

Burden and Drivers of Sudden Cardiac Death in Young Adults in Africa: A Systematic Review of Evidence and Prevention Strategies

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Abstract

Background

Sudden cardiac death (SCD) is an important cause of premature mortality among young adults worldwide. Despite a substantial prevalence of SCD in young adults in Africa, its epidemiology is still poorly characterised. This systematic review aims to synthesise available African evidence on the burden, etiologies, and prevention strategies of SCD.

Methods

We searched PubMed, Embase, Scopus, Web of Science, the Cochrane Library, African Journals Online (AJOL), and Google Scholar from January 2000 to July 2026 for original studies on SCD in Africa. Studies that were eligible examined individuals aged 15–39 years across African populations and were published in English. Findings were synthesised thematically and presented narratively.

Results

Ten studies from Algeria (n = 2), Tunisia (n = 2), South Africa (n = 2), Cameroon (n = 1), Gabon (n = 1), Egypt (n = 1), and Nigeria (n = 1) were included in this review. Included study designs were retrospective autopsy-based studies, cohort studies, observational cross-sectional studies, and a prospective case-control study, conducted across hospital, community, and pre-competition sports screening settings. Reported age across cohorts ranged from 18 to 39 years, and males predominated. No studies reported prevalence figures; incidence ranged from 3 to 33.6 per 100,000 person-years. Cardiovascular disease was the leading identified cause across all settings, with hypertrophic cardiomyopathy accounting for 39.1% in one cohort. Hypertensive heart disease predominated in sub-Saharan Africa, while ischemic causes and cardiomyopathies were more prominent in North Africa. Other contributors identified included enteroviral myocarditis, HIV-associated disease, family history, and obesity. Inherited cardiovascular pathologies accounted for up to 90% of cases in individuals aged 45 years and under in one cohort. Gaps that were reported included limited autopsy utilisation, absent genetic testing infrastructure, and cultural barriers to post-mortem consent.

Conclusion

SCD in young African adults is shaped by a heterogeneous mix of acquired cardiovascular, infectious, and inherited disorders. Future priorities should include strengthening surveillance, expanding post-mortem investigation, integrating cardiovascular risk screening into primary care, and improving emergency response capacity.

1. INTRODUCTION

1.1 Background

Sudden cardiac death (SCD) is defined as an unexpected, non-traumatic death that occurs within one hour of symptom onset in an individual who appears healthy [1]. In cases where death is unwitnessed, the definition extends to individuals who were in good health within the preceding 24 hours [1]. Worldwide, SCD accounts for approximately 4–5 million deaths each year [2]. In young adults, the incidence of SCD ranges from 0.46 to 3.7 per 100,000 person-years [1], with a consistent male predominance of approximately 2:1 [3]. This population is distinct due to unique etiological features. The causes of SCD in young adults differ significantly from those in older individuals. Inherited channelopathies and primary cardiomyopathies, particularly hypertrophic cardiomyopathy and long QT syndrome, are the most common etiologies in younger individuals [3]. In contrast, coronary artery disease is the predominant cause in older adults [1]. This etiological distinction highlights the need for separate epidemiological investigation in young adults. Furthermore, SCD in this group has substantial public health implications, resulting in premature deaths during peak productive years and significant family and community impact. The genetic and inherited nature of these conditions provides opportunities for early identification, family screening, and preventive interventions that are less feasible in older populations, where atherosclerotic disease predominates. Despite the increasing burden of SCD among young adults in Africa, comprehensive epidemiological assessment remains constrained by ongoing challenges related to surveillance systems, death certification, and autopsy availability. For instance, a Cameroonian population-based cohort reported an age-standardised incidence of 33.6 per 100,000 person-years [4], while an Algerian autopsy series identified an incidence of 3 per 100,000 person-years, with cardiac causes responsible for 50.8% of cases [5]. Tunisian autopsy studies have identified cardiovascular causes in 72.6% of young adult deaths, including myocardial ischemia (32.3%), arrhythmias (25.3%), hypertrophic cardiomyopathy (16.2%), and myocarditis (9.1%); 5.1% of cases had a documented family history [6].

Among young patients with cardiac ischemia, coronary artery disease accounts for 75%, while anomalous coronary origin and myocardial bridging represent 25% [7]. In Algeria, younger patients (under 40 years) typically present with primary cardiomyopathies, whereas older young adults have smoking and established cardiovascular disease [5]. Population screening in Egypt identified a positive family history in 3.5% of cases, with clustering of diabetes (55.5%), hypertension (48%), and coronary disease (34.4%) [8]. Collectively, these findings highlight a substantial SCD burden among young African populations. However, persistent gaps in surveillance infrastructure, death certification, and autopsy capacity across low- and middle-income countries (LMICs) continue to impede comprehensive disease characterisation and the implementation of effective prevention strategies [9, 10]. The etiologies of SCD in young African adults include genetic predisposition, acquired cardiac disease, and systemic factors. Inherited channelopathies and primary cardiomyopathies, particularly hypertrophic cardiomyopathy (approximately 1 in 500) and long QT syndrome (approximately 1 in 2,000), are the predominant genetic contributors [3]. Next-

generation sequencing has identified pathogenic variants associated with inherited arrhythmogenic disorders; approximately 4% of unexplained sudden deaths are attributable to genetic variants in catecholaminergic polymorphic ventricular tachycardia (CPVT) and long QT syndrome [11]. Infectious myocarditis, especially due to coxsackievirus B enterovirus, accounts for approximately 12.5% of sudden unexpected deaths [12]. Hypertrophic cardiomyopathy, arrhythmogenic cardiomyopathy, and idiopathic left ventricular hypertrophy are prevalent structural causes [13, 14]. Exertion-related factors are significant triggers: coronary artery anomalies result in death in all cases, arrhythmogenic cardiomyopathy in 83%, and overall SCD occurs during or after exertion in 50% of cases [14]. Major health system limitations in Africa, including restricted autopsy capacity, lack of genetic testing, and absence of post-mortem molecular diagnostics, impede the identification of cardiac pathology and delay risk stratification in affected families [11].

1.2 Rationale

Although a substantial SCD burden and diverse etiologies have been identified across African populations, significant evidence gaps persist regarding sudden cardiac death in young African adults. A South African 10-year retrospective study identified nearly 2,000 sudden unexpected death cases with a mean age of 26.89 years, yet comprehensive epidemiological characterisation remains incomplete. The existing African literature, spanning Cameroon, Nigeria, Tunisia, Algeria, and Egypt, is dispersed across regional publications with limited synthesis. The unique drivers of SCD in young Africans, including genetic and infectious etiologies in resource-limited settings, remain inadequately characterised. A systematic review synthesising available African evidence is necessary to establish the burden, etiological spectrum, and prevention priorities specific to young adults, and to identify critical research gaps requiring future investigation.

1.3 Aim and Objectives

This systematic review seeks to synthesise evidence on the burden, etiologies, and prevention strategies for sudden cardiac death in young adults across African countries.

