**Review Article**

Prevalence and Epidemiological Pattern of Abdominal Aortic Aneurysms in Africa: A Systematic Review

## Abstract

**Introduction:** The incidence of abdominal aortic aneurysms (AAAs) in high-income countries has been declining in the last three decades. However, in most low-income and middle-income countries especially in Africa, little is known about its burden. The absence of screening services for AAA in African countries makes it difficult to detect and promptly manage AAA before rupture, which has significant implications for mortality. This study sought to systematically assess the prevalence of AAA amongst patients visiting hospitals in Africa and evaluate its epidemiological pattern. **Materials and Methods:** A systematic review was performed on the EMBASE, GLOBAL HEALTH, MEDLINE, and PUBMED databases. The review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses statement standards and protocol registered with PROSPERO (CRD42020162214). A data extraction tool was used to get relevant information from these studies. Quality assessment and risk of bias were performed using the Newcastle Ottawa Scale for cross-sectional studies. Results were summarised in tables, figures, and a forest plot. A narrative synthesis approach of the articles was taken. **Results:** Two hundred and sixty-one studies were identified and after the exclusion of 246, a final 15 were deemed suitable for analysis. A total of 4012 participants were screened for AAA and of these, 129 cases were identified. The prevalence of AAA in these studies ranged from 0.7 to 6.4%. Male participants accounted for 115 (89.1%) of the cases. There was a wide age range (31–72 years) reflective of both its possible infective and degenerative aetiology. AAA was reported to be associated with hypertension, smoking, advanced age, coronary artery disease, and HIV infection. There was no association between AAA and diabetes. Over 50% of cases were identified incidentally. About one-third (23–54%) of the participants presented aortic rupture with a mortality rate ranging between 65 and 72%. **Conclusions:** AAA prevalence in Africa is probably higher than the current thinking as there is no baseline data to compare with. Aetiologically, AAA was shown to be associated with hypertension, smoking, coronary artery disease, and possibly infectious pathologies like HIV. Large epidemiological studies would help better characterise AAA in this setting. Lastly, efforts targeting the reduction of the risk factors for AAA would go a long way in reducing the burden of AAA.

**Keywords:** *Abdominal aortic aneurysms, Africa, low-income and middle-income countries, prevalence*

## Abstract

**Introduction:** L’incidence des Anévrismes Aortiques Abdominaux (AAA) dans les pays à hauts revenus est en déclin depuis les trois dernières décennies. En revanche, dans la plupart des pays à faibles et moyens revenus, particulièrement en Afrique, le fardeau représenté est peu connu. L’absence de service de dépistage des AAA dans les pays africains en rend la détection difficile ainsi que la gestion immédiate avant rupture, ce qui a des répercussions importantes sur la mortalité. Cette étude cherche à évaluer systématiquement la prévalence des AAA parmi les patients qui visitent les hôpitaux en Afrique et à évaluer son profil épidémiologique.

**Procédés:** Une revue systématique a été réalisée sur les bases de données EMBASE, GLOBAL HEALTH, MEDLINE et PUBMED. La revue a été menée conformément aux normes et au protocole des Éléments de Rapport Préférés pour les Examens Systématiques et les Méta-Analyses (Preferred Reporting Items for Systematic Reviews and Meta-analyses) enregistrés auprès de PROSPERO (CRD42020162214). Un outil d’extraction de données a été utilisé afin d’obtenir des informations pertinentes de ces études. L’évaluation de la qualité et le risque de partialité a été effectuée au moyen de l’Échelle de Newcastle Ottawa pour les études transversales. Les résultats ont été récapitulés dans des tableaux, des graphiques et un “graphique en forêt” (forest plot). Une approche de synthèse narrative des articles a été adoptée. **Résultats:** Deux cent soixante et une (261) études ont été identifiées et après exclusion de 246, les 15 dernières ont été jugées appropriées pour l’analyse. Un total de 4012 participants ont été dépistés

**How to cite this article:** Ngetich, Ward, Cassimjee, Lee, Handa, On behalf of the Oxford Abdominal Aortic Aneurysm OXAAA Group &. Prevalence and epidemiological pattern of abdominal aortic aneurysms in Africa: A systematic review. J West Afr Coll Surg 2020;10:3-14.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial- ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**For reprints contact:** [reprints@medknow.com](mailto:reprints@medknow.com)

**Ngetich E1\*, Ward J1, Cassimjee I2,**

**Lee R1, Handa A1 (On behalf of the Oxford Abdominal Aortic Aneurysm OXAAA Group)**

*1University of Oxford, Department of Surgical Sciences, John Radcliffe Hospital OX3, 9DU Oxford, United Kingdom, 2University of Witwatersrand, Department of Surgery,*

*Private Bag X2600, Houghton, Johannesburg, South Africa*

**Received:** 04-June-2021 **Accepted:** 11-Sept-2021 **Published:** 05-Mar-2022

***Address for correspondence:***

*Dr. Elisha Ngetich,*

*Department of Surgical Sciences, University of Oxford, John Radcliffe Hospital OX3, 9DU Oxford, United Kingdom.*

*E-mail: elisha.ngetich@nds. ox.ac.uk*

|  |
| --- |
| **Access this article online** |
| **Website:**  [www.jwacs-jcoac.org](http://www.jwacs-jcoac.org/) |
| **DOI:** 10.4103/jwas.jwas\_15\_21 |
| **Quick Response Code:** |

© 2022 Journal of the West African College of Surgeons | Published by Wolters Kluwer ‑ Medknow 3

pour des AAA et, parmi ceux-ci, 129 cas ont été identifiés. La prévalence des AAA de ces études s’étendait de 0.7% à 6.4%. Les hommes représentent 115 (89.1%) des cas. Il a été noté une grande amplitude d’âges (31–72 ans) représentative de sa possible étiologie infectieuse comme dégénérative. Les AAA ont été rapportés en association avec l’hypertension, le tabagisme, l’âge avancé, la maladie coronarienne et la séropositivité. Il n’y a pas eu d’association entre les AAA et le diabète. Plus de 50% des cas ont été incidemment identifiés. Environ un tiers (23–54%) a été présenté en tant que rupture aortique avec un taux de mortalité compris entre 65% et 72%.

**Conclusions:** La prévalence des AAA en Afrique est probablement supérieure à l’état actuel de la réflexion étant donné qu’il n’y a pas de données de référence auxquelles la comparer. Étiologiquement, les AAA ont démontré être associés à l’hypertension, au tabagisme, à la maladie coronarienne et éventuellement aux pathologies infectieuses comme le VIH. Des études épidémiologiques de grande envergure permettraient de mieux déterminer les AAA dans un tel cadre. Enfin, les efforts visant à réduire les facteurs de risque pour les AAA contribueraient grandement à réduire le fardeau des AAA.

