Journal of the American Heart Association

SYSTEMATIC REVIEW AND META-ANALYSIS

Acute Coronary Syndromes in Sub-Saharan Africa: A 10-Year Systematic Review

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BACKGROUND: Data in the literature on acute coronary syndrome in sub-Saharan Africa are scarce.

METHODS AND RESULTS: We conducted a systematic review of the MEDLINE (PubMed) database of observational studies of acute coronary syndrome in sub-Saharan Africa from January 1, 2010 to June 30, 2020. Acute coronary syndrome was defined according to current definitions. Abstracts and then the full texts of the selected articles were independently screened by 2 blinded investigators. This systematic review was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses standards. We identified 784 articles with our research strategy, and 27 were taken into account for the final analysis. Ten studies report a prevalence of acute coronary syndrome among patients admitted for cardiovascular disease ranging from 0.21% to 22.3%. Patients were younger, with a minimum age of 52 years in South Africa and Djibouti. There was a significant male predominance. Hypertension was the main risk factor (50%–55% of cases). Time to admission tended to be long, with the longest times in Tanzania (6.6 days) and Burkina Faso (4.3 days). Very few patients were admitted by medicalized transport, particularly in Côte d'Ivoire (only 34% including 8% by emergency medical service). The clinical presentation is dominated by ST–elevation sudden cardiac arrest. Percutaneous coronary intervention is not widely available but was performed in South Africa, Kenya, Côte d'Ivoire, Sudan, and Mauritania. Fibrinolysis was the most accessible means of revascularization, with streptokinase as the molecule of choice. Hospital mortality was highly variable between 1.2% and 24.5% depending on the study populations and the revascularization procedures performed. Mortality at follow-up varied from 7.8% to 43.3%. Some studies identified factors predictive of mortality.

CONCLUSIONS: The significant disparities in our results underscore the need for a multicenter registry for acute coronary syndrome in sub-Saharan Africa in order to develop consensus-based strategies, propose and evaluate tailored interventions, and identify prognostic factors.

Key Words: acute coronary syndrome ■ acute myocardial infarction ■ sub-Saharan Africa

In recent years, many developing countries, and particularly those in sub-Saharan Africa (SSA), have experienced a sharp increase in acute coronary syndrome (ACS) in a context of rapid urbanization, changes in lifestyle and diet, an aging population and, above all, uncontrolled cardiovascular risk factors.[1] Coronary heart disease (CHD) is now 1 of the 3 leading causes of death in most SSA countries[2] increasing the burden of health expenditures in regions that are also struggling with uncontrolled infectious diseases and malnutrition.

Since the CORONAFRIC I study, the first multicenter study of CHD in SSA conducted in the 1990s,[3] only a few, mostly single-center studies have been conducted. These studies have shown an overall increase in incident cases of ACS and confirmed the epidemic of CHD that was declared 30 years ago.[4] Although the burden of ACS has been steadily

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Supplemental Material for this article is available at https://www.ahajournals.org/doi/suppl/10.1161/JAHA.120.021107

For Sources of Funding and Disclosures, see page 12.

JAHA is available at: www.ahajournals.org/journal/jaha

CLINICAL PERSPECTIVE

What Is New?

- This is an original paper addressing the knowledge gap on acute coronary syndrome in sub-Saharan Africa.
- Based on a systematic review, we showed disparities in population characteristics in acute coronary syndrome, outcomes, and tools of management available across countries.
- Acute management of acute coronary syndrome is a challenging issue in sub-Saharan Africa.

What Are the Clinical Implications?

- In sub-Saharan Africa setting, improvement of the delivery of care in acute coronary syndrome is an urgent need in contemporary cardiology practice.
- Implementation of multicenter registries is required to develop consensus strategies.
- Primary prevention and awareness of populations remain the best weapons to reduce the growing burden of coronary disease in sub-Saharan Africa.

Nonstandard Abbreviations and Acronyms

SSA	sub-Saharan Africa

increasing in recent years in SSA cardiology departments, there are still few published articles on ACS patients in SSA. Yet published data can help to focus the attention of health authorities on developing prevention and management strategies for ACS and at the same time raise public awareness. The low level of mobilization within governments and ministries of health can therefore be attributed in part to the lack of data in the literature. For instance, only 39% of African countries had an action plan against noncommunicable diseases compared with 65% in the United States and 94% in Europe.[5]

In this study, we set out to conduct a systematic review in order to identify the main observational studies over the past decade and to report on the current state of knowledge on the epidemiology of ACS, how it is managed, and patient outcomes. Furthermore, we present the opportunity for a large multinational registry of ACS, to increase awareness of population and healthcare providers, and to improve management of ACS in our practice.

METHODS

Inclusion Criteria

We conducted a systematic review of the MEDLINE (PubMed) database of observational studies (cohort, case-control, longitudinal and cross-sectional studies) of ACS in SSA from January 1, 2010 to June 30, 2020. Included studies were required to report the incidence and/or prevalence, epidemiological data, means of management, and/or prognosis of patients with ACS, regardless of the language of writing. Myocardial infarction (MI) was defined according to the current universal definition.[6,7] ST-segment–elevation MI (STEMI) was defined by the presence of symptoms of myocardial ischemia, at least 2 contiguous leads with ST-segment–elevation ≥1 mm or pathological Q waves, and an increase in serum markers of myocardial necrosis above the upper limit of normal for troponin and/or enzymes.[8] ACS without persistent ST-segment–elevation was defined by the presence of symptoms or signs of myocardial ischemia, the absence of persistent ST-segment elevation on the ECG, and elevation of cardiac biomarkers (non–ST-segment–elevation myocardial infarction [NSTEMI] or non-Q-wave MI) or not (unstable angina).[9] The included studies had to have been conducted in unselected populations (including young subjects, elderly subjects, women, etc) and must have specifically involved hospitalized patients with the exclusive diagnosis of ACS. Randomized studies, meta-analyses, and case reports were excluded from our study.

Research Protocol

The search strategy was based on the Medical Subject Headings tree headings "Africa South of the Sahara," "Africa, Western," "Africa, Eastern," "Africa, Central," "Africa, Southern," "South Africa," "Acute Coronary Syndrome," and "Myocardial Infarction," and associated terms. Table S1 presents the full search strategy used in our study. Two independent reviewers (H.Y. and A.E.) conducted a manual literature search and cross-referenced their results.

