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Review

The use of medicinal plants by pregnant women in Africa: A systematic review

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ABSTRACT

Ethnopharmacological relevance: Medicinal plant (MP) use during pregnancy is common in Africa and may have profound effects on both the mother and the developing foetus. A lack of overview complicates monitoring and regulating the use of MPs during pregnancy.

Aim of the study: This systematic review analyses prevalence of use of MPs during pregnancy, regional distribution, types and prevalence, MP properties, potential health risks, and consensus of MPs use, and suggests relevant measures to mitigate negative effects on pregnancy.

Materials and methods: A search was undertaken using a range of scientific databases (Medline, Embase, African Journals OnLine, Google Scholar and Biological Abstracts), non-governmental organisations, various African universities and regulatory websites for original published and unpublished studies that assess and indicate the prevalence of use of MPs during pregnancy in Africa. Additional articles were located by exploring pertinent bibliographies, and contacting experts.

Results: A total of 3659 MP-use studies were found, but only 303 articles received full-text assessment for eligibility and finally only 50 scientific papers were eligible for the systematic review. The prevalence of MP use by pregnant women varied widely from 2% to 100%. Twenty-eight studies (56%) specified one or more plant species used as MP during pregnancy. The major reasons for MP use were relief of nausea and vomiting during pregnancy (NVP), stimulation of labour, and facilitation of childbirth. The most commonly cited MP species were *Zingiber officinale* Roscoe, *Allium sativum* L. and *Cucurbita pepo* L. and these were used for relief of NVP, motion sickness and as a nutritional supplement. Route of administration was most commonly oral, and few adverse effects were reported.

Conclusions: The use of MPs among pregnant women in Africa is prevalent, and the most commonly used plant species are not known to have harmful foetal effects during pregnancy. However, many of the MP species are poorly studied and teratogenic effects cannot be ruled out. Collaboration between healthcare providers and traditional practitioners to inform about the safe use of MPs may promote safer pregnancies and better health for mothers and infants.

1. Background

In Africa, modern health care and medicine is often available only to a limited number of people because either facilities are too expensive or too few facilities are available for too many people. The value of traditional medical knowledge in these countries is high and often confined to a limited number of traditional healers (Pfeiffer and Butz, 2005). Knowledge of medicinal plants (MPs) has often evolved through many generations, a process that has led to many effective remedies, and filtered out many acutely toxic or non-active remedies (de Boer, 2009). At the same time people in many developing countries often suffer poor health, have short life expectancies, and lack effective cures for many ailments (de Boer et al., 2012).

The African continent, generally known for its rich biodiversity, has

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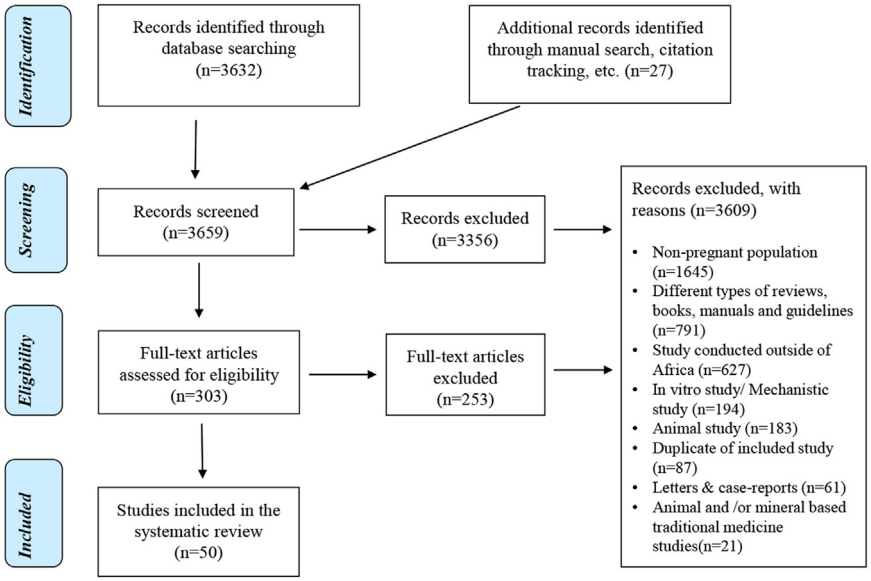

Fig. 1. Identification of 50 studies included in the systematic review.

an estimated total flora of over 70,000 species (Govaerts, 2001). Medicinal plants play a significant role in traditional medicine during pregnancy, childbirth and postpartum care, and include usage for female fertility, menorrhea, birth control, pregnancy, birth, puerperium and lactation (de Boer and Lamxay, 2009; de Boer et al., 2012; Nordeng et al., 2013; Towns and van Andel, 2014; Nergard et al., 2015; Towns and van Andel, 2016). Research focusing on the use of medicinal plants has often inadvertently focused on the realm of knowledge of male traditional healers by relying on traditional patriarchal systems, e.g. male researchers asking the male community leader to identify people knowledgeable in traditional medicine. These biased approaches have missed a wealth of knowledge that is held by women (Pfeiffer and Butz, 2005) and older literature often lists little or no uses of medicinal plants by women (de Boer and Cotingting, 2014).

African women depend on traditional medicine primarily in rural areas for their primary healthcare needs (Kamatenesi-Mugisha and Oryem-Origa, 2007; Towns and van Andel, 2014), but research on the use of herbal medicines for reproductive health matters is still largely limited (Gharoro and Igbafe, 2000; Njamen et al., 2013; Towns and van Andel, 2014). In spite of the specialized knowledge women have on MPs (Camou-Guerrero et al., 2008; Towns and van Andel, 2014), data on the extent of use of MP during pregnancy is especially scarce (Fakeye et al., 2009; Towns and van Andel, 2014). Studies show that medicinal plant use is widespread (Godlove, 2011; van Andel et al., 2014; Laelago et al., 2016), but also highlight data gaps in prevalence, pattern of use, women's perceptions and knowledge about MPs, adverse effects (Kamatenesi-Mugisha and Oryem-Origa, 2007; Godlove, 2011; Kaingu et al., 2011; Malan and Neuba, 2011; Emmanuel et al., 2014; Nergard et al., 2015), spiritual and cultural influences (Bishaw, 1991; Mokgobi, 2014), species identity and consensus of use (Zhang et al., 2014).

The ubiquitous use of MPs during pregnancy in Africa coupled with the piecemeal modernization of healthcare suggests that MPs will continue to play an important role into the near future. The aim of this systematic review is to assess the prevalence and diversity of MP use by women during pregnancy in Africa by looking at published and unpublished studies reporting actual prevalence of MP use during pregnancy. In addition, the review analyses the types and characteristics of MPs used, reasons for use, possible health risks and consensus of use on different medicinal plant species.

2. Materials and methods

2.1. Literature search strategy

A systematic literature search was conducted from July 2016 to January 2017, and included published scientific literature, unpublished studies, theses and dissertations. The following databases, Medline, Embase, AJOL, Google Scholar and Biological abstracts were searched for articles on MPs use during pregnancy in African countries. For this systematic review, unpublished data were obtained through search for dissertations/theses and reports in African universities websites/libraries (electronic data repositories), medical conference proceedings, regulatory and non-governmental organizations websites and personal contacts. In the review process, the following search terms were included (singular or plural forms when necessary): abortifacient, abortion, adverse, Africa, attendant, birth, botanical, delivery, developing, drug, ethnobotan*, ethnomedicin*, ethnopharma*, expectant, folk, gestating, gravid, healing, herb*, indigenous, labour, medicin*, midwife, mother, native, obstetric, outcome, oxytocic, parturient, parturition, phytomedicine, plant, pregnancy, remedy, sub-Saharan, teratogen*, traditional, treatment, uterotonic, women. Searches were adapted to databases terminology and topic categories. Research articles were also searched by examining bibliographies.

In the literature search process the names of the databases searched, the keywords used and the search results were retained as a 'search diary'. Titles and abstracts of studies considered for retrieval were saved to a Mendeley reference database, along with details of where the reference had been found.

2.2. Study selection and data extraction

For a research (article) to be included in the review, it had to assess and indicate the prevalence of use of MPs during pregnancy in an African country, and it should be published or made available within the research period (i.e. up to January 15, 2017). Additionally, studies that reported both the total number of pregnant women that visited healers and those who got MPs treatment were considered. Articles that were excluded were review articles (systematic or literature), those solely concerned with modern medicines, or those where pregnant women were not the study subjects. Furthermore, in vitro studies/mechanistic studies, animal studies, letters, case-reports, books, manuals and guidelines, and those reporting only animal and/or mineral-based

traditional medicines studies were also excluded. Full publications in print or digital formats were located for all included papers, and analysed for this review (Fig. 1).