The specific objectives are:

1. To document the incidence and epidemiological burden of SCD in young adults across African populations.
2. To characterise the etiological spectrum of SCD in young African adults, including genetic, cardiomyopathic, infectious, metabolic, and lifestyle-related factors.
3. To identify critical evidence gaps and prevention priorities for young adults in African settings.

2. METHODOLOGY

2.1 Study Design

This study was conducted in accordance with the PRISMA 2020 guideline [15]. This systematic review synthesises available evidence on the burden, drivers, and prevention strategies of sudden cardiac death (SCD) among young adults in Africa. For this review, young adults were defined as individuals aged 15–39 years, consistent with the National Cancer Institute's Adolescent and Young Adult (AYA) age classification [16, 17].

2.2 Search Strategy

A comprehensive literature search was conducted across multiple electronic databases, including PubMed, Embase, Scopus, Web of Science, the Cochrane Library, African Journals Online (AJOL), and Google Scholar. Searches were restricted to studies published from January 2000 to July 2026 and limited to articles published in English.

The search strategy combined controlled vocabulary terms and free-text keywords related to sudden cardiac death and young populations in Africa. Search terms included combinations of “sudden cardiac death,” “sudden cardiac arrest,” “out-of-hospital cardiac arrest,” “young adult,” “adolescent,” “youth,” “Africa,” “sub-Saharan Africa,” and individual African country names. Database-specific adaptations of the search strategy were employed where appropriate. Reference lists of eligible studies were also screened to identify additional relevant publications.

2.3 Eligibility Criteria

Using the PICO framework, studies were selected according to predefined inclusion and exclusion criteria.

Inclusion Criteria

Studies were eligible if they:

- Included participants classified as young adults, generally between 15 and 39 years of age, or provided extractable subgroup data within this age range.
- Were conducted in African countries or reported data specific to African populations.
- Examined sudden cardiac death or sudden cardiac arrest presumed to be of cardiac origin.
- Reported information on at least one of the following:

- Incidence or prevalence of sudden cardiac death;
 - Risk factors, determinants, or underlying causes of sudden cardiac death;
 - Prevention, screening, management, or surveillance strategies relevant to sudden cardiac death.
- Employed observational study designs, including cohort, case-control, cross-sectional, registry-based, or autopsy-based studies.
 - Were published in peer-reviewed journals between 2000 and 2026.

Exclusion Criteria

Studies were excluded if they:

- Were conducted outside Africa without separately reported African data.
- Focused exclusively on populations outside the predefined age range without extractable data for young adults.
- Investigated non-cardiac causes of sudden death, including trauma, poisoning, overdose, drowning, or other external causes.
- Were case reports, case series involving fewer than 10 participants, editorials, commentaries, conference abstracts without sufficient data, narrative reviews, systematic reviews, or meta-analyses.
- Did not provide primary data related to the burden, drivers, risk factors, or prevention of sudden cardiac death.

2.4 Study Selection Process

All retrieved records were exported into Zotero by M.O.O for reference management and duplicate removal. A total of 610 records were identified through database searching. Following deduplication, 489 unique records remained for screening (see Fig. 1). Title and abstract screening were conducted based on the predefined criteria by two independent reviewers [M.O.O and V.O.A]. Studies that clearly did not meet the inclusion criteria were excluded. Full texts of potentially relevant studies were subsequently retrieved and assessed for eligibility by the same reviewers.

Discrepancies during the selection process were resolved through discussion and consensus involving a third reviewer [H.A.J].

2.5 Data Extraction and Synthesis

A standardised data extraction form was developed and used to collect relevant information from each included study. Extracted data included author and publication year, country of study, study design, study setting, participant characteristics, outcome definitions, incidence or prevalence estimates, identified risk factors and causes, diagnostic methods, prevention strategies, management approaches, key findings, and study limitations. Due to substantial heterogeneity in study designs, outcome definitions, diagnostic approaches, and reporting methods, a quantitative meta-analysis was not considered appropriate. Therefore, findings were synthesised narratively. Included studies were grouped according to major thematic domains, including the burden of sudden cardiac death, underlying drivers and risk factors, diagnostic and surveillance gaps, and prevention and management strategies.

2.6 Quality Assessment and Risk of Bias

Methodological quality and risk of bias were assessed using the Joanna Briggs Institute (JBI) critical appraisal tools appropriate for each study design [18]. Cohort studies, analytical cross-sectional studies, case-control studies, prevalence studies, and case series were evaluated using their respective JBI critical appraisal checklists [18]. Each study was independently assessed across relevant methodological domains, including participant selection, measurement of exposures and outcomes, identification and management of confounding factors, completeness of follow-up where applicable, and appropriateness of statistical analyses. Studies were subsequently categorised as having low, moderate, or high risk of bias based on their overall appraisal scores. The results of the quality assessment were used to inform the interpretation and strength of the evidence but were not used as criteria for study exclusion.

3. RESULTS

3.1 Study Characteristics

A systematic search of Embase, PubMed, and Scopus yielded a total of 603 records. Following removal of 114 duplicates, 489 records were screened at the title and abstract level, of which 447 records were excluded for not meeting the inclusion criteria. 42 full-text articles were assessed for eligibility, of which 31 articles were excluded due to the wrong population (n = 12), wrong outcome (n = 9), wrong study design (n = 7), and being conducted outside Africa (n = 4). A final total of 10 studies were included in the review (see Table 1). Five studies were conducted in North Africa [5, 6, 8, 11, 19] and five studies were done in Sub-Saharan Africa (SSA) [4, 10, 12, 14, 20].

Table 1
Overview of Included Studies

S/N	Author & Year	Country/Region	Study Design	Population Characteristics	Incidence/Prevalence	Risk Factors/Causes Identified	Diagnostic Method	Pr Re
1	Bonny et al., 2017 [4]	Cameroon	Cohort study	Sample size: 86188 Age range:>18 years Men: 49.5% Women: 50.5%	Crude incidence: 31.3/100000 person-years Sudden cardiac death: 9.4% (27/288 deaths)	Hypertension and diabetes were present in 22.2% and 11.1% of victims, respectively. Heart failure – 14.8% Dilated cardiomyopathy- 7.4% Acute MI- 7.4% Tropical disease- 3.7 HIV – 7.4%	Clinical records and verbal autopsies	Us sp fac aw pro
2.	Palemo. Et. al., 2014 [18]	Obafemi Awolowo University, Nigeria	descriptive retrospective autopsy-based review	159 cases M- 108(67.9%) F- 51(32.1%) M: F- 2.1:1 73 cases (45.9%) < 40 years,	28.3% of sudden natural deaths are of cardiac origin. M: F- 5.4:1. The majority of Cardiac deaths occurred at age 21-60years(42.6% of the Nigerian population according to the 2006 census).	64.4% - hypertensive heart disease, Coronary artery disease- 15.6% of cases, Dilated cardiomyopathy, Hypertrophic cardiomyopathy, Rheumatic heart disease, Ruptured aortic aneurysm, Constrictive pericarditis	Autopsy	Aw die hy]
3.	Saadi et. al., 2020 [6]	Tunisia	Retrospective cohort study	137 cases within 18–35 years. Mean age: 26.47 years. M- 107(78.1%), F- 30(21.9%) M/F ratio 3.6	Mean annual sudden death in the young is 4.9 cases/year. Incidence of sudden death in young adults is dependent on the specific geographical, ethnic, and socioeconomic factors of each country	Almost 72% of deaths were classified as cardiac death, and was due to ischemic heart disease in 32.32%. Smoking in 64 cases (46.7%), alcohol consumption in 16 cases (11.7%). Physical activity in 4cases	Autopsy data and clinical record	Re ex lor ca pro
4.	Oussama et al., 2024 [5]	Algeria	Retrospective study	57 cases. SCD in 50.8% of cases	3 cases per 100,000 inhabitants per year.			