Selection of Studies

The titles and abstracts of the selected papers were then independently screened by the 2 investigators (H.Y. and A.E.) for eligibility according to the inclusion criteria. Once the titles and abstracts were selected, an evaluation of the full text of the article was conducted to determine inclusion. Differences regarding the inclusion of studies were resolved by consensus. If disagreement persisted, the decision was made by a third independent reviewer (R.N.).

Data Extraction

Data extraction was performed by both reviewers. The characteristics considered were:

1. First author and year of publication
2. Country in which the study was conducted
3. Study design: prospective, retrospective, cross-sectional
4. Number of patients included in the study
5. Prevalence of ACS: recovered in each study, or calculated by dividing the number of patients diagnosed with ACS by the total population over the period
6. Mean (or median) age of ACS patients
7. Male patient rate (percentage).
8. Time from symptom onset to admission (in hours or days)
9. Management tools: fibrinolysis or coronary angioplasty.
10. Hospital mortality rate
11. Follow-up time and mortality rate

Study Quality and Bias

We used the Loney scoring system to evaluate the quality of the included studies.[10] The Loney scoring system is based on the presence (score=1) or absence (score=0) of the following criteria, with a maximum score of 8 points:

1. Random sample or entire population
2. Unbiased sampling
3. Adequate sample size: prevalence of ACS in SSA cardiology departments is scarce. We considered assumption of 6.1% of coronary emergencies,[11] 5% error, and 95% CI. The calculated minimum sample size is 88 patients.
4. Measurements carried out according to validated criteria
5. Results reported by unbiased interviewers
6. Satisfactory response rate (at least 70%), description of patients who refused
7. CIs, subgroup analyses
8. Description of study subjects

A score ≥5 indicates a good quality study, whereas a score <5 suggests a poor quality study.

Ethics

This systematic review was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses standards.[12,13] As we conducted a literature review, no intervention on human subjects was required, and no consent or ethics committee authorization was required. Our research protocol was submitted to https://www.crd.york.ac.uk/prospero/ (International Prospective Register of Systematic Reviews). It was published under registration number CRD42020201077. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Checklist of our review is in Table S2.

Data Collection and Analysis

A descriptive analysis of the included studies was conducted. A map of SSA was inserted to show the distribution of all studies.

RESULTS

Based on our search strategy, 784 articles were included in the MEDLINE (PubMed) database. Twenty-seven studies met our criteria and were retained. The flow chart is detailed in Figure 1.

Table 1 summarizes the characteristics of the 27 studies.[14–40] In 6 studies, the patients included were exclusively STEMI.[15,19,29,34,35,37] Table S3 show the 12 studies including patients hospitalized for MI.[1] One study evaluated a population of patients with only NSTEMI.[32] The other studies evaluated a heterogeneous ACS population (STEMI and NSTEMI).

The 27 published studies were conducted in 13 (Burkina Faso, Côte d'Ivoire, Djibouti, Ethiopia, Kenya, Mali, Mauritania, Nigeria, Senegal, South Africa, Sudan, Tanzania, and Togo) out of a total of 48 sub-Saharan African countries. With 5 studies each, Côte d'Ivoire (Table 2), South Africa (Table 3), and Kenya (Table 4) present the highest number of publications, according to the specified criteria. The geographic distribution of the 27 studies is shown in Figure 2.

Twenty-one of the 27 studies (77.8%) were of good quality according to Loney's criteria. The lowest reported criteria were satisfactory response rate (>70%), subgroup analyses and study size >88 patients (Figure 3).

Ten studies reported the prevalence of ACS among patients admitted in cardiology departments. Their results ranged from 0.21% to 22.3%.[14,22] The average age in South Africa[29] and Djibouti[35] is 52 years, the highest age was in Kenya (63.3 years).[36] Burden of cardiovascular risk factors across 3 studies was performed in Figure 4. There were some disparities in the burden of diabetes, dyslipidemia, and smoking habits.

The longest average times between the onset of pain and admission to a cardiology department are found in Tanzania (6.6 days)[14] and Burkina Faso (4.3 days),[34] where recent data have shown a significant decrease in this time to 30.55 hours.[20] The shortest time was found in South Africa (2.3–3.6 hours). In this systematic review, very few patients were transferred in an appropriate means of transport: 34% (including only 8% by

*References 15, 19, 25, 26, 29, 32, 33, 35, 37, 39, 40.

