokes): 53/80 (66%) vs. 819/1082 (77%) ($p = 0.03$)		Death/dependency on discharge OR (95% CI): 2.32 (0.85–6.36) Age 18–64 years: 3.09 (1.07–8.95)	Diabetes mellitus: 37/80 (49%) vs. 240/1082 (27%) ($p < 0.001$) Smoker: 48/80 (74%) vs. 394/1082 (46%) ($p < 0.001$) High alcohol consumption: 27/80 (34%) vs. 91/1082 (8%) ($p < 0.001$)	
Lee et al. 2003 [41]						Indigenous mortality after TIA HR (95% CI): 1.45 (1.15–1.83)	Ischaemic stroke risk factors (all people): AF: HR (95% CI): 1.29 (1.15–1.44)	

(Continues)

TABLE 3 | (Continued)

References	Stroke age, years	Stroke incidence/ prevalence (all ages) Age-standardised stroke incidence per 100,000/ year (95% CI)[a]	Stroke incidence/ prevalence (younger age) Age-standardised stroke incidence per 100,000/ year (95% CI)[a]	Ischaemic stroke incidence Age-standardised stroke incidence per 100,000/year (95% CI)[a]	Recurrent stroke	Fatal stroke/ mortality/burden	Stroke risk factors	AF prevalence in stroke
Tiedeman et al. 2019 [42]	Mean (SD): 56.8 vs. 72.6 (SD NR) ($p < 0.001$)					30-day mortality: 4/43 (8.8%) vs. 4/167 (2.3%) OR: 0.25 (95% CI NR) ($p = 0.18$)	Current smoker: 22/43 (51.2%) vs. 25/167 (15.0%) ($p < 0.001$) Diabetes: 16/43 (37.2%) vs. 28/167 (16.8%) ($p = 0.003$) Previous history of CVA: 13/43 (30.2%) vs. 39/167 (22.8%) ($p = 0.032$)	AF known at time of stroke: 5/43 (11.6%) vs. 49/167 (29.5%) ($p = 0.018$)
You et al. 2015 [43]	Distribution of strokes according to age group: Age 15–39: 179/872 (20.5%) vs. 73/1090 (6.7%) Age 40–64: 494/872 (56.7%) vs. 492/1090 (45.1%) Age ≥ 65: 199/872 (22.8%) vs. 525/1090 (48.2%)	307 (282–331) vs. 138 (128–148) Male: 317 (279–355) vs. 160 (145–176) Female: 296 (264–328) vs. 112 (99–124) Age ≥ 65 years: 904 (863–1138) vs. 655 (658–779) IRR 1.55 (1.25–1.92)	Age 15–39: 58 (42–58) vs. 9 (8–13) IRR 4.92 (3.48–6.95) Age 40–64: 356 (349–415) vs. 79 (103–119) IRR 4.38 (3.72–5.17)	109 (94–124) vs. 60 (53–66)		Case fatality: IRR 1.25 (0.90–1.73)		
Zhao et al. 2016 [44]	Median (IQR): 53 vs. 62 years (IQR NR)					Case fatality: 314/1424 (22%) vs. 412/2309 (18%) ($p < 0.01$)	≥ 1 comorbidity: 1113/1424 (78%) vs. 1648/2309 (71%) ($p < 0.001$)	

Abbreviations: AF, atrial fibrillation; CI, confidence interval; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; DALY, disability adjusted life years; HR, hazard ratio; IQR, interquartile range; IRR, incidence rate ratio; NR, not reported; OR, odds ratio; SD, standard deviation.
[a]Unless otherwise indicated.

TABLE 4 | Treatment and management (Indigenous vs. non-Indigenous people).