The selection of the articles was done in four steps. In the first step, the relevance of the studies was checked based on their title. In the second step, abstracts were evaluated to match to the inclusion criteria. If primary inspection of an abstract of a paper did not give adequate information to make an informed judgment, the full paper was searched in the third step and reviewed by the authors prior to making a decision concerning inclusion in the review. Finally, those that appeared to meet the inclusion criteria were retrieved for extra appraisal by three of the authors (Fig. 1). Data were extracted into spreadsheets according to pre-defined criteria and were summarized in narrative form. The summarized data were compared by the authors and any differences of opinion were resolved by discussion and consultation with the original study. All scientific plant names were checked with The Plant List (www.theplantlist.org).

2.3. Consensus on MPs plant species

The Relative Frequency of Citation (RFC) statistic was used to measure consensus on species use between the different studies, and is calculated as $RFC_i = \frac{FC_i}{N}$ with FCi the number of literature sources mentioning species i and N the total number of literature sources consulted (Tardío and Pardo-de-Santayana, 2008; Zhang et al., 2014).

3. Results

3.1. Study characteristics

A total of 3659 publication records were identified, and 303 were assessed and 50 passed the selection criteria for review and data extraction (Fig. 1). Most of the reviewed studies were from West Africa (28 studies), followed by East Africa (13 studies), Southern Africa (6), North Africa (2), and Central Africa (1) (Fig. 2A). An overview of the key characteristics of the 50 included studies is summarized in Table 1. The appraised studies were conducted in the period from 1985 to 2017. Thirty-seven (74%) of the fifty studies were executed in the past 7 years. A total of 22,404 African pregnant or lactating women were involved in the respective studies, ranging from 20 in the smallest survey (Kaingu et al., 2011) to 1594 women in the largest study (Yusuff and Omarusehe, 2011). Eighteen studies included a sample of 450 or more participants (Table 1).

MP use is diverse and encompasses many disease prevention, alleviation and treatment methods. Operational definitions of MPs, such as using the WHO definition of traditional medicine (WHO, 2000) was inconsistent in published literature. In this review, 40% (20 studies) of the reviewed studies defined MPs, whereas the rest did not indicate what was included in the term (for example inclusion of functional foods, prophylactic, strengthening or vitalizing treatments, and dietary proscriptions). Some papers used the WHO definition of traditional medicine (Addo, 2007; Godlove, 2011; Mureyi et al., 2012; Mothupi, 2014; Laelago et al., 2016), but in others the definition varied in one way or the other (Tamuno et al., 2011; Onyiapat, 2014). Some papers included a broad range of traditional medicine therapies in their surveys (Mureyi et al., 2012) whereas others focused on a single specific medicinal plants mixture cf. *Isihlambezo* (Mabina et al., 1997a, 1997b; Varga and Veale, 1997) (Supplementary Table S1).

Data collection in most studies was based on investigator-informant face-to-face interviews (66%), and only a minority papers used self-administered questionnaires (Bello et al., 2011; Abasiubong et al., 2012; Fwacs and Fwacs, 2013; Mugomeri et al., 2015). In approximately a fifth of the reviewed studies (22%), the authors refer to the use of interview techniques without defining the method. The duration of data collection also varied widely, with some studies collecting data on MPs use during pregnancy over the course of 18 months (Hillary, 2013; Mothupi, 2014), whereas others were limited to a two week recall period (Kebede et al., 2009). The majority (88%) were a general cross-sectional survey of medicinal plants used by pregnant women, and four employed a combination of cross-sectional surveying with ethnobotanical surveys and/or focused individual discussions with traditional healers and women (Kamatenesi-Mugisha and Oryem-Origa, 2007; Kaingu et al., 2011; Malan and Neuba, 2011; Rasch et al., 2014). The remaining two studies utilized cross-sectional study method along with document review (Opaneye, 1998; Kebede et al., 2009) (Table 1, Supplementary Table S1). Participant sampling methods include random surveys (38%), representative (consecutive) surveys (34%), and purposive sampling (12%) methods, while the remainder did not clearly indicate the sampling method (Supplementary Table S1).

3.2. Prevalence, diversity and geographic distribution of MPs use

The reported use of MPs by pregnant women in Africa varies widely from 2% (Gebremedhin and Gomathi, 2014) to 100% (Kaingu et al., 2011). The average prevalence rate among the different African regions lies within the range of 30–45% (Fig. 2B). The highest average prevalence rate was reported from central Africa region (45%) and the lowest from East Africa (32%) (Fig. 2B; Table 1). More than half of the studies, 56%, listed the types of MPs used by pregnant women, whereas the other half failed to indicate the kinds of MPs used by expectant women (Table 1, Supplementary Table S1). In aggregation, 28 studies identified a total of 274 different medicinal plants species used in traditional treatment of gestational health ailments/symptom complexes throughout Africa. The distributions of the reported medicinal plants according to African regions are shown in Supplementary Table S2. A higher diversity of medicinal plants (149 plant species) was reported from East Africa followed by West Africa (100 plant species), Southern Africa (32 plant species), and North Africa (14 plant species). Unfortunately, no plant species are indicated in the single study from the Central Africa region (Fig. 2C). Seventeen plant species were reported in more than one region (Supplementary Table S2).

The number of cited plant species varied from study to study, and although 274 medicinal plants were reported to be used by African pregnant women, only 20 species (8.3%) along with their prevalence of use were mentioned in two or more articles (Table 2, Supplementary Table S2). The most popularly cited plant species for the treatment of pregnancy disorders and their corresponding RFCs were *Zingiber officinale* Roscoe (15) (RFC = 0.30), *Allium sativum* L. (12) (RFC = 0.24), *Cucurbita pepo* L. (7) (RFC = 0.14), *Vernonia amygdalina* Delile and *Ricinus communis* L. (5 each) (RFC = 0.10), *Garcinia kola* Heckel (4) (RFC = 0.08), *Ocimum lamiifolium* Hochst. ex Benth., *Azadirachta indica* A. Juss., *Ruta chalepensis* L., *Aloe vera* (L.) Burm.f., and *Ocimum gratissimum* L. (3 each) (RFC = 0.06). Species with high RFC scores are common and widely cultivated species across Africa, whereas species with low RFC scores are more likely to be restricted in distribution and occur only locally.

The four medicinal plant species used most widely by pregnant women were *Z. officinale* (Ginger), *A. sativum* (Garlic), *C. pepo* (Pumpkin) and *R. communis* (Castor oil). Each of these plants were reported in three regions of Africa. *Z. officinale* and *A. sativum* were commonly used in West, East and North Africa (Onyiapat, 2014; Orief et al., 2014; Abeje et al., 2015), whereas C. *pepo* and *R. communis* were frequently used in West, East and Southern Africa (Mureyi et al., 2012; Hillary, 2013; Onyiapat, 2014) (Supplementary Table S2).

3.3. Parts of plant used, methods of preparation and routes of administration

Various studies reported the use of diverse plant parts as medicinal agents, including root, bark, fruit, bulbs, whole plants, rhizomes, seeds, flowers/inflorescences, and stems, but leaves were the predominant

