Epidemiology of uterine fibroid in black African women: a systematic scoping review

Imran O Morhason-Bello 1,2, Clement A Adebamowo 3,4

ABSTRACT

Objective Studies, mainly from high-income countries, suggest that there are ethnic and racial variations in prevalence of uterine fibroids (UF). However, there have been few studies of the epidemiology of UF in sub-Saharan Africa (SSA). We reviewed published articles on the epidemiology of UF in SSA.

Design This was a scoping review of literature.

Settings We searched three databases (PubMed, African Wide Information (EBSCO) and African Journals OnLine (AJOL)). The search for eligible articles was conducted between December 2019 and January 2021.

Primary and secondary outcome measures To describe the reported prevalence/incidence of, and risk factors for UF in SSA.

Results Of the 1052 articles retrieved, 9 met the inclusion criteria for review. The articles were from Nigeria (4/9), Ghana (2/9), Cameroon (1/9), Kenya (1/9) and South Africa (1/9). Two studies from pathology departments and three studies from radiology departments reported prevalence of UF. We did not find any study on the incidence or genomics of UF in SSA. Of the three studies that reported on the risk factors of UF, only one case–control study that was conducted using retrospective data of attendees at a gynaecological clinic conducted multivariable analysis.

Conclusion There is lack of robust epidemiological studies of the prevalence, incidence and risk factors of UF in SSA. There is urgent need to study epidemiological and genomics risk factors of UF in SSA because UF is the most common gynaecological neoplasm in this population where it is associated with significant morbidity and occasional, usually perioperative, mortality.

INTRODUCTION

Uterine fibroids or uterine leiomyomas (UF) are the most common neoplasms affecting women. They are typically composed of disordered fascicles of smooth-muscle cells, vascular smooth-muscle cells, fibroblasts, leiomyoma-associated fibroblasts and an excess of acellular extracellular matrix. They tend to be multiple and may be found in any part of the uterus however, they are the most common in the muscular wall of the uterus (the myometrium).

The incidence and prevalence of UF reported in the literature varies significantly by study design, methods of diagnosis, ethnic composition and age distribution of study participants. The cumulative incidence of UF by the age of 50 years in women in developed countries is 70%–80%. 

Variations in the incidence and prevalence of UF by race and ethnic groups have been widely reported. Studies show that the incidence and prevalence of UF in women of African ancestry is higher than that in other races. For example, a large longitudinal study (Nurses’ Health Study II) in the USA showed that the incidence of UF confirmed by pelvic examination, ultrasound (US) or hysterectomy per 1000 woman-years was 37.9 in African American, 14.5 in Hispanic, 12.5 in white and 10.4 in Asian women. In another longitudinal study conducted in UK, the crude incidence of UF based on primary care physicians’ diagnosis with USS, hysterscopy, laparoscopy or pelvic examination was 5.8 per 1000 woman-years.

There are several epidemiological risk factors for UF. These include advanced age,
race, age at menarche, low or nulliparity, family history, obesity, diet, physical activity, smoking, oral contraceptives, hormone replacement therapy, environmental exposure to high levels of oestrogen and progesterone and vitamin D deficiency. Age is consistently associated with the incidence and prevalence of UF irrespective of ethnicity, race and other risk factors. In general, the risk of UF is about 4–11 times higher in women aged 40–60 years compared with 20–30 years old women and women older than 60 years. Several studies show that early age at menarche is associated with higher risk of UF. Multiparity is linearly associated with reduced risk of UF. The risk reduction among multiparous women ranges from 20% to 50% compared with nulliparous women.

Overweight and obesity are independent risk factors for UF. A meta-analysis of 325,899 women among whom 19,593 had UF showed association with obesity. The association was present whether obesity was assessed using waist-to-hip ratio, waist circumference, weight change from age 18 years, or body mass index (BMI). Some studies found a dose response relationship between obesity and UF while other studies did not find such a relationship.

While few studies reported no associations between dietary intakes and UF, other studies showed a reduced risk with consumption of vegetables and fruits, and increased risk with intake of food additives, sweeteners, soya milk and dairy fats. Most studies found low level of serum vitamin D to be associated with increased risk of UF while a few reported no effect. The association between vitamin D and UF was stronger in black compared with white women. Exposure to sunlight for more than an hour a day was also associated with reduced risk of UF. Smoking was associated with reduced risk of UF, especially in women with low BMI. Most studies reported an inverse relationship between regular physical activities and risk of UF. Oral and injectable contraceptives use were associated with reduced risk of UF, however a few studies found increased or no risk in women using oral contraceptives. Hormone replacement therapy or exposure to exogenous hormones, particularly among postmenopausal women was associated with increased risk of UF in some studies.

Genetic and epigenetic factors have been associated with risk of UF. Positive family history is associated with increased risk of UF and higher risk was reported among sisters. The estimates of heritability for UF were 26%–69% in twin studies while data from genome-wide association studies (GWAS) reported heritability risk of 13%. The risk of UF is 2.5-fold among first degree relatives compared with the general population. The concordance rate of UF among monozygotic twins is twice that of dizygotic twins of the same sex, and a lot higher than in first-degree relatives. Recently, GWAS identified several candidate loci for UF in chromosome regions among African American—22q13.1 (CYP2H); Caucasian—11p15.5 (BET1L), 17q25.3 (FASN, CCDC57 and SLC16A5), 22q13.1 (TNRC6B); and Asian—10q24.33 (OBFC1), 11p15.5 (BET1L) and 22q13.1 (TNRC6B) populations.

