Methods for Gestational Age Estimation during Pregnancy in Africa: A Scoping Review

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Abstract

Monitoring foetal growth and managing pregnancy complications require the precise determination of gestational age. Estimation of gestational age during pregnancy is of utmost importance as it assists with the identification of high-risk pregnancies like polyhydramnios, multiple pregnancy and intrauterine growth restriction. The purpose of the SR was to map the evidence of estimation of gestational age during pregnancy in Africa using the Joanna Briggs Institute (JBI) Scoping Review Methodology. Electronic search engines were used to search articles published from 1 January 2013 to 31 December 2023. A total of 79 eligible articles were retrieved and uploaded to Rayyan – a web and mobile app for systematic reviews. The selection process included title and abstract screening as well as full text article screening, which resulted in 19 articles. A Preferred Reporting Items for Systematic Review and Meta-Analysis Extension for Scoping Reviews (PRISMA-ScR) flow chart was developed to report the 19 studies identified for final SR. There was a minimal publication of studies between 2013 and 2014 with a marked increase in 2019 (n = 4) and 2020 (n = 4). Countries where studies were done included Northern Africa (n = 3), Eastern Africa (n = 3), Western Africa (n = 3), Central Africa (n = 2), Southern Africa (n = 3), and multiple countries (n = 5). Among the 19 articles included in the SR, 16 adopted a quantitative design. This scoping review (SR) identified several methods for gestational age estimation, namely, ultrasound; last

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menstrual period (LMP); symphysis fundal height (SFH); and clinical data. More systematic reviews should be conducted on the estimation of gestational age to add to the information obtained from the SR.

Keywords: African continent; estimation of gestational age; foetal growth monitoring; symphysis fundal height measurement; pregnancy

Introduction

Pregnancy is described as the period during which a foetus develops inside a woman's uterus. It is calculated from the first day of the last menstrual period (LMP) until delivery. A normal pregnancy usually lasts about 38 to 42 weeks. During pregnancy, there is a continual adaptation in maternal physiology (Mockridge and Maclennan 2022). There are changes occurring in all the woman's body systems due to hormonal influences of the placenta. Some of the changes occur to accommodate the growing foetus (Mockridge and Maclennan 2022). Foetal growth is monitored to check whether the foetus has been compromised by those changes in the woman's cardiovascular, renal, gastrointestinal, respiratory, endocrine and musculoskeletal systems.

Foetal growth monitoring is an important practice during antenatal care (ANC). It is monitored through estimation of gestational age which is done at the first antenatal visit and throughout pregnancy. Gestational age is defined as the length of pregnancy calculated from the first day of the woman's LMP (Cronje et al. 2016). The usual practice of using a woman's LMP to estimate gestational age poses challenges when ultrasound assessments are not available because up to 45% of women receiving ANC are unsure of their menstrual dates, which could lead to inaccurate estimation of gestational age (Self et al. 2022). According to Cronje et al. (2016), a normal pregnancy ranges from 38 to 40 weeks. When the delivery occurs at a gestational age of less than 38 weeks, it is considered prematurity. Accurate estimation of gestational age determines the antenatal outcomes by identifying maternal risks, such as intrauterine growth retardation, multiple pregnancy, polyhydramnios, oligohydramnios and postdate pregnancy (Cronje et al. 2016).

If the maternal risks are not identified, this may lead to mismanagement. Gestational age is also used to determine when to repeat screening tests (Hb, HIV and RPR) throughout pregnancy (Naidu and Fredlund 2023). It also assists in making clinical decisions and the timing of administration of corticosteroids for foetal lung maturation in case of suspected preterm labour (Naidu and Fredlund 2023). According to basic antenatal care (BANC), Hb is repeated at 30 and 38 weeks; and HIV and RPR are repeated at every visit if negative. According to BANC, ANC is defined as the care rendered to a woman during pregnancy which aims at identifying problems that can affect her and the foetus. It is essential because it reduces maternal morbidity and mortality since the pregnant woman is receiving skilled services (Dickson et al. 2022). This was concluded by Dickson et al. (2022) when reporting the findings of their study conducted in Sub-Saharan Africa about the utilisation of skilled services. Gestational

age is estimated during antenatal visits of which there should be at least eight throughout pregnancy (BANC). Gestational age estimation is done at different levels of healthcare which may differ among African countries.

ANC, including estimation of gestational age, may be provided at different levels of care. The primary health care (PHC) clinic is the first step in the provision of ANC. PHC clinics cater for pregnant women who need BANC. When a woman needs further investigations and management, she is referred to the community health centre (CHC), which is the second step and provides 24-hour maternity services. Uncomplicated deliveries are conducted at CHCs. The third step is the district hospital where ANC is rendered by the nurses and doctors. The patients are referrals from PHC clinics and CHCs. Level 2 care is provided by the specialists to high-risk maternal cases. Level 3 care is provided by specialists at the provincial tertiary hospitals. These hospitals consist of generalists who specialise in other services. At Level 4, central hospitals provide highly specialised care and have highly specialised units to cater for women referred by the provincial tertiary hospitals (KwaZulu-Natal Department of Health 2014).

