Prevalence and risk factors for long COVID and post-COVID-19 condition in Africa: a systematic review

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Summary

Background An improved estimation of the clinical sequelae of SARS-CoV-2 infection is crucial in African countries, where the subject has received little attention despite more than 12 million reported cases and evidence that many more people were infected. We reviewed the evidence on prevalence, associated risk factors for long COVID, and systemic or sociocultural determinants of reporting long COVID.

Methods We conducted a systematic review, searching PubMed, the Living OVerview of Evidence platform, and grey literature sources for publications from Dec 1, 2019, to Nov 23, 2022. We included articles published in English, French, Spanish, or Portuguese that reported on any study type in Africa with participants of any age who had symptoms for 4 weeks or more after an acute SARS-CoV-2 infection. We excluded secondary research, comments, and correspondence. Screening and data extraction were performed by two reviewers. Summary estimates were extracted, including sociodemographic factors, medical history, prevalence of persistent symptoms, and symptoms and associated factors. Results were analysed descriptively. The study was registered on the Open Science Framework platform.

Findings Our search yielded 294 articles, of which 24 peer-reviewed manuscripts were included, reporting on 9712 patients from eight African countries. Only one study exclusively recruited children, and one other study included children as part of their study population. Studies indicated moderate to low risk of bias. Prevalence of long COVID varied widely, from 2% in Ghana to 86% in Egypt. Long COVID was positively associated with female sex, older age, non-Black ethnicity, low level of education, and the severity of acute infection and underlying comorbidity. HIV and tuberculosis were not identified as risk factors. Factors influencing reporting included absence of awareness, inadequate clinical data and diagnostics, and little access to health-care services.

Interpretation In Africa, research on long COVID is scarce, particularly among children, who represent the majority of the population. However, existing studies show a substantial prevalence across settings, emphasising the importance of vaccination and other prevention strategies to avert the effects of long COVID on individual wellbeing, the increased strain on health systems, and the potential negative effects on economically vulnerable populations. At a global level, including African countries, tools for research on long COVID need to be harmonised to maximise the usefulness of the data collected.

Funding None.

Lancet Glob Health 2023; 11: e1713–24

This online publication has been corrected. The corrected version first appeared at thelancet.com/lancetgh on February 9, 2024

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For more on **COVID-19 morbidity and mortality** see https://covid19.who.int

Introduction

With almost 800 million cases and 7 million deaths, the COVID-19 pandemic has caused morbidity and mortality at an unprecedented scale globally. Global surveillance data indicate that Africa has been less severely affected than the rest of the world; however, more than 12 million cases have been reported and evidence suggests that many more people were infected. A meta-analysis of seroprevalence data estimated the pooled prevalence at 65·1% in Africa, reflecting one of the highest estimates worldwide,[1] with country-specific prevalence as high as 73% in Ethiopia[2] and 87% in Gabon.[3] COVID-19 presented itself differently in Africa compared with in other global settings. The high seroprevalence is driven predominantly by mild or asymptomatic infections, which account for more than two-thirds of all infections.[1] The relatively young population (ie, >60% younger than 25 years) might be responsible for this low occurrence of severe disease, among other factors that are poorly understood.[4]

There is growing evidence on persistent or new symptoms and long-term sequelae following SARS-CoV-2 infection, now widely referred to as long COVID and post-COVID-19 condition. Evidence suggests that SARS-CoV-2 vaccination might reduce the risk of long COVID. It is unclear whether this protective effect extends to vaccination after acute infection.[5,6] However, vaccination coverage on the African continent is low,[7] partly due to the perceived low risk of severe COVID-19 and COVID-19-related mortality.[8] Apart from the effect of

Research in context

Evidence before this study

Before this systematic review, we carried out a search for evidence on long COVID in Africa published in Embase and the Living OVerview of Evidence platform on Sept 27, 2022, without any restrictions on date or language. In addition to there being no published systematic reviews on long COVID or post-COVID-19 in Africa, we identified no registered systematic reviews on the Open Science Framework or Prospero. However, in one international review, among the recommendations noted was a call for region-specific synthesis of the available evidence for low-income countries. In these settings, the subject has received little attention despite more than 12 million reported cases and evidence of many more infected.

Added value of this study

This systematic review on long COVID in the African region complements previous syntheses from other global regions. None of the previous reviews have estimated the prevalence or described symptoms and associated patient characteristics for long COVID in this setting, which is predominated by a young population and has a relatively low burden of severe COVID-19. Our review also provides additional data on factors that might have influenced reporting of symptoms of long COVID.

Implications of all the available evidence

There is an urgent need for evidence from longitudinal studies, including studies in vulnerable populations, particularly children and rural populations across Africa, that maximise usefulness through use of harmonised research tools. Existing evidence shows a substantial burden, emphasising the importance of prevention strategies to avert the effects of long COVID on individual wellbeing, the increased strain on the health system, and the potential negative effects on economically vulnerable populations, especially in the African region.

the low vaccination coverage, characterisation and reporting of long COVID could be influenced by the unique presentation of the acute infection, multiple reinfections, the predominance of asymptomatic cases in a predominantly young population, and prevalent comorbidities, such as tuberculosis, across the African region. Furthermore, information is scarce on the effects of symptoms on people's day-to-day functional capacities or health-related quality of life. The challenges associated with seeking health care for neuropsychiatric conditions in Africa, such as stigma, misconceptions, and the absence of culturally appropriate interview-based instruments, can also contribute to underestimation of the true burden of long COVID because of the prevalence of neuropsychiatric symptoms related to long COVID.[9–11]

See Online for appendix

Evidence of a hidden burden of long COVID in Africa would reshape the current understanding of the true burden of COVID-19 across the continent, accounting for its diverse effects not only on individuals' wellbeing but also on their economic productivity and on health systems, warranting renewed efforts to expand coverage of vaccines and other preventive and supportive measures.

To date, reviews on long COVID or post-COVID-19 condition have not included any studies from the African region,[12,13] and hence a review published in 2022 called for a region-specific synthesis of the available evidence, especially in low-income countries.[14]

We conducted a systematic review to estimate burden, describe risk factors, and determine systemic or sociocultural factors that might influence reporting of long COVID in Africa. We aim to synthesise existing knowledge on long COVID in Africa to guide policy makers at a national, regional, and global level and to build the basis for primary research to add evidence to the knowledge on long COVID from a population with widespread but mostly mild COVID-19.