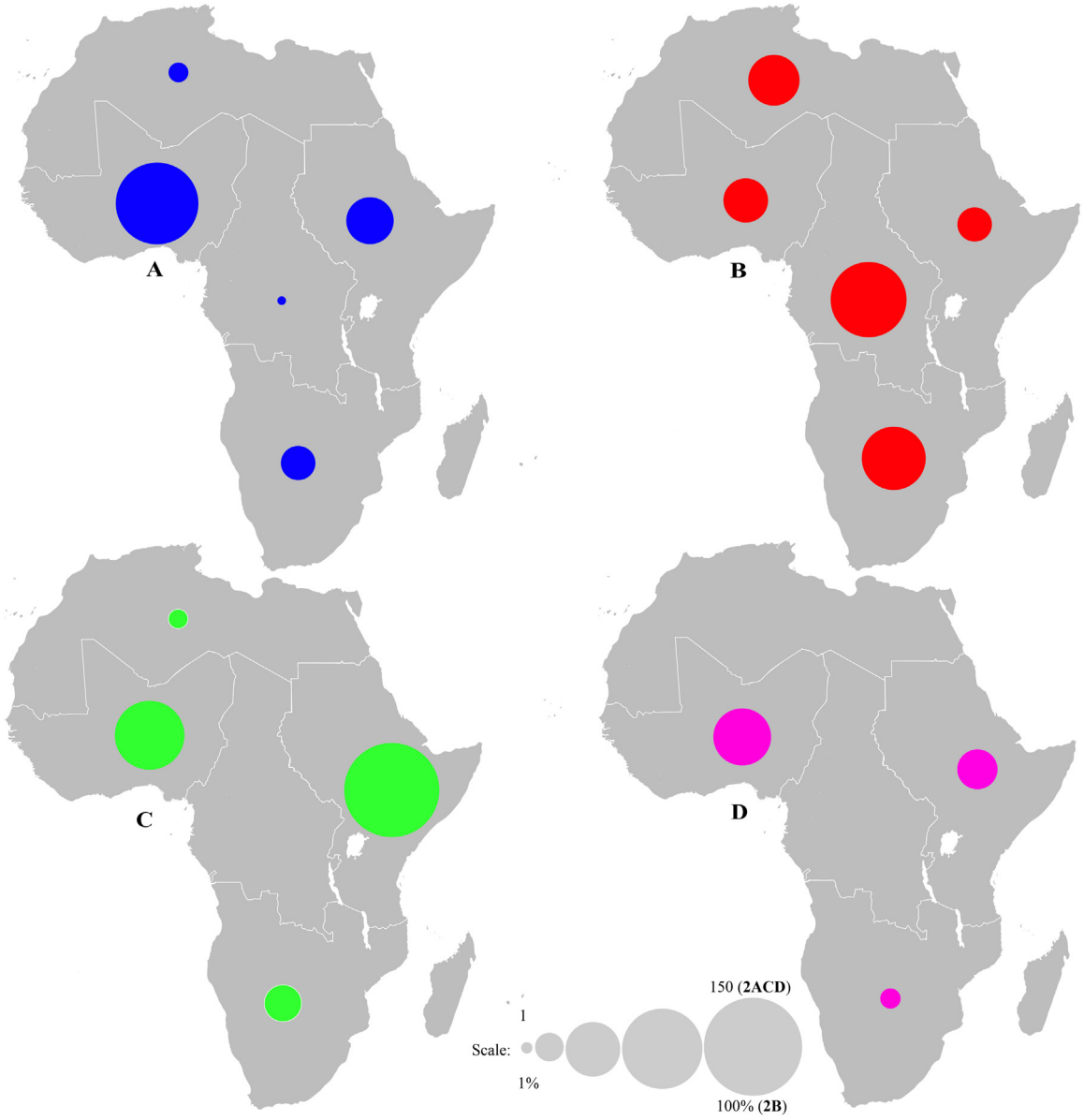

Fig. 2. A. Distribution of number of reviewed studies across African regions. **B.** Distribution of reported prevalence of MP use across African regions. **C.** Distribution of reported MP species across African regions. **D.** Distribution of reported concomitant use of MPs and conventional medicine across African regions.

parts used (Kamatenesi-Mugisha and Oryem-Origa, 2007; Kaingu et al., 2011; Malan and Neuba, 2011; Duru et al., 2016a, 2016b; Hanafy et al., 2016). The commonest methods of preparation/extraction were infusions/tea, maceration, squeezing, chewing, decoction, bathing, evaporating/inhaling as well as ingestion of raw medicinal plant (Varga and Veale, 1997; Kamatenesi-Mugisha and Oryem-Origa, 2007; Bayisa et al., 2014; Nergard et al., 2015). Routes of administration included oral, topical, nasal, intra-vaginal and rectal, but oral was the most frequent route and indicated in 38 (76%) studies (Varga and Veale, 1997; Kamatenesi-Mugisha and Oryem-Origa, 2007; Kaingu et al., 2011; Malan and Neuba, 2011; Mureyi et al., 2012; Nergard et al., 2015). Surprisingly, the frequency of administration and the dose of the MPs were not indicated in many of the analysed works (Table 1). Concurrent use of oral and rectal routes, and oral, rectal and vaginal together were also reported (Addo, 2007).

3.4. Reasons for use and sources of information

Users of MPs during pregnancy had several reasons for consumption of these medicines. Informants in over a quarter of the studies (26%) reported the use of MPs to alleviate pregnancy associated symptom like nausea, vomiting, etc. (e.g. Kaingu et al., 2011; Aboyeji et al., 2014; Bayisa et al., 2014; Onyiapat, 2014; Duru et al., 2016a; Laelago et al., 2016), whereas others reported improvement of foetal growth (12%) (e.g. Malan and Neuba, 2011; Adusi-Poku et al., 2015; Mkize, 2015; Mugomeri et al., 2015), stimulation of labour or facilitation of labour and delivery (14%) (e.g. Mabina et al., 1997b; Kamatenesi-Mugisha and Oryem-Origa, 2007; Omane-Adjekum, 2010; Mureyi et al., 2012; Hanafy et al., 2016), and prevention of premature labour and spontaneous abortions (12%) (e.g. Kaingu et al., 2011; Malan and Neuba, 2011; Mugomeri et al., 2015). Other uses were specifically postpartum, such as alleviation of postpartum haemorrhage (e.g. Kamatenesi-Mugisha and Oryem-Origa, 2007; Kaingu et al., 2011) and aiding expulsion of the placenta (Kamatenesi-Mugisha and Oryem-Origa, 2007; Kaingu et al., 2011; Olowokere and Olajide, 2013; Adusi-Poku et al., 2015). The South African medicinal plants concoction *'Isihlambezo'* was reported to ensure a quick and painless delivery and reduce the placental size (Mabina et al., 1997a, 1997b; Varga and Veale, 1997; Mkize,

Table 1
Overview of the studies on medicinal plant use during pregnancy in Africa (N = 50).

Reference, Country	Study setting (city, province)	Study population (No.)	Prevalence[#]	Common MPs used, route of administration, reasons for use, [§]predictors of MP use, and related information
West Africa (N = 28)				
Joseph et al. (2017), Nigeria	Ante-natal clinics in three selected hospitals in Jos, Plateau state	Pregnant women (350)	Herbal medicine, 11.8%	• Seven percent of the pregnant women consumed conventional and herbal medicines concomitantly • A very large majority of pregnant women were reported to have adequate knowledge about medicine safety • Most critical period to avoid medication: 1st TMP
Chukwurah et al. (2016), Nigeria	Government and private health facilities in Badagry, Lagos State	Pregnant women (450)	Herbs, 11.0%	• Less than a third of the pregnant women used herbs to prevent malaria
Duru et al. (2016a), Nigeria	Clinics in a tertiary Hospital in Owerri, Imo state	Pregnant and lactating women (500)	Herbal medicine, 36.8%	• Commonly used herbs: bitter leaf (*Veronica amygdalina*), palm kernel oil, utazi(*Cochorus olitorius*), bitter kola (*Garcinia kola*) • Significantly affect herbal medicine use: age (40+ years), AOR = 0.17 (0.03-0.85), ever married AOR = 8.46 (3.00-23.83), tertiary education AOR = 0.04 (0.01-0.14).
Duru et al. (2016b), Nigeria	Clinics in a tertiary hospital in Owerri, Imo state	Pregnant and nursing mothers (500)	Herbs, 36.8% (1st trimester, 28.3% 2nd trimester, 44.0% 3rd trimester, 21.7% Throughout pregnancy, 9.2% During labor, 15.8%)	• Commonly used herbs: *Vernonia amygdalina*, *Garcinia kola*, *Azadirachta indica*, *Allium sativum* and *Zingiber officinale* • Significantly associated with herb use: fair knowledge AOR = 2.05 (1.34–3.12) and poor attitude, AOR = 7.60 (4.44–13.03) • Common reasons for use: to alleviate pregnancy symptoms, to treat malaria, and affordability • Common sources of information: Radio, friends, neighbors, relatives, television
Adusi-Poku et al. (2015), Ghana	Health facilities in the Offinso North district, Ashanti region	Pregnant women (384)	Herbal medicines, 6.5%	• Commonly used herbal medicines: *Cassia occidentalis*, *Sida acuta*, *Cola gigantea* • Common reasons for use: to aid in easy labour, delivery and improve on foetal outcome
Agyei-Boateng (2015)*, Ghana	Government hospitals, Ashanti region	Pregnant women (300)	Herbal drugs, 23.5%	• Common reasons for use: headaches, cold and flu, and stomach problems • Other conditions prompting use: less expensiveness, past experiences, inconveniences at health facilities
Alaku et al. (2015), Nigeria	Nasarawa state	Pregnant women (360)	Indigenous herbs, 4.4%	• Local herbs had 100% sensitivity to plasmodium falciparum than orthodox drugs • Those patients who use to take herbs had no malaria attack
Alor (2015)*, Ghana	Kpetoe and Ziope clinics, Agotime-Ziope district,Volta region	Pregnant women (210)	Traditional medicine, 15.0%	• Commonly used MPs: nim tree (leaves), mahogany (root) • Common reasons for use: conventional medicine can't cure ailment, part of culture to use it, safe to use during pregnancy • Common source of MPs: herbalist, forest/wild, herb shops • More than a third of pregnant women used TM together with conventional medicines
Bello and Isah (2015), Nigeria	Aminu Kano teaching hospital and Murtala Muhammad specialist hospital, Kano, Kano State	Pregnant women (378)	Herbal medicine, 42.0%	• Major source of herbal medicines: herbalist/traditional houses • Common reasons for use: treating illness, preventing disease, promoting health
Nergard et al. (2015), Mali	Community health care centers in Bamako, Siby and Dioila	Pregnant women (209)	Medicinal plants, 79.9%	• Commonly used medicinal plants: *Lippia chevalieri*, *Combretum micranthum*, *Parkia biglobosa* • Common reasons for use: for well-being, symptoms of malaria and to reduce edema • Nearly a third of the pregnant women claimed that medicinal plants had no adverse effects for the mother
Aboyeji et al. (2014), Nigeria	Antenatal clinic, University of Ilorin teaching hospital, Ilorin, Kwara state	Pregnant women (335)	Herbal drug, 12.2%	• Commonly used herbal medicines bitter: kola (Garcinia kola), kola-nut
Emmanuel et al. (2014), Nigeria	Antenatal clinics at three selected hospitals, Jos, Plateau state	Pregnant women (120)	Herbal remedies, 10.0%	• Common reasons for use: minor illness, prior experience and doctors are scarce and expensive to see
Onyiapat (2014)*, Nigeria		Pregnant women (400)	CAM, 81.2%	