Nxiweni et al. (2022) conducted a study in South Africa which concurred that women received ANC provided by health care professionals: doctors (18%), nurses or midwives (70%), and traditional birth attendants (2%), while some received no ANC (10%).

Statistics have shown that Western Cape has the highest percentage of women utilising ANC services. Several cohort studies were conducted to estimate gestational age in Sub-Saharan countries and South Africa (Malaba et al. 2018; Unger et al. 2019; Yovo et al. 2022a). The studies looked at different methods for gestational age estimation, namely: LMP, symphysis fundal height (SFH) and ultrasound. The findings revealed that there was poor to moderate correlation between ultrasound and the other methods. However, there were no previous scoping reviews (SRs) that had been conducted on gestational age estimation during pregnancy in Africa.

Aim and Research Questions for the Scoping Review

The aim of the SR was to map and synthesise the evidence on gestational age estimation during pregnancy in Africa. The following questions were addressed for the SR:

- What are the publication characteristics of evidence conducted to estimate gestational age during pregnancy in Africa?
- What type of pregnancy can be identified from the identified evidence?
- What are the methods used to estimate gestational age during pregnancy in Africa?
- What gaps are there in the methods used to estimate gestational age during pregnancy in Africa?

Methodology

An SR protocol was developed according to the Joanna Briggs Institute (JBI) Manual (Peters et al. 2022). The SR protocol specified the inclusion and exclusion criteria, databases and search strategy, and provided the reviewers with the direction on how to conduct the SR and report on the results (Peters et al. 2022). The SR protocol was registered on Open Framework Science on 26 August 2023 (https://archive.org/details/osf-registrations-5a2mx-v1) to avoid unintentional duplication of reviews.

Eligibility Criteria

When developing the search terms, and inclusion and exclusion criteria, the reviewers applied the Population, Concept, Context (PCC) framework as indicated in Table 1.

Table 1: PCC eligibility criteria

Variable	Description	Inclusion criteria	Exclusion criteria
Population	A pregnant woman is a woman attending an ANC clinic with a singleton or multiple pregnancy	Pregnant women, pregnant mothers or expecting mothers, antenatal patients	Non-pregnant women
Concept	Gestational age is defined as the length of pregnancy calculated from the first day of the last menstrual period	Estimation of gestational age; gestational aging; foetal growth monitoring; symphysis fundal height measurement	Studies conducted on embryonic gestational age
Context	Africa is the second largest continent on Earth	Africa* OR African countries* OR developing countries* OR low resource countries* OR low- and middle-income countries* OR Sub-Saharan Africa, Southern Africa, East Africa, Central Africa, West Africa, North Africa, community health centres, primary health care clinics and district hospitals, tertiary and central hospitals	Studies not conducted in Africa

Types of Articles

Articles written in English on studies conducted between 2013 and 2023, either peer or non-peer reviewed, quantitative articles, qualitative articles, review articles, mixed methods articles, documents or guidelines were considered.

Search Words

The following search word combinations of PCC, separated by Boolean operators (AND and OR) and a truncation symbol (*), were used (see Table 2).

Table 2: Search word combinations as informed by PCC

pregnant women OR pregnant mothers OR expecting mothers OR antenatal patients AND estimation of gestational age OR gestational aging OR foetal growth monitoring OR symphysis fundal height measurement AND Africa* OR African countries* OR developing countries* OR low resource countries* OR low- and middle-income countries* OR Sub-Saharan Africa OR Southern Africa OR East Africa OR Central Africa OR West Africa OR North Africa

Searching in Selected Search Engines and Electronic Data Bases

During step one of the initial search, two databases, PubMed and EBSCOhost, were searched and titles and abstracts were screened from the retrieved articles. To refine the search terms, keywords and Mesh terms were discussed with the review team (Peters et al. 2020). In step two, the search was done using Google, Google Scholar, CINHAL, Sabinet, AJOL, Web of Science, Science Direct, professional organisations like the WHO, UNICEF and nursing and midwifery organisations. Grey literature was also searched in the form of dissertations and theses. In step three, the reference lists of the articles included were searched. The key authors of the reviews and primary studies were not contacted since there was no additional information required (Peters et al. 2022). The review team, with the help of the subject librarian, applied the eligibility criteria to screen the articles. Relevant studies obtained from the search were uploaded to Rayyan – a web and mobile app for systematic reviews – in preparation for selection.

Process of Source Selection

During the first phase of source selection, the review team removed the duplicates and then independently screened the titles and abstracts of articles that were searched. Initially with blind on, first two reviewers (WC and GC) piloted the 15 articles, and the agreement level was greater than 75%. Thereafter, the reviewers continued with the first level screening based on abstract and title. Secondly, the inclusion and exclusion criteria were applied to screen the full text of the articles. All the disagreements at each level of screening were discussed and resolved in the presence of the third and fourth reviewers (PM and MM). The number of articles selected was presented in the Preferred Reporting Items for Systematic Review and Meta-Analysis Extension for Scoping Reviews (PRISMA-ScR) with the aim of making readers understand the relevant items selected for the final SR write up (Tricco et al. 2018).