Methods

Search strategy and selection criteria

We conducted a systematic review following the PRISMA guidelines and checklist.[15] The detailed PRISMA checklist is available in the appendix (pp 1–2). On expert advice to synthesise empirical data on prevalence and risk factors, the initial protocol of a scoping review was adapted to perform a systematic review, including risk of bias analysis and grey literature search.

We searched the literature for publications from Dec 1, 2019, to Nov 23, 2022, without restrictions on the language of publication or publication status in the databases PubMed and the Living OVerview of Evidence (L·OVE) platform. L·OVE is a system based on two inter-related components: a repository and a classification platform that includes trial registries, electronic databases, and preprint servers, such as PubMed, Embase, ClinicalTrials.gov, Pan African Clinical Trial Registry, medRxiv, bioRxiv, SSRN Preprints, and Research Square.[16]

We adapted our search strategy from the strategy used by Franco and colleagues[14] and included search terms specific to Africa (appendix pp 3–4).[17] In both databases, we used the preset long COVID classification or filter and our own search strategy. We additionally hand-searched the literature via forward and backward citation matching using CoCites[18] and contacted experts on long COVID in Africa. These experts hold leadership roles within public health systems in the region.

To identify grey literature, we searched the most commonly used grey literature sources: the International Health Technology Assessment database, Scopus, Cochrane Central Register of Controlled Trials, and Proquest Dissertations and Theses Global. We covered the WHO International Clinical Trials Registry Platform and ClinicalTrials.gov via the L·OVE platform. To specifically include sources from Africa, we examined

the websites and publications of African public health institutes and the website of South African Health Review.

There are varying definitions of long COVID and post-COVID-19 condition. Post-COVID-19 condition has been defined in a Delphi consensus guided by WHO.[19] In this consensus, adults with a history of probable or confirmed SARS-CoV-2 infection with symptoms for 12 weeks or longer from the onset of COVID-19 over a duration of 2 months without an alternative diagnosis are recognised as having post-COVID-19 condition. Long COVID is referenced to health problems from a period of 4 weeks after SARS-CoV-2 infection or onset of acute COVID-19 symptoms and hence includes both ongoing symptomatic COVID-19 (from 4 weeks to 12 weeks after COVID-19 onset) and post-COVID-19 condition (12 weeks or more after COVID-19 onset).[20] In this Article, we applied the most inclusive definition we found in the literature of a minimum of 4 weeks and have used the term long COVID to refer to long COVID and post-COVID-19 condition.

Studies were considered eligible for inclusion if they included people of any age with a previous history of probable or confirmed SARS-CoV-2 infection (including self-reported infection) who had symptoms for 4 weeks or more after the onset of the infection and if the study was done in Africa. Articles in English, French, Spanish, and Portuguese were eligible for review. All types of studies, including clinical trials, cohort studies, case-control studies, cross-sectional studies, case reports, and case series, were included. Reviews, comments, and correspondences were excluded; however, we included relevant primary studies reported in the reviews. If primary data included a subset of potentially relevant data for the African region, we contacted the corresponding authors.

We used EndNote 20 for deduplication, screening, and study selection. Screening of titles and abstracts was performed independently by two primary reviewers (SAM and LI) to identify potentially relevant articles. The same reviewers subsequently categorised all potentially relevant records into those that were to be included and excluded. Discrepancies were resolved by a third reviewer (AA). Summary estimates were extracted.

The protocol was registered on the Open Science Framework (OSF) platform.[21] At the time the protocol was developed, no similar research projects were registered in either the PROSPERO database[22] or the OSF database.

Data analysis

The primary reviewers (SAM and LI) independently extracted the following data from eligible articles into a structured form created in Microsoft Excel: publication description (ie, author, publication year, title, type of publication, and journal), study design (ie, country, study period, study type, sample size, sampling, setting, length of follow-up, and contact type), and study population (ie, age, sex or gender, subpopulation, comorbidities, vaccination status, diagnosis of SARS-CoV-2 infection, and severity of COVID-19). The primary outcome was the prevalence estimates of long COVID or post-COVID-19 condition, in addition to persistent symptoms and associated factors.

The quality of studies was assessed using the Joanna Briggs Institute critical appraisal tool for prevalence studies.[23] Bias was assessed using a 9-point ranking system with 9 points indicating low risk of bias and 0 points indicating very high risk of bias, whereby a point was given for appropriate statistical analysis if the numerator and denominator were clearly reported or percentages were given with CIs. To assess systemic and sociocultural factors, the primary reviewers screened the results and discussion sections of all included studies.

Although we were unable to do a formal meta-analysis due to the heterogeneity of the included studies, using R version 4.0.5 meta package, we constructed a forest plot to illustrate magnitude and distribution of prevalence estimates across studies in a random-effects statistical model.

We presented the geographical distribution of included studies graphically using MapChart. We