UF is associated with significant morbidity and substantial socioeconomic costs. Data from a global systematic review of the cost of UF showed that the total direct and indirect cost after diagnosis or from surgical care ranged from US$11,717 to US$25,023 per patient per year. In USA, the annual cost of UF to the economy was estimated to be between US$5.9 and US$34.4 billion with obstetrical complications contributing the highest fraction of the economic burden.

Consistent with the high incidence and prevalence of UF in African populations in developed countries, case reports and clinical evidence suggest high prevalence of UF in black women living in Africa. However, in contrast to developed countries, there have been very few, adequately powered, systematic epidemiological studies of UF in Africa. In this scoping review of current publications on the epidemiology of UF in Africa, we aim to establish the state of the evidence and their limitations, the burden of UF and priorities for research on UF in black women living in sub-Saharan Africa (SSA).

**METHODS**

In this review, we used the Joanna Briggs Institute guidelines for the conduct of systematic scoping review which was earlier described by Arksey and O’Malley. Briefly, we base this review on five frameworks: (a) identifying the research question, (b) identifying the relevant studies (search strategy), (c) selecting the eligible studies, (d) charting the data and (e) collating, summarising and reporting the results with or without consultation with experts on the specific field.

**Research question**

The research questions for this scoping review are: What are the prevalence and incidence of UF among black women in SSA? What are the risk factors for UF among SSA women?

**Information sources and search strategy**

We conducted a systematic search of three online databases for records in English: PubMed, African Wide Information (EBSCO) and African Journal OnLine (AJOL). We used the following keywords to search the databases to retrieve published articles on the incidence, prevalence and risk factors of UF; uterine fibroids or fibroids or leiomyoma or myoma; prevalence, incidence, risk factors or causes and SSA (using subregions within SSA (West Africa OR East Africa OR Central Africa OR Southern Africa), and by specific country names) (online supplemental table 1—Search Term Strategy). We used Boolean terms AND/OR to separate the keywords during the search. We included Medical Subject Headings (MeSH) terms in the search terms. We also manually searched references and bibliography of relevant articles on this subject. The
A search was conducted between December 2019 and 27 January 2021.

**Eligibility criteria**

We used the PICO format (population, intervention, comparator and outcome) to design the eligibility criteria for the studies that were included in this review. These are (a) published peer-reviewed article with observational or experimental design that reported on the aetiology or risk factors or incidence or prevalence or proportion of women with UFs and (b) data must have been collected in SSA among Indigenous black women population. We excluded case reports, letter to editors or expert opinion without primary data on UFs in SSA as well as studies that only reported the outcome of treatment.

**Study selection process**

All titles retrieved from searches were compiled and reviewed with EndNote X8.0 (Thomson Reuters). We removed all duplicates using the EndNote automated system and manually. We screened abstracts in accordance with our inclusion and exclusion criteria. Next, we screened the full texts of abstracts that were eligible for further consideration. Only articles that met the inclusion criteria during full-text screening were finally selected for data charting in this review.

**Charting data**

We entered our data into a prepared Microsoft Excel sheet using the following data charting fields: authors, date, country, study design, aim/objectives, sample size, recruitment strategy (probability or non-probability sampling), study settings (health facility/community/online), outcome measured (prevalence/incidence/proportion), analysis (descriptive/test of association/multivariable analysis) and summary of key findings.

**Collating, summarising and reporting the results**

We present a descriptive summary of eligible studies and we created a Preferred Reporting Items for Systematic Reviews and Meta-Analyses-extension for Scoping Reviews flow chart to summarise the process and number of articles that were finally selected for data charting (online supplemental table 2). The chart shows the overall number of studies included, study designs and settings, publication years, the characteristics of the study populations, the outcomes reported and the countries where the studies were conducted. In line with scoping reviews’ methodology, we did not perform an assessment of the quality of the included studies.

**Patient and public involvement**

It was not possible to describe patient and public involvement in this research.

**RESULTS**

We retrieved 1052 studies from the three databases (figure 1). After removal of duplicate publications, we screened 484 titles and abstracts and found only 48 articles were eligible for full-text screening. We excluded 39 of the 48 full-text articles because 17 of them were on symptoms/management of UF, 7 were animal studies, 5 each were case reports and reviews, 2 were from outside SSA, 1 each were on recurrent UF after treatment, full texts not available and on somatic genetic mutation in UF. Of the 9 studies that met the inclusion criteria, 4 were from Nigeria, 2 from Ghana and 1 study each from Cameroon, Kenya and South Africa.

**Incidence or prevalence of UF**

Five of the nine studies screened described the prevalence of UF (table 1). Two of these studies, one each from pathology departments in single institutions in South Africa and Nigeria, examined the proportion of UF in surgical specimens. In Northern Nigeria, UF accounted for 2.2% of all surgical specimen at a single facility over a 5-year period. The South African study reported that the proportion of UF among all hysterectomy specimens in a single institution over a 6-month period was 64.6%.