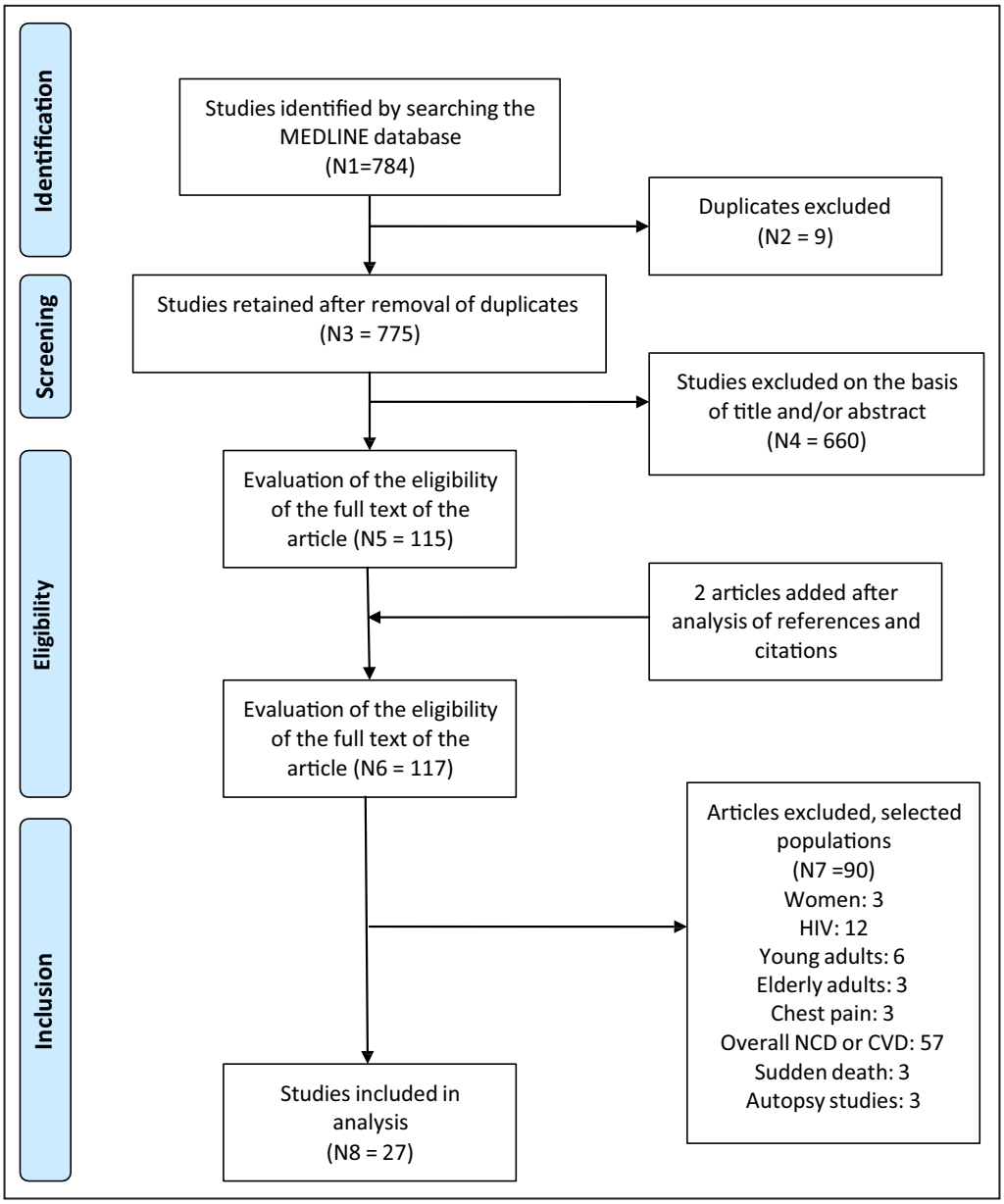

Figure 1. Flow chart of the study.
CVD indicates cardiovascular disease; and NCD, noncommunicable diseases.

emergency medical service) in Côte d'Ivoire,[27] 29% in Mauritania,[17] 11.9% in Senegal,[30] and 4.5% in Togo.[22]

The clinical presentation of ACS is dominated by STEMI in most studies, as in Côte d'Ivoire[27] and Kenya[23] with 71.5% and 57.1%, respectively, but it was found in lower proportions in South Africa (41.1%).[38] Percutaneous coronary interventions (PCI) were performed in South Africa,[25,29,32,37,38] Kenya,[21,23,26,36] Côte d'Ivoire,[15,18,24,27] Sudan,[28] and Mauritania.[17] Fibrinolysis was the most widely reported and available means of revascularization in most of our studies (18/27 or 66.7%).[16,17,19–23,25–30,34–38]

Hospital mortality in ACS was highly variable across studies, with estimates ranging between 1.2% and 24.5%.[2] The highest mortality rate was reported in Ethiopia (24.5%). In STEMI, the reported mortality was very low, varying from 1.2% to 1.8% of patients who underwent primary PCI[15] or early thrombolysis (median admission-fibrinolysis time of 45 minutes).[25]

Mortality at 30 days was estimated to range from 7.8% to 43.3%.[14,20,21,30,35] The highest 30-day rate in the study period, 43.3%, was reported in Tanzania.[14] In South Africa, mortality at 30 days was 2.4% in STEMI and 1.7% in NSTEMI.[38] In the longer term, 1-year mortality was 5.7% in South Africa,[38] 13.9% in Kenya,[21] and 20% in Djibouti.[35] After a median follow-up of

[†]References 14, 16, 19–21, 24–28, 30–36, 39.

Table 1. Studies on ACS in Sub-Saharan Africa Available on MEDLINE Based on Our Research Strategy (2010–2020)

Author (y)	Country	Design	Population	Prevalence (%)	Age (y)	Male sex (%)	Time from symptoms to admission	Fibrinolysis/ angioplasty	In-hospital mortality (%)	Follow-up mortality (follow-up time)
Hertz (2020)[14]	Tanzania	Prospective	152 ACS	22.3	61.2	59.9	6.6 h	N/N	…	43.3% (30 d)
Ekou (2020)[15]	Côte d'Ivoire	Cross-sectional	166 STEMI	…	54.5	91.6	20 h	N/Y	1.2	…
Desta (2020)[16]	Ethiopia	Retrospective	151 ACS	…	59.1	72.2	95.85 h	Y/Y	24.5	…
Ba (2019)[17]	Mauritania	Cross-sectional	80 ACS	10.2	62.4	70.0	34.8 h	Y/Y	3.8	…
Yao (2019)[18]	Côte d'Ivoire	Cross-sectional	256 ACS	…	53.2	85.9	…	N/Y	…	…
Yao (2019)[19]	Côte d'Ivoire	Prospective	329 STEMI	…	57	82.6	20 h	Y/Y	14.3	10.4% (39 mo)
Kaboré (2019)[20]	Burkina-Faso	Prospective	111 ACS	4.2	57.6	77.5	30.55 h	Y/N	8.1	16.2% (30 d)
Varwani (2019)[21]	Kenya	Retrospective	230 ACS		60.5	81.7		Y/Y	7.8	7.8% (30 d) 13.9% (1 y)
Pessinaba (2018)[22]	Togo	Cross-sectional	67 ACS	3.5	60	65.7	81.9 h	Y/N	10.5	…
Bahiru (2018)[23]	Kenya	Retrospective	196 ACS		57.5	65		Y/Y	17	
N'Guetta (2018)[24]	Côte d'Ivoire	Prospective	165 ACS	…	55.6	93	…	N/Y	1.2	1.2% (1 y)
Chetty (2016)[25]	South Africa	Cross-sectional	122 MI	…	61	65	…	Y/N	1.8 (STEMI)	…
Kimeu (2016)[26]	Kenya	Retrospective	64 MI	…	56.7	87.5		Y/Y	9.4	
N'Guetta (2016)[27]	Côte d'Ivoire	Cross-sectional	425 ACS	13.5	55.4		44.7 h	Y/Y	10	…
Mirghani (2015)[28]	Soudan	Cross-sectional	197 ACS	…	56.8	56.8	…	Y/Y	6.6	…
Meel (2015)[29]	South Africa	Prospective	100 STEMI	…	52	70	2.3 h	Y/N	…	…
Mboup (2014)[30]	Senegal	Prospective	59 ACS	4.05	57.1	79.7	53.2 h	Y/N	15.25	18.6% (30 d)
Giday (2013)[31]	Ethiopia	Retrospective	21 ACS	…	57.1	65.2	…	N/N	14.4	…
Moses (2013)[32]	South Africa	Retrospective	76 NSTEMI	…	60.5	21.5	24.21 h	N/Y	15.8	…
Kolo (2013)[33]	Nigeria	Retrospective	14 MI	0.21	56	92	…	N/N	21.44	
Yameogo (2012)[34]	Burkina-Faso	Cross-sectional	43 STEMI		56.5	88	4.3 d	Y/N	11.6	…
Maurin (2012)[35]	Djibouti	Prospective	35 STEMI	40	52	88.6	23 h	Y/N	20%	14% (30 d) 20% (1 y)
Shavadia (2012)[36]	Kenya	Cross-sectional	111 ACS	5.1	63.3	75.7	12.9 h (STEMI)	Y/Y	8.1	…
Maharaj (2012)[37]	South Africa	Retrospective	161 STEMI	…	54	…	3.2 h	Y/N	…	…
Schamroth (2012)[38]	South Africa	Prospective	615 ACS	…	58	…	3.6 h (STEMI)	Y/Y	…	2.4% STEMI (30 d) 1.7% NSTEMI (30 d) 5.7% (1 y)
Ogeng'o (2010)[39]	Kenya	Retrospective	120 MI	…	56.8	66	…	N/Y	5%	…
Bèye (2011)[40]	Mali	Cross-sectional	8 MI	7.3	54.62	100	…	N/N	28.6%	…