References	Treatment/management
Balabanski et al. 2020 [33]	In patients without known AF, transthoracic echocardiogram was performed more frequently for Indigenous patients 32/39 (82.1%) vs. 19/33 (57.6%) ($p = 0.023$)
Clarke et al. 2021 [21]	Median (IQR) hospital stay: 4 (2–7) vs. 3 (1–7) days ($p < 0.001$)
Santos 2022 [36]	7/45 (15%) of Indigenous and 424/1798 (23.6%) of non-Indigenous patients arrived at hospital within treatment (4.5 h) time
Gwynn et al. 2021 [6]	Screening identified 4/619 (0.64%) unknown AF cases
Katzenellenbogen et al. 2015 [30]	Admitted to private hospital for stroke: Age 20–54 years: 6/441 (1.4%) vs. 1313/4129 (31.7%) ($p < 0.001$) Age 55–84 years: 13/482 (2.7%) vs. 11,423/32045 (35.4%) ($p < 0.001$) Length of hospital stay for stroke (days): Age 20–54 years, mean (SD): 8.9 (14.4) vs. 5.4 (12.6) ($p < 0.001$)
Kilkenny et al., 2013 [40]	Indigenous patients more likely to receive a mood assessment during admission ($p < 0.05$) Indigenous patients less likely to: be admitted to a stroke unit ($p < 0.05$) have an allied health assessment within 48 h ($p < 0.05$) be discharged on antithrombotics ($p < 0.05$)
Nedkoff et al. 2020 [22]	Length of hospital stay (days, median [IQR]): 6 (3–12) vs. 2 (1–7) ($p < 0.001$)
Nguyen et al. 2020 [23]	Warfarin time in therapeutic range: 40% (SD 29) vs. 50% (SD 31) ($p = 0.006$) Univariate predictors of time in therapeutic range: Indigenous status −9.97 (95% CI, −17 to −2.9) ($p = 0.006$)
Rocheleau et al. 2021 [24]	CHA_2DS_2-VASc of 2 or more treated with oral anticoagulation: 23.7% vs. 28.7% Associations of anticoagulation use with hypertension: OR (95% CI): 0.68 (0.39–1.19) vs. 1.28 (1.20–1.36) ($p = 0.02$)
Tiedeman et al. 2019 [42]	Post-stroke Indigenous patients less likely to have: Holter monitor ordered 8/43 (18.0%) vs. 69/167 (41.4%) ($p = 0.008$) Carotid imaging completed 40/43 (93.8%) vs. 167/167 (100%) ($p = 0.012$) Echocardiography completed 31/43 (73.3%) vs. 163/167 (97.7%) ($p = 0.004$) Doctor follow-up post-discharge 32/43 (74.4%) vs. 146/167 (87.4%) ($p = 0.034$)
Wong et al. 2015 [31]	Indigenous status was a significant predictor of NON-guideline prescription in multivariate analyses using CHA_2DS_2-VASc scores (OR 1.60, 95% CI 1.25–2.05).
Zhao et al. 2016 [44]	Mean Lifetime observed costs per patient: $143,750 vs. $83,968 Lifetime costs for stroke (inverse probability weighted Kaplan–Meier survival analysis; mean): $335,394 vs. $212,745 Net lifetime costs per patient: RR 1.440 (95% CI 1.431–1.448)

Abbreviations: AF, atrial fibrillation; CHA_2DS_2-VA and $CHADS_2$, stroke risk tools for patients with AF; CI, confidence interval; DALY, disability adjusted life years; IQR, interquartile range; OR, odds ratio; RR, risk ratio; SD, standard deviation.

3.4.2 | Recommendation #2

When AF is found, follow guideline recommendations for management of rate, rhythm, stroke prevention, and concomitant risk factors/comorbidities. Consider the logistics of care when deciding on the localised care pathway.