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Table 1 (*continued*)

Reference, Country West Africa (N = 28)	Study setting (city, province)	Study population (No.)	Prevalence[#]	Common MPs used, route of administration, reasons for use, [§]predictors of MP use, and related information
	Antenatal care units of the various health centers, Udi Local Government area, Enugu state			• Commonly used CAMs: bitter cola, ginger, garlic • Common reasons for use: easy access, reduce the weight of the baby, relieve morning sickness, prevent abortion • Just under four-fifths of the pregnant women reported that CAM is beneficial and is without adverse effect • Common route of administration: oral
Fwacs and Fwacs (2013), Nigeria	Aminu Kano Teaching Hospital, Kano,Kano state	Pregnant women (440)	Herbal medicines, 25.0% (1st trimester, 58.2% 2nd trimester, 56.4% 3rd trimester, 6.4%)	• Commonly used herbal medicines: ginger, garlic • Significantly associated with herbal medicine use: absence of formal education OR = 2.97 (1.49–5.91), and low socioeconomic class OR = 1.90 (1.17–3.08) • Major sources of information: radio / television, community societies, mothers and traditional healers
Olowokere and Olajide (2013), Nigeria	Rural communities, Ife North local government area, Osun state	Pregnant women and nursing mothers (300)	Herbal remedies, 39.3%	• Commonly used herbs: bitter leaf water, ginger, cannabis • Common reasons for use: augment labour, induce labour, induce abortion • Other reasons for use: antiemetic, relief of pain, fever and constipation
Abasiubong et al. (2012), Nigeria	Three general hospitals, Uyo, Akwa Ibom state	Pregnant women (518)	Herbal medicines, 9.1%	• One in twenty pregnant women used mixture of herbs and other drugs
Oladeinde et al. (2012), Nigeria	A leading traditional birth center, Benin city, Edo state	Pregnant women (119)	Herbal remedies, 22.7%	• Just over three quarters of the women used herbal remedies ('Agbo Iba') concomitantly with orthodox medicine • Anemia was significantly associated with consumption of MPs OR = 2.97 (1.21, 7.33)
Bello et al. (2011), Nigeria	At three levels of care (primary, secondary and tertiary) in Ibadan, Ibadan, Oyo State	Pregnant women (410)	Herbal medicines, 46.3%	• Rural pregnant attendees more likely to use herbal concoctions OR = 5.79 (2.56–13.10) • Significantly associated with (herbal medicine) self-medication: married women OR = 0.2 (0.05–0.75), spouses had higher education OR = 0.43 (0.21–0.89), hypertensive women OR = 22.54 (3.81–133.49)
Malan and Neuba (2011)[§], Côte d'Ivoire	The Yakassé-Feyassé health centre, Yakassé-Féyassé, Anyi-Ndenye	Pregnant women (55)	Medicinal plants, 90.3%	• 28 medicinal plant species listed • Commonly used medicinal plants: *Ocimum gratissimum*, *Desmodium adscendens*, *Pothomorphe umbellata*, • Common reasons for use: good development of the foetus, facilitate labour, prevent/cure malaria • Commonly used plant parts: Leaves, barks, roots
Tongo et al. (2011), Nigeria	Hospitals, Ibadan, Oyo state	Parturient woman (796)	Herbal medications, 21.7%	• Non-use of herbal medications was associated with reduced risk of preterm birth AOR = 0.55 (0.36, 0.85)
Yusuff and Omarusehe (2011), Nigeria	Antenatal clinics at major antenatal care facility, Ibadan, Oyo state	Pregnant women (1,594)	Local herbs, 19.9%	• Local herb use (Self-medication) is strongly associated with self-employment OR = 3.80 (2.6–4.7), Unemployment OR = 2.60 (1.40–4.20) and 3rd TMP OR = 4.20 (3.10–5.60)
Oman-Adjekum (2010)*, Ghana	Dormaa Presbyterian hospital, Dormaa Ahenkro, Brong-Ahafo region	Pregnant women (600)	Herbal medicine, 49.3%	• Commonly used herbal medicines: living bitters, pomaa bitters • Common reasons for use: treat malaria, abdominal pains, abort pregnancy, protect pregnancy, and smooth delivery
Tamuno et al. (2011), Nigeria	Aminu Kano Teaching Hospital, Kano, Kano state	Pregnant women (500)	Herbal medicines, 31.4%	• Commonly used herbal medicines: garlic, ginger • Significantly associated with herbal medicine use: no formal education, low economic status, self-medication with orthodox drugs, 1st and 2nd TMP
Fakeye et al. (2009), Nigeria	Maternity hospitals in Nigeria	Pregnant women (600)	Herbal medicine, 67.5%	• The preferred vehicle: potable water • Nearly a fifth of the pregnant women experienced some form of untoward effects
Sam-Wobo et al. (2008), Nigeria	Abeokuta, Ogun state	Pregnant women (1400)	Herbal medicine, 68.0%	• Common reasons for use: herbs are effective and suitable, financial constraints, religious belief • More than half of the pregnant women used herbal drugs daily
Addo (2007), Ghana	Komfo Anokye teaching hospital, Kumasi, Ashanti region		Herbal medicine, 56.3%	

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Table 1 (*continued*)