A cross-sectional study of pregnant women undergoing abdominal USS examination in two regional hospitals in Cameroon reported that 16.8% (38/226) had UF. Another cross-sectional study in Ghana among 244 non-pregnant women referred for abdominal USS showed that 36.9% had UF and the proportion of women with UF increased with age. A 2-year retrospective review of attendees at the gynaecology clinic of a public tertiary health institution in Nigeria showed that 30.7% (178/580) of all patients had a diagnosis of UF. Another study of pregnant women referred for prenatal abdominal USS at...
| Author; year | Reference | Research focus | Study design | Sampling methods | Sample size | Outcome measured | Age of study participants | Summary of key findings |
|-------------|-----------|----------------|-------------|-----------------|-------------|-----------------|--------------------------|------------------------|
| Tiltman et al (South Africa) | 50 | Pathology | Case series | Non-probability | 661 | Proportion of UF within hysterectomy specimen | 12.0–84.0 | The proportion of UF was 427/661 (64.6%). |
| Wango et al (Kenya) | 49 | Pathology | Case series | Not clearly described | 20 | Evaluation of oestradiol, progesterone and their receptors | Range 31.0–42.0 | The UF tissue contained significantly higher levels of oestrogen receptor (28.2±1.6 vs 19.1±0.4 fm/mg protein) and progesterone receptor (16.8±0.7 vs 9.4±0.2 fm/mg protein) compared with normal myometrial tissue, a relatively significant higher levels of oestrogen (1117.6±20.9 vs 616.9±19.8 pm/mg protein) and progesterone (7.7±0.25 vs 3.2±0.34 nm/mg protein) in the myometrium than in the leiomyomata. |
| Mohammed et al (Nigeria) | 42 | Pathology | Case series | Non-probability | 209 | Proportion of UF pathological specimen and degenerative changes | Range 25.0–50.0 | The proportion of myometrial UF was 2.2% of all surgical specimen over 5 years. |
| Eze et al (Nigeria) | 43 | Radiology | Case control | Non-probability | 200 (100 cases vs 100 controls) | Frequency and growth rate of uterine fibroids in pregnancy | Cases (31.6±4.5 year); controls (29.1±5.5 year) | The frequency of UFs in pregnancy was 12.3%; the most common type was subserous fibroids (27.5%). The mean size of UFs measured on ultrasound was lowest during third scan. |
| Oluwole et al (Nigeria) | 44 | Clinical | Case control | Non-probability | 580 | Proportion of UF and risk factor analysis | 35.5±5.8 | The proportion of women with UFs was 31% (178/580). Presence of UFs was associated with 40–49 years (OR=4.9%; 95% CI 1.8% to 31.1%); lower parity (OR=0.6; 95% CI 0.2 to 0.9); family history of UFs (OR=1.9; 95% CI 1.9 to 4.8); and history of infertility (OR=5.0; 95% CI 0.9 to 25.9). |
| Awowole et al (Nigeria) | 45 | Pathology | Cross-sectional | Non-probability | 60 | To measure expression of oestrogen receptor α (ERα) and progesterone receptor (PR) in myometrium and UF | 26.0–53.0 | UF had a higher mean expression of ERα (H-score 193.4±64.6 vs 153.3±69.1; p=0.01) and PR (214.9±66.6 vs 171.5±63.5; p<0.001) than in myometrial tissues. The tumour diameter correlated negatively with the immunoscores of both receptors irrespective of age, parity and body mass index, but this was only significant for PR (p=0.44; p<0.001). |

Continued
| Author, year       | Reference | Research focus          | Study design   | Sampling methods | Sample size | Outcome measured                          | Age of study participants | Summary of key findings                                                                                                                                                                                                                                                                                                                                 |
|-------------------|-----------|-------------------------|----------------|------------------|-------------|------------------------------------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sarkodie et al    | 46        | Radiology               | Cross-sectional| Non-probability  | 244         | Prevalence of UF and risk factors analysis| 14.0–54.0                 | In this study, 23% (38/168) of women <35 had prevalent fibroids, compared with 67% (36/54) of women 35–44 and 73% (16/22) of women at 45 or above years. Factors that associated significantly with UF in Ghanaian women included obesity ($X^2=17.3$, $p=0.001$), participant's age range ($X^2=47.4$, $p=0.001$), parity ($X^2=-10.2$, $p=0.001$) and age at last delivery ($X^2=34.6$, $p=0.001$). |
| Sarkodie et al    | 47        | Radiology               | Cross-sectional| Non-probability  | 244         | Assessment of sonographic characteristics of UF| 14.0–54.0                 | The prevalence of UF was 36.9% (90/244). The majority of the UFs were intramural (57.8 %) with only 4.4% noted as submucosal. Most (55.6 %) of the UFs were located in more than one part of the uterus.                                                                                                                                                                                                                   |
| Egbe et al        | 48        | Radiology and clinical  | Cross-sectional| Non-probability  | 226         | Proportion of UF and risk factors analysis| $\geq 21.0$              | The prevalence of UF in pregnancy was 16.7% (38/226). Respondents with UF were older than those without ($p<0.001$) and of low parity ($p=0.02$).                                                                                                                                                                                                                 |

UF, uterine fibroids.
a tertiary hospital in eastern Nigeria showed that the prevalence of UF was 12.3% during pregnancy.43