Footnote: CAD, coronary artery disease; CPR, cardiopulmonary resuscitation; CVD, cardiovascular disease; CVS, cardiovascular system; DM, diabetes mellitus; HTN, hypertension; MI, myocardial infarction; NGS, next-generation sequencing; SCA, sudden cardiac arrest; SCD, sudden cardiac death; SD, standard deviation; SUDY, sudden unexpected death in the young; NGS, next-generation sequencing; VUS, variants of uncertain significance.

S/N	Author & Year	Country/Region	Study Design	Population Characteristics	Incidence/Prevalence	Risk Factors/Causes Identified	Diagnostic Method	Prevalence
5.	van Deventer et al., 2025 [10]	South Africa	Cohort study	51 cases, Age range: 1 to 45 years. Average age: 28 years	Global incidence of SCD is between 15 and 159 cases/ 100,000 people per year. Approximately 4 to 5 million global deaths/ annum. Appx 2,000 young South Africans die suddenly each year	In younger populations (≤ 45 years), up to 90% of cases are caused by inherited cardiac diseases, mostly cardiomyopathies and arrhythmogenic disorders	Autopsy and clinical records, genetic testing	
6.	Gaaloul et al., 2012 [11]	Tunisia	Observational study	Sample size: 48 cases. All males. Mean age: 29.8 years Control: 37 cases with an age range of 23 to 35 years (mean age 28.7 years)		Enterovirus represents the most common agent of myocarditis	Autopsy	Co co mo pa an im tec die my
7.	Hamid et al., 2018 [8]	Egypt	Prospective(case control)	Sample size: 7916 Median age: 18 years. < 20 years; 77.6% (6497). 20 to 40 years; 10.4% (868). 293 had a positive family history of SCD	Approx. 3.7 million per year around the world,	Family history of SCD is a potential marker of vulnerability to SCD, coronary artery disease, and primary ventricular fibrillation	Questionnaire, ECG, examinations and lab investigations	Se po su dia int str
Footnote: CAD, coronary artery disease; CPR, cardiopulmonary resuscitation; CVD, cardiovascular disease; CVS, cardiovascular system; DM, diabetes mellitus; HTN, hypertension; MI, myocardial infarction; NGS, next-generation sequencing; SCA, sudden cardiac arrest; SCD, sudden cardiac death; SD, standard deviation; SUDY, sudden unexpected death in the young; NGS, next-generation sequencing; VUS, variants of uncertain significance.								

S/N	Author & Year	Country/Region	Study Design	Population Characteristics	Incidence/Prevalence	Risk Factors/Causes Identified	Diagnostic Method	Pr Re
8.	Swart et al., 2024 [14]	Cape Town	Retrospective study	1997 cases, Median Age: 26.89 ± 10.87 years. The pulmonary system (n = 552; 30.16%) and cardiovascular system (n = 392; 21.42%) were the two most prominent organ systems associated with death in SUDY cases	200 sudden, unexpected deaths in the young annually. SUDY accounted for 5.77% of the 10-year caseload	Overweight is a risk factor for SCD in young people. The main cause of death involving the CVS was ischaemic heart disease	Autopsy record and investigations	Ea fac dis aw rec syl fac
9.	Schmied et al., 2009 [17]	Algeria	Cross-sectional study	155 male football players; mean age 16.4 (SD 0.68) years (range 14 to 17).			Medical history, clinical examination, 12-lead resting electrocardiogram (ECG) and echocardiography	
10.	Schmied et al., 2013 [12]	Gabon	Cross-sectional study	210 native male africans(Gabonians) Age range: 18 -22years			Medical history, Clinical examination, 12-lead ECG, Echocardiography	
Footnote: CAD, coronary artery disease; CPR, cardiopulmonary resuscitation; CVD, cardiovascular disease; CVS, cardiovascular system; DM, diabetes mellitus; HTN, hypertension; MI, myocardial infarction; NGS, next-generation sequencing; SCA, sudden cardiac arrest; SCD, sudden cardiac death; SD, standard deviation; SUDY, sudden unexpected death in the young; NGS, next-generation sequencing; VUS, variants of uncertain significance.								

Algeria [5, 17], Tunisia [6, 11], and South Africa [10, 14] contributed 2 studies each, followed by Cameroon [4], Gabon [12], Egypt [8], and Nigeria [20]. The study designs included retrospective autopsy-based studies (n = 4) [5, 6, 20], cohort studies (n = 2) [4, 10], observational cross-sectional studies (n = 3) [11, 12, 19], and a prospective case-control study (n = 1) [8]. Study settings encompassed hospital/mortuary-based (n = 6) [5, 6, 10, 11, 14, 20], community-based (n = 2) [4, 8], and pre-competition athletic screening settings (n = 2) [12, 19]. Across studies, reported age ranges varied. Palemo et al. (2014) reported that 45.9% of all cardiovascular deaths occurred in individuals under 40 years in the Nigerian cohort [20]. Mean age at SCD was 26.5 years in the Tunisian cohort, per Saadi et al. (2020) [6], and 28 years in the South African series of Van Deventer et al. (2025) [10]. Male predominance was reported in most studies: the male-to-female ratio was 5.4:1 in the Nigerian cohort [20], 3.6:1 in the Tunisian cohort [6], and all 48 cases in the Tunisian enteroviral myocarditis cohort were male [11]. Only one study reported near-equal sex distribution [4], while athletic cohorts exclusively evaluated male participants [12, 19].

3.2 Burden of Sudden Cardiac Death in Young Adults in Africa

Four studies reported incidence figures for SCD in young adults in Africa: Bonny et al. (2017) reported a crude incidence of 31.3 per 100,000 person-years and an age-standardised incidence of 33.6 per 100,000 person-years in the Cameroonian cohort [4]. Oussama et al. (2024) reported 3 cases per 100,000 inhabitants per year across 305 consecutive autopsies in the Algerian cohort [5]. Saadi et al. (2020) reported a mean of 4.9 SCD cases per year in the Tunisian cohort [6]. In Cape Town, Swart et al. (2024) reported approximately 200 sudden unexpected deaths in young people annually at a single mortuary, with cardiovascular involvement in 21.4% of cases over a decade [14]. None of the included studies reported prevalence estimates. Cardiovascular disease was the frequently reported cause of sudden death across all included studies [4–7, 14, 20]. In sub-Saharan Africa, hypertensive heart disease was the commonly reported aetiology. In Nigeria, it accounted for 64.4% of cardiovascular deaths, with hypertension identified in 18.2% of all sudden deaths [20]; in Cameroon, hypertension and diabetes were reported in 22.2% and 11.1% of SCD victims, respectively [4]. In North Africa, ischemic causes and primary cardiomyopathies were more commonly observed. Saadi et al. (2020) identified cardiovascular causes in 72.6% of 137 sudden deaths, with the leading subtypes being myocardial ischemia (32.3%), arrhythmia (25.3%), hypertrophic cardiomyopathy (16.2%), and myocarditis (9.1%) in one Tunisian cohort [6]. In the Algerian cohort, Oussama et al. (2024) reported that primary cardiomyopathies predominated in younger individuals, while established risk factors, particularly smoking, were more common among those over 40 years [5].