Data Extraction

A charting table was developed to extract data that answered the SR questions. The first two reviewers (WC and GC) piloted the charting template on two articles to ensure that the required data was added. They ascertained whether the data extracted was consistent with the SR questions and the inclusion criteria, and they also familiarised themselves with the form. During the data extraction process, the reviewers revised and modified charting of the data. The first two reviewers double checked the data independently, and the third and fourth reviewers (PM and MM) were involved to ensure that consensus was reached. The reviewers focused on the following data: author(s); year of publication; country of origin (where the study was published or conducted); research design; study population; sample and sampling; setting; methods used to estimate gestational age; and gaps identified that relate to the SR question(s) (Peters et al. 2022).

Data Analysis and Presentation of Evidence

The information identified from the evidence was analysed through numerical counting and simple descriptive statistics, followed by narration of the results. The synthesised findings were presented in the form of line graphs, while bar charts and tables were used to chart and present the extracted data.

Results

A total of 124 articles were retrieved from the databases search, of which 79 articles were deemed eligible for inclusion and were uploaded to Rayyan. The first screening was done where the titles and the abstracts were screened, then 65 articles were included for the second screening and 14 duplicates were removed. Full text screening of 65 articles was done and 46 articles were excluded because they did not meet the eligibility criteria of the study. Nineteen articles were included and all of those studies were peer reviewed and were published in the following journals: *PLoS One* (4); *Egyptian Journal of Hospital Medicine* (3); *BMC Pregnancy and Childbirth* (1); *BMC Medical Research Methodology* (1); *Journal of Medical Ultrasound* (1); *Ultrasound in Obstetrics and Gynaecology* (1); *Journal of Maternal-Fetal and Neonatal Medicine* (1); *Annals of African Medicine* (1); *Pan African Medical Journal* (1); *Journal of Infectious Diseases* (1); *Reproductive Health* (1); *Annals of Epidemiology* (1); *Trials* (1); and *Lancet Digital Health* (1). The results are presented as a PRISMA-ScR flow chart in Figure 1.