**Role of oestrogen, progesterone and their receptors**

A study in Kenya reported on cytosolic quantification of oestrogen and progesterone and their receptors in UF tissue measured using radioimmunoassay.49 The study showed that UF contained lower levels of oestrogen and progesterone but higher levels of receptors for these hormones compared with normal uterine tissue.49 In a more recent Nigerian study using immunohistochemistry, the level of oestrogen and progesterone receptors in UF was higher than in uterine tissue.45 The Nigerian study further showed a significant negative correlation between UF size and the progesterone receptors levels only (table 1).45

**Risk factors for UF**

Three studies presented data on risk factors of UF (tables 1 and 2).44 46 48

In a Nigerian case–control study of gynaecology clinic attendees, advanced age (OR=4.90; 95% CI 1.80 to 13.1) and positive family history (OR=3.7; 95% CI 1.90 to 8.7) were associated with higher risk while obesity (OR=0.4; 95% CI 0.10 to 0.90) and primiparity (OR=0.60; 95% CI 0.20 to 0.90) were associated with lower risk of UF.44 A cross-sectional study of 244 women referred for abdominal USS at three centres in Ghana found that women with UF tended to be older (p=0.001), obese (p=0.001), older at last pregnancy and delivery (p=0.001) and have lower parity (p=0.001).46 In another cross-sectional study of factors associated with UF in pregnancy in Cameroon, women with UF were older (p<0.001) and had higher gravidity (p=0.02).48

**DISCUSSION**

In this review, we mapped published epidemiological studies on incidence, prevalence and risk factors for UF in indigenous African women. Our results confirmed the paucity of systematic epidemiological study of UF among black women in Africa. Only few studies have some information on prevalence/proportion of, and risk factors for UF.42 44 46 48 50 The five studies that reported the prevalence of UF used different populations, denominators and study designs.42 44 46 48 50 Two studies from pathology departments in Nigeria and South Africa used different reporting periods and denominators to calculate the proportions of UF.42 50 We also observed variations in the reporting of the prevalence of UF in pregnancy in the two studies from radiology departments in Nigeria and Cameroon.43 48 They both used convenience sampling technique and were silent on the gestational ages of participants. The only Nigerian study that presented data on the prevalence of UF among non-pregnant women was a retrospective review of case records that used all other attendees at a gynaecological clinic as controls.44 There was no study in this review that has information on the incidence of UF in pregnant or non-pregnant women.

Two studies were on the role of oestrogen and progesterone and their receptors. The two hormonal studies used different diagnostic techniques (radioimmunoassay vs immunohistochemistry), laboratory estimation of cut-off levels for oestrogen and progesterone and comparator groups (UF and normal myometrial tissue from same patient versus UF and normal myometrial tissue from different patients as cases and control).45 49 The observed differences in the methodology of the two studies make it difficult to compare and interpret their findings. We observed that the sample sizes of these three studies were too small to allow for rigorous multivariable analysis for confounders. In addition, the three studies were conducted with specimen from women who had treatment in specific health facilities.

Three studies described risk factors for UF among black African women, but they all used different research designs and data analysis techniques.44 46 48 All the studies were conducted within single facilities, two were cross-sectional and one was a retrospective case–control study.

---

**Table 2** Summary of reported risk factors associated with UF in SSA

| Risk factors       | Pregnant women | Non-pregnant women |
|--------------------|----------------|--------------------|
|                    | Egbe *et al* 2018 | Sarkodie *et al* 2016a | Oluwole *et al* 2015 |
|                    | (Cross-sectional study from Cameroon) | (Cross-sectional study from Ghana) | (Case-control study from Nigeria) |
| Advanced age       | ↑              | ↑                  | ↑                  |
| Family history     | Not considered | Not considered     | ↑                  |
| Obesity            | Not considered | ↑                  | ↓                  |
| Nulliparity        | Not considered | ↑                  | Not considered     |
| Gravidity          | ↑              | Not considered     | Not considered     |
| Advanced age at delivery | Not considered | ↑                  | Not considered     |
| At least primiparity | Not considered | Not considered     | ↓                  |

↑ - increased risk, ↓ - decreased risk, not considered as a risk factor in the study.

SSA, sub-Saharan Africa; UF, uterine fibroid.
The risk factors identified in the three studies were similar to those reported in studies conducted in USA, Europe and Asia. \(^5\)\(^\text{12}\)\(^\text{53}\) Briefly, advancing age was the only risk factor that was common to all three studies and low parity was reported in two studies.\(^44\)\(^\text{46}\)\(^\text{48}\) The only other risk factor reported among non-pregnant women was self-report of family history of UF.\(^44\) Obesity was reported as a protective factor in non-pregnant Nigerian women and as a risk factor in pregnant women in Ghana.\(^44\)\(^\text{48}\) The tests for association in these studies were not well described in the methods sections of their manuscripts.\(^44\)\(^\text{46}\)\(^\text{48}\) The studies from Cameroon and Ghana used bivariate tests and did not adjust for age in their analyses.\(^46\)\(^\text{48}\) The only Nigerian study that used multivariable analysis to adjust for confounders, used data collected from a retrospective review of cases managed in a tertiary public health facility and assigned other attendees as controls.\(^44\)

Although, we did not assess the risk of bias in studies that we reviewed because that is outside the objective of scoping review generally, we observed that the majority of the studies used data collected from case series or cross-sectional studies (6/9) while two (3/9) were case-control studies.\(^42\)-\(^50\) None of the nine studies we reviewed used probability sampling technique to select their subjects and only one study reported on sample size and power calculation.