4 | Discussion

Our systematic review of the literature identified 24 studies that provided evidence for lowering the AF screening age to at least 55 years for Indigenous people. Our analysis clearly indicates that Indigenous Australians experience AF at a higher incidence rate and mean 15.9 years younger age and, after AF onset, have far worse outcomes when compared with non-Indigenous Australians. Further, we found that 55–64-year-old Indigenous Australians have a higher prevalence of AF than non-Indigenous Australians of the same age, and substantially higher prevalences below age 55 years. The risk of stroke for Indigenous Australians with AF is substantially elevated relative to similarly aged non-Indigenous Australians, highlighting the imperative to reduce stroke risk in those with AF. The current Australian AF guidelines (screen from 65 years) do not reflect the needs of Indigenous Australians.

Prevalent cardiovascular risk factors impact Indigenous Australians' risk of AF as well as ischaemic stroke. If we are to address the high risk of AF and AF-related stroke experienced by Indigenous Australians, we must better manage risk factors

[21, 43]. To achieve this, it is incumbent upon health service providers to deliver care in ways that respond to the heightened risk for Indigenous Australians. Primary care providers should consider the logistics of and access to healthcare when deciding on localised screening and care pathways, to ensure timely assessment and that management is culturally safe and accessible for Indigenous people. This can be achieved through community involvement and co-design [51].

4.1 | Limitations

This is the first study to perform a meta-analysis of the age of occurrence of AF for Indigenous people. Meta-analysis of outcome data, other than mean age, was not possible due to the variation in reported outcome measures. Heterogeneity for the meta-analysis of mean age was high ($I^2 = 98\%$), reflective of the high heterogeneity within research of Indigenous populations and also heterogeneity more generally across Indigenous populations [52].

Five of the included studies limited the included population age to a maximum age of 84 years; therefore, the mean ages reported in this review are likely to be conservative for non-Indigenous people, due to the longer life expectancy of non-Indigenous people. Thus, it is possible that the age gaps are larger than reported in this review and the recommendation for screening from at least age 55 years could be considered conservative. Furthermore, the data were predominately derived from hospital data and may not be reflective of community risk. Finally, although there are no randomised controlled studies, the observational, analytical and descriptive studies combined make a compelling case for reducing the age at which AF screening and initiation of treatment are recommended, given the high stroke risk in this population.

5 | Conclusions

Early detection and effective treatment of AF could reduce the number of preventable strokes among Indigenous Australians. This review overwhelmingly supports a call for earlier opportunistic AF screening for Indigenous Australians, at least from age 55 years. Moreover, when AF is found for Indigenous Australians, it is imperative that guideline recommendations for managing rate, rhythm, stroke prevention and risk factors/comorbidities are followed. This study also demonstrates that population-level guidelines are created from data that fail to capture the impact on Indigenous Australians. There is a crucial need to increase Indigenous cardiovascular research to minimise missed diagnoses, and ensure timely, accessible, appropriate and culturally secure care/treatment.

Author Contributions

Conceptualisation: Kylie Gwynne, Vita Christie; Data curation: Alena Haines, Rekha Khatri, Nicole Lowres, Vita Christie, Kylie Gwynne, Josephine Gwynn; Formal analysis: Vita Christie, Kylie Gwynne, Alena Haines, Rekha Khatri, Nicole Lowres; Funding acquisition: Lee Nedkoff, Kylie Gwynne, Josephine Gwynn, Jessica Orchard, Ben Freedman, Nicole Lowres, Katrina Ward; Investigation: Vita Christie, Connie Henson, Kylie Gwynne, Nicole Lowres; Methodology: Vita Christie, Kylie Gwynne, Josephine Gwynn; Project administration: Vita Christie, Kylie Gwynne; Validation: Vita Christie, Kylie Gwynne, Nicole Lowres; Writing – original draft: Vita Christie, Kylie Gwynne, Connie Henson; Writing – review and editing: all authors.

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Disclosure

Not commissioned; externally peer reviewed.

Conflicts of Interest

Dr. Freedman reports receiving honoraria from BMS/Pfizer alliance and Omron.

Data Availability Statement

The authors have nothing to report.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** mja270208-sup-0001-supinfo.pdf.