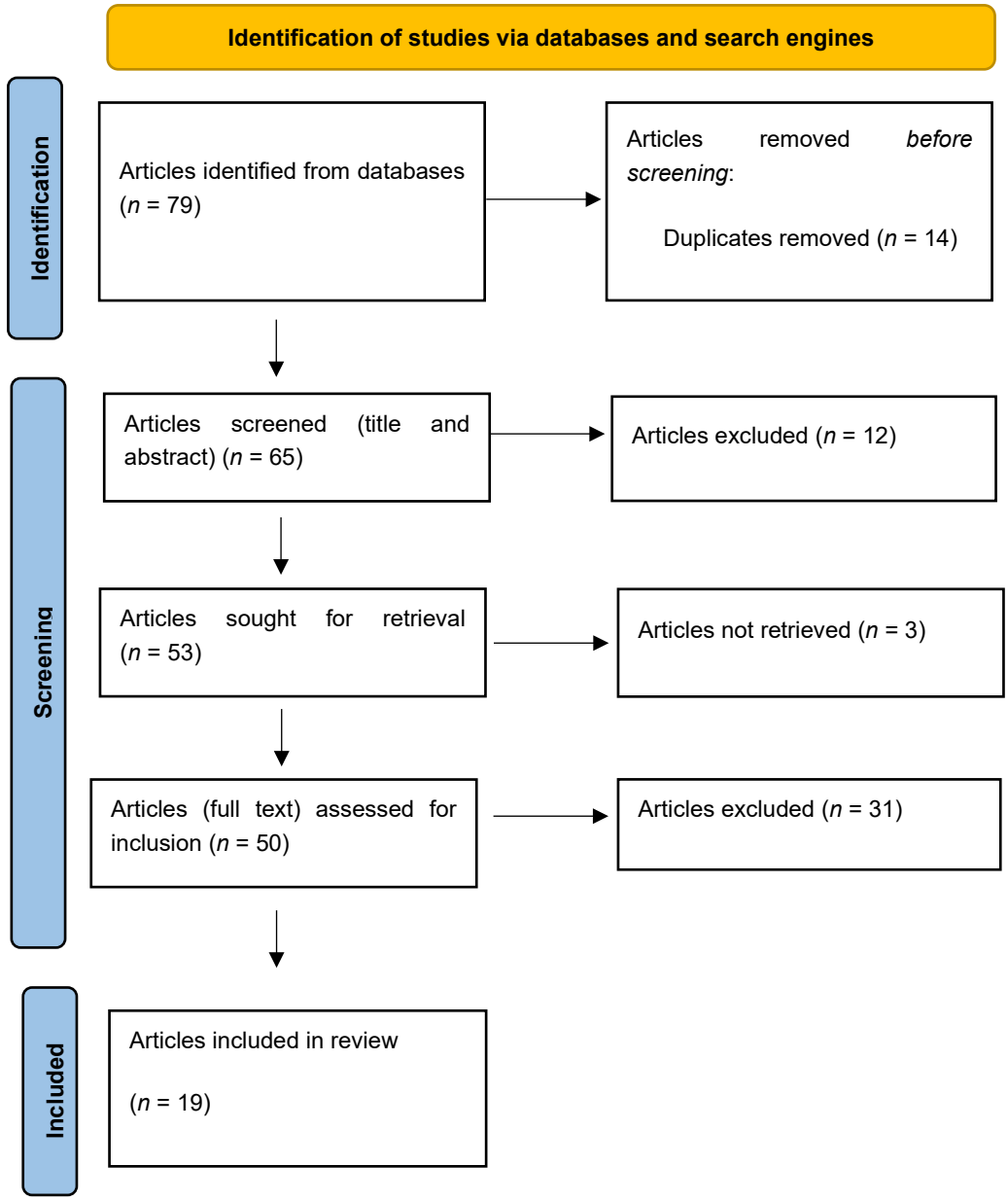

Figure 1: PRISMA-ScR flow chart for selection of articles on estimation of gestational age during pregnancy in Africa

Publication Characteristics

The publication characteristics included year of publication and country where the study was done; type of methodology; study population and sampling; as well as study setting. These are presented here.

Year of Publication and Country

Studies included in the SR were conducted from 2013 to 2023. Most of the studies were conducted in 2019 ($n = 4$) and 2020 ($n = 4$) and only one study in each of the following years: 2013, 2015 and 2021. There were no studies conducted in 2014 and 2015 (refer to Table 3; Figure 2). Countries where studies were done included Northern Africa ($n = 3$), Eastern Africa ($n = 3$), Western Africa ($n = 3$), Central Africa ($n = 2$), Southern Africa ($n = 3$), and multiple countries ($n = 5$).

The single country studies were conducted in Egypt, Kenya, Nigeria, Cameroon, Benin and South Africa. The three multi-country studies were conducted in Kenya, South Africa, Democratic Republic of Congo, Egypt, Burkina Faso, Ghana, Malawi, Zambia, Benin, Gabon, Mozambique and Tanzania (Ohuma et al. 2013; Rada et al. 2018; Unger et al. 2019) (see Table 3).

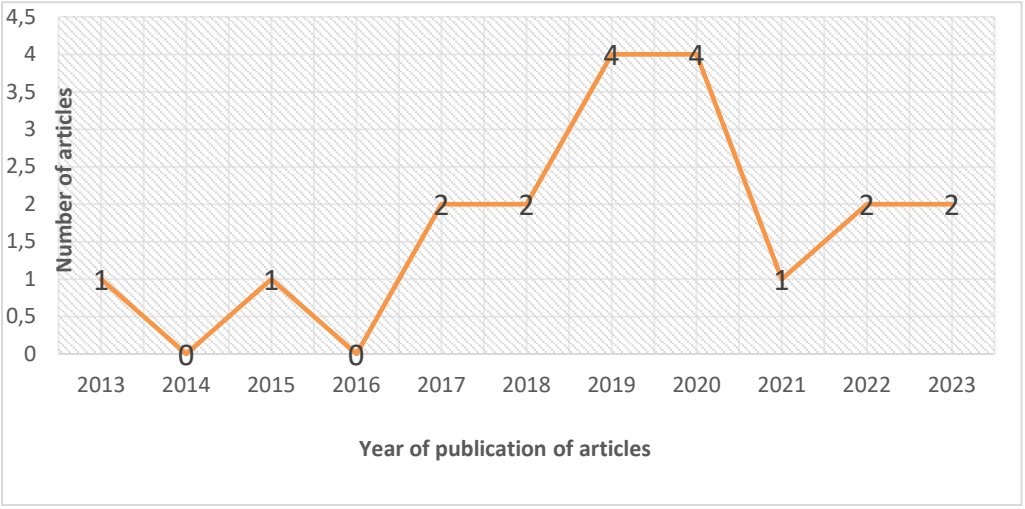

Figure 2: Publication trends of estimation of gestational age research in Africa

Type of Methodology

The identified studies adopted qualitative (longitudinal observational and longitudinal prospective study) ($n = 2$); quantitative (prospective, cross-sectional and RECIPAL cohorts) ($n = 16$); and mixed methods ($n = 1$) designs (see Table 3; Figure 3).

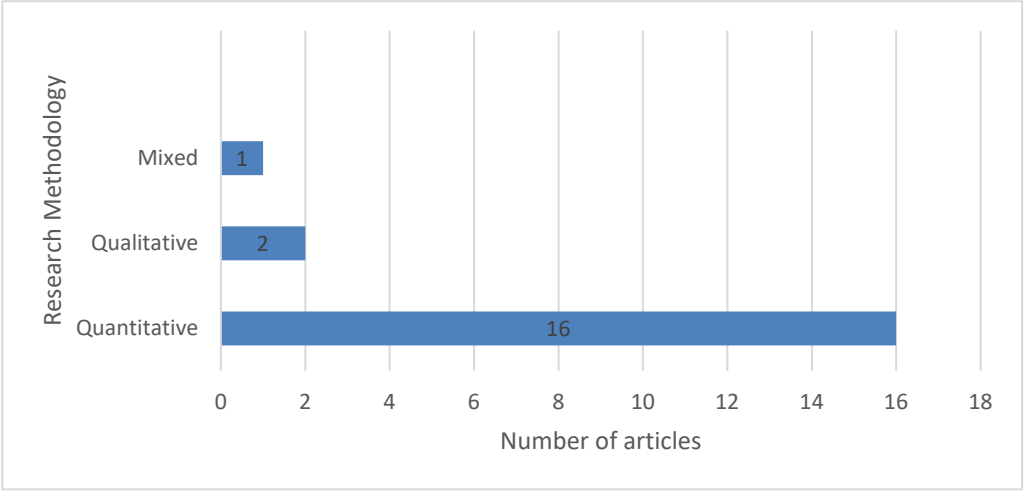

Figure 3: Types of methodologies included in the SR (n = 19)