**Mots clés:** *Afrique, anévrismes abdominaux aortiques, pays à faibles et moyens revenus, prévalence*

# Introduction

The Lancet Commission on Global Surgery highlighted surgery as a neglected component of health systems with over 30% of the global disease burden attributable to surgical conditions.[1] Abdominal aortic aneurysm (AAA) is one of the main vascular surgical conditions that pose a significant health challenge globally.[2] Although the burden of AAA in high-income countries has significantly decreased over the last three decades,[3-5] low-income and middle-income countries still struggle with a rising burden, with epidemiological studies indicating an increase in the incidence and prevalence of AAA due to an ageing population, increase in smoking and a rising burden of hypertension and coronary heart disease.[6,7] AAA poses a significant mortality threat if not identified early because of rupture with a mortality rate as high as 65–80% even in high-income countries.[8,9]

The challenge presented by AAA in Africa is growing, with modelled projections indicating a rise in Disability- Adjusted Life Years by 35% from 1990 to 2017.[10] Although this may partly be explained by the increase in population, other plausible explanations include an increasing burden of noncommunicable diseases, and that AAA affects a much younger population (10–15 years younger) than in the western countries.[11-13] There are no national screening programs in African countries for the early detection of AAA, which worsens prognoses. Further, the continent carries over 70% of the global burden of HIV as well as other infections such as *Streptococcus*, Tuberculosis, and Schistosomiasis that have all also been associated with increased risk of developing AAA.[14-18] These challenges coupled with weak health systems across the continent may explain the growing AAA burden.[19]

Very little is known about the actual prevalence of AAA in the African continent. Major global systematic reviews and meta-analyses on AAA commonly exclude Africa.[20-22] Since no African country currently has a national screening program for AAA, most of the cases are detected either as an incidental finding on imaging for nonaneurysmal indications or when they present with symptoms consistent with a large aneurysm at high risk of rupture.[7,23] In addition, deaths primarily attributable to AAA may not be captured in available data because of a

general cultural aversion towards autopsies.[6,7] Even with early identification of AAA, gold standard care may not be possible as this requires consistent and costly follow-up measuring of aortic diameter growth, which may be unaffordable for the average patient in this setting.

A better understanding of the prevalence of AAA in Africa is required as this will provide an insight into the burden of this disease and also inform screening and risk prevention policies. This is especially pressing with the increasing burden of risk factors for AAA from both noncommunicable and communicable diseases. To date, no systematic review has been undertaken on prevalence, epidemiological patterns, and the management of AAA in Africa.

## Objectives of the study

The primary objective of this study was to determine the prevalence of AAA among patients visiting hospitals in Africa. The secondary objectives were to assess the epidemiological patterns and risk factors for AAA as reported in the studies conducted in the region thus far to help characterise the nature of the disease in Africa and provide a baseline for further work in the field.

# Materials and Methods

## Design

This was a systematic review of studies on the prevalence and epidemiological pattern of AAA among patients visiting hospitals in Africa. The objectives, outcome measures, inclusion and exclusion criteria as well as methods of analysis were summarised in a protocol and registered with Prospective Register of Systematic Reviews in Healthcare and Social Care PROSPERO (CRD42020162214) before the formal review commenced.

## Search strategy

Several databases were searched for relevant studies and these included MEDLINE, EMBASE, Global Health, and PubMed. The studies from the individual databases were collated and duplicates were eliminated. These studies were further taken through the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) protocol analysis to identify the studies most suitable to answer the

4 Journal of the West African College of Surgeons | Volume 10 | Issue 1 | January‑March 2020

question. References of all the relevant studies were also reviewed for additional potentially useful articles. Both free and controlled texts were used for the terms to ensure that the search was as comprehensive as possible. Key terms used in the search included “aortic aneurysms,” “intimal medial mucoid degeneration,” “abdominal aneurysm,” “aorto- abdominal aneurysm,” “Africa,” “Sub-Saharan developing country,” “prevalence,” and “low-and-middle income country.” We also included the names of each of the 54 African countries in our search terms.

## Eligibility criteria

Because of a paucity of studies on the subject at hand in Africa, few exclusion requirements were applied. However, only those studies that provided clear and adequate information on their methods were included. A summary table of the inclusion and exclusion criteria is provided in Table 1.

## Article selection and data extraction

Two independent reviewers (E.N. and J.W.) undertook the search and selection of the articles. Reasons for exclusion of studies were also reviewed by both reviewers and mutually agreed on. Any disagreements between the two reviewers were discussed and if no consensus was achieved, then one-third researcher was asked to adjudicate (R.L.). An established data extraction tool was used to collect relevant information from the studies. This included author name, study design, country of study, population screened, sample size, setting, study objectives, and prevalence of AAA, and of comorbidities/ risk factors.

## Assessment of risk of bias

The risk of bias and the quality of evidence of the cross- sectional studies were evaluated using the Newcastle-Ottawa scale.[24] This scale was adopted from the original design for cohort studies.[25] Each study was assessed on three key aspects: selection of study groups, comparability in design and analysis, and outcome.

Stars awarded in each section were reflective of the quality of the study. The maximum score was 10. The quality of the retrospective case series was assessed using a scale developed from Pierson,[26] Bradford Hill, and Newcastle Ottawa modifications. The scale has 4 domains: selection, ascertainment, causality, and reporting. There were eight leading questions from these domains but questions 4, 5, and

6 were excluded as they are specific for adverse drug reaction retrospective case series.[27]

## Data synthesis

The key outcomes of interest were the prevalence and epidemiological pattern of AAA in Africa. Prevalence was defined as the number of cases of AAA divided by the number of participants screened, expressed as a percentage.

Individual prevalence from the studies was summarised in a table with their confidence intervals. There was further assessment of the suitability of data pooling and further meta-analysis based on the quality of the reviewed literature. Results were presented in tables and a forest plot. A narrative synthesis approach was taken to describe the epidemiological pattern including the age and sex distribution, types of aortic aneurysms, risk factors as well as the management options reported in the studies.

# Results

## Literature search results

Two hundred and sixty-one studies were obtained from white literature search and an additional five were retrieved through grey literature search. After removing duplicates, 245 studies remained. Of these, 220 were excluded for irrelevance or incorrect article type (letters, editorials, or case reports). A further eight studies were excluded because they measured the wrong outcome or did not provide adequate information on their methodology. In the final analysis, 15 (5.7%) of the total searched studies were deemed fit for analysis. Seven cross-sectional studies specifically addressed the question of AAA prevalence in their countries and eight retrospective case series addressed the epidemiological pattern and management approaches to AAA. The PRISMA flow diagram of the studies screened, assessed, and included in the study with reasons is presented in Figure 1. A summary of the studies included in the final analysis is presented in Table 2. Only 10 of the 54 African countries had studied the prevalence and/ or epidemiological pattern of AAA. These countries are sparsely distributed in the continent as shown on the map in Figure 2 with six countries from Sub-Saharan Africa.

## Results of risk of bias assessment

Quality assessment was performed for cross-sectional and retrospective case series. Three cross-sectional studies scored 7/10 and above.[28-30] Three studies scored 6/10[31-33] and one scored 4/10.[34] Of the retrospective case series, three studies

**Table 1: Inclusion and exclusion criteria**

**Inclusion and exclusion criteria**

**Inclusion Exclusion**

* Screening date from 1990 to 2019 ■ Editorials
* All sex ■ Case reports
* All ethnic groups ■ Letters
* All languages ■ Studies conducted before 1990
  + Animal studies

Journal of the West African College of Surgeons | Volume 10 | Issue 1 | January‑March 2020 5

scored 5/5,[13,16,35] three of them scored 4/5,[36-38] and two scored 3/5.[39,40] The summary of the quality assessment results is presented in Tables 3 and 4.