We found several gaps in the epidemiology of UF in SSA. There was no genomic epidemiology study of UF in SSA. Studies from high-income countries have shown that only 20.0%–40.0% of women with symptomatic UF seek medical treatment, suggesting that a significant number of women with UF are not captured by facilities-based studies.\(^3\)\(^\text{12}\)\(^\text{53}\)\(^\text{54}\) We did not find any published population-based study with adequate statistical power and sampling strategy which can generate generalisable information on incidence, prevalence and risk factors of UF among Indigenous black African women. There are many epidemiological risk factors of UF that are yet to be investigated in SSA. These factors include reproductive factors (age at menarche and menopause, birth interval or inter pregnancy interval, contraceptives and hormone replacement therapy), diets including vitamin D, trace elements and heavy metals, lifestyle and physical activity, reproductive tract infections, microbiome and pollution.\(^3\)\(^\text{12}\)\(^\text{53}\)\(^\text{54}\) Lack of information on these risk factors prevent development of preventive and therapeutic interventions. This is a serious gap in knowledge considering the morbidity, mortality and economic costs of UF in SSA.

The interpretation of findings from this scoping review may be limited for the following reasons. We searched published articles from online databases only. We may have missed papers published in journals that are not indexed in these online databases. We excluded one article that we could not retrieve the full texts, but the abstract shows that this was on the association between UF and BMI. Despite these limitations, this scoping review confirmed the dearth of studies on the epidemiology of UF among SSA women and argues for urgent remedia-
tion of this situation.

CONCLUSIONS

Our results show that there is limited information on the epidemiology of UF and identified gaps in knowledge of UF among women in SSA despite its high prevalence, morbidity and economic costs. We recommend urgent implementation of well-designed and adequately powered studies to address this gap.

Twitter Clement A Adebamowo @adebamowo

Contributors CAA conceived and designed the study. He conducted literature review, reviewed, revised and approved the manuscript. IOM-B designed, conducted literature search, screening of articles and data charting. He wrote the first draft, revised and approved the manuscript. CAA is responsible for the overall content as the guarantor.

Funding Support for CAA was provided by the African Collaborative Center for Microbiome and Genomics Research (ACCMRE) Grant (U54HG01069447) and African Female Breast Cancer Epidemiology (AFBRECANE) Grant (U01HG009784) from the Office Of The Director, National Institutes Of Health (OD) and the National Human Genome Research Institute (NHGRI); funds through the Maryland Department of Health’s Cigarette Restitution Fund Program (CH-649-CRF); and the University of Maryland Greenebaum Cancer Center Support Grant (P30CA133374). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the Maryland Department of Health.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data will be made available upon request from the corresponding author.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.

ORCID iDs

Imran O Morhason-Bello http://orcid.org/0000-0002-7448-4824
Clement A Adebamowo http://orcid.org/0000-0002-6571-2880

REFERENCES

1 Stewart EA, Cookson CL, Gandolfi RA, et al. Epidemiology of uterine fibroids: a systematic review. BJOG 2017;124:1501–12.
2 Holdsworth-Carson SJ, Zaitseva M, Vollenhoven BJ, et al. Clonality of smooth muscle and fibroblast cell populations isolated from human fibroid and myometrial tissues. Mol Hum Reprod 2014;20:250–9.
Genet association study of uterine fibroids.
Maturitas 2020;11:5129-40.

Ponomar E, Epidemiol Genet 2015;6:9-19.
fibroids—review of the literature and novel concepts.
Semin Reprod Med 2013;24:447-53.

Wise LA, Palmer JR, Rosenberg L, et al. Associate weight and lifestyle factors including diet, physical activity and stress: a case-control study. Am J Clin Nutr 1997;66:967-73.

Wischedo R, Xu Q, Xu J, et al. Environmental exposure and risk of uterine leiomyoma: a prospective study. Am J Obstet Gynecol 2005;193:211.e1-11.e9.

Woolfson A, Sheth S, Ahmed S. Uterine leiomyomata: a five year clinicopathological review in Zaria, Nigeria. Niger J Surg Res 2005;7:206-8.

Woo PW, Owie E, Babah O. Epidemiology of uterine leiomyomata at the Lagos university teaching hospital, Ibadan, Nigeria. Nig Hosp Pract 2015;14:15-20.

Woo G, Badjogj N, Ovowolo A, Owie E, Babah O. Epidemiology of uterine leiomyomata among premenopausal women by age and race. Obstet Gynecol 1997;90:563-8.

Wang P, Zhang Q, Wang D, et al. Association between HSD17B1 rs605059 polymorphisms and the risk of uterine fibroids: a systematic review and meta-analysis. J Epidemiol Community Health 2015;71:197-204.

Wang Q, Lin Z, Vang H, Du EX, et al. Symptoms of uterine myomas: a study at 3-year clinicopathological review. Int J Gynecol Obstet 2016;135:314-8.