Study Population and Sampling

The study population comprised pregnant women (first, second and third trimester). Sample sizes ranged from 72 to 4 611. Three sampling techniques were adopted in these studies. Purposive sampling was the most used technique (n = 13), followed by random sampling (n = 4), and lastly convenience sampling (n = 2) (see Table 3).

Study Setting

The majority of the estimation of gestational age studies (n = 6) were conducted in hospital clinics and district hospitals, while others (n = 5) took place in PHC clinics. Some studies (n = 5) were caried out in multiple centres including ultrasound centres in different hospitals, two (n = 2) in tertiary care centres, and one (n = 1) study took place in the community (see Table 3).

Type of Pregnancy Identified from the Evidence

The findings revealed that the population in all the African countries that were included in the SR review had a singleton pregnancy. There were no twin or triple pregnancy studies that were retrieved. The pregnancies were of different gestational ages of which some were first trimester (n = 3) (Azagidi et al. 2020; Constant et al. 2017; Ohuma et al. 2013), while others were conducted from the second to third trimesters (n = 4) (Adeyekun and Oriji 2015; El-Ebeisy, Mohammed and Mohammed 2019; Fung et al. 2020; Rada et al. 2018). Two other studies focused on third trimester singleton pregnancies (Saleh et al. 2022; Stirnemann et al. 2017). Richter et al.'s study (2020) focused on first time mothers with singleton pregnancies. Nine studies did not specify the stage of pregnancy in weeks.

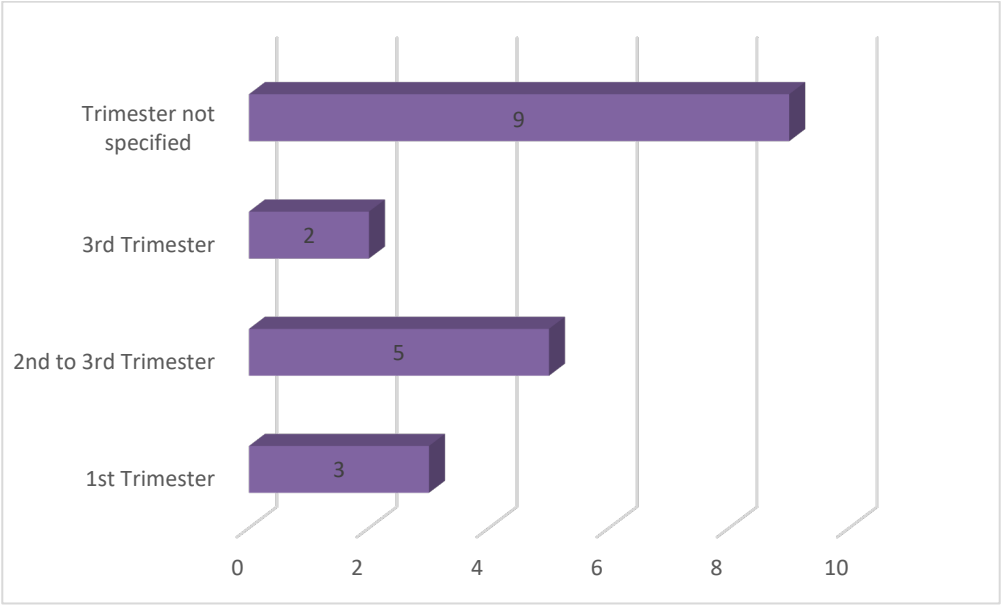

Figure 4: Singleton pregnancy studies included in the SR

Methods Used to Estimate Gestational Age during Pregnancy in Africa

Ultrasound, LMP, clinical data, symphysis fundal height (SFH) and Ballard Score were the methods identified to be used in estimation of gestational age. Out of 19 studies identified, ultrasound was the most used method in the estimation of gestational age during pregnancy in Africa (n = 18). These studies identified the use of SFH which was identified in three studies only. Ultrasound was used to check the foetal biometric data, transcerebellar diameter (TCD), biparietal diameter (BPD), foetal crown-rump length (CRL), and placental thickness. Studies conducted in Kenya and Benin identified clinical data and ultrasound (Vesel et al. 2019; Yovo et al. 2022b).

Gaps in Methods Used to Estimate Gestational Age during Pregnancy in Africa

Ultrasound was found to be the most accurate method used to estimate gestational age but the research setting was in hospital clinics, district hospitals and tertiary hospitals and not in PHC clinics (Azagidi et al. 2020; Bisahnyui et al. 2020; Richter et al. 2020). This could mean that ultrasound services are not available at the PHC clinics. Few studies identified SFH as a method used even though it is considered the most available, cost effective and least invasive method (Malaba et al. 2018; Rada et al. 2018; Unger et al. 2019).