Infectious and inherited causes were also reported across cohorts. Gaaloul et al. (2012) documented enteroviral infection in 12.5% of SCD cases in one Tunisian cohort [11]. In the Cameroonian cohort, HIV-associated cardiac disease accounted for 7.4% of SCD cases [4]. In the South African cohort, Van Deventer et al. (2025) reported 175 genetic missense variants, of which 7.4% were novel; a probable genetic arrhythmic or cardiac conduction disorder was documented in approximately 4% of cases, and pathogenic variants in KCNE1, SCN10A, and RYR2 were associated with long QT syndrome and Brugada syndrome [10]. In one Egyptian cohort, population-level family history screening reported a positive family history of SCD in 293 of 8,786 individuals screened (3.3%) [8]. Within this group, the family history of coronary artery disease was 12 times more common, diabetes mellitus 8.7 times more common, hypercholesterolaemia 9 times more common, and hypertension 7 times more common than in those without such a family history, with associated consanguinity [8]. Physical activity was frequently reported across multiple studies. Swart et al. found associated exertion in 50% of cardiovascular deaths in the Cape Town cohort [14]. In athletic screening cohorts, Schmied et al. (2009) demonstrated the feasibility of pre-competition cardiovascular screening using 12-lead ECG and echocardiography among adolescent football players in Algeria [19]. Furthermore, Schmied et al. (2013) evaluated young Gabonese athletes and observed that abnormal ECG patterns raising clinical concern were twice as prevalent in African athletes compared with Caucasian counterparts (12% vs. 5–7%), highlighting the challenge of differentiating physiological remodelling from underlying cardiomyopathy [12]. A commonly reported diagnostic challenge across included studies was the high proportion of sudden deaths without an identifiable pathological cause at autopsy. Where post-mortem genetic testing was unavailable, an estimated 50% of SCD cases were reported as unexplained even after conventional autopsy [10].

3.3 Major Drivers and Risk Factors

Hypertension was the most consistently reported risk factor across studies, accounting for a high proportion of deaths in the Cameroonian and Nigerian populations [4,20]. Revealed by survey screening, a family history of hypertension is highly related to SCD risk [8]. Coronary artery disease (CAD) was a dominant structural cause of death noted across a majority of the studies. Inherited cardiovascular pathologies also play a major role, especially in younger populations aged 35 years and under [6, 7]. This was reported by Van Deventer et al. [10] to be implicated in up to 90% of SCD cases of young adults under 45 years. This genetic predisposition is amplified by consanguineous marriage and a positive family history of SCD, making the individual especially vulnerable [8]. Viral and infectious cardiac disease, specifically coxsackie B enterovirus, was highlighted as a possible largely undiagnosed risk [11]. Other endemic infections such as HIV were discovered, escalating the possibility of SCD [4]. Exertion and athletic training were highlighted as important triggers unmasking underlying silent cardiovascular pathologies and distinct repolarisation variants [6, 10, 12, 14, 19]. Lifestyle risks such as smoking, alcohol consumption, and obesity were also majorly implicated, showing up as a marker in the included studies [5, 6, 20].

3.4 Diagnostic and Surveillance Gaps

A significant lack of surveillance was noted in the studies. It was common for sudden death to be the first noted clinical manifestation of cardiac pathology in victims and for victims to never have sought medical attention for their condition before death [4–6, 10, 20]. A lack of minimal resuscitation equipment, absence of defibrillators, and high out-of-pocket healthcare costs were documented; autopsies were also not done systematically; rather, home-by-home surveillance was used [4]. In Cameroon, despite 88.9% of arrests being witnessed, virtually no CPR was attempted due to a systemic lack of needed infrastructure [4]. Pelemo et al [20] highlighted that the true prevalence of SCD in Nigeria is likely underestimated, as many cases of sudden death are never autopsied. In Egypt, cultural and religious backgrounds were noted as barriers to autopsy consent [8]. The post-mortem genetic testing done by Van Deventer et al. [10] is still mainly unavailable in many African countries, and they reported that without it, approximately 50% of SCDs remain unexplained even after autopsy [6,10].

3.5 Existing Prevention Strategies in Africa

Several prevention strategies were noted: Schmied et al. [19] confirmed that pre-competition cardiological screening using resting 12-lead ECG and echocardiography was feasible in young African footballers in Algeria, though Schmied et al. [12] underscored the necessity of race-specific ECG interpretation criteria to avoid false-positive athlete disqualifications in Sub-Saharan populations; Hamid et al. [8] proposed family history screening as a scalable early detection strategy, particularly in populations with elevated consanguinity rates. Bonny et al. [4] called for CPR awareness programmes and broader screening for inherited cardiac disorders. Swart et al. [10] recommended public awareness campaigns targeting early recognition of cardiovascular risk factor symptoms. Deventer et al. [10] advocated for post-mortem genetic testing infrastructure as a policy priority.

3.6 Quality Assessment

Methodological quality and risk of bias across the 10 included studies were evaluated using the appropriate Joanna Briggs Institute (JBI) Critical Appraisal Tools tailored to each study design (Tables 2–6). Overall, a majority of the studies exhibited strong methodological rigour: 6 studies (60.0%) were rated as high quality (low risk of bias), 3 studies (30.0%) as moderate quality (moderate risk of bias), and 1 study (10.0%) as low quality (high risk of bias). All included studies reporting prevalence data (Pelemo et al., 2014; Saadi et al., 2020; Swart et al., 2024; van Deventer et al., 2025) [6,10,14,20] and the case series design (Kerrouche et al., 2024) [5], as well as the single cohort study (Bonny et al., 2017) [4], demonstrated low overall risk of bias, consistently meeting key requirements regarding valid outcome measurement and clear sampling frames. Conversely, analytical cross-sectional studies and the case-control study exhibited higher susceptibility to bias, primarily driven by a failure to identify and adjust for potential confounding factors (Gaaloul et al., 2012; Hamid et al., 2018; Schmied et al., 2009; Schmied et al., 2013) [8,11,12,19]. The lowest-rated study, Hamid et al. (2018) [8], scored 3/8 due to poorly defined inclusion criteria, unvalidated exposure and outcome measurements, and an absence of confounding strategies.