## Outcome synthesis

*Prevalence of aortic aneurysms in Africa*

Seven studies reported on the prevalence of AAA.[28-34] A total of 4012 participants were screened and of these, 129 were found to have AAA. Of the seven studies, four were from North Africa, a predominantly Arab population, and the remaining three from Sub-Saharan Africa, composed predominantly of the black African population. The prevalence of AAA ranged from 0.7% to 6.4%. A forest plot of the event rates (prevalence of AAA) is presented in Figure 3. No further statistical analysis was performed due to the extensive methodological, clinical, and statistical heterogeneity amongst the studies.

Of the studies included in the review, two were from Egypt.[28,29] Shalaan *et al.* in 2015 screened 1048 patients who were above 50 years old visiting Alexandria Main University Hospital for nonaneurysmal presentations. In this study, 974 (92.9%) had normal aortic size, 18 (1.7%) had aortic dilatation (25–29 mm), and 56 had AAA giving a prevalence of 5.3%.[28]



Records identified through database searching

(n = 261)

Additional records identified through other sources

(n = 5)

Records aGer duplicates removed (n =245)

Similarly, Shaker *et al.* in 2018 screened 1000 patients in Kasr Al-Ainy Hospital. The mean aortic suprarenal diameter (mm) was 18.6 (3.2) and 15 (1.5%) had AAA.[29]

There were two studies on AAA prevalence from Algeria.[30,31] Bouferrouk *et al.*[31] in 2016 reported a prevalence of 6.4% among 674 patients having echocardiography for suspected cardiac disease. Ouarab *et al.*[30] in a different part of Algeria 2 years later in 2018 reported a prevalence of 2.2% amongst patients reporting to the hospital for nonaneurysmal reasons.

Nseka *et al.*[34] conducted a screening study in Uganda in 2014 to establish the prevalence of AAA amongst hypertensive patients. This study reported a prevalence of 1.5% from the 353 patients who were screened. A similar study was conducted in South Africa by Rothberg *et al.*[33] in 2007 on the feasibility and affordability of an age-targeted screening for AAA found a prevalence of 5.3% in men over the age of 60 years. Of all these studies; however, the lowest prevalence was reported in Seychelles by Yerly *et al.* in 2012 where a prevalence of 0.7% and ectatic dilatation of the aorta (25 mm–29 mm) of 2% was reported among 353 participants above 60 years old.[32]

**Identification**



Records screened (n = 245)

Records excluded (n = 220)

(Irrelevant topic Letters Editorial

Case reports studies

**Screening**

**Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-analyses flowchart**



Full-text articles assessed for eligibility (n = 25)

Full-text articles excluded, with reasons

(n = 10)

Wrong outcome measure Insufficient information

Studies included in qualitative synthesis (n =15)

**Included**

**Eligibility**

6 Journal of the West African College of Surgeons | Volume 10 | Issue 1 | January‑March 2020



## Table 2: Summary of the studies included in the review

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Study title** | **Author and**  **year** | **Study design** | **Country** | **Age**  **(mean)** | **Population** | **Sample**  **size** | **Prevalence%**  **(95% CI)** | **Sex (cases**  **of AAA)** |
| 1. Screening of the aneurysm of the abdominal aorta during the  echo-cardiography:  experience of an Algerian centre | Bouferrouk *et al*. (2016)[31] | Cross-sectional | Algeria | – | ≥60 years | 674 | 6.4 (4.5, 8.25) | M-452(29)  F-222(2) |
| 2. Screening for | Shalaan | Cross-sectional | Egypt | **–** | ≥50 years | 1048 | 5.3 (3.94, | M-630(53) |
| abdominal aortic aneurysms and analysis of the associated risk factors in a general  population | *et al*. (2015[28] |  |  |  |  |  | 6.66) | F-418(3) |
| 3. Low prevalence of abdominal aortic aneurysm in the Seychelles population of age  50–65 years | Yerly *et al*. (2012)[32] | Cross-sectional | Seychelles | 55.4 *± 6.3* | 50-65 years | 353 | 0.7 (‒0.17,  1.57) | M-151(1)  F-178(0) |
| 4. Screening for | Rothberg | Cross-sectional | South | 62.7 *± 4.2* | 60-65 years | 207 | 5.3 (2.25, | M-207(11) |
| abdominal aortic aneurysm – a pilot study in six  medical schemes | *et al*. (2007)[33] |  | Africa |  |  |  | 8.35) | F-0(0) |
| 5. Prevalence of | Nseko *et al*. | Cross-sectional | Uganda | **–** | ≥50 years | 130 | 1.5 (‒0.59, | M-94(1) |
| aortic aneurysms at abdominal ultrasound  and associated findings among hypertensive adults (≥50 years) at  Mulago Hospital | (2014)[34] | study |  |  | Hypertensive patients |  | 3.59) | F-36(0) |
| 6. Prevalence and | Ouarab | Cross-sectional | Algeria | **–** | ≥60 years | 600 | 2.2 (1.03, | M-424(11) |
| risk factors of subrenal abdominal aortic aneurysm  in an Algerian  population aged over 60 | *et al*. (2018)[30] |  |  |  |  |  | 3.37) | F-176(2) |
| 7. Frequency of | Shaker | Cross-sectional | Egypt | 57.97 *±* | All patients | 1000 | 1.5 (0.75, | M-468(11) |
| abdominal aortic aneurysm in persons who have been examined with ultrasound at Kasr Al-Ainy  Hospitals: a single-  centre pilot study | *et al*. (2019)[29] |  |  | 7.68 | ≥50 years |  | 2.25) | F-532(4) |
| 8. Pattern of aortic aneurysms in an  African country | Ogeng’o  *et al*. (2010)[13] | Retrospective case series | Kenya | 56.15 *± 22.1* | All patients | 254 | NA |  |

Journal of the West African College of Surgeons | Volume 10 | Issue 1 | January‑March 2020 7

## Table 2: Continued

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Study title** | **Author and**  **year** | **Study design** | **Country** | **Age**  **(mean)** | **Population** | **Sample**  **size** | **Prevalence%**  **(95% CI)** | **Sex (cases**  **of AAA)** |
| 9. Pattern of Vascular Diseases at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia | Seyuom *et al*. (2019)[39] | Prospective Case series | Ethiopia | 39.5 ± 10.2 | All patients | 384 | NA |  |
| 10. A study of extracranial aneurysms at UNTH in Enugu,  Nigeria | Eze *et al*. (2010)[41] | Retrospective case series | Nigeria | 44.75 *± 6.2* | All patients | 26 | NA |  |
| 11. Aortic aneurysm: A life- threatening condition in a low-  resource nation | Ogunleye *et al*. (2019)[35] | Retrospective case series | Nigeria | 62.75 ± 20.92 | All patients | 17 | NA |  |
| 12. Pattern of Arterial Aneurysms in Acquired Immunodeficiency  Disease | Marks *et al*. (1995)[16] | Retrospective case series | Zimbabwe | – | All patients | 28 | NA |  |
| 13. Sudden cardiovascular deaths in adults: Study of 361  autopsy cases | Mesrati *et al*. (2017)[36] | Retrospective case series | Tunisia | 55.75 | All patients | 361 | NA |  |
| 14. Abdominal aortic aneurysm and the challenges of management  in a developing country: A review  of three cases | Sule *et al*. (2012)[37] | Retrospective case series | Nigeria | – | All patients | 3 | NA |  |
| 15. Cardiovascular causes of death  in an east African country: an autopsy  study | Ogeng’o *et al*. (2011)[65] | Retrospective case series | Kenya | – | All patients | 134 | NA |  |