Discussion

Publication Characteristics

The reviewers mapped the available literature on estimation of gestational age in Africa (n = 19) and studies conducted from 2013 to 2023 were found. Few studies were published in each country thus indicating the inadequacy of research conducted on estimation of gestational age between 2013 and 2023. There was an increase in the number of publications in 2019 and 2020 which might be due to funding of some studies (Richter et al. 2020; Unger et al. 2019). Quantitative research was predominant in estimation of gestational age, which might be due to collection of data from the large sample and from a distance. Hence, more studies adopted quantitative prospective cohort designs (El-Ebeisy, Mohammed and Mohammed 2019; Fung et al. 2020; Madkour et al. 2023; Mustafa et al. 2021; Ohuma et al. 2013; Kiserud et al. 2017; Saleh et al. 2022). Qualitative and mixed methods designs were the least employed as they are time consuming since a large population is required.

Five multi-country studies were conducted to estimate gestational age (Kiserud et al. 2017; Ohuma et al. 2013; Rada et al. 2018; Stirnemen et al. 2017; Unger et al. 2019) thereby indicating the promotion of collaboration between researchers in different countries. This was shown in the study conducted in Benin, Gabon, Mozambique and Tanzania where the researchers worked in collaboration to compare the three methods for gestational age estimation, namely, the Ballard Score, LMP and SFH (Rada et al. 2018). The findings from these different countries showed no agreement between using the three methods (Rada et al. 2018). The implication of multi-country studies is that it becomes easy to generalise findings including standardisation of procedures performed. Similarly, Unger et al. (2019) used a standard operating procedure (SOP) for obstetrical ultrasound for the assessment of foetal growth during pregnancy. The SOP was used to ensure quality and was applicable and mandatory across all research sites (Unger et al. 2019).

Type of Pregnancy Identified from the Evidence

Azagidi et al. (2020), Constant et al. (2017) and Ohuma et al. (2013) focused on first trimester singleton pregnancy, whereas other studies focused on second and third trimester (Adeyekun and Oriji Orji 2015; El-Ebeisy, Mohammed and Mohammed 2019; Fung et al. 2020; Mustafa et al. 2021; Rada et al. 2018; Saleh et al. 2022; Stirnemann et al. 2017). There were no twin or triple pregnancy studies conducted in Africa among the included studies. However, in Singapore, Chaudhuri et al. (2013) determined the gestational age in twin pregnancy using foetal CRL. The objective was to check which CRL should be used. The main concern was that in twin pregnancy a discrepancy is common in CRL between the two foetuses. The target population was twin pregnancy that resulted from assisted reproduction. The findings revealed smaller CRL to be more accurate in the estimation of gestational age in comparison to larger or mean CRL values (Chaudhuri et al. 2013).

Methods Used to Estimate Gestational Age during Pregnancy in Africa

Ten of the studies used ultrasound only (Adeyekun and Orji 2015; El-Ebeisy, Mohammed and Mohammed 2019; Fung et al. 2020; Kiserud et al. 2017; Madkour et al. 2023; Mustafa et al. 2021; Ohuma et al. 2013; Richter et al. 2020; Saleh et al. 2022; Stirnemann et al. 2017). SFH was used to measure gestational age in three studies conducted in South Africa, and other multiple countries mentioned under publication characteristics. SFH was used together with LMP. In instances where a woman was unsure of her LMP, SFH could be used alone (Constant et al. 2017; Malaba et al. 2018; Unger et al. 2019). As mentioned previously, with ultrasound being the most used method, it was also used together with the clinical data in other studies conducted (Bisahnyui et al. 2020; Vesel et al. 2019; Yovo et al. 2022a). These SFH findings affirmed the findings of Whelan et al. (2022) in their systematic review and meta-analysis which was done in Asia, South Africa, America and Europe. They identified 19 methods for gestational age estimation where they used a tape measure, ultrasound, finger width and SFH.

SFH is the only available method for gestational age estimation in low-to-middle income countries, but it is inaccurate and should not be used for dating gestational age (Whelan et al. 2022). In two studies, the Ballard Score together with LMP and SFH were used to estimate gestational age. The findings revealed ultrasound as the most accurate method when the woman was sure of her LMP. In Northen Africa, the studies conducted focused on measuring the TCD, BPD, head and abdominal circumference, and femur length (FL) (El-Ebeisy, Mohammed and Mohammed 2019; Madkour et al. 2023; Saleh et al. 2022). Ultrasound is also used in other countries outside Africa with the same objective of gestational age estimation by evaluating TCD, compared to BPD and FL. This is evidenced by the study in India where normal pregnancy TCD was shown to be used alone to estimate gestational age where the woman was unsure of her LMP (Mandal et al. 2019).