Table 2

JBI Critical Appraisal of Analytical Cross-Sectional Studies Legend: Y = Yes; N = No; U = Unclear

JBI Criteria	Hamid et al. (2018)	Schmied et al. (2009)	Schmied et al. (2013)
1. Were the criteria for inclusion in the sample clearly defined?	N	Y	Y
2. Were the study subjects and setting described in detail?	Y	Y	Y
3. Was the exposure measured in a valid and reliable way?	U	Y	Y
4. Were objective, standard criteria used for measurement of the condition?	Y	Y	Y
5. Were confounding factors identified?	N	N	N
6. Were strategies to deal with confounding factors stated?	N	N	N
7. Were the outcomes measured in a valid and reliable way?	N	Y	Y
8. Was appropriate statistical analysis used?	Y	Y	Y
Total Score	3/8	6/8	6/8
Quality Rating	Low	Moderate	Moderate

Table 3

JBI Critical Appraisal of Cohort Studies Legend: Y = Yes; N = No; U = Unclear

JBI Criteria	Bonny et al., 2017
1. Were the two groups similar and recruited from the same population?	Y
2. Were exposures measured similarly to assign participants to groups?	Y
3. Was the exposure measured in a valid and reliable way?	Y
4. Were confounding factors identified?	N
5. Were strategies to deal with confounding factors stated?	N
6. Were groups/participants free of the outcome at the start of the study?	Y
7. Were outcomes measured in a valid and reliable way?	Y
8. Was the follow-up time reported and sufficient to be long enough for outcomes to occur?	Y
9. Was follow-up complete and, if not, were reasons for loss to follow-up described and explored?	N
10. Were strategies used to address incomplete follow-up?	Y
11. Was appropriate statistical analysis used?	Y
Total Score	9/11
Quality Rating	High

Table 4
JBI Critical Appraisal for Studies Reporting Prevalence Data Legend: Y = Yes; N = No; U = Unclear

JBI Criteria	Pelemo et al., 2014	Saadi et al. (2020)	Swart et al. (2024)	van Deventer et al. (2025)
1. Was the sample frame appropriate to address the target population?	Y	Y	Y	Y
2. Were study participants sampled in an appropriate way?	Y	Y	Y	Y
3. Was the sample size adequate?	Y	Y	Y	N
4. Were the study subjects and setting described in detail?	Y	Y	Y	Y
5. Was the data analysis conducted with sufficient coverage of the identified sample?	Y	Y	Y	Y
6. Were valid methods used for identification of the condition?	Y	Y	Y	Y
7. Was the condition measured in a standard, reliable way for all participants?	Y	Y	Y	Y
8. Was there appropriate statistical analysis?	Y	Y	Y	Y
9. Was the response rate adequate, and if not, managed appropriately?	N/A	N/A	N/A	Y
Total Score	8/9	8/9	8/9	8/9
Quality Rating	High	High	High	High

Table 5
JBI Analytical Case-Control Framework Legend: Y = Yes; N = No; U = Unclear

JBI Criteria	Gaaloul et al. (2012)
1. Were the groups comparable other than the presence of disease in cases or absence in controls?	Y
2. Were cases and controls matched appropriately?	Y
3. Were the same criteria used for identification of cases and controls?	Y
4. Was exposure measured in a standard, valid and reliable way?	Y
5. Was exposure measured in the same way for cases and controls?	Y
6. Were confounding factors identified?	N
7. Were strategies to deal with confounding factors stated?	N
8. Were outcomes assessed in a standard, valid and reliable way for cases and controls?	Y
9. Was the exposure period of interest long enough to be meaningful?	Y
10. Was appropriate statistical analysis used?	N
Total Score	7/10
Quality Rating	Moderate

Table 6
Overall Risk of Bias Summary

S/N	Study	Design / Tool	Score	Quality Rating	Risk of Bias
1	Bonny et al., 2017	JBI Cohort Checklist	9/11	High	Low Risk of Bias
2	Pelemo et al., 2014	JBI Prevalence	8/9	High	Low Risk of Bias
3	Saadi et al., 2020	JBI Prevalence	8/9	High	Low Risk of Bias
4	Oussama et al., 2024	JBI Case Series	9/10	High	Low Risk of Bias
5	van Deventer et al., 2025	JBI Prevalence	8/9	High	Low Risk of Bias
6	Swart et al., 2024	JBI Prevalence	8/9	High	Low Risk of Bias
7	Gaaloul et al., 2012	JBI Case-Control	7/10	Moderate	Moderate Risk of Bias
8	Schmied et al., 2009	JBI Cross-Sectional	6/8	Moderate	Moderate Risk of Bias
9	Schmied et al., 2013	JBI Cross-Sectional	6/8	Moderate	Moderate Risk of Bias
10	Hamid et al., 2018	JBI Cross-Sectional	3/8	Low	High Risk of Bias

3.7 GRADE Assessment

The certainty of the synthesised evidence was evaluated using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework (see Table 7) for observational prognostic and epidemiological studies across four major domains: (1) population incidence and burden, (2) acquired structural causes, (3) inherited and genetic pathologies, and (4) infectious drivers. Evidence was initially rated as Low certainty due to the observational nature of the included studies and was subsequently downgraded based on serious risk of bias, inconsistency, indirectness, imprecision, or publication bias.

Table 7
GRADE Assessment of Outcomes

Outcome /Domain	No. of Studies (N)	Study Design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other Considerations	Certainty of Evidence (GRADE)
Incidence & Population Burden	4 studies (n = 88,542)	Cohort & Retrospective Autopsy	Serious ^a	Serious ^b	Serious ^c	Very Serious ^d	Suspected Publication Bias ^e	VERY LOW ^{a,b,c,d,e}
Acquired Structural Causes (HTN, CAD)	4 studies (n = 2,625)	Autopsy Series & Cohort	Serious ^a	Serious ^b	Not Serious	Not Serious	None	LOW ^{a,b}
Inherited & Genetic Pathologies	3 studies (n = 8,260)	Genetic Cohort, Case-Control & Autopsy	Serious ^a	Not Serious	Not Serious	Serious ^f	High VUS rate (72.5%)	LOW ^{a,f}
Infectious & Inflammatory Drivers	2 studies (n = 136)	Molecular Pathology & Cohort	Serious ^g	Not Serious	Not Serious	Serious ^d	Highly selected cohorts	LOW ^{d,g}

^a Downgraded by 1 level for Risk of Bias: High reliance on verbal autopsies and retrospective mortuary registers with inconsistent case ascertainment and unstandardized post-mortem protocols across centers.

^b Downgraded by 1 level for Inconsistency: Marked unexplained heterogeneity in reported incidence rates across regions (ranging from 3.0 to 33.6 per 100,000 person-years) and conflicting dominant etiologies between North and Sub-Saharan Africa.

^c Downgraded by 1 level for Indirectness: Substantial variation in operational age definitions across included studies

^d Downgraded by 2 levels for Imprecision: Small sample sizes, wide confidence intervals, and sparse absolute event numbers in population-based denominator estimates.

^e Downgraded by 1 level for Publication Bias: High risk of geographic selection bias; available data represent only six African countries (Cameroon, Algeria, Tunisia, South Africa, Egypt, Nigeria).