The dashes (–) represent missing data, NA = not applicable

## Epidemiological pattern and risk factors

*Age and sex distribution*

The majority of the aneurysms were infrarenal Crawford type

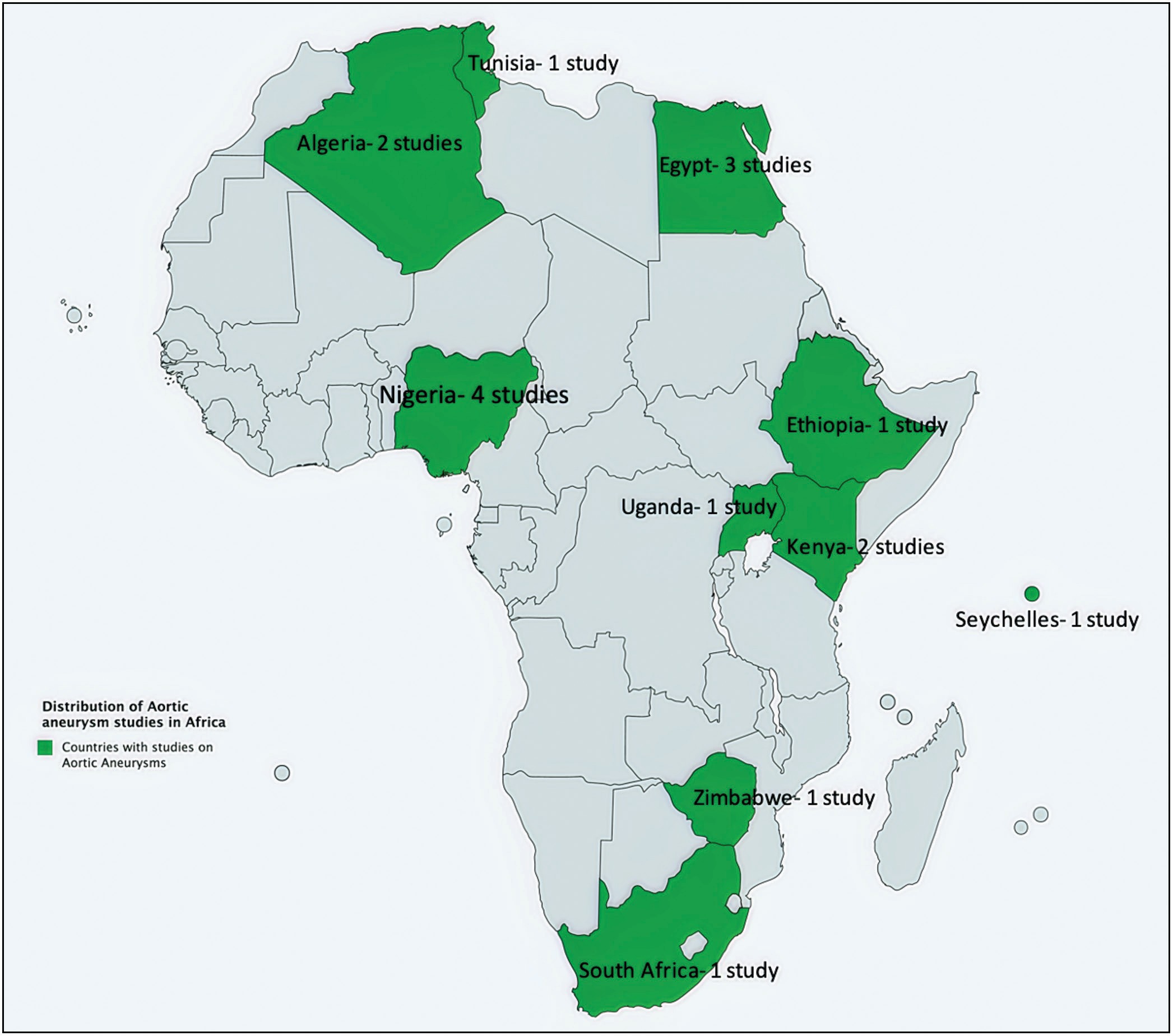
IV.[13,28-33,35,40] Of the studies that reported on sex, men accounted for 115 (89%) of the cases. However, one retrospective study by Ogeng’o *et al.*[13] on patterns of AAA in Kenya found a male to female ratio of 1:1.9 among the cases. Further, age distribution varied widely (31–72 years). The mean age of the cases of AAA was 56.4 years.

*Risk factors*

Several factors were reported to be associated with AAA in these studies. Both Shalaan *et al.* and Shaker *et al.*[28,29] reported a statistically significant association between AAA

and advancing age (*P* < 0.001), male sex (*P* < 0.001), smoking (*P* < 0.001), hypertension (*P* < 0.001), coronary heart disease (*P* < 0.001), and peripheral arteriopathy (*P* < 0.001). However, both Shalaan *et al.* (*P* = 0.668) and Shaker *et al.* (*P* = 0.208) did not show any statistically significant association between diabetes and AAA. Ogeng’o *et al.*[13] found that AAA patients had co-existing hypertension in 51.5% and were smokers in 11.4%. Similarly, Ogunleye *et al.*[35] in Nigeria reported that AAA patients had hypertension in 14 (84.4%), and were smokers in 8 (47.6%), and 1 (5.8%) had Marfan’s syndrome. Several retrospective case series also showed hypertension as a comorbidity in those that were diagnosed with AAA.[13,35,41] HIV infection was also associated with AAA as Marks *et al.*[16] reported in a retrospective case series of 28 patients with aneurysms among whom 12 (42.9%) were found to have HIV.

8 Journal of the West African College of Surgeons | Volume 10 | Issue 1 | January‑March 2020



**Figure 2: Distribution of abdominal aortic aneurysm studies in Africa**

*Presentation and clinical outcomes*

More than 50% of aneurysms were detected incidentally and about one-third (23–54%) of cases presented as aortic rupture.[13] The commonest presentations were abdominal pain (34–41.2%) and pulsatile swelling (9.5–17.8%).[13,35] Open surgical approach was the main surgical management option for AAA in Africa.[35,40-43] However, some countries are beginning to adopt endovascular aortic repair (EVAR) and an Egyptian cohort study found better mortality outcomes and fewer complications when using EVAR compared with a hybrid approach.[44]

Two studies reported outcomes post-surgical intervention. Ogunleye *et al.*[35] reported operative mortality for AAA patients of 35.3% and a 30-day mortality of 64.7% with a loss to follow-up of 17%. In Ogeng’o *et al*.’s[13] study, 61 (23.1%) of AAA patients presented as rupture and the overall mortality rate for these patients was 72.1% (44 patients).