Wagenaar LM, Stuy D, Dunson DB, Hill MC, Schectman JM, et al. Prospective study of dietary fat and risk of uterine leiomyoma. Am J Clin Nutr 2014;99:1105-16.

Whitaker et al. Heritability and risk factors for self-reported uterine leiomyomata in the black women’s health study. Obstetrics & Gynecology 2005;105:563-8.

Whitaker et al. Clinical correlates of leiomyoma estrogen and progesterone receptors among Nigerian women. Int J Gynecol Obstet 2018;169:467-73.

Whitaker et al. A pilot study. Fertil Steril 2013;8(9):1951-7.

White AK, Odeuru EA, Ochike C, et al. Sonographic assessment of pregnancy co-existing with uterine leiomyoma in Owerri, Nigeria. Afr Health Sci 2013;13:453-60.

Whitaker et al. Epidemiology of uterine leiomyomata at the Lagos university teaching hospital, Ibadan, Nigeria. Nig Hosp Pract 2015;14:15-20.

White AK, Odeuru EA, Ochike C, et al. Sonographic assessment of pregnancy co-existing with uterine leiomyoma in Owerri, Nigeria. Afr Health Sci 2013;13:453-60.

Whitaker et al. Prospective study of dietary fat and risk of uterine leiomyoma. Am J Clin Nutr 2014;99:1105-16.

Whitaker et al. Heritability and risk factors for self-reported uterine leiomyomata in the black women’s health study. Obstetrics & Gynecology 2005;105:563-8.

Whitaker et al. Clinical correlates of leiomyoma estrogen and progesterone receptors among Nigerian women. Int J Gynecol Obstet 2018;169:467-73.

Whitaker et al. A pilot study. Fertil Steril 2013;8(9):1951-7.

Whitaker et al. Epidemiology of uterine leiomyomata at the Lagos university teaching hospital, Ibadan, Nigeria. Nig Hosp Pract 2015;14:15-20.

Woo G, Badjogj N, Ovowolo A, Owie E, Babah O. Epidemiology of uterine leiomyomata among premenopausal women by age and race. Obstet Gynecol 1997;90:563-8.

Wang P, Zhang Q, Wang D, et al. Association between HSD17B1 rs605059 polymorphisms and the risk of uterine fibroids: a systematic review and meta-analysis. J Epidemiol Community Health 2015;71:197-204.

Wang Q, Lin Z, Vang H, Du EX, et al. Symptoms of uterine myomas: a study at 3-year clinicopathological review. Int J Gynecol Obstet 2016;135:314-8.

Wagenaar LM, Stuy D, Dunson DB, Hill MC, Schectman JM, et al. Prospective study of dietary fat and risk of uterine leiomyoma. Am J Clin Nutr 2014;99:1105-16.

Whitaker et al. Heritability and risk factors for self-reported uterine leiomyomata in the black women’s health study. Obstetrics & Gynecology 2005;105:563-8.

Whitaker et al. Clinical correlates of leiomyoma estrogen and progesterone receptors among Nigerian women. Int J Gynecol Obstet 2018;169:467-73.

Whitaker et al. A pilot study. Fertil Steril 2013;8(9):1951-7.

Whitaker et al. Epidemiology of uterine leiomyomata at the Lagos university teaching hospital, Ibadan, Nigeria. Nig Hosp Pract 2015;14:15-20.
### Supplementary Table 1: Search Strategy used for PubMed