ACS indicates acute coronary syndrome; MI, myocardial infarction; N, no; NSTEMI, non–ST-segment–elevation myocardial infarction; STEMI, ST-segment–elevation myocardial infarction; and Y, yes.

Table 2. Studies on ACS in Côte d'Ivoire (2010–2020)

Author (y)	Country	Design	Population	Prevalence (%)	Age (y)	Male sex (%)	Time from symptoms to admission	Fibrinolysis/ angioplasty	In-hospital mortality (%)	Follow-up mortality (follow-up time)
Ekou (2020)[15]	Côte d'Ivoire	Cross-sectional	166 STEMI	…	54.5	91.6	20 h	N/Y	1.2	…
Yao (2019)[18]	Côte d'Ivoire	Cross-sectional	256 ACS	…	53.2	85.9	…	N/Y	…	…
Yao (2019)[19]	Côte d'Ivoire	Prospective	329 STEMI	…	57	82.6	20 h	Y/Y	14.3	10.4% (39 mo)
N'Guetta (2018)[24]	Côte d'Ivoire	Prospective	165 ACS	…	55.6	93	…	N/Y	1.2	1.2% (1 y)
N'Guetta (2016)[27]	Côte d'Ivoire	Cross-sectional	425 ACS	13.5	55.4		44.7 h	Y/Y	10	…

ACS indicates acute coronary syndrome; N, no; STEMI, ST-segment–elevation myocardial infarction; and Y, yes.

39 months, a study conducted in Côte d'Ivoire found an all-cause mortality rate of 10.4%, with a higher rate in patients who did not receive coronary reperfusion (13.3%).[19]

DISCUSSION

Epidemiology

Prevalence

The first multicenter epidemiological data on CHD in SSA, CORONAFRIC I, dates back to the period 1988 to 1991.[3] The cumulative incidence of CHD was 3.17%. In 2006, Bertrand et al[11] conducted the multicenter MULTAF-UCASS study on cardiovascular emergencies in SSA. Six hundred and sixty-five patients were included from 7 participating centers (Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Gabon, Mauritania, Senegal). Although CHD accounted for only 6.1% of admissions, the burden of CHD had significantly increased in just over a decade.

Significant differences in prevalence across studies included reflect disparities in the diagnostic criteria and tools available between SSA countries and the population's level of knowledge about the symptoms of coronary disease, which can lead to the underdiagnosis of ACS.[41] The limited availability of diagnostic tools (notably troponins) reported in several studies, including those by Kolo et al[33] and Hertz et al in Tanzania,[42] may also explain the low rate of documented MI cases (notably NSTEMI). The widespread use of troponin testing, as in developed countries, allows a greater screening of infarction cases, particularly NSTEMI.[43]

Age, Sex

All the studies conducted in SSA are unanimous: patients with ACS are much younger than those in developed countries, with an age difference that often reaches 10 years. The population of SSA, which is younger as a result of population dynamics,[44] including lower life expectancy, appears to be at earlier risk for the most severe form of CHD. Male predominance was very strong in all studies, reaching 91.2% in a series of 166 patients in Côte d'Ivoire in whom primary PCI was performed.[15] The highest female representations was found in Sudan (43.1%)[28] and Tanzania and Kenya (40.1%).[14,23]

Cardiovascular Risk Factors

In the INTERHEART Africa multicentric study,[45] hypertension was the risk factor most positively associated with the occurrence of a first episode of myocardial infarction in Black Africans (50.4%; OR, 6.99; 95% CI, 4.23–11.55). Overall, hypertension was the main risk

Table 3. Studies on ACS in South Africa (2010–2020)

Author (y)	Country	Design	Population	Prevalence (%)	Age (y)	Male sex (%)	Time from symptoms to admission	Fibrinolysis/ angioplasty	In-hospital mortality (%)	Follow-up mortality (follow-up time)
Chetty (2016)[25]	South Africa	Cross-sectional	122 MI	…	61	65	…	Y/N	1.8 (STEMI)	…
Meel (2015)[29]	South Africa	Prospective	100 STEMI	…	52	70	2.3 h	Y/N	…	…
Moses (2013)[32]	South Africa	Retrospective	76 NSTEMI	…	60.5	21.5	24.21 h	N/Y	15.8	…
Maharaj (2012)[37]	South Africa	Retrospective	161 STEMI	…	54	…	3.2 h	Y/N	…	…
Schamroth (2012)[38]	South Africa	Prospective	615 ACS	…	58	…	3.6 h (STEMI)	Y/Y	…	2.4% STEMI (30 d) 1.7% NSTEMI (30 d) 5.7% (1 y)

ACS indicates acute coronary syndrome; MI, myocardial infarction; N, no; NSTEMI, non–ST-segment–elevation myocardial infarction; STEMI, ST-segment–elevation myocardial infarction; and Y, yes.