For more on **MapChart** see https://www.mapchart.net

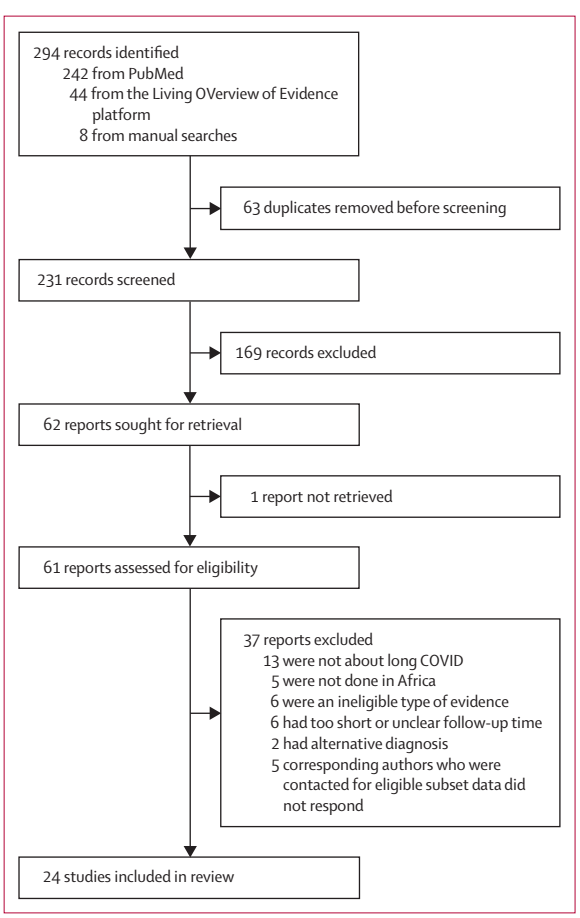

Figure 1: **PRISMA flow diagram**

For more on the **OSF database** see https://osf.io/

	Study design	Country	Sample size, n	Means of diagnosis of acute infection	Means of diagnosis of long COVID	Age distribution, years	Male sex, n (%)	Female sex, n (%)	Vaccination status	Study population characteristics
Abdelghani et al (2022)[26]	Comparative cross-sectional	Egypt	170*	RT-PCR	Face-to-face semi-structured interview	Mean 36·0 (SD 9·4)	16/85 (18·8%)	69/85 (81·2%)	NR	General adult population discharged from COVID-19 isolation hospital
Abdelghani et al (2022)[27]	Comparative cross-sectional	Egypt	170*	RT-PCR	Face-to-face semi-structured interview	Mean 36·0 (SD 9·4)	16/85 (18·8%)	69/85 (81·2%)	NR	General adult population discharged from COVID-19 isolation hospital
Abdelrahman et al (2021)[28]	Prospective cohort	Egypt	172	NR	Mobile phone questionnaires	Mean 41·8 (range 17–80)	59 (34·3%)	113 (65·7%)	NR	Individuals without severe illness and no pregnant or lactating women
Aly and Saber (2021)[29]	Cross-sectional	Egypt	115	RT-PCR	Online via social media	Mean 73·2 (SD 6·4)	0	115 (100·0%)	NR	Female participants aged >60 years
Amer et al (2020)[30]	Cross-sectional cohort	Egypt	96	RT-PCR	Questionnaires during medical visit	Mean 34·3 (SD 11·9)	42 (43·8%)	54 (56·3%)	NR	Individuals with olfactory complaints but without history of olfactory dysfunction, nasal surgery, or sinonasal tumours, who were not treated in ICU, confused, or illiterate and did not have mental illness
Azab et al (2021)[31]	Retrospective cross-sectional	Egypt	977	RT-PCR, serological test, chest CT, or a combination	Questionnaire by physician	Mean 60·2 (SD 15·8)	444 (45·4%)	533 (54·6%)	NR	Individuals with neurological complications after COVID-19 infection
Crankson et al (2022)[32]	Cross-sectional	Ghana	2334	RT-PCR	Hospital dataset	1343/2334 (57·5%) aged 30–59	1402 (60·1%)	932 (39·9%)	NR	Individuals who were admitted to hospital
Dryden et al (2022)[33]	Prospective cohort	South Africa	2410 at 1-month follow-up; 1872 at 3-month follow-up	RT-PCR or rapid antigen test	Hospital surveillance system and telephone follow-up	Median 52 (IQR 41–62)	913/1873 (48·7%)†	960/1873 (51·3%)	942/1872 (50·3%) had ≥1 vaccination at 3-month follow-up	Individuals who were admitted to hospital
El Otmani et al (2022)[34]	Case-control	Morocco	236*	RT-PCR	Online questionnaire	Median 29 (IQR 21–54)	34/118 (28·8%)	84/118 (71·2%)	63/118 (53·4%) individuals in the case group were vaccinated	Health-care workers who were not admitted to ICU
Eldokla et al (2022)[35]	Cross-sectional	Egypt	322	RT-PCR, antibody testing, or both	Medical records and clinical visit	Mean 35·9 (SD 11·9)	87 (27·0%)	235 (73·0%)	NR	Participants with long COVID and without diagnosis of cognitive dysfunction, neurodegenerative brain disorders, known history of autonomic dysfunction, or medications affecting the autonomic nervous system
Galal et al (2021)[36]	Cross-sectional	Egypt	430	RT-PCR or clinical and radiological criteria	Interview in follow-up clinic	Mean 37·4 (SD 12·6)	156 (36·3%)	274 (63·7%)	NR	General adult population
Halouani et al (2022)[37]	Cross-sectional	Tunisia	154	RT-PCR or CT chest	Telephone call by physician	Mean 66·6 (SD 13·3)	93 (60·4%)	61 (39·6%)	NR	Hospitalised individuals with no ICU admission and no history of psychiatric disease
Kaggwa et al (2021)[38]	Case report	Uganda	1	RT-PCR	Hospital admission	41	0	1 (100·0%)	NR	NA
Mendelsohn et al (2022)[39]	Retrospective cross-sectional	South Africa	174	RT-PCR	Telephone call	Mean 50·3 (SD 13·6)	66 (37·9%)	108 (62·1%)	NR	Adults aged ≥45 years, individuals of any age with high-risk comorbidities, or health-care workers or workers in congregate settings of any age
Mohamed Hussein et al (2021)[40]	Cross-sectional	Egypt	444	RT-PCR or clinical or radiological assumption	Interview in clinic and survey forms	Mean 33·1 (SD 12·1)	192 (43·2%)	252 (56·8%)	NR	General adult population
Pretorius et al (2022)[41]	Cross-sectional	South Africa	845	RT-PCR	Self-report in the Long COVID registry	642/845 (76%) were aged 31–60 years	252 (29·8%)	593 (70·2%)	NR	Participants with long COVID

(Table 1 continues on next page)