| CONCEPTS | SN | TERMS | SEARCH DETAILS |
|----------|----|-------|----------------|
| **Concept 1: Uterine fibroids** | #1 | uterine fibroids | "leiomyoma"[MeSH Terms] OR "leiomyoma"[All Fields] OR "uterine"[All Fields] AND "fibroids"[All Fields] OR "uterine fibroids"[All Fields] OR "leiomyoma"[MeSH Terms] OR "leiomyoma"[All Fields] OR "fibroid"[All Fields] OR "fibroids"[All Fields] |
| | #2 | fibroids | "fibroids"[All Fields] OR "leiomyoma"[MeSH Terms] OR "leiomyoma"[All Fields] OR "fibroid"[All Fields] OR "fibroids"[All Fields] |
| | #3 | leiomyoma | "leiomyoma"[MeSH Terms] OR "leiomyoma"[All Fields] OR "leiomyomas"[All Fields] OR "myoma"[MeSH Terms] OR "myoma"[All Fields] OR "myomata"[All Fields] OR "myoma s"[All Fields] |
| | #4 | myoma | "leiomyoma"[MeSH Terms] OR "leiomyoma"[All Fields] OR "myoma"[MeSH Terms] OR "myoma"[All Fields] OR "myomata"[All Fields] OR "myoma s"[All Fields] |
| | #5 | #1 OR #2 OR #3 OR #4 | |
| **Concept 2: Epidemiological indicators/measure used** | #6 | Cause OR causes | "causative"[All Fields] OR "causatively"[All Fields] OR "causatives"[All Fields] OR "cause"[All Fields] OR "caused"[All Fields] OR "causing"[All Fields] OR "etiology"[MeSH Subheading] OR "etiology"[All Fields] OR "causes"[All Fields] OR "causality"[MeSH Terms] OR "causality"[All Fields] OR "causative"[All Fields] OR "causatively"[All Fields] OR "causatives"[All Fields] OR "cause"[All Fields] OR "caused"[All Fields] OR "causing"[All Fields] OR "etiology"[MeSH Subheading] OR "etiology"[All Fields] OR "causes"[All Fields] OR "causality"[MeSH Terms] OR "causality"[All Fields] |
| | #7 | aetiology OR etiology | "aetiology"[All Fields] OR "aetiologies"[All Fields] OR "etiology"[All Fields] OR "etiologies"[All Fields] OR "etiology"[MeSH Subheading] OR "etiology"[All Fields] OR "causality"[MeSH Terms] OR "causality"[All Fields] OR "etiology"[MeSH Subheading] OR "etiology"[All Fields] OR "causality"[MeSH Terms] OR "causality"[All Fields] |
| | #8 | Risk factor | "risk factors"[MeSH Terms] OR "risk factors"[All Fields] OR "risk factor"[MeSH Terms] OR "risk factor"[All Fields] OR "risk factor"[All Fields] |
| | #9 | Prevalence OR preval* | "prevalence"[MeSH Subheading] OR "epidemiology"[All Fields] OR "prevalence"[MeSH Terms] OR "prevalence"[All Fields] OR "prevalences"[All Fields] OR "prevalent"[All Fields] OR "prevalently"[All Fields] OR "prevalents"[All Fields] |
| | #10 | Incidence OR inciden* | "incidence"[MeSH Terms] OR "incidence"[All Fields] OR "incidence"[MeSH Subheading] OR "incidence"[All Fields] OR "incidences"[All Fields] OR "incidence"[All Fields] OR "incident"[All Fields] OR "incidents"[All Fields] OR "incidens"[All Fields] |
| | #11 | epidemiology | "epidemiologies"[All Fields] OR "epidemiology"[MeSH Subheading] OR "epidemiology"[All Fields] OR "epidemiology"[MeSH Terms] OR "epidemiology"[All Fields] |
| | #12 | #6 OR #7 OR #8 OR #9 OR #10 OR #11 | |
| **Concept 3: Women** | #13 | Women OR Woman | "women"[All Fields] OR "women"[MeSH Terms] OR "women"[All Fields] OR "women"[All Fields] OR "women s"[All Fields] OR "womens"[All Fields] |
| | #14 | #13 | |
| **Concept 4: Sub-Saharan Africa** | #15 | Africa | "africa"[MeSH Terms] OR "africa"[All Fields] OR "african s"[All Fields] OR "africas"[All Fields] |
| | #16 | West Africa | "africa, western"[MeSH Terms] OR "africa"[All Fields] AND "western"[All Fields] OR "western africa"[All Fields] OR "west"[All Fields] AND "africa"[All Fields] OR "west africa"[All Fields] |
| | #17 | East Africa | "africa, eastern"[MeSH Terms] OR "africa"[All Fields] AND "eastern"[All Fields] OR "east"[All Fields] AND "africa"[All Fields] |
| | #18 | Central Africa | "africa, central"[MeSH Terms] OR "africa"[All Fields] AND "central"[All Fields] OR "central africa"[All Fields] OR "central"[All Fields] AND "africa"[All Fields] |
| | #19 | Southern Africa | "africa, southern"[MeSH Terms] OR "africa"[All Fields] AND "southern"[All Fields] AND "africa"[All Fields] |
| | #20 | Angola OR Benin OR Botswana OR Burkina Faso OR Burundi OR Cameroon OR Cape Verde OR Central | "angola"[MeSH Terms] OR "angola"[All Fields] OR "angola s"[All Fields] OR "benin"[MeSH Terms] OR "benin"[All Fields] OR "benin s"[All Fields] OR "botsvana"[MeSH Terms] OR "botsvana"[All Fields] OR "botsvana s"[All Fields] OR "burkina faso"[MeSH Terms] OR "burkina"[All Fields] AND "burkina faso"[All Fields] OR "burkina faso"[MeSH Terms]
| African Republic OR Chad | "faso"[All Fields] OR "burkina fas"[All Fields] OR ("burundi"[MeSH Terms] OR "burundi"[All Fields]) OR ("cameroon"[MeSH Terms] OR "cameroon"[All Fields] OR "cameroons"[All Fields] OR "cameroon s"[All Fields]) OR ("cabo verde"[MeSH Terms] OR "cabo"[All Fields] AND "verde"[All Fields]) OR ("cape"[All Fields] OR "cape verde"[All Fields]) OR ("central african republic"[MeSH Terms] OR "central"[All Fields] AND "african"[All Fields] AND "republic"[All Fields]) OR "central african republic"[All Fields]) OR ("chad"[MeSH Terms] OR "chad"[All Fields]) OR ("comoros"[MeSH Terms] OR "comoros"[All Fields]) OR ("cote d'ivoire"[MeSH Terms] OR "cote"[All Fields] AND "d'ivoire"[All Fields]) OR "cote d'ivoire"[All Fields]) OR ("democratic republic of the congo"[MeSH Terms] OR ("democratic"[All Fields] AND "republic"[All Fields] AND "congo"[All Fields]) OR "democratic republic of the congo"[All Fields]) OR ("djo"[All Fields] OR "djibout"[All Fields] OR ("equatorial guinea"[MeSH Terms] OR "equatorial"[All Fields] AND "guinea"[All Fields]) OR ("equatorial guinea"[All Fields]) OR ("eritrea"[MeSH Terms] OR "eritrea"[All Fields]) OR ("ethiopia"[MeSH Terms] OR "ethiopia"[All Fields]) OR ("Gabon"[MeSH Terms] OR "Gabon"[All Fields]) OR ("gambia"[MeSH Terms] OR "gambia"[All Fields] OR "the gambia"[All Fields]) OR ("gambia"[MeSH Terms] OR "togo"[All Fields]) OR ("guinea"[MeSH Terms] OR "guinea"[All Fields] OR "guinea s"[All Fields] OR "guineas"[All Fields] OR ("guinea bissau"[MeSH Terms] OR "guinea bissau"[All Fields] OR "guinea s"[All Fields] AND "bissau"[All Fields]) OR ("guinea bissau"[MeSH Terms] OR "guinea bissau"[All Fields] OR "kennya"[MeSH Terms] OR "kenya"[All Fields] OR "kenya s"[All Fields] OR ("lesotho"[MeSH Terms] OR "lesotho"[All Fields]) OR ("liberia"[MeSH Terms] OR "liberia"[All Fields]) OR ("madagascar"[MeSH Terms] OR "madagascar s"[All Fields]) OR ("malawi"[MeSH Terms] OR ("malawi"[All Fields] OR "malawi s"[All Fields]) OR "mali"[MeSH Terms] OR "mali"[All Fields]) OR ("mauritania"[MeSH Terms] OR "mauritania"[All Fields]) OR ("mauritius"[MeSH Terms] OR "mauritius"[All Fields]) OR ("mozambique"[MeSH Terms] OR "mozambique"[All Fields] OR ("mozambique s"[All Fields]) OR ("namibia"[MeSH Terms] OR "namibia"[All Fields]) OR ("niger"[MeSH Terms] OR "niger"[All Fields]) OR ("nigeria"[MeSH Terms] OR "nigeria"[All Fields]) OR ("republic of the congo"[MeSH Terms] OR ("rwanda"[MeSH Terms] OR "rwanda"[All Fields]) OR ("sao tome and principe"[MeSH Terms] OR ("sao"[All Fields] AND "tome"[All Fields] AND "principe"[All Fields]) OR ("senegal"[MeSH Terms] OR ("senegal"[All Fields]) OR ("sao tome and principe"[All Fields]) OR ("swaziland"[MeSH Terms] OR "swaziland"[All Fields]) OR ("tanzania"[MeSH Terms] OR ("tanzania" OR "tanzania s"[All Fields]) OR ("togo"[MeSH Terms] OR ("togo"[All Fields]) OR ("uganda"[MeSH Terms] OR "uganda"[All Fields] OR ("zambia"[MeSH Terms] OR ("zambia" OR "zambia s"[All Fields]) OR ("zimbabwe"[MeSH Terms] OR ("zimbabwe" OR "zimbabwe s"[All Fields])))) | #21 and #15 OR #16 OR #17 OR #18 OR #19 OR #20
| Final Combined Terms | #23 | #5 AND #12 AND #14 AND #21