In Eastern Africa, ultrasound and clinical data were used together to estimate gestational age. For instance, in Kenya, ultrasound performed by midwives was found to be time consuming and they were not being paid to do it (Vesel et al. 2019). Although the midwives regarded performing ultrasound as time consuming, a shortage of skilled midwives who could perform the ultrasound might have been another factor. In Nigeria, ultrasound was done to check the thickness of the placenta once at 10–11 weeks of gestation. This could not form a placental curve since it was monitored only once throughout pregnancy. A study of a similar nature was conducted in India where ultrasound was performed to estimate gestational age in the first, second and third trimester of pregnancy (Naik et al. 2022). This was contrary to the above Nigerian study which included only women in their first trimester of pregnancy (Azagidi et al. 2020).

In India, the findings revealed a significant positive relation between placental thickness and gestational age in the second and third trimester up to 37 weeks. Therefore, placental thickness is a reliable determinant of gestational age without performing foetal biometry

(Naik et al. 2022). Ultrasound was found to be accurate compared to using clinical data alone (Azagidi et al. 2020; Bisahnyui et al. 2020) and was performed at different levels of pregnancy, depending on the examinations performed. This also applied to the studies conducted in Southern Africa where ultrasound was performed to estimate gestational age, including SFH (Constant et al. 2017; Malaba et al. 2018; Richter et al. 2020). Among the methods that were used to estimate gestational age were the Ballard Score, LMP and SFH (Kiserud et al. 2017; Ohuma et al. 2013; Rada et al. 2018; Stirnemann et al. 2017; Unger et al. 2019). Rada et al. (2018) and Unger et al. (2019) conducted multi-country studies which included a Ballard Score done to assess the gestational age of a new-born baby. Although a Ballard Score is done to ascertain gestational age, it does not meet the inclusion criteria of this SR since the target population was pregnant women.

Internationally, Shen et al. (2022) conducted research in the United States (US) and Turkey to estimate gestational age using the foetal brain MRI and the foetal brain maturity was predicted, in comparison to studies conducted in Africa. It was highlighted that it was not easy to predict brain age because the appearance of the foetal brain is constantly changing (Shen et al. 2022). The methods used to estimate gestational age could be associated with hospital-based research settings identified in this review. This was highlighted in several studies where in hospitals, clinical methods were used versus ultrasound (Azagidi et al. 2020; Bisahnyui et al. 2020; Mustafa et al. 2021). In agreement with the latter statement**,** in maternity hospitals the midwives used clinical data and ultrasound to estimate gestational age (Vesel et al. 2019). This is an indication that midwives need to be capacitated to function independently in remote areas where there are no doctors and ultrasound services.

Gaps in Methods Used to Estimate Gestational Age during Pregnancy in Africa

Most of the studies were conducted in hospital settings, thus indicating that services were not primary health care oriented. Some of the studies targeted women with specific conditions (inclusion criteria), therefore the findings could not be generalised. This was confirmed in a study conducted in Benin where ultrasound was used to estimate gestational age, but limited to malaria cases; therefore, the findings could not be generalised to all pregnant women in Benin. In KwaZulu-Natal and Western Cape, a cross-sectional study targeted pregnant women below 12 weeks using LMP and ultrasound. The gap identified was that ultrasound was only performed below 12 weeks, hence it could not be determined whether the uterus was growing according to the dates since below 12 weeks, it is still within the pelvis.

Conclusions and Recommendations for Midwives

The SR aimed at mapping and synthesising the evidence on gestational age estimation during pregnancy in Africa. There was a minimal publication of studies between 2013 and 2014 with a marked increase in 2019 and 2020. Ultrasound was found to be the

method used most in African countries to estimate gestational age during pregnancy. Few authors mentioned SFH in their studies although it is the best method to be used in remote areas where ultrasound is unavailable and where women cannot always recall their LMP. The number of articles obtained was inadequate; thus, there is a need for more studies on gestational age estimation in Africa with inclusion of other methodologies such as systematic reviews, mixed methods and qualitative studies. Qualitative research will assist the researchers in obtaining in-depth information on issues surrounding the estimation of gestational age. Further, the findings of the SR will assist the policy makers when reviewing the policies pertaining to ANC including consideration of training of midwives in ultrasonography to broaden their scope of practice.

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Table 3: Charting table for the estimation of gestational age during pregnancy in Africa (n = 19)

Author/s; Year	Country	Research design	Population; Type of pregnancy	Sample; Sampling	Setting	Methods for gestational age estimation	Gaps identified
Northen Africa							
El-Ebeisy et al. 2019	Egypt	Quantitative: Prospective study	Singleton pregnancy between 14–40 weeks	1 000; Purposive	Antenatal outpatient clinic	Ultrasound – TCD	The method is accurate, it can be used when their LMP is known which is a gap since some of the women could not remember their LMP
Saleh et al. 2022	Egypt	Quantitative: Prospective cohort	Pregnant women in third trimester	132; Purposive	Obstetrics and Gynaecology Department at a University Hospital	Ultrasound – BPD, AC and FL	Third trimester ultrasound found to be more effective. In other cases, ultrasound is only done before 24 weeks of gestation
Madkour et al. 2023	Egypt	Quantitative: Prospective observational cohort	Singleton pregnancy	150; Purposive	Obstetrics and Gynaecology Department at a University Hospital	Ultrasound – BPD, AC and FL	Ultrasonography becomes a challenge if the women are unsure of their LMP, and it is not always available in remote areas
Eastern Africa							
Vesel et al. 2019	Kenya	Mixed methods: Interviews and a survey	Pregnant women	4 611; Purposive	Maternity hospital	Ultrasound and clinical data	Midwives performing ultrasound did not get paid and found it time consuming
Fung et al 2020	Kenya	Quantitative: International prospective cohort study	Singleton pregnancy between 20–30 weeks	4 607; Purposive	Eight urban areas	Ultrasound foetal derived biometric data	Ultrasound done after 24 weeks is considered inaccurate