	Study design	Country	Sample size, n	Means of diagnosis of acute infection	Means of diagnosis of long COVID	Age distribution, years	Male sex, n (%)	Female sex, n (%)	Vaccination status	Study population characteristics
(Continued from previous page)										
Saad et al (2021)[42]	Prospective cohort	Egypt	192	RT-PCR	Clinical follow-up	Mean 37·9 (SD 11·8)	127 (66·1%)	65 (33·9%)	NR	Individuals referred from chest clinic or emergency department
Shendy et al (2021)[43]	Cross-sectional	Egypt	81	RT-PCR, CT chest, and serology	Telephone questionnaire	Mean 34·0 (SD 4·9)	26 (32·1%)	55 (67·9%)	NR	Individuals with mild or moderate disease, excluding those with chronic illness, psychiatric problems, cognitive impairment, and medications that cause fatigue
Tawfik et al (2021)[44]	Retrospective cohort	Egypt	120	RT-PCR and CT chest	Questionnaire	Mean 33·7 (SD 7·3)	50 (41·7%)	70 (58·3%)	NR	Health-care workers
Tohamy et al (2021)[45]	Retrospective case-control	Egypt	200*	NR	Clinical examination	Mean 55·5 (SD 6·2)	57/100 (57·0%)	43/100 (43·0%)	NR	General adult population
Toulgui et al (2022)[46]	Cross-sectional	Tunisia	14	RT-PCR	Clinical examination	Mean 61·4 (SD 4)	14 (100·0%)	0	NR	Men with post-COVID-19 condition, aged >50 years, with extensive or severe parenchymal lung injury, who were admitted to hospital but not admitted to ICU, without unstable angina or myocardial infarction within the previous month, with a resting heart rate <120 beats per min, with a systolic blood pressure <180 mm Hg and diastolic blood pressure <100 mm Hg, without contraindication to spirometry, and without orthopaedic, rheumatological, or muscular history that could interfere with walking
Weldetsadik et al (2022)[47]	Prospective cohort	Ethiopia	79	RT-PCR	Telephone call	Mean 6·9 (SD 6·4)	39 (49·4%)	40 (50·6%)	NR	Children aged 0–19 years admitted to COVID-19 treatment centre
Wose Kinge et al (2022)[48]	Cross-sectional	South Africa	62	NR	Online platform	Median 33·5 (IQR 30–44)	15 (24·2%)	47 (75·8%)	NR	Health-care workers
Zulu et al (2022)[49]	Prospective cohort	Zambia	302	RT-PCR	Telephone or in-person questionnaire	Mean 32 (range 1–85)	128 (42·4%)	174 (57·6%)	NR	Individuals who were not admitted to hospital

ICU=intensive care unit. NA=not applicable. NR=not reported. *Cases and controls. †Reported as 913/1873 (48·8%) in the original paper, but corrected to 48·7% here.

Table 1: **Characteristics of included studies**

overlaid the temporal distribution of the included studies on a regionally stratified epicurve of the pandemic by use of global reporting data from WHO.[24] The distribution of included studies sorted by symptom set, age group, and follow-up time was generated using EPPI-Mapper.[25]

Role of the funding source

There was no funding source for this study.

Results

We identified 294 articles through database and manual searches. After removal of duplicates and assessment of titles and abstracts, we identified 62 potentially relevant articles for full-text evaluation. We contacted five corresponding authors to request subsets of potentially relevant data without success. Other reasons for exclusion were studies outside Africa, ineligible type of evidence (ie, secondary data, comments, or correspondence), a follow-up time that was unclear or less than 4 weeks, alternative diagnosis for condition, and studies not on long COVID (appendix p 6). Application of the eligibility criteria resulted in a final selection of 24 articles (figure 1). The additional search for grey literature did not yield any relevant papers as all statements referred to already included studies.

The included studies were conducted across eight African countries (table 1; appendix p 7): 13 papers from Egypt (n=3219),[26–31,35,36,40,42–45] four from South Africa (n=3491),[33,39,41,48] two from Tunisia (n=168),[37,46] and one from each of Ethiopia (n=79),[47] Ghana (n=2334),[32] Morocco (n=118 cases),[34] Uganda (n=1),[38] and Zambia (n=302).[49] All studies were conducted between March, 2020, and November, 2021, during the first three waves of the pandemic in Africa (appendix p 8), driven by the ancestral strain (first wave), the alpha variant (B.1.1.7) and beta variant (B.1.351; second wave), and the delta variant (B.1.617.2; third wave).[50] This time window corresponds to a period when less than 0·1% of the African population was vaccinated.[51]