# Discussion

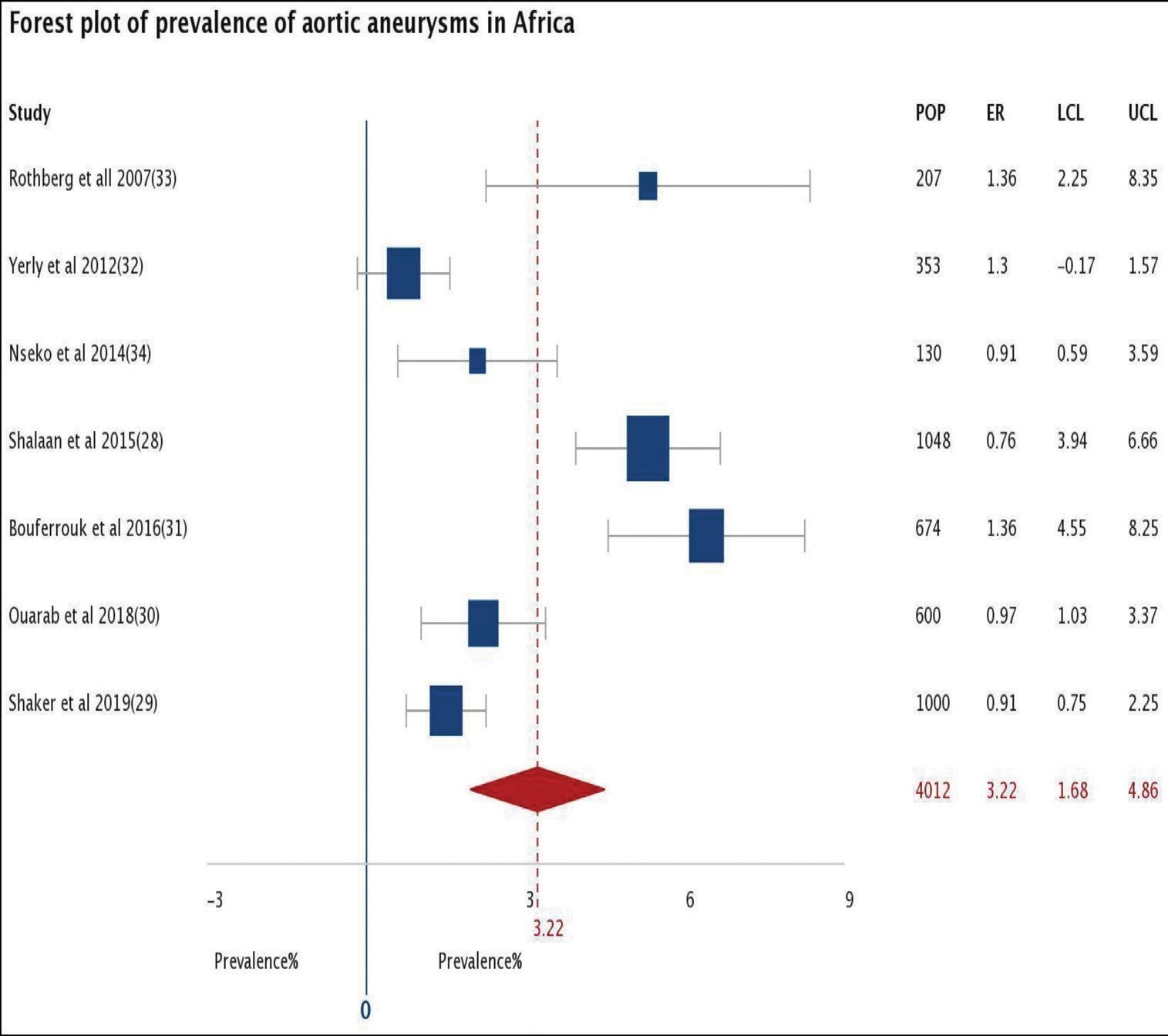
This systematic review sought to better characterise AAA in Africa through assessing its prevalence and epidemiological pattern. Key issues arising from the findings above. First, the paucity of data in Africa on this important cardiovascular disease is disturbing, with only 10 of the 54 African countries having studies conducted on AAA prevalence or its epidemiological pattern since 1990. Potential reasons for this observation may include low research funding, as priority is given to infectious diseases, poor surgical outcomes, and competing priorities for researchers, especially from clinical work.[45]

Although there was no obvious regional variation in prevalence across the continent, there were some variations in studies conducted within some countries including Egypt and Algeria. The variability observed in the prevalence of AAA in the different studies analysed in this review may be explained by the differences in the screened populations. For instance, although the studies of Bouferrouk *et al.* and

Journal of the West African College of Surgeons | Volume 10 | Issue 1 | January‑March 2020 9

Ouarab *et al.* were both conducted in Egypt and used almost similar sample sizes (674 vs. 600), Bouferrouk *et al.* targeted patients having echocardiography for suspected cardiac disease, whereas Ouarab focused on any patient above 60 years in two Algerian hospitals.[30,31] This may explain

the high prevalence of 6.4% reported in Bouferrouk’s study since cardiac diseases share similar risk factors with AAA. The prevalence reported in these studies is comparable to, if not higher than what has been reported in some Western countries.[46,47]



**Figure 3: Forest plot of prevalence of aortic aneurysms in Africa**

POP = population; ER = Event rate; LCL = Lower Confidence Level; UCL = Upper Confidence Level

## Table 3: Quality assessment using Newcastle-Ottawa Scale for cross-sectional studies

**Study Design Selection Comparability Outcome Score**

**Representativeness of sample**

**Sample size**

**Nonrespondents Ascertainment**

**of exposure**

**Based on Design and analysis**

**Assessment of outcome**

**Statistical test**

Bouferrouk *et* Cross-

Somewhat

\* \* No comparator

\*\* \* 6

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *al*. (2016)[31] | sectional | representative\* |  | group |  | | |
| Shalaan *et al*.  (2015)[28] | Cross-  sectional | Somewhat  representative\* | \* \* \*\* | No comparator  group | \*\* | \* | 8 |
| Yerly *et al*.  (2012)[32] | Cross-  sectional | Totally  representative\*\* | \* | No comparator  group | \*\* | \* | 6 |
| Rothberg *et al*.  (2007)[33] | Cross-  sectional | Totally  representative\*\* | \* | No comparator  group | \*\* | \* | 6 |
| Nseko *et al*.  (2014)[34] | Cross-  sectional | Selected sample | \* | No comparator  group | \*\* | \* | 4 |
| Ouarab *et al*.  (2018)[30] | Cross-  sectional | Somewhat  representative\* | \* \* \* | No comparator  group | \*\* | \* | 7 |
| Shaker *et al*.  (2019)[29] | Cross-  sectional | Somewhat  representative\* | \* \* \* | No comparator  group | \*\* | \* | 7 |