factor in this review and was found in 50% to 55% of patients with ACS. The preponderance of hypertension as a risk factor for CHD is probably related to a higher prevalence and a lower control rate compared with developed countries.[46]

Time to Hospital Admission

The time to admission remained very high in most studies, influencing the rate of patients who benefit from urgent myocardial reperfusion. Continuous training and equipment for prehospital and emergency services for the management of ACS (ECGs, fibrinolytics, etc) are essential measures to reduce the time required for treatment.[47] South Africa has the shortest time, between 2.3 and 3.6 hours for patients with STEMI, which means that primary PCI or thrombolysis are performed more often than in other SSA countries. In Côte d'Ivoire, there has been an encouraging reduction of more than 50% in the time to admission from 44.7 to 20 hours within 4 years.[15,27]

Mode of Transport

In the majority of studies, patients are admitted by nonmedical transport. Prehospital structures like ambulances and firefighters are rarely used, unlike in Western countries where they are in the front line of care. These observations underlie the enormous need for public awareness and information but also for the establishment of care networks and collaboration between specialized care centers and prehospital emergency services to improve patient care and outcomes.

Angiographic Data: Severity of Coronary Lesions

Scarcity of angiographic data in SSA is related to the lack of centers with catheterization laboratories.[47] In a South African study of patients with NSTEMI, 80% of the patients had multivessel CHD (40% 2 vessel and 40% 3 vessel),[32] confirmed in 2 other series of patients in Côte d'Ivoire[18] and Kenya.[36] Among STEMI, data from an Ivorian catheterization laboratory[18,24] reported a predominance of 1-vessel CHD up to 52.4% of cases, and a minority of patients (between 10% and 16%) had multivessel CHD.

Disease Management

Percutaneous Coronary Intervention

The implementation of PCI in SSA remains a challenge. Most countries have limited access to heart centers where PCI can be performed. In East and Central Africa, there were 2 catheterization laboratories with routine procedures in 2006 (both located in Kenya). This number increased recently to 12 in 2017, spread

Table 4. Studies on ACS in Kenya (2010–2020)

Author (y)	Country	Design	Population	Prevalence (%)	Age (y)	Male sex (%)	Time from symptoms to admission	Fibrinolysis/angioplasty	In-hospital mortality (%)	Follow-up mortality (follow-up time)
Varwani (2019)[21]	Kenya	Retrospective	230 ACS		60.5	81.7		Y/Y	7.8	7.8% (30 d) 13.9% (1 y)
Bahiru (2018)[23]	Kenya	Retrospective	196 ACS		57.5	65		Y/Y	17	
Kimeu (2016)[26]	Kenya	Retrospective	64 MI	…	56.7	87.5		Y/Y	9.4	
Shavadia (2012)[36]	Kenya	Cross-sectional	111 ACS	5.1	63.3	75.7	12.9 h (STEMI)	Y/Y	8.1	…
Ogeng'o (2010)[39]	Kenya	Retrospective	120 MI	…	56.8	66	…	N/Y	5%	…

ACS indicates acute coronary syndrome; MI, myocardial infarction; N, no; STEMI, ST-segment–elevation myocardial infarction; and Y, yes.

over 3 countries.[21] South Africa is an exception considering that it has, to our knowledge, the most cardiac catheterization facilities of any SSA country (62 in 2017).[48]

Fibrinolysis

Given the low number of catheterization laboratories in SSA, fibrinolysis is often a therapeutic alternative of choice, and there is evidence of comparable clinical benefits with primary PCI.[49–51] In SSA, early fibrinolysis is worth developing, particularly through prehospital emergency medical services, or even by implementing a pharmacoinvasive strategy. Streptokinase is the most widely used fibrinolytic in more than 80% of studies reporting fibrinolysis, probably because of its low cost and availability.[16,17,20,22,29,30,34,38] Alteplase is used in Côte d'Ivoire[27] and South Africa.[29,38] As in European and North American countries, tenecteplase is available in routine practice in Kenya[26,36] and South Africa.[38]

Mortality

Hospital Mortality

The high variability of mortality across studies was certainly a result of the varying populations (ACS, STEMI, and NSTEMI) and revascularization procedures performed. In studies that evaluated heterogeneous ACS populations (including STEMI and NSTEMI), mortality ranged from 1.2% to 24.5%. The lowest rate (1.2%), found in the study by N'Guetta et al, involved patients hospitalized for ACS who underwent PCI.[24] The highest mortality rate in Ethiopia may certainly have been influenced by very long treatment times (95.85 hours).

Mortality During Follow-Up and Predictors of Mortality

Few studies reported mortality rates in the follow-up of patients with ACS. In multivariate analysis, STEMI and heart failure at admission (OR, 10.7; 95% CI, 3.34–34.6) was associated with in-hospital occurrence of a combined major adverse cardiovascular event end point (death, recurrent infarction, stroke, major bleeding, or cardiac arrest).[23] Left ventricular dysfunction <50% was also a factor associated with mortality in Djibouti, whereas the successful thrombolysis (73%) seemed positively associated with hospital survival and at 1 month (P<0.005).[35] In a study conducted in Côte d'Ivoire, after a longer period of follow-up (39 months), age ≥70 years (OR, 4.61; 95% CI, 2.09–10.17), female sex (OR, 2.55; 95% CI, 1.13–5.74) and heart failure at admission (OR, 2.17; 95% CI, 1.01–4.69) were predictors for death, after adjustment for risk factors, history of MI, left ventricular ejection fraction <50%, and revascularization procedures.[19]