	Reported prevalence, n (%) N	Follow-up time, months	Clinical presentation and symptoms, n/N (%)*	Associated factors†
Abdelghani et al (2022)[26]	65/85 (76·5%)	≥1	Neuropsychiatric: sleep disturbances (65/85 [76·5%]), depression (25 [29·4%]), and anxiety (21 [24·7%])	Poor global Pittsburgh Sleep Quality Index: female sex (p=0·034), low-to-medium education level (p=0·004), depressive symptoms (p=0·002), and anxiety symptoms (p=0·003)
Abdelghani et al (2022)[27]	44/85 (51·8%)	≥1	Neuropsychiatric: cognitive impairment (44/85 [51·8%])	Old age (OR 1·1, 95% CI 1·03–1·2), and low-to-moderate education (4·9, 1·6–15·1)
Abdelrahman et al (2021)[28]	105/172 (61·0%)	8–10	Persistent neuropsychiatric: fatigue (64/172 [37·2%]‡), depression (38 [22·1%]), insomnia (23 [13·4%]), headache (18 [10·5%]); persistent pulmonary: dyspnoea (38 [22·1%]); persistent other: joint pain (21 [12·2%]), generalised muscle pain (19 [11·0%]); new neuropsychiatric: disorientation (19 [11·0%]); new other: alopecia (18 [10·5%])	Adjusted: age (OR 1·03, 95% CI 1·01–1·05)
Aly and Saber (2021)[29]	89/115 (77·4%)	1	Neuropsychiatric: sleep disturbance (73/115 [63·5%]), fatigue (66 [57·4%]), stress (65 [56·5%]), sadness (55 [47·8%]), cognitive dysfunction (29 [25·2%]), recurrent falls (29 [25·2%]), dry eye (16 [13·9%]), headache (14 [12·2%]), and anosmia or ageusia (14 [12·2%]); pulmonary: dyspnoea (20 [17·4%]); cardiovascular: palpitations (13 [11·3%]), chest pain and palpitations (12 [10·4%]); endocrine or gastrointestinal: decreased appetite (19 [16·5%]); other: incontinence (21 [18·3%]), muscle pain (18 [15·7%]), and weakness (12 [10·4%])	Stress (p=0·005), sadness (p=0·007), and sleep disturbances (p<0·001)
Amer et al (2020)[30]	64/96 (66·7%)	≥1	Neuropsychiatric: anosmia	Age (p<0·001), male sex (p=0·005), comorbidities (p<0·001), non-smoking (p<0·001), and history of allergic nasal disease (p<0·001)
Azab et al (2021)[31]	NA§	1–3	Neuropsychiatric: fatigue (780/977 [79·8%]), headache (603 [61·7%]), neuralgia (503 [51·5%]), convulsions (461 [47·2%]), altered mental status (364 [37·3%]), weakness (222 [22·7%]), memory problems (203 [20·8%]), and syncope (104 [10·6%]); pulmonary: shortening of breath (588 [60·2%]), cough (190 [19·4%]), and hypoxia (190 [19·4%]); cardiovascular: chest pain (240 [24·6%]); endocrine or gastrointestinal: nausea, vomiting, and diarrhoea (268 [27·4%]); other: hyperpyrexia (426 [43·6%]) and myalgia (256 [26·2%])	Mortality: immunosuppressors (OR 2·10, 95% CI 1·19–3·73), smoking (0·71, 0·51–0·99), hypertension (2·02, 1·33–3·07), and epilepsy (2·75, 1·38–5·47)
Crankson et al (2022)[32]	50/2334 (2·1%)	≥1	NR	Adjusted: female sex (OR 0·52, 95% CI 0·27–0·99), primary education (0·73, 0·01–0·66), secondary or vocational education (0·26, 0·09–0·77), tertiary education (0·23, 0·07–0·72), hypertension or diabetes (4·18, 1·61–10·85); tuberculosis was not found to be associated
Dryden et al (2022)[33]	1978/2410 (82·1%) at 1-month follow-up; 1249/1873 (66·7%) at 3-month follow-up	1–3	Neuropsychiatric at 1 month: fatigue (1226/1873 [65·5%]), headache (406 [21·7%]), confusion (318 [17·0%]), problems seeing (224 [12·0%]), and dizziness (222 [11·9%]); pulmonary at 1 month: shortness of breath (864 [46·1%]) and dry cough (276 [14·7%]); cardiovascular at 1 month: chest pain (280 [14·9%]); other at 1 month: muscle aches (198 [10·6%]); neuropsychiatric at 3 months: fatigue (942/1873 [50·3%]), confusion (327 [17·5%]), headache (258 [13·8%]), and problems seeing (190 [10·1%]); pulmonary at 3 months: shortness of breath (439 [23·4%])	Adjusted: female sex (OR 1·20, 95% CI 1·04–1·38) and ICU admission (1·17, 1·01–1·37) were associated with new or persistent symptoms; female sex (1·37, 1·05–1·77), self-reported White ethnicity (1·86, 1·32–2·63), self-reported mixed ethnicity (1·69, 1·04–2·76), supplemental oxygen (2·19, 1·41–3·39), and at least four acute symptoms (2·73, 1·11–6·71) were associated with persistent breathlessness; female sex (1·92, 1·37–2·705), self-reported White ethnicity (1·84, 1·24–2·70), self-reported mixed ethnicity (1·95, 1·10–3·45), self-reported Indian ethnicity (1·89, 1·02–3·52), mechanical ventilation (2·07, 1·28–3·32), pre-existing asthma (2·19, 1·35–3·57), pre-existing diabetes type 1 (0·64, 0·41–0·99), pre-existing hypertension (1·81, 1·28–2·56), and pre-existing depression (2·73, 1·02–5·48) were associated with self-reported non-recovery; HIV and tuberculosis were assessed but no association was found
El Otmani et al (2022)[34]	56/118 (47·5%)	≥1	Neuropsychiatric: asthenia (25·3%), attention disorders, memory impairment, and brain fog (14·4%), headache (12%), sleep disorder (12%); cardiovascular: palpitations (10·8%); other: myalgia (13·3%)	Severity of the pulmonary involvement on chest CT (p=0·001)
Eldokla et al (2022)[35]	NA¶	≥1	Neuropsychiatric: high compass score (247/322 [76·7%])	COMPASS-31 total score was associated with long COVID duration (p<0·001)
Galal et al (2021)[36]	370/430 (86·0%)	Mean duration of symptoms of 176 months (SD 35·1 days)	Neuropsychiatric: decreased daily activities (57·0%), nervousness or hopelessness (53·3%), and sleeping troubles (50·9%); pulmonary: cough (29·3%) and dyspnoea (29·1%); cardiovascular: chest pain (32·6%); endocrine or gastrointestinal: anorexia (42·6%), gastritis (32·3%); other: myalgia (60·0%) and arthralgia (57·2%)	Hypertension (p=0·039), chronic pulmonary disease (p=0·012), any chronic disorder (p=0·004), need for oxygen therapy (p<0·001), previous seasonal influenza vaccination (p=0·003), and symptom score during acute attack (p<0·001)

(Table 2 continues on next page)

	Reported prevalence, n (%) N	Follow-up time, months	Clinical presentation and symptoms, n/N (%)*	Associated factors†
(Continued from previous page)				
Halouani et al (2022)[37]	NR	>3	Neuropsychiatric: anxiety (38/154 [24·7%]), post-traumatic stress disorder (21 [13·6%]), and depression (17 [11·0%])	Anxiety was associated with level of education (p=0·034) and asthenia (p=0·032); depression was associated with female sex (p=0·025), gastrointestinal involvement (p=0·002), and stigma (p=0·002)
Kaggwa et al (2021)[38]	NA‖	6	Endocrine or gastrointestinal: polyphagia	NA‖
Mendelsohn et al (2022)[39]	105/174 (60·3%)	2	Neuropsychiatric: fatigue (60/174 [34·5%]), ageusia (34 [19·5%]), anosmia (32 [18·4%]), and headache (27 [15·5%]); pulmonary: dyspnoea (35 [20·1%]); cardiovascular: chest pain (19 [10·9%]) and palpitations (18 [10·3%]); endocrine or gastrointestinal: gastrointestinal complaints (21 [12·1%]); other: body aches (26 [14·9%])	Self-reported non-recovery was associated with ≥3 long COVID symptoms (OR 15·0, 95% CI 5·9–37·8)
Mohamed Hussein et al (2021)[40]	355/444 (80·0%)	≥1	Post-COVID-19 Functional Status scale: trivial limitation (280/444 [63·1%]), slight limitation (64 [14·4%])	Post-COVID-19 functional status score: age (p=0·003), female gender (p=0·014), duration since COVID-19 symptom onset (p<0·001), need for oxygen supplementation (p<0·001), ICU admission (p=0·003), seasonal influenza vaccination (p<0·001), smoking status (p<0·001), and presence of any comorbid disorders (p<0·001)
Pretorius et al (2022)[41]	NA¶	2	Neuropsychiatric: fatigue, brain fog, loss of concentration, and forgetfulness; pulmonary: shortness of breath; other: joint and muscle pains	NR
Saad et al (2021)[42]	77/192 (40·1%)	2–3	Neuropsychiatric: anosmia, asthenia, and headache; pulmonary: dyspnoea; cardiovascular: chest pain and palpitations; endocrine or gastrointestinal: weight loss (>5% of bodyweight) and digestive disorders; other: cutaneous signs, arthralgia, or fever	At least one medical comorbidity (p<0·05), higher CT severity score (p<0·001), and older age (p=0·009)
Shendy et al (2021)[43]	52/81 (64·2%)	3–5	Neuropsychiatric: fatigue (52/81 [64·2%])	Fatigue: level of dyspnoea (p=0·04)
Tawfik et al (2021)[44]	NR	1–3	Neuropsychiatric at 1 month: fatigue, depressive symptoms (75%), headache, insomnia, dizziness, panic attacks, ageusia, and anosmia; pulmonary at 1 month: dyspnoea (>50%); cardiovascular at 1 month: chest pain and palpitations; endocrine or gastrointestinal at 1 month: loss of appetite and diarrhoea; other at 1 month: myalgia, body aches; neuropsychiatric at 3 months: fatigue (approximately 37%), depressive symptoms, headache, insomnia, panic attacks, dizziness; pulmonary at 3 months: dyspnoea; cardiovascular at 3 months: chest pain and palpitations; other at 3 months: body aches and myalgia (18%)	Aged >35 years (associated with symptoms after 3 months; OR 2·4, 95% CI 1·1–5·4)
Tohamy et al (2021)[45]	NA**	1–3	NA	NR
Toulgui et al (2022)[46]	NA¶	≥2	NR	NR
Weldetsadik et al (2022)[47]	3/65 (4·6%)	3	Neuropsychiatric: fatigue and headache; pulmonary: cough; other: joint pain and fever	NR
Wose Kinge et al (2022)[48]	15/62 (24·2% at 3 months)	3	Neuropsychiatric at 4 weeks: fatigue (42%), anxiety (34%), difficulty sleeping (31%), and brain fog (21%); cardiovascular at 4 weeks: chest pain (24%); other at 4 weeks: muscle pain (21%) and joint pain (19%)	No significant association found with fatigue
Zulu et al (2022)[49]	27/155 (17·4%)	2	Neuropsychiatric: headache (7/27 [25·9%]) and fatigue (4 [14·8%]); pulmonary: cough (10 [37·0%]), rhinorrhoea (5 [18·5%]); cardiovascular: chest pain (6 [22·2%]); endocrine or gastrointestinal: appetite (4 [14·8%]); other: rhinorrhoea (5 [18·5%]), fever (4 [14·8%]), arthralgia (4 [14·8%]), and abdominal pain (3 [11·1%])	At least five symptoms at onset (OR 2·87, 95% CI 1·09–7·56) and loss of appetite (3·40, 1·30–8·86)