The star score represents the quality of the study. The higher the score the lower the risk of bias (Maximum score 10)

10 Journal of the West African College of Surgeons | Volume 10 | Issue 1 | January‑March 2020

## Table 4: Quality assessment using scale for retrospective case series

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Domains** | **Leading** | **Ogeng’o** | **Seyuom** | **Eze *et al*.** | **Ogunleye** | **Marks** | **Mesrati** | **Sule *et al*.** | **Ogeng’o** |
|  | **explanatory** | ***et al*.** | ***et al*.** | **(2010)[41]** | ***et al*.** | ***et al*.** | ***et al*.** | **(2012)[37]** | ***et al*.** |
|  | **questions** | **(2010)[13]** | **(2019)[39]** |  | **(2019)[35]** | **(1995)[16]** | **(2017)[36]** |  | **(2011)[38]** |
| Selection | 1. Does  the patient represent the whole experience of the  investigator or  is the selection method clear? | \* | \* | \* | \* | \* | \* | \* | \* |
| Ascertainment | 2. Was the exposure adequately  ascertained? | \* |  |  | \* | \* | \* |  |  |
|  | 3. Was the outcome adequately  ascertained? | \* | \* | \* | \* | \* | \* | \* | \* |
| Causality | 4. Were other alternative causes ruled  out? |  |  |  |  |  |  |  |  |
|  | 5. Was there a challenges/ re-challenge  phenomenon |  |  |  |  |  |  |  |  |
|  | 6. Was there a dose effect  response |  |  |  |  |  |  |  |  |
|  | 7. Was  follow-up long enough for outcomes to occur? | \* |  |  | \* | \* |  | \* | \* |
| Reporting | Is the case(s) described with sufficient details to allow other investigators  to replicate? | \* | \* | \* | \* | \* | \* | \* | \* |
| Score |  | **5** | **3** | **3** | **5** | **5** | **4** | **4** | **4** |

The star score represents the quality of the study. The higher the score the lower the risk of bias. (Maximum score 5)

The wide age range (31–72 years) in the cases of AAA across the studies is indicative of possible different aetiologies including infections affecting younger people and degenerative causes for the older population. On average, AAA patients in this study are found to be 10–15 years younger than their western counterparts, with the mean age of the cases being

56.4 years old compared with 72 years in Spain and 75 years in England.[48,49] In the Ogeng’o *et al.* study, in particular, about 21% of AAA cases were below the age of 40 years.[13]

These findings raise two key issues are as follows: first, the need for a large multinational community-based screening study to

establish the true prevalence of AAA in the general population. This is particularly important as most of the reviewed studies were conducted in hospital settings and therefore may not be generalisable. Second, African countries need to evaluate the feasibility of national AAA screening programs, although potentially in a younger population than in Western countries. African countries could learn from the experiences of the United Kingdom, Sweden, and the United States which already have screening programs.[50] These efforts will help in the early detection and management of AAA as screening has been shown to reduce emergency surgery by 50–75%, rupture rate by 49–55%, and mortality by 42–75%.[22,51]

Journal of the West African College of Surgeons | Volume 10 | Issue 1 | January‑March 2020 11

Interestingly, despite the relatively high prevalence of AAA reported in the studies conducted within the African continent, very few deaths have been primarily attributed to AAA compared with other cardiovascular causes. Possible explanations for this may include the low population life expectancy or misdiagnosis. Life expectancy is shorter in Africa (mean 63 years),[52] and AAA typically presents beyond 65 years of age; people may be dying from other causes despite having AAA. Also, because of the lack of screening services, most AAA is not detected before rupture, and deaths at this stage may be misdiagnosed as sudden cardiac death. A cultural reluctance to perform postmortems also hinders accurate diagnoses.[53,54] Noteworthy is that about half of the studies on AAA prevalence were from Northern Africa (Egypt, Algeria, and Tunisia) and are predominantly from an Arab population. This further emphasizes the paucity of data in the Sub-Saharan region and the need for more research.

Risk factors associated with AAA identified in this study are similar to those reported elsewhere including hypertension, increasing age, male sex, and coronary heart disease.[55] The challenge for Africa may be greater as infectious diseases especially HIV are thought to also play a role in AAA growth.[40,56,57] Trends in the incidence and prevalence of ischemic heart disease (IHD) have been shown to correlate with AAA.[58] IHD is on the rise in Africa with projections of a 70% and 74% increase in age-standardised mortality, respectively, in men and women from 2010 to 2030.[59] This provides additional evidence that we may be missing most of the AAA. Smoking was shown to be a key risk factor for AAA in studies included in this review which is consistent with findings in studies conducted in other continents.[7,60,61] Some African countries including Ethiopia, Rwanda, and Zambia have experienced a significant increase in tobacco smoking among both men and women in the last two decades, and some countries like Sierra Leone and South Africa have a smoking prevalence of 25.8% and 22%, respectively, in a most recent study.[62] It is therefore important that efforts should target a reduction of cardiovascular risk factors as well as other infectious diseases.

About one-third of AAA (23–54%) presented as aortic ruptures, which have generally worse surgical outcomes in well-studied Western populations.[8,63] This is reflected by Ogunleye *et al.* whose study reported operative mortality between 35.3% and 30-day mortality of 64.7%.[35] This reiterates the great challenge of managing this disease in a resource-poor setting and the need to improve vascular surgery in these regions.[43] The majority of African countries do not have dedicated vascular surgery units or vascular surgeons, leaving most of the vascular procedures to the cardiothoracic and general surgeons. As a result, the management of AAA (particularly in the emergent setting) poses a significant challenge.[21] These findings are; however, not surprising considering that access to essential surgical care alone, as shown by the global surgery Lancet commission report, is poor in low-income and middle-income countries with an annual unmet need of 42 million cases.[1] Although some case

reports from Malawi and Congo have reported on successful AAA operations, a lot still needs to be done.[42,64]

The findings from the current study should be interpreted cautiously owing to a number of limitations. The risk of bias in the included studies was high and there were significant heterogeneities as a result of differences in the screened populations, that is, high risk (e.g. hypertensive group) vs. the general population. Also, all these studies were observational meaning no causal relationship could be established between the outcome of interest (AAA prevalence) and the risk factors.