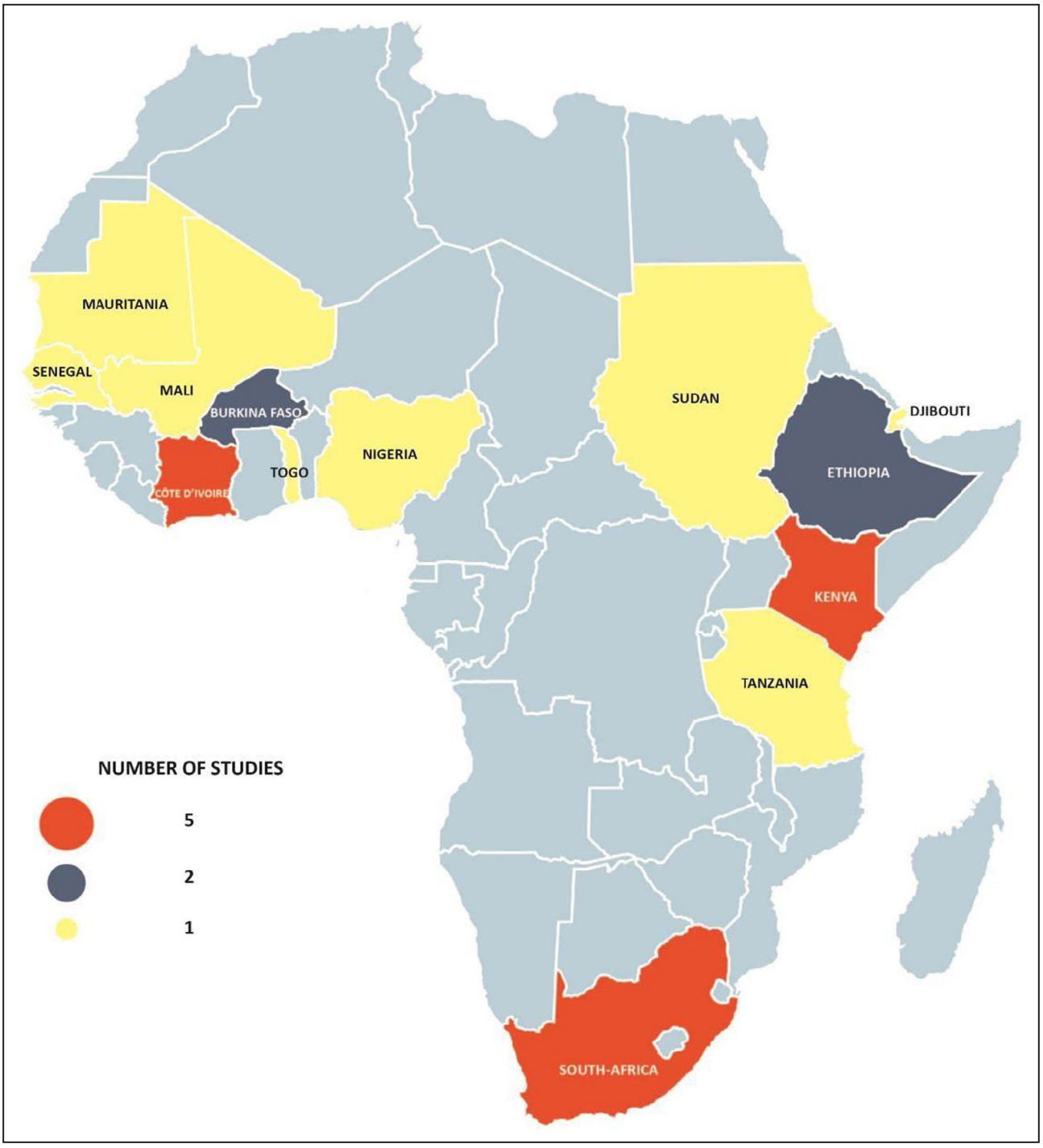

Figure 2. Sites and number of studies on ACS in sub-Saharan Africa available on MEDLINE 2010 to 2020.
ACS indicates acute coronary syndrome.

Limitations

Our study has several limitations. There were sometimes large disparities in the numbers of inclusions and the different populations, the designs and periods of the studies, and the procedures performed (PCI, fibrinolysis, etc) making comparisons between studies and a possible meta-analysis difficult. Although blinded by 2 investigators, some studies may have been omitted. Only 1 database was chosen for this systematic review (MEDLINE), which could lead to selection and publication bias. Most of these studies were carried out in reference hospitals in urban areas and are not representative of the entire population. The period of interest (2010–2020) was chosen arbitrarily.