Numerators and denominators are reported when available from the literature. ICU=intensive care unit. NA=not applicable. NR=not reported. OR=odds ratio. *Reported if symptom prevalence >10%. †Analyses were not adjusted for potential confounding or effect modification, unless otherwise stated. ‡Reported as 64/172 (37·3%) in the original paper, but corrected to 37·2% here. §Only participants with neurological complications after COVID-19 were included. ¶Only patients with long COVID were included. ‖Case report. **Case-control study.

Table 2: **Prevalence, clinical presentation, symptoms, and factors associated with long COVID**

Altogether, these studies reported data on 9712 (range 1–2410) people aged 0–85 years with long COVID or post-COVID-19 condition. For 9175 participants with data available for sex or gender, 4228 (46·1%) were male and 4947 (53·9%) were female. One study focused exclusively on children (n=79).[47] Most were cross-sectional studies (14 [58%] of 24), followed by cohort studies (seven [29%]). There were two (8%) case-control studies and one (4%) case report. Three studies reported to have enrolled a random sample of study participants,[33,39,45] and one study was nationally representative of the South African population.[33] 17 studies included individuals with symptoms for less than 3 months and, therefore, did not meet the WHO definition for post-COVID-19 condition.[19] The longest follow-up period was 10 months (table 1).[28]

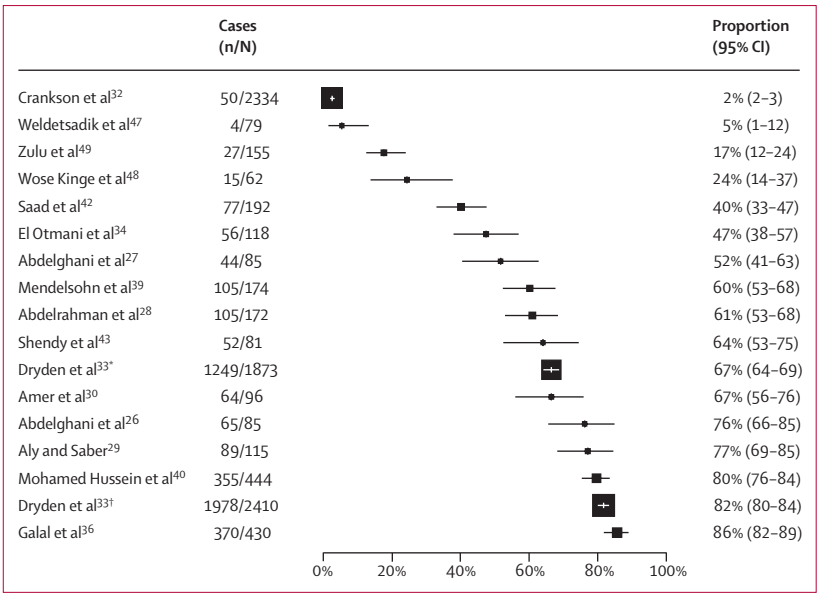

Figure 2: **Forest plot on prevalence of long COVID in included studies**
*After 3 months. †After 1 month.

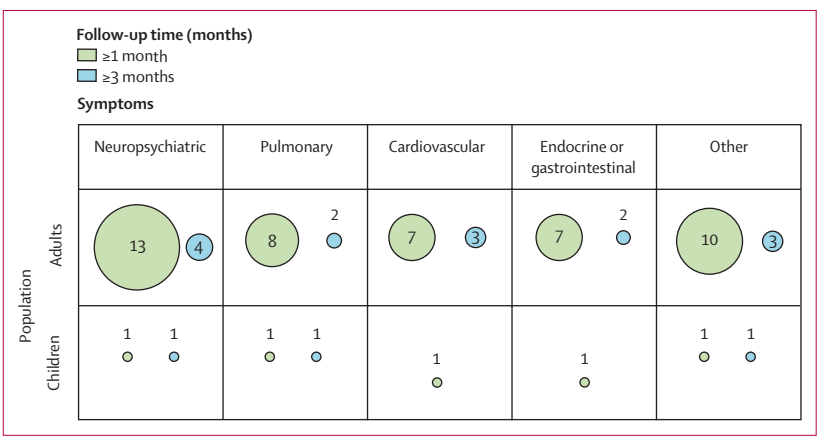

Figure 3: **Evidence map sorted by symptom set, population, and follow-up time**
Sample size of 1–13 studies. Created using EPPI-Reviewer[52] and EPPI-Mapper.