# Conclusion

This study highlights that the prevalence of AAA in Africa may not be as low as was previously thought. The rising burden of noncommunicable diseases like hypertension, increasing life expectancy and background of the unresolved burden of communicable diseases like HIV are risk factors for AAA and these may contribute to its prevalence. Although several health system challenges still remain in the management of AAA in this setting, priority should be given to the better characterisation of the burden, epidemiology, and outcomes of this disease. This, therefore, calls for larger epidemiological studies to provide a better understanding of AAA in African countries with the aim of informing policy and management approaches.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

# References

1. Meara JG, Leather AJ, Hagander L, Alkire BC, Alonso N, Ameh EA, *et al*. Global surgery 2030: Evidence and solutions for achieving health, welfare, and economic development. Lancet 2015;386:569- 624.
2. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, *et al*. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: A systematic analysis for the global burden of disease study 2010. Lancet 2012;380:2095-128.
3. Lederle FA. The rise and fall of abdominal aortic aneurysm. Circulation 2011;124:1097-9.
4. Choke E, Vijaynagar B, Thompson J, Nasim A, Bown MJ, Sayers RD. Changing epidemiology of abdominal aortic aneurysms in England and Wales: Older and more benign? Circulation 2012;125:1617-25.
5. Svensjö S, Björck M, Gürtelschmid M, Djavani Gidlund K, Hellberg A, Wanhainen A. Low prevalence of abdominal aortic aneurysm among 65-year-old Swedish men indicates a change in the epidemiology of the disease. Circulation 2011;124:1118-23.
6. Mathur A, Mohan V, Ameta D, Gaurav B, Haranahalli P. Aortic aneurysm. J Transl Int Med 2016;4:35-41.
7. Forsdahl SH, Singh K, Solberg S, Jacobsen BK. Risk factors for abdominal aortic aneurysms: A 7-year prospective study: The Tromsø Study, 1994-2001. Circulation 2009;119:2202-8.
8. Karthikesalingam A, Holt PJ, Vidal-Diez A, Ozdemir BA, Poloniecki JD, Hinchliffe RJ, *et al*. Mortality from ruptured

12 Journal of the West African College of Surgeons | Volume 10 | Issue 1 | January‑March 2020

abdominal aortic aneurysms: Clinical lessons from a comparison of outcomes in England and the USA. Lancet 2014;383:963-9.

1. Harris LM, Faggioli GL, Fiedler R, Curl GR, Ricotta JJ. Ruptured abdominal aortic aneurysms: Factors affecting mortality rates. J Vasc Surg 1991;14:812-8; discussion 819-20.
2. Gouda HN, Charlson F, Sorsdahl K, Ahmadzada S, Ferrari AJ, Erskine H, *et al*. Burden of non-communicable diseases in Sub- Saharan Africa, 1990–2017: Results from the Global Burden of Disease Study 2017. Lancet Glob Heal 2019;7:e1375-87.
3. Kushitor MK, Boatemaa S. The double burden of disease and the challenge of health access: Evidence from access, bottlenecks, cost and equity facility survey in Ghana. PLoS One 2018;13.e0194677.
4. Hamid S, Groot W, Pavlova M. Trends in cardiovascular diseases and associated risks in Sub-Saharan Africa: A review of the evidence for Ghana, Nigeria, South Africa, Sudan and Tanzania. Aging Male 2019;22:169-76.
5. Ogeng’O JA, Olabu BO, Kilonzi JP, Ogeng JA, Olabu BO, Kilonzi JP, *et al*. Pattern of aortic aneurysms in an African country. J Thorac Cardiovasc Surg 2010;140:797-800.
6. Kharsany AB, Karim QA. HIV infection and AIDS in Sub-Saharan Africa: Current status, challenges and opportunities. Open AIDS J 2016;10:34-48.
7. Demopoulos D, Hendson W, Technau K, Cilliers A. Vasculopathy in HIV-infected children: A case series. SAJCH South African J Child Heal 2009;3:27-30.
8. Marks C, Kuskov S. Pattern of arterial aneurysms in acquired immunodeficiency disease. World J Surg 1995;19:127-32.
9. Canaud L, Marzelle J, Bassinet L, Carrié AS, Desgranges P, Becquemin JP. Tuberculous aneurysms of the abdominal aorta. J Vasc Surg 2008;48:1012-6.
10. Sörelius K, di Summa PG. On the diagnosis of mycotic aortic aneurysms. Clin Med Insights Cardiol 2018;12:1179546818759678.
11. Olafsdottir AE, Reidpath DD, Pokhrel S, Allotey P. Health systems performance in Sub-Saharan Africa: Governance, outcome and equity. BMC Public Health 2011;11:237.
12. Li X, Zhao G, Zhang J, Duan Z, Xin S. Prevalence and trends of the abdominal aortic aneurysms epidemic in general population-a meta-analysis. PLoS One 2013;8:e81260.
13. Sidloff D, Stather P, Dattani N, Bown M, Thompson J, Sayers R, *et al*. Aneurysm global epidemiology study: Public health measures can further reduce abdominal aortic aneurysm mortality. Circulation 2014;129:747-53.
14. Hoornweg LL, Storm-Versloot MN, Ubbink DT, Koelemay MJ, Legemate DA, Balm R. Meta analysis on mortality of ruptured abdominal aortic aneurysms. Eur J Vasc Endovasc Surg 2008;35:558-70.
15. Mensah GA, Roth GA, Sampson KA, Moran AE, Feigin VL, Forouzanfar MH, *et al*. Mortality from cardiovascular diseases in Sub-Saharan Africa, 1990-2013: A systematic analysis of data from the Global Burden of Disease Study 2013. Cardiovasc J Afr 2015;26:S6-10.
16. Modesti PA, Reboldi G, Cappuccio FP, Agyemang C, Remuzzi G, Rapi S, *et al*.; ESH Working Group on CV Risk in Low Resource Settings. Panethnic differences in blood pressure in Europe: A systematic review and meta-analysis. Plos One 2016;11:e0147601.
17. Wells, G. The Newcastle-Ottawa Scale (NOS) for assessing the quality of non randomised studies in meta-analyses. 2021. Available from: [http://www.ohri.ca/programs/clinical\_epidemiology/oxford.](http://www.ohri.ca/programs/clinical_epidemiology/oxford) asp 2001; [Last accessed on 14 May 2020].
18. Pierson DJ. How to read a case report (or teaching case of the month). Respir Care 2009;54:1372-8.
19. Murad MH, Sultan S, Haffar S, Bazerbachi F. Methodological quality and synthesis of case series and case reports. BMJ Evid Based Med 2018;23:60-3.
20. Shalaan W, Mahdi AM El, Allam AK, El Mahdi AM, Allam AK, El AM. Screening for abdominal aortic aneurysms and analysis of the associated risk factors in the general population. Al-Azhar Assiut Med J 2015;13:83-7.
21. Shaker AA, Khairy HM, Elkaffas KH, Ghanem AAAA. Frequency of abdominal aortic aneurysm in persons who have been examined with ultrasound at Kasr Al-Ainy Hospitals: A single center pilot study. Acta Angiol 2019;25:133-9.
22. Ouarab C, Brouri M, Laroche JP, Ayoub S. Prevalence and risk factors of sub-renal abdominal aortic aneurysm in an Algerian population aged over 60. Des Stud 2018;43:361-8.
23. Bouferrouk A, Boutamine S, Mekarnia A. Screening of the aneurysm of the abdominal aorta during the echo-cardiography: Experience of an Algerian center. Arch Cardiovasc Dis Suppl 2016;8:81.
24. Yerly P, Madeleine G, Riesen W, Bovet P. Low prevalence of abdominal aortic aneurysm in the Seychelles population aged 50 to 65 years. Cardiovasc J Afr 2013;24:17-8.
25. Rothberg AD, McLeod H, Walters L, Veller M. Screening for abdominal aortic aneurysm: A pilot study in six medical schemes. South African Med J 2007;97:58-62.
26. Nseko MS. Prevalence of aortic aneurysms at abdominal ultrasound and associated findings among hypertensive adults (≥50years) at Mulago Hospital. 2014. Available from: <http://makir.mak.ac.ug/> handle/10570/4334?show=full [Last accessed on 15 May 2020].
27. Ogunleye E, Adekola O, Dada OO. Aortic aneurysm: A life- threatening condition in a low-resource nation. J Clin Sci 2019;16:15- 19.
28. Mesrati MA, Belhadj M, Aissaoui A, HajSalem N, Oualha D, Boughattas M, *et al*. Sudden cardiovascular death in adults: Study of 361 autopsy cases. Ann Cardiol Angeiol (Paris) 2017;66:7-14.
29. Sule AZ, Ardil B, Ojo EO. Abdominal aortic aneurysm and the challenges of management in a developing country: A review of three cases. Ann Afr Med 2012;11:176-81.
30. Ogeng’O J. Aneurysms in the arteries of the upper extremity in a Kenyan population. Cardiovasc Pathol [Internet] 2011;20:e53-6.
31. Seyoum N, G/Giorgis D, Nega B. Pattern of vascular diseases at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. Ethiop J Health Sci 2019;29:377-82.
32. Nwafor IA, Eze JC, Ezemba N, Anyanwu CH. The challenges facing the management of arterial aneurysm in UNTH, Enugu. Niger J Med 2012;21:438-40.
33. Eze JC, Ezemba N, Adamu Y. A study of extracranial aneurysms at UNTH in Enugu, Nigeria. Niger J Clin Pract 2010;13:272-5.
34. Swift CP, Ekyinabah E, Graglia S, Adeiza MA. “Never say never”: The first successful management of a type A aortic dissection in Liberia. BMJ Case Rep 2019;12:12-7.
35. Edaigbini SA, Delia IZ, Aminu MB, Bosan IB, Ibrahim A, Anumenechi N. Vascular surgeries in West Africa: Challenges and prospects. Asian Cardiovasc Thorac Ann 2015;23:552-7.
36. Soliman H, El-Ganainy MN, Darweesh RM, Bakhoum S, Abdel- Ghany M. Short term outcome of thoracic endovascular aortic repair in patients with thoracic aortic diseases. Egypt Heart J 2018;70:89-94.
37. Oluwasanu MM, Atara N, Balogun W, Awolude O, Kotila O, Aniagwu T, *et al*. Causes and remedies for low research productivity among postgraduate scholars and early career researchers on non-communicable diseases in Nigeria. BMC Res Notes 2019;12:403.
38. Summers KL, Kerut EK, Sheahan C, Unruh M, Chawla A, Brooke EA, *et al*. Prevalence of abdominal aortic aneurysms in the United States: Re-evaluating the screening guidelines. J Vasc Surg 2019;70:e89-90.