^f Downgraded by 1 level for Imprecision: High proportion of Variants of Uncertain Significance (VUS = 72.5%) and low total event count for confirmed pathogenic variants (n = 2/51).

^g Downgraded by 1 level for Risk of Bias: Highly selected, small tertiary forensic/hospital cohorts (n = 48 males for enteroviral myocarditis analysis) prone to selection and diagnostic spectrum bias.

4. DISCUSSION

4.1 Summary of Main Findings

Sudden cardiac death (SCD) remains an important yet insufficiently studied cause of premature mortality among young adults in Africa. Although evidence was available from only a limited number of countries, a number of consistent patterns emerged across the included studies. Cardiovascular disease accounted for most reported SCD cases, while risk factors such as hypertension, diabetes, smoking, obesity, and alcohol use were frequently identified across the literature [4, 6, 8, 14, 20]. The causes of SCD were not uniform across the continent. In the Nigerian autopsy study, hypertensive heart disease accounted for most cardiovascular deaths [20], whereas studies from Tunisia reported a greater contribution from ischemic heart disease and coronary artery disease [6, 7]. Infectious and inflammatory conditions also emerged as important contributors. HIV-associated disease and enteroviral myocarditis were reported among SCD cases in Cameroon and Tunisia [4, 11]. In South Africa, genetic investigations suggested that inherited cardiomyopathies and arrhythmogenic disorders may explain a proportion of sudden unexplained deaths among young adults [10]. Overall, the evidence suggests that SCD in Africa is driven by a combination of cardiovascular disease, persistent infectious conditions, inherited cardiac disorders, and limitations in diagnosis and prevention. While many of these causes are recognised globally, their relative contribution appears to differ across African settings.

4.2 Comparison with Global Evidence

Several findings from this review are consistent with evidence reported from Europe, North America, and Australia. Cardiomyopathies, inherited arrhythmogenic disorders, ischemic heart disease, and myocarditis are recognised causes of SCD worldwide and were also identified in the African studies

included in this review [6, 7, 10, 11, 21, 24]. The South African genetic study further supports growing evidence that inherited cardiac disorders contribute to a proportion of sudden unexplained deaths among young adults [10, 24]. These similarities suggest that many of the biological mechanisms underlying SCD are shared across populations regardless of geographic setting. Despite these similarities, important differences were observed. Studies from Nigeria and Cameroon identified hypertensive heart disease as a leading cause of sudden death among young adults [4, 20], whereas research from many high-income countries more commonly highlights inherited cardiomyopathies and primary electrical disorders as predominant causes in younger populations [21, 24]. This difference may reflect the high prevalence of uncontrolled hypertension, delayed diagnosis, and limited access to preventive cardiovascular care in many African settings, allowing complications to develop earlier in life. Infectious causes seemed to play a greater role in SCD than is generally reported in high-income countries. HIV-associated disease and viral myocarditis were identified among causes of sudden death in the included studies [4, 11]. This pattern reflects the continuing coexistence of communicable and non-communicable diseases across many African countries and highlights the unique epidemiological context within which cardiovascular disease occurs. Differences in diagnostic capacity may also influence the reported distribution of causes. Several studies relied on retrospective records, verbal autopsy, or limited post-mortem investigations [4–8, 10, 14, 20], suggesting that inherited and arrhythmogenic causes may remain under-recognised. Consequently, some of the observed differences between African and high-income settings may reflect variations in case ascertainment rather than true biological differences. Together, these findings indicate that prevention and screening approaches developed in high-income countries may require adaptation to local disease patterns and healthcare realities in Africa.

4.3 Public Health and Clinical Implications

Findings from this review suggest that many SCD events may be preventable through earlier detection and management of cardiovascular disease. The prominence of hypertensive heart disease is particularly important because hypertension can often be identified years before the development of severe cardiovascular complications [4, 20]. Strengthening blood pressure screening programs and improving long-term treatment adherence may therefore represent one of the most practical and cost-effective approaches to reducing SCD risk in many African settings. Equally important is the early identification of individuals who may be at increased risk of SCD. Young adults presenting with unexplained syncope, exertional symptoms, structural heart disease, abnormal electrocardiographic findings, or a family history of sudden cardiac death may benefit from further evaluation where resources permit [8, 10, 21]. Findings from South Africa also support family-based assessment following unexplained sudden death, particularly when inherited cardiac disease is suspected [10]. Several studies highlighted important gaps in surveillance and diagnostic capacity. Incomplete medical records, limited autopsy utilisation, and uncertainty surrounding the precise cause of death were common challenges [4–8, 10, 14, 20]. As a result, the true burden of SCD may be underestimated. Improved surveillance systems, standardised reporting frameworks, and stronger collaboration between clinicians, pathologists, and public health authorities would help generate more reliable data and support targeted prevention initiatives. Collectively, these findings underscore the need for greater emphasis on prevention, risk stratification, and surveillance.

4.4 Prevention Strategies and Future Directions

The risk factors identified across the included studies provide a useful framework for prevention efforts. Hypertension, diabetes, obesity, smoking, and excessive alcohol use were repeatedly associated with increased SCD risk [4, 6, 8, 14, 20]. Strengthening cardiovascular prevention within primary healthcare systems should therefore remain a priority. Earlier identification and management of these conditions may reduce progression to structural heart disease and other complications associated with sudden death. Targeted screening may offer an additional opportunity for prevention. Several studies emphasised the importance of evaluating individuals with a family history of SCD, inherited cardiovascular disease, unexplained syncope, or participation in competitive sports [8, 10, 12]. Where feasible, clinical assessment supported by electrocardiography and selective use of echocardiography may improve identification of high-risk individuals before a catastrophic event occurs [12, 21]. Beyond primary prevention, strengthening emergency response systems remains an important component of reducing mortality following sudden cardiac arrest. In Cameroon, limited access to resuscitation equipment and defibrillators was identified as a major challenge [4]. Expanding cardiopulmonary resuscitation (CPR) training, increasing public awareness of sudden cardiac arrest, and improving access to automated external defibrillators may improve survival following out-of-hospital cardiac arrest [20, 23]. At the policy level, integrating cardiovascular risk assessment into routine primary healthcare services may improve early identification of individuals at risk. Strengthening surveillance systems, expanding access to diagnostic services, and supporting population-based research will be essential for improving understanding of SCD and guiding future prevention strategies across Africa.

4.5 Strengths and Limitations of the Review

This review provides a focused synthesis of the available evidence on sudden cardiac death among young adults in Africa. By including studies from different regions of the continent and incorporating community-based, hospital-based, autopsy-based, and genetic investigations, it offers a broad overview of current knowledge regarding disease burden, causes, risk factors, and prevention strategies [4–8, 10–12, 14, 19]. However, the available evidence was limited in both quantity and geographic representation, with studies originating from only a small number of African countries [4–8, 10–12, 14, 19]. Considerable variation existed in study design, diagnostic methods, and outcome reporting, making direct comparisons challenging. Although this review defined young adults as individuals aged 15–39 years, some included studies used a broader age range of up to 45 years (Van deventer et al), which may have introduced some heterogeneity.