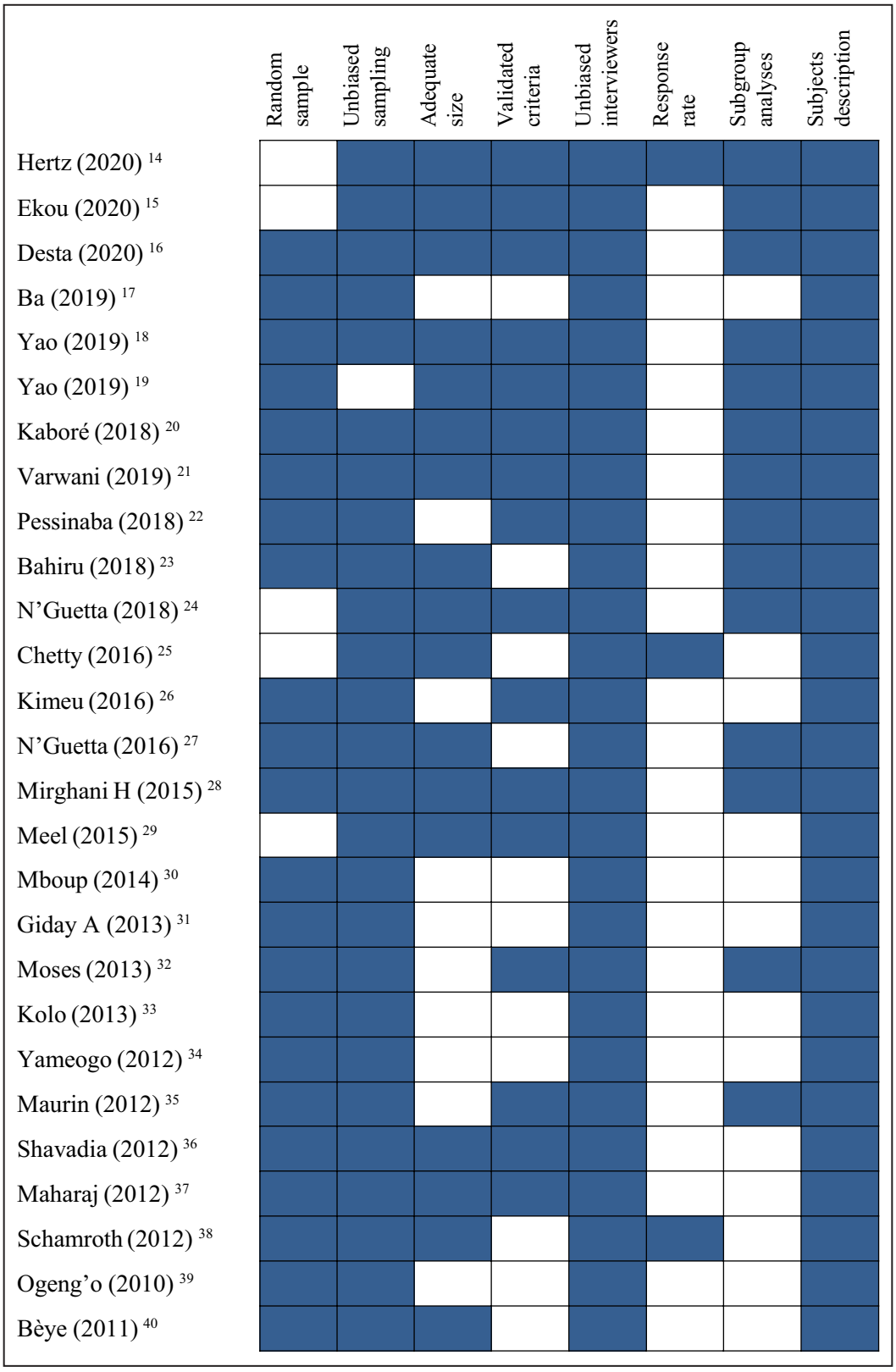

Figure 3. **Quality bias assessment according to Loney's criteria.**

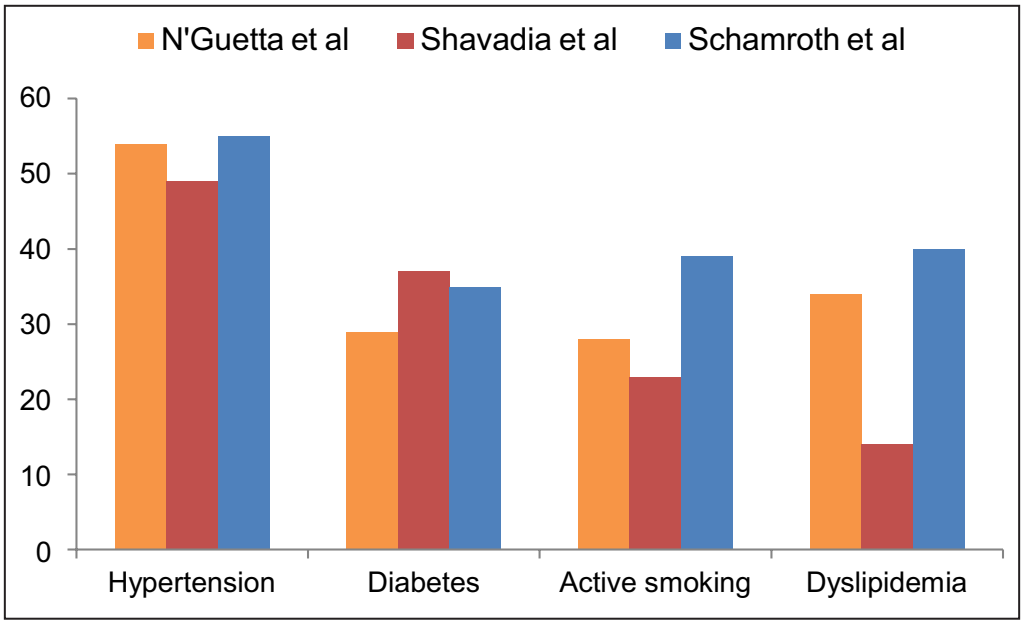

Figure 4. Distribution of cardiovascular risk factors in patients with acute coronary syndrome.
Data derived from 3 studies: N'Guetta et al,[27] Shavadia et al,[36] and Schamroth et al.[38]

However, we have excluded studies that used selected populations, allowing us to obtain more reliable and comprehensive observations on CHD in our practice. Moreover, over 70% of studies included were of good quality according to Loney criteria.

Outlook: Need for an International Multicenter Registry in SSA

In developed countries, the implementation and application of recommendations for good practice in ACS has led to significant reductions in mortality in recent years.[52] In contrast, consensus teams have published "feasible" proposals to improve patient management in SSA, but these have yet to be implemented.[47,53]

This systematic review underlines the heterogeneity of study enrolments and procedures performed in patients with ACS but also the heterogeneity of study designs. Taking into account the available human resources and the rather limited technical means, it would be interesting to develop shared management protocols adapted to the specificities of the region. This underlines the need for an international multicenter prospective registry in SSA on ACS. Such a registry could be used to provide more reliable data on coronary emergencies, evaluate practices, implement interventions and assess their impact, and identify prognostic factors in order to target management strategies, similar to developed countries.[54] The data from these registries would make it possible to develop recommendations that are tailored to the specificities of SSA.

CONCLUSIONS

ACS has been on the rise in recent years in SSA, where it affects a relatively young population. In most countries, treatment times remain very high, access to emergency coronary care is limited, and the prehospital system is inadequate. Mortality is also very high, though certain prognostic factors were confirmed in the studies. However, there are significant disparities according to the countries, the populations considered, and the procedures performed. These alarming findings should attract the attention of populations and practitioners. Health policy must allocate more resources to the prevention and management of CHD, which is today, according to the World Health Organization, 1 of the 3 main causes of mortality in SSA, ahead of HIV-AIDS, tuberculosis, and malaria. Similar to what is done in developed countries, there is a need to create a multicenter registry in order to develop consensus strategies, evaluate them, and propose feasible interventions. Improving the management of CHD in developing countries also requires primary prevention through public awareness campaigns, continuing education of healthcare personnel, and ongoing efforts to limit cardiovascular risk factors.

ARTICLE INFORMATION

Received February 21, 2021; accepted August 16, 2021.

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Acknowledgments

We thank Suzanne Rankin for English assistance, and Marc Antoine Aie for Figure 2 art design.

Sources of Funding

None.

Disclosures

None.

Supplemental Material

Tables S1–S3

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SUPPLEMENTAL MATERIAL

Table S1. Research strategy.