Five studies excluded people with intensive care admission or particular pre-existing medical conditions. Six studies included only participants with a prespecified symptom set. Pre-existing comorbidities were reported in most studies (15 [63%] of 24).

Prevalence of long COVID and post-COVID-19 condition ranged from 2% in a cross-sectional study in Ghanaian adults and 5% in a cohort study in Ethiopian children[32,47] to 86% in a cross-sectional study in Egypt[36] (table 2). Notably, the studies that reported the lowest prevalence (ie, the study by Crankson and colleagues,[32] conducted in Ghana from March, 2020, to August, 2021, and the study by Weldetsadik and colleagues,[47] conducted in Ethiopia from August, 2020, to January, 2021) overlapped temporally with the studies reporting the highest prevalence (ie, the study by Galal and colleagues,[36] conducted in Egypt from July to August, 2020; figure 2). Comparing symptoms at 1-month and 3-month follow-up, the main timepoints of the long COVID definition, one study observed a declining trend from 82·1% to 66·7%.[33]

Patients with long COVID reported a wide range of new or persisting symptoms. We extracted and categorised the symptoms into the following physiological clusters: neuropsychiatric, pulmonary, cardiovascular, endocrine or gastrointestinal, and other (figures 3, 4).[53] On the basis of reported prevalences in the included studies, the most common symptoms were neuropsychiatric symptoms, such as fatigue and headache. Pain sensations, such as chest and muscle pain, were more frequent than respiratory symptoms, such as dyspnoea or shortness of breath. Symptoms such as sleep disturbances, cognitive functioning complaints, cough, and gastrointestinal symptoms were also reported. Joint pain, despite the low frequency, was perceived as most bothersome.[48] Five studies focused on a specific symptom set: ocular,[45] fatigue,[43] anosmia,[30] neurological presentation,[31] and cognitive effects.[27]

Five studies assessed the effect of long COVID on patients' quality of life. One study that followed up patients for 3 months identified that 2·5% (47 of 1873) reported a change in occupation and, of these, only a third attributed this change to the effects of long COVID.[33] Among health-care workers, no difference in physical activity was identified at 3 months' follow-up compared with before infection[48] and, in Egypt, one study reported that most patients had trivial to slight functional limitations.[40] Contrarily, one study that followed up non-critical patients with COVID-19 for 2 months identified that more than half of participants reported missing work due to ongoing COVID-19 symptoms,[39] and in Egypt, more than half of participants reported restriction of their daily activites.[36]

We identified considerable diversity in reported risk factors. Three studies that reported adjusted analyses identified increased risk associated with sociodemographic factors, such as female sex, older age, non-Black ethnicity, and low level of education, in addition to factors related to the acute infection, such as admission to an intensive care unit, oxygen supply or mechanical ventilation, and medical history, such as pre-existing asthma, depression, or anxiety.[28,32,33] Other studies with non-adjusted analysis reported that male sex, smoking, severity of chest involvement, and comorbidities, such as allergies, diabetes, hypertension, and chronic pulmonary disorders, were associated with long COVID (table 2). Five studies assessed the association with HIV or tuberculosis, but neither was determined to be a risk factor.

In terms of pathophysiological factors, platelet hyperactivation and increased amyloid microclotting were identified in all individuals with long COVID in one study.[41] None of the studies focused directly on systemic

or socioeconomic and cultural factors that could influence reporting. Included studies reported a lack of awareness of effects of long COVID, particularly among men, as an important factor influencing reporting. This lack of awareness, coupled with a perceived greater concern for health among women than among men and poor health-seeking behaviour among men, was postulated to have contributed towards the higher apparent risk of long COVID among women.[30,33]

Scarcity of data due to limited capacity to perform investigations, such as MRI or PCR on cerebrospinal fluid, was also perceived to have influenced reporting.[31] Additionally, difficulty in ascertaining symptoms that were directly related to long COVID versus those that were related to other respiratory-related comorbidities (eg, tuberculosis and chronic obstructive pulmonary disease) was described.[39,49]

Access to medical care during individuals' post-acute COVID-19 phase was a challenge due to interruptions to public primary health-care services. In one study, only 12 (29%) of 42 people with persistent symptoms had follow-up care in public facilities. But access to care in private facilities is difficult due to the prohibitively high costs, emphasising that few patients with long COVID receive ongoing treatment.[39] Studies agreed that the high burden of long COVID is concerning because of a potential additional burden to already strained health-care systems, causing decreased work productivity and increased need for economic support.[33]

We used the Joanna Briggs Institute critical appraisal tool to rate studies out of a maximum score of 9 points (appendix p 5). Studies scored from 5 to 9, indicating moderate to low risk of bias. Risk of bias primarily arose from aspects such as sampling of participants, statistical analysis, or non-reporting of response rates. Seven studies were not rated, as they were not performed as prevalence studies.[30,31,35,38,41,45,46]

Discussion

Across the African region, data for long COVID are scarce, and despite our inclusive search strategy, we included only 24 studies from eight African countries, in which previous studies have reported high levels of infection-derived seroprevalence.[1] Of these 24 studies, only two studies included children, who represent the majority of the population in Africa. This data scarcity underscores the lack of understanding of long COVID in younger populations in Africa and other parts of the world.[54] An urgent need exists for carefully designed geographically and demographically representative prospective studies to characterise long COVID globally, and particularly in Africa.