These search terms were used in the 3 databases (MEDLINE/PubMed, AJOL & AWI)
**Supplementary Table 2: Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist**

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---------|------|---------------------------|--------------------|
| TITLE   | Title| Identify the report as a scoping review. | #1 |
| ABSTRACT| Structured summary | Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives. | #2 |
| INTRODUCTION | Rationale | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach. | #3, 4, & 5 |
| | Objectives | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives. | #6 & 7 |
| METHODS | Protocol and registration | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number. | Not done |
| | Eligibility criteria | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale. | #7 & 8 |
| | Information sources* | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed. | #7 |
| | Search | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated. | #7 [Supplement Table 2] |
| | Selection of sources of evidence† | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review. | #9 |
| | Data charting process‡ | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators. | #10 |
| | Data items | List and define all variables for which data were sought and any assumptions and simplifications made. | #11 |
| | Critical appraisal of individual sources of evidence§ | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate). | #12 |
| | Synthesis of results | Describe the methods of handling and summarizing the data that were charted. | #13 |
| RESULTS | Selection of sources of evidence | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram. | #14 |
| | Characteristics of sources of evidence | For each source of evidence, present characteristics for which data were charted and provide the citations. | #15 |
| | Critical appraisal within sources of evidence | If done, present data on critical appraisal of included sources of evidence (see item 12). | #16 |
| | Results of individual sources of evidence | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives. | #17 |
| | Synthesis of results | Summarize and/or present the charting results as they relate to the review questions and objectives. | #18 |
| DISCUSSION | Summary of evidence | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | #19 |

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s).
| SECTION     | ITEM | PRISMA-ScR CHECKLIST ITEM                                                                 | REPORTED ON PAGE # |
|------------|------|------------------------------------------------------------------------------------------|--------------------|
| Limitations| 20   | Discuss the limitations of the scoping review process.                                    | #13                |
| Conclusions| 21   | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | #13                |
| FUNDING    | 22   | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | #14                |

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where sources of evidence (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.
† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with information sources (see first footnote).
‡ The frameworks by Arksey and O’Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.
§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of “risk of bias” (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O’Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.