Reference, Country	Study setting (city, province)	Study population (No.)	Prevalence[#]	Common MPs used, route of administration, reasons for use, [§]predictors of MP use, and related information
West Africa (N = 28)				
		Obstetrics and gynaecology patients (597)		• Route of administration: Oral, rectal, vaginal • Significantly associated with herbal medicine use: primary or no education, OR = 1.55 (1.04–1.44), unskilled woman OR = 2.16 (1.53–3.05)
Gharoro and Igbafe (2000), Nigeria	Three hospitals in Benin city, Edo state	Pregnant patients (1200)	Herbal medicine, 12.1%	• Use of native herbs was more prevalent amongst nulliparous mothers
Opaneye (1998), Nigeria	Ogun state University teaching hospital, Sagamu, Ogun state	Parturient mothers (300)	Traditional medicine, 53.3%	• Commonly used TMs: herbal brew, herbal soup • Perinatal mortality is higher in TM users
East Africa (N = 13)				
Laelago et al. (2016), Ethiopia	Antenatal clinics of public health facilities, Hossana, Southern Nations, Nationalities, and Peoples' region	Pregnant women (363)	Herbs, 73.1%	• Commonly used herbal medicines: garlic, ginger, *Ruta chaplenssis*, *Ocimum lamiifolium* • Significantly associated with herbal medicine use: being students AOR = 5.68 (1.53, 21.13), 2nd TMP AOR = 0.22 (0.08–0.76), sufficient knowledge on herbal medicine AOR = 0.37 (0.19, 0.79), no formal education AOR = 4.41 (1.11–17.56), and primary education AOR = 4.15 (1.51–11.45) • Major sources of herbal medicine: Market places, Self-preparation, herbalist
Nyeko et al. (2016), Uganda	Postnatal clinics, Gulu district, Northern region	Pregnant women (383)	Herbal medicines, 21.0%	• Common reasons for use: abdominal/waist pain, induce/enhance labour, nausea and vomiting, keep the baby healthy • Significantly associated with herbal medicine use: perception that herbal medicines are effective AOR = 2.18 (1.02–4.66), ever used herbal medicines during previous pregnancy AOR = 2.51 (1.21–5.19)
Abeje et al. (2015), Ethiopia	Governmental health centers, Bahir Dar city, Amhara region	Pregnant women (518)	Traditional herbs, 7.8%	• Commonly used herbs: ginger, garlic, *Zehneria scabra* (*areg resa*), *Hageenia abyyssinica* (*kosso*), and *Cucurbita pepo L* (*Duba*). • Significantly associated with (herbal) self-medication practice: Multi gravida AOR = 2.10 (1.30–3.40), pregnant women with maternal illness AOR = 4.80 (2.80–8.00) and location of health centres AOR = 4.60 (2.90–7.40)
Bayisa et al. (2014), Ethiopia	Nekemte hospital, Nekemte city, Oromia region	Pregnant women (250)	Herbal medicine, 50.4% (1st trimester, 69.84% 2nd trimester, 15.08% 3rd trimester, 10.32% throughout pregnancy, 4.76%)	• Commonly used herbal medicines: garlic, ginger, eucalyptus (*Eucalyptus globulus*), and tena adam (*Ruta chalepensis)* • Common reasons for use: nausea, vomiting • Method of extraction: crude, extract, maceration, and decoction • Major sources of information: neighbour, family, herbalist, health professionals
Gebremedhin and Gomathi (2014), Ethiopia	Four hospitals, Mekelle city, Tigray region	Pregnant women (400)	Herbal drugs, 2.0%	• Significantly associated with (herbal) Self-medication: illiterates AOR = 3.65 (1.31, 10.20) and secondary school complete participants AOR = 4.03 (1.09, 14.96)
Mothupi (2014), Kenya	District public health hospital, Nairobi	Pregnant women (333)	Herbal medicine, 12.0% (Ever used herbal medicine, 41.4%)	• Common reasons for use: toothache, various types of pain, flu and stomach problems • Significantly associated with herbal medicine use: no formal or only primary education and use before the index pregnancy • More than a fifth of the pregnant women used herbal medicine and pharmaceuticals concomitantly
Rasch et al. (2014)[x], Tanzania	Kagera regional hospital, Bukoba, Kagera	Aborting women (187)	Medicinal plants, 43.0%	• 16 medicinal plant species were found to have uterine contractive effect • Common reasons for use: to induce abortion • Route of administration: oral, intra-vaginal
Hillary (2013)*, Kenya	Embu provincial general hospital, Embu, Eastern province	Pregnant and post-partum women (157)	Herbal medicines, 70.0%	• Commonly used herbal medicines: ginger, garlic • Significantly associated with herbal medicine use: age, distance to the nearest health facility, employment status and number of children

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Table 1 (*continued*)

Reference, Country	Study setting (city, province)	Study population (No.)	Prevalence[#]	Common MPs used, route of administration, reasons for use, [§]predictors of MP use, and related information
West Africa (N = 28)				
Godlove (2011)*, Tanzania	Antenatal clinic at Mbeya referral hospital, Mbeya	Pregnant women (401)	Herbal medicines, 55.0% (1st trimester, 6.8% 2nd trimester, 7.3% 3rd trimester, 39.1% during labour, 90.5%)	• Common reasons for use: modern medicines alone are not sufficient, herbal medicines are easily accessible • Routes of administration: Oral, topical and intravaginal • Significantly associated with herbal medicine use: long distance to the nearest health facility and low education level
Kaingu et al. (2011)***, Kenya	Kyevaluki and Kathiani sub locations, Machakos district, Eastern province	Pregnant women (20)	Herbal remedy, 100.0%	• 55 plant species were used by women • Common reasons for use: delayed labor, protracted labor, PPH, nausea and vomiting • Commonly used plant parts: leaves, roots
Kebede et al. (2009), Ethiopia	Health institutions, Addis Ababa,City Government of Addis Ababa	Pregnant women (1268)	Herbal medicine, 2.2%	• Commonly used Herbs: *Allium sativum, Ocimum lamiifolium, Lepidium sativum, Cucrbita pepo, Linum usitatissimum*
Kamatenesi-Mugisha and Oryem-Origa (2007), Uganda	Kyambura and Katerera health centres in Bushenyi and Kasese districts, western Uganda	Pregnant women (483)	Herbal remedies, 100.0%	• 75 medicinal plant species were used in inducing labour • Commonly used plant parts: leaves • Common methods of preparation: squeezing or chewing fresh plants, infusion • Common reasons for use: to maintain pregnancy, induce labour and aid childbirth process • Common route of administration: oral
Mbura et al. (1985), Tanzania	Antenatal clinics in urban and rural Tanga district, Tanga region	Pregnant women (214)	Herbal medicine, 42.0% (Urban, 43.3% and rural areas, 40.2%)	• The highest use rate was towards the end of the 1st TMP and during labor • Common route of administration: oral
South Africa (N = 6)				
Mugomeri et al. (2015), Lesotho	The referral hospital, Maseru, Maseru district	Pregnant women (72)	Herbal medicines, 47.2% (1st trimester, 30.9% 2nd trimester, 50.0%, 3rd trimester, 19.1%)	• Commonly used herbs: *Gunnera perpensa*, *Pentanisia prunelloides*, *Hermannia* depressa, *Zantedeschia albomaculata and Eucomio autumnalis* • Common reasons for use: leucorrhoea of pregnancy, prevention of placenta praevia, prevention of abortion, for foetal growth
Mkize (2013)*, South Africa	The post-natal ward of Bertha Gxowa hospital, Gauteng province	Postpartum women (442)	Traditional medicine, 41.5% (1st trimester, 2.7% 2nd trimester, 10.8% 3rd trimester, 73% labour, 13.5%)	• Commonly used TM: Isihlambezo** • Common reasons for use: quick delivery, good growth of baby • Significantly associated with TM use: Older women, Zulu speaking women • Major sources of information: Family, friends
Mureyi et al. (2012), Zimbabwe	Twelve Harare public maternity clinics, Harare	Pregnant women (248)	Traditional medicines, 52.0%	• Commonly used MPs: mbanje *(Cannabis sativum)* • Common reason for use: induction / speed up of labour • Significantly associated with prenatal use of TM: age (20-25 group), nulliparity, nulligravidity, and residence area • Significantly associated with adverse events: nulliparity, nulligravidity
Mabina et al. (1997a), South Africa	King Edward VIII hospital, Durban, KwaZulu-Natal	Women in early labour (229)	Herbal medicine, 55.0%	• Herbal medicine use was significantly associated with a higher rate of meconium staining, and caesarean section
Mabina et al. (1997b), South Africa	King Edward VIII hospital, Durban, KwaZulu-Natal	Pregnant women (577)	Medicinal herbs, 43.7%	• Common reasons for use: improve foetal conditions, make labour easier, as purgative • A very large majority of pregnant women knew about Isihlambezo** • Common routes of administration: oral
Varga and Veale (1997)[##], South Africa	Rural and urban areas of KwaZulu-Natal	Pregnant women (218)	Medicinal herb, 7.0%	• Urban women were more likely than rural women to mixing isihlambezo with western antenatal care (P = 0.01). • Common reasons for use: quick and painless delivery, edema, constipation, infection, indigestion, high blood pressure, reduced placental size, protection from evil forces
North Africa (N = 2)				
Hanafy et al. (2016), Egypt	20 antenatal care clinics, Alexandria, Alexandria governorate	Pregnant women (600)	Herbs, 41.8% (1st trimester, 56.3% 2nd trimester, 33.0% 3rd trimester, 10.7%)	• Commonly used herbs: peppermint, hibiscus, anise • Common reasons for use: GIT disorders, respiratory disorders, hypertension, uterine contractions, headache, gestational diabetes, labour stimulant