We identified a wide variation in the burden of long COVID, with symptoms being mostly assessed less than 3 months after SARS-CoV-2 infection, and few studies on the effects of symptoms on quality of life. However, some studies reported very high prevalence. These findings

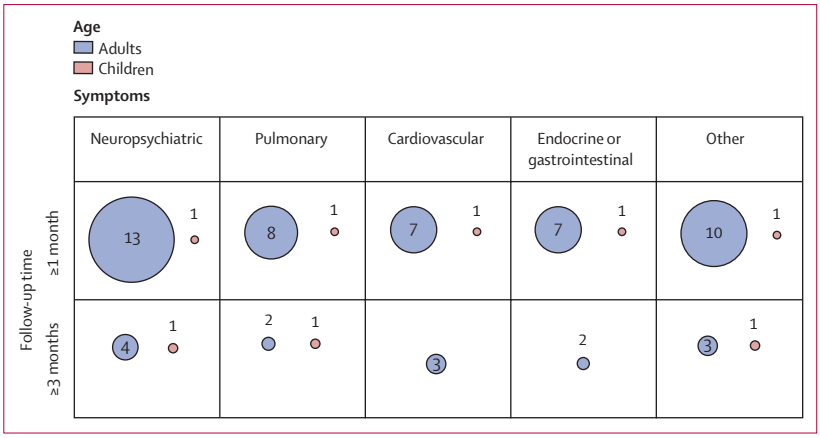

Figure 4: **Evidence map sorted by symptom set, follow-up time, and population age**
Sample size of 1–13 studies. Created using EPPI-Reviewer[52] and EPPI-Mapper.

contrast with substantially lower rates of reported severe disease and death across the region,[1] and imply a substantial burden of long COVID in Africa. The wide variation of prevalence could be amplified by the diversity of applied study designs (eg, case-control, cohort, and cross-sectional studies) and by the studied subpopulations (eg, health-care workers, older people, or children). Data from this systematic review add evidence to observations from many other countries that long COVID is prevalent and has a long-term effect on health, wellbeing, and functional capacities, even in populations with mainly mild COVID-19.[55,56]

Even though long COVID is a complex condition with diverse presentations, symptoms identified from this review were similar to those reported in other settings worldwide. Neuropsychiatric symptoms, such as fatigue and headache, pain sensations, and respiratory constraints, have been reported among the most prevalent symptoms in other parts of the world.[55–57] However, symptoms are highly subjective and likely to be prone to reporting bias, which might be especially relevant in the settings where young children, who may not be able to express their symptoms adequately,[54] account for a substantial proportion of the population.

Previous studies have identified many potential determinants of post-COVID-19 condition or long COVID. Risk factors from adjusted analyses reflect those also present in other regions of the world.[13] Associations between female sex, increasing age, minority ethnicities (specific to the study setting), and the severity of acute disease and long COVID have been previously described.[13] HIV and tuberculosis were not associated with an increased risk of long COVID. Given that tuberculosis is considered a risk factor for severe COVID-19,[58] this finding warrants further investigation. This evidence is of interest to policy makers in the prevention and control of these infectious diseases, considering the high burden of HIV and tuberculosis in Africa.

When considering systemic or sociocultural factors potentially influencing reporting, we should take into account that access to medical care during individuals' post-acute COVID-19 phase was limited by interruptions to primary health-care services. Factors such as lack of awareness, inadequate clinical data and diagnostics, and insufficient access to health-care services can further hamper reporting and lead to a potential underestimation of long COVID across the African region.

Our study has several limitations. Despite our inclusive approach, we identified studies from only eight African countries, of which only one was nationally representative, and hence the generalisability of our findings is extremely low. Because of data scarcity, we extracted relevant data from all eligible manuscripts, including those with short follow-up times that were inconsistent with the WHO definition of post-COVID-19 condition.[19] The applicability of this definition in the African context is uncertain, as experts from Africa were underrepresented in the Delphi exercise that formed the basis of the definition.[59] Furthermore, the criterion that "symptoms cannot be explained by an alternative diagnosis" might be difficult to ascertain as additional testing might not always be available.[59] Only three studies applied random sampling, or adjusted for confounding factors. Although the clinical case definition for post-COVID-19 condition in children and adolescents was published after completion of our selection and review,[60] the statement does not change our findings but rather presents an important step towards more comparable research, the need for which we emphasise. Many long COVID symptoms are based on subjective self-reporting and might be biased by individual, cultural, and socioeconomic influences. Barriers to symptom reporting, such as lack of knowledge, fear of the disease, stigmatisation, economic consequences, and challenges related to attending a health-care facility, have been shown worldwide.[61] However, only a minority of included studies discussed contextual factors, emphasising the need for studies with longitudinal design to evaluate these factors in reporting and access to health-care during disease outbreaks, especially in low-income settings.

Finally, estimates should be interpreted with caution given the worldwide absence of standardised methods for evaluating long COVID[55] and the likelihood of underreporting arising from the relatively low prevalence of symptomatic acute infection in Africa.[62]

A key strength of this systematic review is its rigorous and inclusive approach. Despite this, COVID-19 research is extremely dynamic, and frequent updating of evidence is needed as it emerges.[13] Living and systematic reviews might facilitate this better than journal publications, which reflect a moment in time.[13]

Africa is vast and diverse; this review does not aim to reflect all contextual factors affecting reporting. We identified difficulties in ascertaining long COVID and interrupted public primary health-care services leading to an absence of ongoing follow-up and treatment. Provision of chronic care in countries across the African region is constrained, particularly in primary care settings,[63] reducing care of people with long COVID who are in need of individualised comprehensive supportive management. This triple burden of long COVID, a high burden of other chronic diseases, and the negative effects of the pandemic on primary health-care services has been described in other regions of the world, reinforcing the value of prevention and treatment.[64] In Africa, where vaccine coverage is low, the findings of this review should reignite discussions on the true toll of COVID-19 on the continent and guide advocacy and policy efforts to scale up effective interventions, including for vaccine uptake. Our review emphasises the glaring inequity in global research on COVID-19 and even more so gaps in research on long COVID compared with that on acute COVID-19. An urgent need exists for evidence that includes vulnerable populations, particularly children and rural populations. As urban lifestyle and increasing age are likely to be associated with non-communicable comorbidities,[65] a risk factor for long COVID, we suggest further explicit investigation through longitudinal studies focusing on children versus adults and urban versus rural populations. To generate robust conclusions, these investigations should include control groups with confirmed absence of previous SARS-CoV-2 infection. These primary studies should use harmonised data collection tools to maximise the usefulness of the data collected globally and across the African continent.

Contributors

The study was first conceived of by JH, and AA provided overall supervision. SAM, LI, RM, CS-N, KH, AS, MA, CEB, JH, and AA conceptualised the study. SAM and LI searched and extracted the data. SAM wrote the first draft of the report with input from LI and AA. RM helped to design the evidence map. All authors critically revised the manuscript for intellectual content. All authors had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Declaration of interests

We declare no competing interests.

Data sharing

The datasets generated during or analysed during the current study are available from the corresponding author on reasonable request.

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