Search	Query
1	(Acute Coronary Syndromes OR Coronary Syndrome, Acute OR Coronary Syndromes, Acute OR Syndrome, Acute Coronary OR Syndromes, Acute Coronary OR Infarction, Myocardial OR Infarctions, Myocardial OR Myocardial Infarctions OR Cardiovascular Stroke OR Cardiovascular Strokes OR Stroke, Cardiovascular OR Strokes, Cardiovascular OR Heart Attack OR Heart Attacks OR Myocardial Infarct OR Infarct, Myocardial OR Infarcts, Myocardial OR Myocardial Infarcts OR ST Segment Elevation Myocardial Infarction OR ST Elevated Myocardial Infarction OR STEMI OR Non ST Elevated Myocardial Infarction OR NSTEMI OR Non-ST-Elevation Myocardial Infarction OR Infarction, Non-ST-Elevation Myocardial OR Infarctions, Non-ST-Elevation Myocardial OR Myocardial Infarction, Non-ST-Elevation OR Myocardial Infarctions, Non-ST-Elevation OR Non ST Elevation Myocardial Infarction OR Non-ST-Elevation Myocardial Infarctions OR Non ST Elevated Myocardial Infarction OR NSTEMI OR Non-ST-Elevation Myocardial Infarction OR Infarction, Non-ST-Elevation Myocardial OR Infarctions, Non-ST-Elevation Myocardial OR Myocardial Infarction, Non-ST-Elevation OR Myocardial Infarctions, Non-ST-Elevation OR Non ST Elevation Myocardial Infarction OR Non-ST-Elevation Myocardial Infarctions OR Myocardial Infarction, Anterior Wall OR Anterolateral Myocardial Infarction OR Anterolateral Myocardial Infarctions OR Infarction, Anterolateral Myocardial OR Infarctions, Anterolateral Myocardial OR Myocardial Infarction, Anterolateral OR Myocardial Infarctions, Anterolateral OR Anteroseptal Myocardial Infarction OR Anteroseptal Myocardial Infarctions OR Infarction, Anteroseptal Myocardial OR Infarctions, Anteroseptal Myocardial OR Myocardial Infarction, Anteroseptal OR Myocardial Infarctions, Anteroseptal OR Acute Anterior Wall Myocardial Infarction OR Myocardial Infarction, Inferior Wall OR Diaphragmatic Myocardial Infarction OR Diaphragmatic Myocardial Infarctions OR Infarction, Diaphragmatic Myocardial OR Infarctions, Diaphragmatic Myocardial OR Myocardial Infarction, Diaphragmatic OR Myocardial Infarctions, Diaphragmatic OR Inferior Myocardial Infarction OR Infarction, Inferior Myocardial OR Infarctions, Inferior Myocardial OR Inferior Myocardial Infarctions OR Myocardial Infarction, Inferior OR Myocardial Infarctions, Inferior OR Acute Inferior Myocardial Infarction)
2	(Africa South of the Sahara OR Sub-Saharan Africa OR Subsaharan Africa OR Africa, Sub-Saharan OR Africa, Western OR Africa, West OR West Africa OR Western Africa OR Africa, Eastern OR East Africa OR Eastern Africa OR British Indian Ocean Territory OR Africa, Central OR Central Africa OR Africa, Southern OR Southern Africa OR Union of South Africa OR Republic of South Africa)

Research strategy used on PubMed®: (1) AND (2)

Table S2. PRISMA 2020 Checklist.

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Page 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Page 2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 3-4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 4
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 4
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplemental Table 1
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 4-5
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 5
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 5-6
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Pages 6, 15
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 6
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Pages 5-6
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 6, Figure 1
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Page 5
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Page 7 Figure 1
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Page 7 Figure 1
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Page 6
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Page 6
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Page 7 Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Figure 1
Study characteristics	17	Cite each included study and present its characteristics.	Page 7
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Figure 3
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Table 1
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Pages 9-12
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Pages 9, 11, 12, 13-14
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Pages 9-12
	23b	Discuss any limitations of the evidence included in the review.	Page 13
	23c	Discuss any limitations of the review processes used.	Page 13
	23d	Discuss implications of the results for practice, policy, and future research.	Pages 13-14
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Page 6
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Page 6
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Page 15
Competing interests	26	Declare any competing interests of review authors.	Page 15

Section and Topic	Item #	Checklist item	Location where item is reported
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Table 1 Supplemental Table 1

From: 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. doi: 10.1136/bmj.n71

Table S3. Studies on MI patients in sub-Saharan Africa available on MEDLINE based on our research strategy (2010-2020).

Author (year)	Country	Design	Population	Prevalence (%)	Age (years)	Males (%)	Time from symptoms to admission	Fibrinolysis/ Angioplasty	In-hospital mortality (%)	Follow-up mortality (follow-up time)
Ekou (2020) [15]	Côte d'Ivoire	Cross-sectional	166 STEMI	-	54.5	91.6	20 hours	N / Y	1.2	-
Yao (2019) [19]	Côte d'Ivoire	Prospective	329 STEMI	-	57	82.6	20 hours	Y / Y	14.3	10.4 % (39 months)
Chetty (2016) [25]	South Africa	Cross-sectional	122 MI	-	61	65	-	Y / N	1.8 (STEMI)	-
Kimeu (2016) [26]	Kenya	Retrospective	64 MI	-	56.7	87.5		Y / Y	9.4	
Meel (2015) [29]	South Africa	Prospective	100 STEMI	-	52	70	2.3 hours	Y / N	-	-
Moses (2013) [32]	South Africa	Retrospective	76 NSTEMI	-	60.5	21.5	24.21 hours	N / Y	15.8	-
Kolo (2013) [33]	Nigeria	Retrospective	14 MI	0.21	56	92	-	N / N	21.44	
Yameogo (2012) [34]	Burkina-Faso	Cross-sectional	43 STEMI		56.5	88	4.3 days	Y / N	11.6	-
Maurin (2012) [35]	Djibouti	Prospective	35 STEMI	40	52	88.6	23 hours	Y / N	20%	14% (30 days) 20 % (1 year)
Maharaj (2012) [37]	South Africa	Retrospective	161 STEMI	-	54	-	3.2 hours	Y / N	-	-
Ogeng'o (2010) [39]	Kenya	Retrospective	120 MI	-	56.8	66	-	N / Y	5%	-
Bèye (2010) [40]	Mali	Cross-sectional	8 MI	7.3	54.62	100	-	N / N	28.6%	-

STEMI: ST-segment elevation myocardial infarction. NSTEMI: non-ST-segment elevation myocardial infarction. MI: myocardial infarction. Y: yes. N: no.