Author/s; Year	Country	Research design	Population; Type of pregnancy	Sample; Sampling	Setting	Methods for gestational age estimation	Gaps identified
Mustafa et al. 2021	Somali	Quantitative: Prospective cohort study	Singleton pregnancy between 16–40 weeks	1 107; Purposive	Tertiary care centre	Ultrasound	Somali population residing in the US
Western Africa							
Adeyekun et al. 2015	Nigeria	Quantitative: Prospective study	Singleton pregnancy between 13–42 weeks	250; Purposive	Antenatal clinic	Ultrasound foetal derived biometric data	Scanty studies conducted on foetal TCD in Nigeria
Azagidi et al. 2020	Nigeria	Quantitative: Cross-sectional study	Pregnant women between 10–11 weeks	400; Convenience	Hospital antenatal clinic	LMP; Placental thickness (Ultrasound)	Ultrasound only performed once; thus it is not a serial measurement that can form a placental growth curve
Bisahnyui et al. 2020	Cameroon	Quantitative: Observational, cross-sectional and participatory study	Pregnant women	72; Simple random	District hospital	Clinical methods versus ultrasound	Ultrasound found to be more accurate. Limitation is that LMP should be accurate
Central Africa							
Yovo et al. 2022	Southern Benin	Quantitative: RECIPAL cohort	Pregnant women with singleton pregnancy	411; Convenience	Recruited from the community	Ultrasound – AC and EFW, and clinical data	Proportion for the EFW was below the 10th percentile, not certain whether it can be used to identify foetal growth restriction in Africa. Small sample was used
Koladjo et al. 2023	Benin	Quantitative: RECIPAL Peri-conceptional cohort	Pregnant women	411; Purposive	Maternity clinic	LMP and ultrasound	Study was limited to malaria cases

Author/s; Year	Country	Research design	Population; Type of pregnancy	Sample; Sampling	Setting	Methods for gestational age estimation	Gaps identified
Southern Africa							
Constant et al. 2017	South Africa	Quantitative: Cross-sectional study	Pregnant women below 12 weeks	211; Purposive	Non-governmental reproductive health clinics	LMP and ultrasound	Limited to 60 days of gestation
Malaba et al. 2018	South Africa	Quantitative: Prospective cohort	Pregnant women with and without HIV	3 972; Purposive	PHC Antenatal clinic	LMP, SFH and ultrasound	Smaller and non-significant association between antiretroviral therapy and gestational age
Richter et al. 2020	South Africa	Quantitative: Randomised control trial	Singleton pregnancy	300; Random	Tertiary public health facilities	Ultrasound	Smaller sample. Study was limited to first time mothers
Multi-country studies							
Ohuma et al. 2013	Kenya and other seven countries	Quantitative: Prospective study	Pregnant women between 9–13 weeks	1 600; Purposive	Eight health institutions in geographically diverse countries	Ultrasound – Foetal CRL	Although the foetal CRL is recommended it is measured between 9–13 weeks which could be missed by the women who start antenatal clinic after 13 weeks
Stirnemann et al. 2017	Nairobi, Kenya and South Africa	Qualitative: Longitudinal study	Well-nourished pregnant women between 26–32 weeks	4 231; Purposive	Multicentre – Eight urban health institutions	Ultrasound – Foetal CRL	Using one foetal measure is a disadvantage
Kiserud et al. 2018	Democratic Republic of Congo, Egypt	Qualitative: Prospective longitudinal observational study	Pregnant women	1 439; Purposive	Ultrasound centres	Ultrasound	Findings cannot be generalised to the African continent since only two countries were included in the study
Rada et al. 2018	Benin, Gabon, Mozambique and Tanzania	Quantitative: Randomised trial – Cohort study	Pregnant women between 22–44 weeks	4 390; Random	Multi-centre in eight urban areas	SFH, LMP and New Ballad score	LMP needs to be accurate, and ultrasound is not always available

Author/s; Year	Country	Research design	Population; Type of pregnancy	Sample; Sampling	Setting	Methods for gestational age estimation	Gaps identified
Unger et al. 2019	Burkina Faso, Ghana, Malawi and Zambia	Quantitative: Randomised controlled trial	Pregnant women	1 630; Random	Multi-centre – seven sites	LMP, SFH, Ballard Score versus ultrasound	Ultrasound is limited in low resource areas, and it requires trained personnel

Abbreviations: AC – Abdominal Circumference; BPD – Biparietal Diameter; EFW – Estimated Foetal Weight; CRL – Crown Rump Length; FL – Femur Length; LMP – Last Normal Period; SFH – Symphysis Fundal Height; TCD – Transcerebellar Diameter