Journal of the West African College of Surgeons | Volume 10 | Issue 1 | January‑March 2020 13

1. Benson RA, Poole R, Murray S, Moxey P, Loftus IM. Screening results from a large United Kingdom abdominal aortic aneurysm screening center in the context of optimizing united kingdom national abdominal aortic aneurysm screening programme protocols. J Vasc Surg 2016;63:301-4.
2. Sisó-Almirall A, Kostov B, Navarro González M, Cararach Salami D, Pérez Jiménez A, Gilabert Solé R, *et al*. Abdominal aortic aneurysm screening program using hand-held ultrasound in primary healthcare. Plos One 2017;12:e0176877.
3. Howard DP, Banerjee A, Fairhead JF, Handa A, Silver LE, Rothwell PM; Oxford Vascular Study. Age-specific incidence, risk factors and outcome of acute abdominal aortic aneurysms in a defined population. Br J Surg 2015;102:907-15.
4. Stather PW, Dattani N, Bown MJ, Earnshaw JJ, Lees TA. International variations in AAA screening. Eur J Vasc Endovasc Surg 2013;45:231-4.
5. Wilmink T, Claridge MW, Fries A, Will O, Hubbard CS, Adam DJ, *et al*. A comparison between the short term and long term benefits of screening for abdominal aortic aneurysms from the Huntingdon aneurysm screening programme. Eur J Vasc Endovasc Surg 2006;32:16-20.
6. The World Bank. Life expectancy at birth, total (years) - Sub-Saharan Africa | Data. 2018. Available from: https://data.worldbank.org/indicator/ SP.DYN.LE00.IN?locations=ZG [Last accessed on 23 May 2020].
7. Aborigo RA, Allotey P, Tindana P, Azongo D, Debpuur C. Cultural imperatives and the ethics of verbal autopsies in rural ghana. Glob Health Action 2013;6:18570.
8. Yawson AE, Tette E, Tettey Y. Through the lens of the clinician: Autopsy services and utilization in a large teaching hospital in Ghana. BMC Res Notes 2014;7:943.
9. Altobelli E, Rapacchietta L, Profeta VF, Fagnano R. Risk factors for abdominal aortic aneurysm in population-based studies:

A systematic review and meta-analysis. Int J Environ Res Public Health 2018;15:2805.

1. Lindholt JS, Shi GP. Chronic inflammation, immune response, and infection in abdominal aortic aneurysms. Eur J Vasc Endovasc Surg 2006;31:453-63.
2. Nair R, Robbs JV, Naidoo NG, Woolgar J. Clinical profile of HIV- related aneurysms. Eur J Vasc Endovasc Surg 2000;20:235-40.
3. Durieux R, Van Damme H, Labropoulos N, Yazici A, Legrand V, Albert A, *et al*. High prevalence of abdominal aortic aneurysm in patients with three-vessel coronary artery disease. Eur J Vasc Endovasc Surg 2014;47:273-8.
4. Lukwiya C. Review article epidemiology of ischaemic heart disease in Sub-Saharan Africa. Cardiovasc J Afr 2013;24:34-42.
5. Norman PE, Curci JA. Understanding the effects of tobacco smoke on the pathogenesis of aortic aneurysm. Arterioscler Thromb Vasc Biol 2013;33:1473-7.
6. Thromb A, Biol V. Smoking Increases Expansion Rate and Rupture Risk. 2013. Available from: [http://ahajournals.org](http://ahajournals.org/)
7. Brathwaite R, Addo J, Smeeth L, Lock K. A systematic review of tobacco smoking prevalence and description of tobacco control strategies in Sub-Saharan African countries; 2007 to 2014. Plos One 2015;10:e0132401.
8. Munday E, Walker S. Mortality outcomes of ruptured abdominal aortic aneurysms and rural presentation. Vascular 2016;24:449- 53.
9. Manda GE, Chaziya P, Mwafulirwa W, Kasenda S, Borgstein E. Successful open surgical repair of an infrarenal, abdominal aortic aneurysm (AAA) in a young Malawian female: A case report. Malawi Med J 2018;30:215-7.
10. Ogeng’O J., Maina P. Cardiovascular causes of death in an East African country: Autopsy study. Eur J Med Res 2010;15:32.

14 Journal of the West African College of Surgeons | Volume 10 | Issue 1 | January‑March 2020