Moreover, many studies also relied on retrospective data, verbal autopsy, or incomplete clinical records [4–8, 10, 14, 20], which may have affected the accuracy of case classification. In addition, limited access to autopsy services and genetic testing across many settings may have resulted in under-recognition of inherited and arrhythmogenic causes of sudden death. Despite these limitations, the review highlights important patterns in the burden and drivers of SCD among young adults in Africa and underscores the need for stronger surveillance, prevention, and research efforts across the continent.

Conclusion

Sudden cardiac death is a recognised cause of mortality among young adults in Africa. Causes include acquired cardiovascular disease, infectious conditions, and inherited cardiac disorders. Hypertensive heart disease and infectious contributors are seen more prominently than in high-income settings. Although many SCD events may be preventable through earlier detection and management of hypertension, targeted screening of high-risk individuals, and stronger emergency response systems, barriers like diagnostic and surveillance gaps continue to hinder progress and obscure the true burden across the continent. Future priorities should focus on expanding autopsy capacity, scaling post-mortem genetic testing, and standardising death reporting, in order to generate more reliable data. As well, cardiovascular surveillance and primary prevention infrastructure across African health systems are critical for reducing premature cardiac deaths in this population.

Abbreviations

CAD
Coronary Artery Disease
CPR
Cardiopulmonary Resuscitation
CVD
Cardiovascular Disease
CPVT
Catecholaminergic Polymorphic Ventricular Tachycardia
DM
Diabetes Mellitus
HF
Heart Failure
HIV
Human immunodeficiency virus
HTN
Hypertension
ECG
Electrocardiogram
SCD
Sudden Cardiac Death
SUD
Sudden Unexpected Death
SUDA
Sudden Unexpected Death in Adults
SUDY
Sudden Unexpected Death in the Young
SSA
sub-Saharan Africa
LMICs
Low- and Middle-Income Countries
MI
myocardial Infarction
MD(c)
Doctor of Medicine Candidate

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VOA conceived and designed the study. HAJ and MOO performed the data analysis. VOA, HAJ, MOO, JCA, IOV, HOS, NCB, AOA, AO, OEA, DAW, KGN, and MAS contributed to drafting the initial manuscript, critically revised subsequent versions, and approved the final version for publication.

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References

1. Priori SG, Blomström-Lundqvist C, Mazzanti A, Blom N, Borggrefe M, Camm J, Elliott PM, Fitzsimons D, Hatala R, Hindricks G, Kirchhof P. Authors/Task Force Members; Document Reviewers. 2015 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death: The Task Force for the Management of Patients with Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death of the European Society of Cardiology (ESC) Endorsed by: Association for European Paediatric and Congenital Cardiology (AEPC). *Eur Heart J*. 2015 Nov 1;36(41):2793-867. <https://doi.org/10.1093/eurheartj/ehv316>
2. Del Duca F, Ghamlouch A, Manetti AC, Napoletano G, Sonnini E, Treves B, De Matteis A, La Russa R, Sheppard MN, Fineschi V, Maiese A. Sudden cardiac death, post-mortem investigation: a proposed first and second-line genetic tests. *Journal of Personalized Medicine*. 2024 May 20;14(5):544. <https://doi.org/10.3390/jpm14050544>
3. Ackerman M, Atkins DL, Triedman JK. Sudden cardiac death in the young. *Circulation*. 2016 Mar 8;133(10):1006-26. <https://pubmed.ncbi.nlm.nih.gov/articles/PMC5033115/>
4. Bonny A, Tibazarwa K, Mbouh S, Wa J, Fonga R, Saka C, Ngantcha M, Pan African Society of Cardiology (PASCAR) Task Force on Sudden Cardiac Death. Epidemiology of sudden cardiac death in Cameroon: the first population-based cohort survey in sub-Saharan Africa. *International Journal of Epidemiology*. 2017 Aug 1;46(4):1230-8. <https://doi.org/10.1093/ije/dyx043>
5. Kerrouche O, Amghar H, Haddad H. Mort subite de l'adulte: données de 305 cas d'autopsies consécutives en Algérie. In *Annales de Caln Annales et d'Angéologie* 2024 Jun 1 (Vol. 73, No. 3, p. 101760). Elsevier Masson. <https://doi.org/10.1016/j.ancard.2024.101760>
6. Saadi S, Ben Jomaa S, Bel Hadj M, Oualha D, Haj Salem N. Sudden death in the young adult: a Tunisian autopsy-based series. *BMC Public Health*. 20(1):1915. <https://doi.org/10.1186/s12889-020-10012-z>
7. Belhadj M, Saadi S, Jomaa SB, Dhouieb R, Kort I, Marzougui M, Mesrati MA, Chadly A, Salem NH. La mort par infarctus du myocarde chez le sujet jeune: étude de 312 cas de mort subite. In *Annales de Cardiologie et d'Angéologie* 2020 Apr 1 (Vol. 69, No. 2, pp. 67-73). Elsevier Masson. <https://doi.org/10.1016/j.ancard.2020.03.006>
8. Hamid L, Abdelfattah A, Hussien K, Farouk K, Amin M, Omar L, Mokhtar MS. Screening general population for family history of sudden cardiac death unmasks high-risk individuals as potential victims (pilot study). *The Egyptian Journal of Critical Care Medicine*. 2018 Apr;6(1):9-16. <https://doi.org/10.1016/j.ejccm.2018.04.002>
9. Srivats S, Zghyer F, Shahriri Z, Albert C, Al-Khatib SM, Chugh S, Etheridge SP, Goldberger ZD, Gopinathannair R, Lakkireddy D, Morin DP. Sudden cardiac arrest: Limitations in risk-stratification and treatment, and the potential for digital technologies and artificial intelligence to improve prediction and outcomes. *Progress in Cardiovascular Diseases*. 2025 Jun 18. <https://doi.org/10.1016/j.pcad.2025.06.005>
10. Van Deventer BS, du Toit-Prinsloo L, Van Niekerk C. Next-generation sequencing: a possible answer to sudden unexplained deaths in a young South African cohort?. *Forensic Science, Medicine and Pathology*. 2025 Sep;21(3):1081-90. <https://doi.org/10.1007/s12024-025-00944-6>
11. Gaaloul I, Riabi S, Harrath R, Evans M, Salem NH, Mlayeh S, Huber S, Aouni M. Sudden unexpected death related to enterovirus myocarditis: histopathology, immunohistochemistry and molecular pathology diagnosis at post-mortem. *BMC Infectious Diseases*. 2012 Sep 11;12(1):212. <https://doi.org/10.1186/1471-2334-12-212>
12. Schmied C, Di Paolo FM, Zerguini AY, Dvorak J, Pelliccia A. Screening athletes for cardiovascular disease in Africa: a challenging experience. *British journal of sports medicine*. 2013 Jun 1;47(9):579-84. <https://doi.org/10.1136/bjsports-2012-091803>
13. Petek BJ, Churchill TW, Moulson N, Kliethermes SA, Baggish AL, Drezner JA, Patel MR, Ackerman MJ, Kucera KL, Siebert DM, Salerno L. Sudden cardiac death in National Collegiate Athletic Association athletes: a 20-year study. *Circulation*. 2024 Jan 9;149(2):80-90. <https://doi.org/10.1161/CIRCULATIONAHA.123.065908>
14. Swart ML, Vandayar Y, Mole CG, Oghenechovwen O, Hamadziripi D, Heathfield LJ. A 10-year retrospective analysis of sudden unexpected death in the young investigated at Salt River Mortuary, Cape Town. *International Journal of Legal Medicine*. 2025 Jan;139(1):335-52. <https://doi.org/10.1007/s00414-024-03331-y>
15. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.