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Table 1 (*continued*)

Reference, Country	Study setting (city, province)	Study population (No.)	Prevalence#	Common MPs used, route of administration, reasons for use, §predictors of MP use, and related information
West Africa (N = 28)				
Orief et al. (2014), Egypt	A family health center, Alexandria, Alexandria governorate	Pregnant women (300)	Herbal medicine, 27.3%	● Commonly used herbal medicines: aniseed, fenugreek, ginger, garlic ● Common reasons for use: abdominal colic, nausea and vomiting, dysuria, headache ● Primary sources of information: family, friends
Central Africa (N = 1)				
Mbarambara et al. (2016), DR Congo	14 selected health centers in Bukavu town, South Kivu province	Pregnant women (920)	Herbal remedies, 45.0%	● Significantly associated with self-medication practice: use of herbal remedies, AOR = 1.70 (1.26–2.42), previous self-medication, AOR = 6.10 (4.36–8.64), advised by Pharmacist/druggist, AOR = 4.70 (3.34–6.87), and lack of sensitizing on drug's danger, AOR = 2.50 (1.84–3.61)

Key: *Theses (N = 7); **A herbal decoction used by many Zulu women in South Africa as a preventative health tonic during pregnancy; #Traditional herbal medicine terminology as defined by the study reviewed; §Malan and Neubab (2011): Respondents = 55 pregnant women + 26 Men & women + 15 Girls + 8 female healers; ^Rasch et al. (2014): Respondents = 87 women with incomplete abortions + 21 traditional providers + 2 nurses; ***Kaingu et al. (2011): Respondents = 20 Pregnant women + 200 TBAs; ##Varga and Veale (1997): Respondents = 218 Pregnant women + 45 Traditional healers. Abbreviations: GIT = Gastrointestinal tract, PPH = Post-partum haemorrhage, TM = Traditional medicine, TMP = Trimester of pregnancy; §'Significantly associated' indicates at least P = < 0.05.

2015) (Tables 1 and 2, Supplementary Table S2).

Nearly half (48%) of the reviewed materials disclosed the sources from which pregnant women received MP information. The principal sources were family, friends, grandmothers, traditional healers, herbalists, mothers-in-law, parents/relatives and traditional birth attendants (e.g. Orief et al., 2014; Agyei-Boateng, 2015; Mugomeri et al., 2015; Nergard et al., 2015; Nyeko et al., 2016). On the other hand, some expectant women indicated health professionals as a major source of MP information (Bayisa et al., 2014; Agyei-Boateng, 2015; Laelago et al., 2016).

3.5. Adverse effects and concurrent use of conventional medicine

Seven studies reported that women perceived MPs to be more effective, work faster and safer to use during pregnancy (Fakeye et al., 2009; Yusuff and Omarusehe, 2011; Hillary, 2013; Nyeko et al., 2016). Contrasting with those results, a few studies reported that respondents avoid using MPs during pregnancy because the MPs are not safe for pregnant women, have adverse/side effects that could be dangerous to their health and the unborn baby and should be avoided or used with caution (Fakeye et al., 2009; Alor, 2015). This appraisal revealed that the majority of the reviewed papers made no mention of possible adverse effects. Only few studies reported some form of adverse effects, and these included excessive uterine contractions, foetal distress and abortions (Godlove, 2011), bleeding and diarrhoea (Onyiapat, 2014), abortion, premature childbirth and foetal death (Mbarambara et al., 2016). The other adverse effects encountered were diarrhoea, dizziness, vomiting, nausea, abdominal pain, weakness and burning sensation (Fakeye et al., 2009; Omane-Adjekum, 2010; Duru et al., 2016a; Laelago et al., 2016).

With regard to concurrent use of MPs with conventional medicine, ten articles reported the concurrent use of MPs with conventional medicine, with prevalence ranging from 2.4% (Mothupi, 2014) to 77.3% (Oladeinde et al., 2012). Concurrent use was frequently reported from West Africa (6 studies), followed by East Africa (3 studies) (Fig. 2D). In addition, 22% of the reviewed studies reported that pregnant women use MPs to treat malaria (Sam-Wobo et al., 2008; Omane-Adjekum, 2010; Malan and Neuba, 2011; Tongo et al., 2011; Oladeinde et al., 2012; Emmanuel et al., 2014; Alaku et al., 2015; Alor, 2015; Nergard et al., 2015; Chukwurah et al., 2016; Duru et al., 2016b).

3.6. Spiritual and cultural influences

Religion and witchcraft also played an important role for some of the respondents. Some pregnant women prayed to ancestors to manage pregnancy conditions such as delayed labour; took various MPs to manage protracted labour due to witchcraft or other superstition (Kaingu et al., 2011); drank *"church-made"* coffee to widen the birth canal and induce labour (Mureyi et al., 2012); drank mixtures of MPs to protection from witches, witchcraft and evil (Abasiubong et al., 2012; Mkize, 2015); or practiced Kombe, a form of Koranic medicine that includes the use of amulets with Koranic inscriptions (Mbura et al., 1985). Furthermore, the South African concoction of medicinal plants '*Isihlambezo*' is also claimed to provide spiritual cleansing or protection from evil forces (Varga and Veale, 1997).

3.7. Predictors of MP use

Socio-demographic characteristics of MP users and non-users showed interesting differences. In several studies MP use during pregnancy was significantly associated (P = < 0.05) with a lower education level, increasing age, being married, low economic status, lower educational level of spouse, poor pregnancy outcome, MP use experience in previous pregnancy, perception that MPs are effective, large family size, selfemployment, unemployment and rural residence (e.g. Godlove, 2011; Tamuno et al., 2011; Yusuff and Omarusehe, 2011; Fwacs and

Table 2
Overview of the most frequently used medicinal plants during pregnancy in Africa: prevalence, preparations and indications (N = 20).

Vernacular name(s) (language)	Scientific name (Family name)	Part(s) of plant used	Preparation method(s)	Most common indications	Route of administration	Prevalence[a]	Prevalence range citation	No. of cit.	RFC
Ntangahuzi (NY, RU), Ginger (EN)	*Zingiber officinale* Roscoe (Zingiberaceae)	Rhizome	Ginger is eaten raw or ground and mixed with a local palm wine or soup	Emesis, morning /motion sickness	Oral	0.1–40.8%	Kebede et al., 2009; Laelago et al., 2016	15	0.30
Nechi shinkurit (AM), Tungurusumu (KO), Garlic (EN)	*Allium sativum* L. (Amaryllidaceae)	Bulb, leaves	Chewing	Pregnancy symptoms	Oral	3.0–51.0%	Onyiapat, 2014; Laelago et al., 2016	12	0.24
Bishusha (RU), Byozi (NY), Duba (AM), Pumpkins (EN)	*Cucurbita pepo* L. (Cucurbitaceae)	Leaves, seeds	Leaves squeezed in water and mixed with milk	Nutritional supplement	Oral	0.2–0.5%	Kebede et al., 2009; Onyiapat, 2014	7	0.14
Ewuro (YB), Kibiriri (KO), Omubirizi (NY, KI, RU), Mululuza (GA), Omubabazi no.2 (NG), Bitter leaf/iron weed (EN)	*Vernonia amygdalina* Delile (Asteraceae)	Leaves, roots	Squeezing by hand, chewing, leaf soup	Emesis, fever, constipation, loss of appetite	Oral	17.3–20.0%	Olowokere and Olajide, 2013; Duru et al., 2016a	5	0.10
Omudimu (NG), Castor oil (EN)	*Ricinus communis* L. (Euphorbiaceae)	Roots, seeds, leaves, fruits	Oil Extract	Delayed/protracted labor, RAB, PPH, constipation and labour induction	Oral	0.1–4.4%	Onyiapat, 2014; Hillary, 2013	5	0.10
Bitter Kola/Garcinia kola (EN)	*Garcinia kola* Heckel (Clusiaceae)	Roots, bark, fruit, seeds	Chewing	Nausea, vomiting	Oral	8.5–14.6%	Onyiapat, 2014; Duru et al., 2016b	4	0.08
Isihlambezo (ZU)	*Isihlambezo*[b]	Various plant parts	Decoction/infusion, the "tea" or tonic is then taken	Quick and painless delivery, RVD, RPS, drain edema, foetal well-being	Oral	7.0–55.0%	Varga and Veale, 1997; Mabina et al., 1997a	4	0.08
Damakesse (AM), Omweya (RU), Omwenyi, Omwenye, Mushaija (NY)	*Ocimum lamiifolium* Hochst. ex Benth. (Labiatae)	Leaves, roots	Squeezing by hand	Antispasmodic effects	Oral	0.3–16.7%	Kebede et al., 2009; Laelago et al., 2016	3	0.06
Dogonyaro (NG), Kikikarabo (NG), Nim tree (EN)	*Azadirachta indica* A. Juss. (Meliaceae)	Leaves, bark, seeds	Squeezing(liquid), crude (raw) forms	Pain, anemia, malaria, piles, make the unborn baby strong	Oral	0.8–13.2%	Onyiapat, 2014; Duru et al., 2016a	3	0.06
Tena adam (AM)	*Ruta chalepensis* L. (Rutaceae)	Leaves	Tea form, raw leaf, squeezing by hand, chewing	Nausea, vomiting, common cold, stomachache	Oral	0.1–19.3%	Kebede et al., 2009; Laelago et al., 2016	3	0.06
Aloe vera (Common Name)	*Aloe Vera* (L.) Burm.f. (Xanthorrhoeaceae)	Leaves	Leaf juice	Pregnancy symptoms, skin treatment	Oral, topical	0.8–7.8%	Onyiapat, 2014; Duru et al., 2016b	3	0.06
Amanyire (AN), Efirin (NG), Scent leaf (EN)	*Ocimum gratissimu m* L. (Lamiaceae)	Leaves	Leaf is squeezed with salt and sieved to extract the water	Abdominal pain, loss of appetite, fever, cold and catarrh	Oral, anal	26.0–90.3%	Olowokere and Olajide, 2013; Malan and Neuba, 2011	3	0.06
Peppermint (EN)	*Mentha piperita* L. (Lamiaceae)	Leaves	Oil, leaf extract, leaf water	Gastrointestinal disorders, common cold, muscle pain, headache	Inhalation, topical	3.0–14.0%	Orief et al., 2014; Hanafy et al., 2016	2	0.04
Aniseed/Anise (EN)	*Pimpinella anisum* L. (Apiaceae)	Seeds	Tea form, powdered seed, decoction, oil	Nausea, vomiting, abdominal colic	Oral	8.7–11.0%	Hanafy et al., 2016; Orief et al., 2014	2	0.04
Fenugreek (EN)	*Trigonella foenum-graecum* L. (Fabaceae)	Leaves, seeds	Decoction, powder, tea form, etc.	Stimulates uterine contractions, milk production, BSLR, stomach ache	Oral	5.3–8.7%	Hanafy et al., 2016; Orief et al., 2014	2	0.04
Nech Bahirzaf (AM), Eucalyptus (EN)	*Eucalyptus globulus* Labill. (Myrtaceae)	Leaves	Leaf boiled and inhaled	Fever, upset stomach, help loosen coughs	Inhalation	5.2–8.5%	Bayisa et al., 2014; Laelago et al., 2016	2	0.04
Mbanje (SH), Cannabis (EN)	*Cannabis sativa* L. (Cannabaceae)	Leaves	Aqueous extract is drunk as soon as labour commences	Pain, fever, catarrh, loss of appetite, labour induction / speed up	Oral	4.7–52.0%	Olowokere and Olajide, 2013; Mureyi et al., 2012	2	0.04
Moringa/Morringer (EN)	*Moringa oleifera* Lam. (Moringaceae)	Leaves, roots, bark, fruit, seeds, flowers	Raw leaves, seed powder, tea form, etc.	Fever, cough, emesis, helminths, diarrhoea, diuretic	Oral, topical, etc.	1.8–5.6%	Onyiapat, 2014; Duru et al., 2016b	2	0.04
Sriman (AN), Aboshi (IG)	*Baphia nitida* Lodd. (Fabaceae)	Leaves, stems	NG	Therapeutic meal	Oral, anal	2.5–90.3%	Onyiapat, 2014; Malan and Neuba, 2011	2	0.04

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Table 2 (*continued*)

Vernacular name(s) (language)	Scientific name (Family name)	Part(s) of plant used	Preparation method(s)	Most common indications	Route of administration	Prevalence[a]	Prevalence range citation	No. of cit.	RFC
Palm kernel oil (EN)	*Elaeis guineensis* Jacq. (Arecaceae)	Oil	Heat dried nuts, ground to paste, mix with water, heat to release the oil	Pregnancy symptoms	NG	17.0–17.0%	Duru et al., 2016a; Duru et al., 2016b	2	0.04

Abbreviations: BSLR: Blood sugar levels reduction, PPH: postpartum haemorrhage, RAB: Retained after birth, RFC: Relative frequency of citation, RPS: Reduce placental size, RVD: Reduced vaginal discharge. Language/ Dialects: AM–Amharic, GA–Luganda, KI–Rikiga, KO–Rukonjo, NY–Runyankole, RU–Runyaruguru, KB–Kamba, SH–Shona, AN–Anyi, YB-Yoruba, ZU-Zulu, EN–English, IG-Igbo, NG-Not Given.

[a] The proportion of pregnant women who reported to have used (using) that particular medicinal plant;

[b] Isihlambezo is a herbal decoction used by many Zulu women in South Africa as a preventative health tonic during pregnancy (see also definitions in manuscript).

Fwacs, 2013; Hillary, 2013; Olowokere and Olajide, 2013; Mothupi, 2014; Duru et al., 2016a; Laelago et al., 2016; Nyeko et al., 2016). On the contrary, several studies found different results. For instance, Duru et al. (2016a) showed that index pregnancy did not significantly affect the use of MPs during pregnancy. Besides, higher income status was found a strong predictor for MP use during pregnancy (Alor, 2015). Tongo et al. (2011) found that the non-use of MPs preparations was significantly associated with reduced risk of preterm birth. Moreover, Addo (2007) and Mugomeri et al. (2015) disclosed that marital status had no significant association with use of MPs. Anemia was strongly associated with consumption of MP remedies (Oladeinde et al., 2012) (Table 1).

4. Discussion

A systematic review of MPs use during pregnancy in the African continent was long overdue, and this comprehensive review increases our understanding of the potential health risks by focusing on MPs utilization pattern and traditions of MPs used during pregnancy among African women. The review covers 13 African countries, and includes 37 papers published in the past seven years, which could suggest an intensification of research focusing on MP use for the treatment and/or prevention of conditions affecting expectant or lactating women. Despite this emerging focus on MPs use during pregnancy, the review has identified a number of gaps in the scientific literature relating to its use.

4.1. Study characteristics, prevalence of use, diversity and geographic distribution

Comparison of results across studies is difficult due to differences in methodology and study participants, as well as varying practices between different African countries. Notwithstanding, this review shows that MP use among parturient women in Africa is common, and that a wide range of MPs is used. Existing studies show that the prevalence of MP use among pregnant women varies widely from 2% to 100% and this is consistent with findings from other parts of the world. Varying rates of gestational MP usage reported elsewhere were 12–36% in Australia (Pinn and Pallett, 2002; Forster et al., 2006), 36–40% in Norway (Nordeng and Havnen, 2004; Nordeng et al., 2011), 7–45% in the United States (e.g. Gibson et al., 2001; Tsui et al., 2001; Hepner et al., 2002; Glover et al., 2003), 9–96% in Canada (Westfall, 2003; Moussally et al., 2009), and 39–51% in Malaysia (Rahman et al., 2007). Similarly, a multinational cross-sectional, internet-based study across Europe, Australia, North and South America involving 9459 women found that 29% (ranging from 4% to 69%) used phytotherapy in pregnancy (Kennedy et al., 2013). These findings imply that MP use during pregnancy is not only common in Africa as an entrenched part of culture but is also common elsewhere in developed societies where traditions no longer play a strong role. Such differences in the estimates of magnitude of use of MP remedies could be related to variations in study design, data collection methods, cultural features of the studied women, and the definition of MPs used.

Compared to studies done elsewhere, MP use is more prevalent in Africa. This disparity can be attributed to differences in the dominant medical system. In Africa traditional medicine is the primary source of health care for a greater proportion of the population (WHO, 2002; Abdullahi, 2011), leading to a stronger reliance on MPs. Also, the variation depends on socio-cultural contexts, such as study participants, study settings, and health care systems in the different parts of Africa. Considering the differences in number of reviewed studies per region, the computed average prevalence (Fig. 2B) doesn't reliably show regional variability, but it rather indicates where research is lacking. In spite of the variability in MP use rates and number of studies reviewed, the empirical literature does appear to show extensive prevalence rates for MP use amongst expectant women across a number of African

countries.