16. National Cancer Institute. Adolescents and Young Adults with Cancer. Bethesda (MD): National Cancer Institute; July 22, 2026. Available from: <https://www.cancer.gov/types/aya>
17. Lang MJ, David V, Giese-Davis J. The Age Conundrum: A Scoping Review of Younger Age or Adolescent and Young Adult as a Risk Factor for Clinical Distress, Depression, or Anxiety in Cancer. *J Adolesc Young Adult Oncol*. 2015 Dec;4(4):157-73. doi: 10.1089/jayao.2015.0005.
18. Aromataris E, Munn Z, editors. JBI manual for evidence synthesis. Adelaide: JBI; 2020 [cited 2026 Jun 17]. Available from: <https://synthesismanual.jbi.global>.
19. Schmied, C., Zerguini, Y., Junge, A., Tscholl, P., Pelliccia, A., Mayosi, B. M., & Dvorak, J. (2009). Cardiac findings in the precompetition medical assessment of football players participating in the 2009 African Under-17 Championships in Algeria. *British Journal of Sports Medicine*, 43(9), 716–721. <https://doi.org/10.1136/bjsm.2009.064196>
20. Pelemo, O.E., Sabageh, D., Komolafe, A.O. et al. An autopsy review of sudden unexpected natural deaths in a suburban Nigerian population. *Popul Health Metrics* 12, 26 (2014). <https://doi.org/10.1186/s12963-014-0026-9>
21. Zeppenfeld K, Tfelt-Hansen J, de Riva M, Winkel BG, Behr ER, Blom NA, et al. 2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death. *Eur Heart J*. 2022;43(40):3997–4126. doi:10.1093/eurheartj/ehac262.
22. Panchal AR, Bartos JA, Cabañas JG, Donnino MW, Drennan IR, Hirsch KG, et al. Part 3: Adult Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2020;142(Suppl 2). doi:10.1161/CIR.0000000000000916.
23. Berg KM, Cheng A, Panchal AR, Topjian AA, Aziz K, Bhanji F, et al. Part 7: Systems of Care: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2020;142(Suppl 2). doi:10.1161/CIR.0000000000000899.
24. Bagnall RD, Weintraub RG, Ingles J, Duflou J, Yeates L, Lam L, et al. A prospective study of sudden cardiac death among children and young adults. *N Engl J Med*. 2016;374(25):2441–2452. doi:10.1056/NEJMoa1510687.

Additional References

National Cancer Institute. Adolescents and Young Adults with Cancer. Bethesda (MD): National Cancer Institute; July 22, 2026. Available from: <https://www.cancer.gov/types/aya>

Lang MJ, David V, Giese-Davis J. The Age Conundrum: A Scoping Review of Younger Age or Adolescent and Young Adult as a Risk Factor for Clinical Distress, Depression, or Anxiety in Cancer. *J Adolesc Young Adult Oncol*. 2015 Dec;4(4):157-73. doi: 10.1089/jayao.2015.0005.

Figures

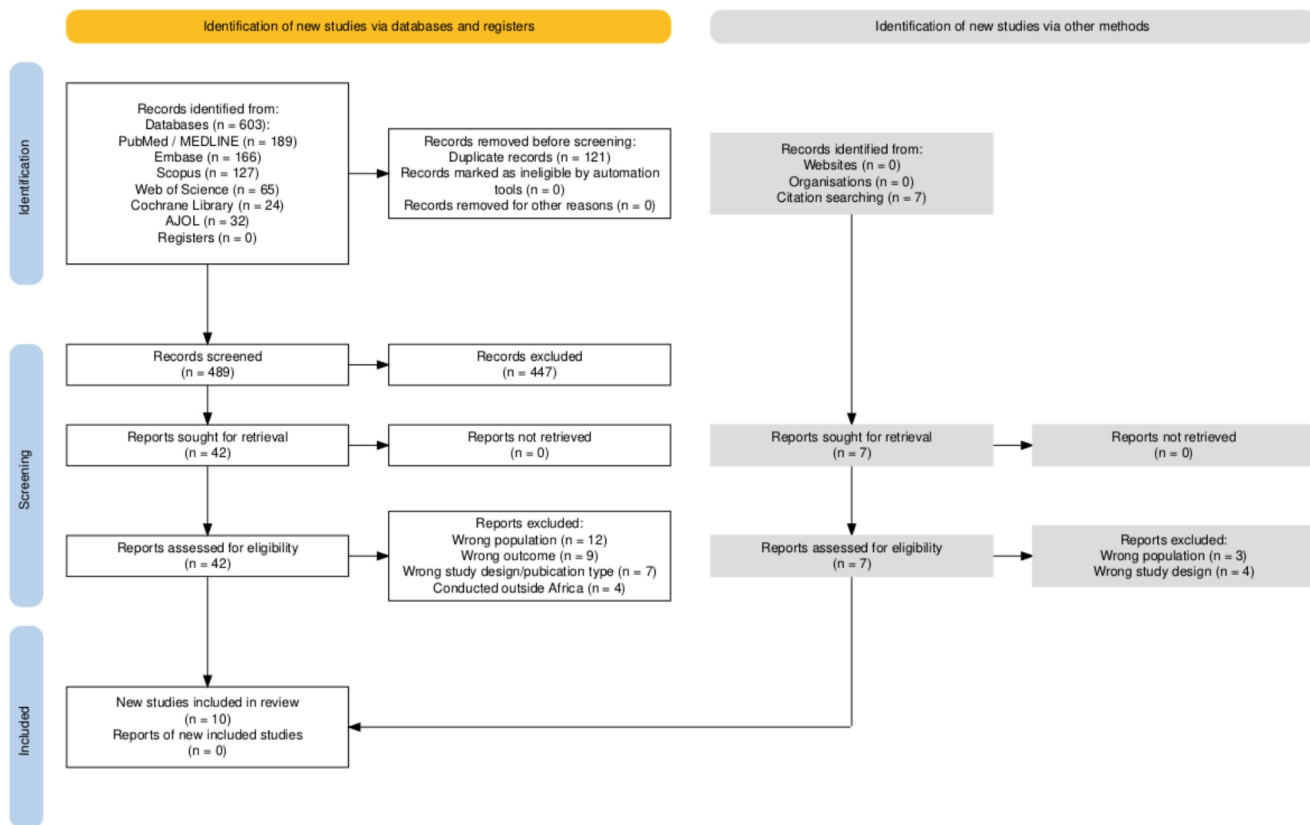


Figure 1

Overview of Selection Process