The present review showed that African expectant mothers use a wide diversity of MPs, and a total of 274 different plant species in 87 families are reported. On the contrary, a review of studies from the Middle East found that pregnant women used only 18 MPs (John and Shantakumari, 2015). The wide range of medicinal plant species and families reported from Africa could reflect the total species diversity. Even though the lion's share of the analysed studies is from West Africa, over half of the reported medicinal plant species (149 plant species) were from East Africa (Fig. 2A; C). The main reason is that most of the studies from West Africa did not indicate the specific medicinal plant types, signifying that the use of MP during pregnancy is poorly documented and inadequately studied. Additionally, despite having rich floral diversity (Govaerts, 2001), combined with limited access to modern health facilities and high maternal mortality (WHO, 2015; Mbarambara et al., 2016), studies reporting MPs use amongst parturient women are extremely rare in the Central Africa region. This may reflect serious gaps in ethnomedical and/or ethnobotanical studies and documentation of medicinal knowledge and resources in the continent.

4.2. Reasons for use, safety, efficacy and information sources

Many of the papers indicated that different medicinal plants are claimed to be used in the management of various pregnancy related illnesses. The top MPs cited in the studies were *Zingiber officinale* Roscoe, *Allium sativum* L., *Cucurbita pepo* L., *Ricinus communis* L., *Vernonia amygdalina* Delile and *Garcinia kola* Heckel (Table 2). *Z. officinale* (ginger) was the most common species for the treatment of pregnancy induced nausea and vomiting, and reported in 15 studies (Table 2). Previous studies have shown that ginger is commonly used globally by parturient women for nausea and vomiting in pregnancy (NVP) (Maats and Crowther, 2002; Glover et al., 2003; Westfall, 2003; Forster et al., 2006; Holst et al., 2011; Nordeng et al., 2011; Kennedy et al., 2013; de Boer and Cotingting, 2014; John and Shantakumari, 2015). The fact that the same plant species are used by different societies could indicate their effectiveness and is pertinent for prioritizing future studies on efficacy and safety. It should be noted that by looking at consensus we are identifying widely used garden plants as those with highest consensus, but extensive research into these species does support their dual use as nutraceuticals or functional foods. The efficacy of some of the abovementioned MPs in treating nausea and vomiting has been investigated to varying degrees. In a clinical setting in the context of pregnancy, only *Z. officinale* has been studied. A recently published review suggested potential benefits of ginger in reducing nausea symptoms in pregnancy. However, it neither significantly affects vomiting episodes nor poses a risk for negative pregnancy effects in pregnancy (Viljoen et al., 2014). A systematic review critically appraising fourteen randomized controlled trials of herbal therapies in pregnancy found that ginger was the most investigated MP (Dante et al., 2013). It was reported to ameliorate the bouts of nausea and vomiting that women experience during parturition better than placebos. A prior systematic review of randomized clinical trials of ginger suggested that ginger was more effective than placebos and about as effective as metoclopramide for nausea and vomiting (Ernst and Pittler, 2000).

The use of MPs is increasing throughout Africa and globally, but there is scant research on the safety of medicinal plants especially during pregnancy (Adusi-Poku et al., 2015;). Even though all the fifty reviewed studies reported the use of medicinal plants during pregnancy, only a little over 10% found that the informants perceived phytomedicines to be more effective and free of adverse effects. Concerning the safety of MPs during pregnancy, reliable data are currently lacking and often contradictory. A review that evaluated the safety of ginger for NVP revealed it did not have harmful maternal or neonatal effects (Boltman-Binkowski, 2016). Furthermore, a cohort study from Norway showed that it was not associated with a higher-risk of birth defects, premature birth, perinatal mortality, or low birth weight (Heitmann et al., 2013). However, many of the MPs used in parturition are understudied (Black and Hill, 2003) and thus, contrary to these reports, concerns exist as to the safety of these medicinal plants. For example, *Z. officinale*, is reported to have serious adverse effects including mutation of the foetus, abortifacient, emmenagogue effects and increased risk for bleeding (Fischer-Rasmussen et al., 1991; Ernst, 2002; Wen et al., 2008). In addition, prenatal exposure to ginger is associated with increased uterine activity, foetal loss, and inhibition of platelet aggregation (Guh et al., 1995; Spolarich and Andrews, 2007). Also, there is no adequate information about the hazards of its long-term usage in pregnancy. Thus, cautious use is recommended and further research is needed to verify the clinical safety of ginger.

In this study, in line with research and reviews from other corners of the world (Ernst, 2002; Westfall, 2003), *R. communis* (Castor oil) was claimed to be used to aid labour and relief of constipation (Table 2). A prospective evaluation by Garry et al. (2000) indicated castor oil to be effective for inducing labour. However, another study demonstrated castor oil to have no effect on the time of birth (Boel et al., 2009). Its most common reported side effect was nausea. Nevertheless, there is paucity of research data on neonatal mortality or morbidity that may result from castor oil ingestion (Boel et al., 2009; Dante et al., 2014). Furthermore, there is no compelling evidence of efficacy for its use in initiating labour (Ernst, 2002).

The other group of MPs frequently used by pregnant women were *A. sativum*, *C. pepo*, and *M. piperita* (Table 2). *A. sativum* is used to alleviate pregnancy symptoms including NVP. Studies from other places have shown that it enhances the immune system of parturients (Charlson and McFerren, 2007) and has antifungal properties (Westfall, 2003). Likewise, *M. piperita* is used for handling of gastrointestinal disorders, common cold, muscle pain, and headache. A clinical trial showed that compared to placebo peppermint oil was found to be more effective in the treatment of post-operative nausea (Tate, 1997). However, for all the three plants, there is scarcity of clinical experiments about their safety and efficacy in NVP (McKay and Blumberg, 2006; Charlson and McFerren, 2007; Wills and Forster, 2008; Adnan et al., 2017). Many of these MPs are generally harmless in small doses; however, they can cause serious effects when used in large amounts (John and Shantakumari, 2015). The fact that these phytomedicines are among those widely utilized in Africa is apprehensive.

Anticipating mothers will seek knowledge when confronted with ailments and discomfort during pregnancy, and this can come from many sources (Westfall, 2003). In the current review, families, friends, traditional healers, and traditional birth attendants were indicated as the main sources of information about MPs. Likewise, family and friends were the prime sources of information about medicinal plants for Arabian (John and Shantakumari, 2015), Canadian (Hollyer et al., 2002; Westfall, 2003), the US (Tsui et al., 2001), UK (Holst et al., 2009) and Norwegian (Nordeng and Havnen, 2004) parturient population. As pregnancy is a time of particular vulnerability, it is worrying that mothers do not look for advice from appropriate healthcare professionals. Family members and confidants may simply not have quality and accurate information to provide counselling to pregnant women (Nordeng et al., 2013). This is a solid indication that health care providers, especially those working at the primary healthcare level, should ensure that they have proper comprehension to advise women in a culturally-sensitive context (Skouteris et al., 2008; Hall et al., 2011). Considering the high popularity of MPs in pregnancy in Africa, care providers should be more diligent in asking questions about the use of MPs and document it in the patient medical record. Additionally, pregnant women should be informed that 'natural' can be equated with 'safe' is not essentially always the case. In many teaching curricula in Africa traditional medicine is currently overlooked, and this should be addressed to provide better and more balanced advice to expecting mothers.

4.3. Potentially unsafe MPs and concurrent use of conventional medicine

In seven of the reviewed studies, women reported one or more adverse effects. Similar to this finding, mild to severe adverse events were reported in reviews conducted in other areas (Posadzki et al., 2013). Many medicinal plants that are consumed by African expectant women were reported to have potentially toxic effects for the mother and the foetus (Supplementary Table S2). For example, *Ruta chalepensis* L. contains furanocoumarins that are embryotoxic, and cause implantation failure and abortion (de Sa et al., 2000; Ciganda and Laborde, 2003). Steenkamp (2003) in her review revealed that some plants used during pregnancy resulted in adverse consequences: *Callilepis laureola* DC. can cause hypoglycemic and strychnine-like symptoms, *Clivia miniata* (Lindl.) Bosse can cause paralysis and collapse effects, and *Rhoicissus tridentata* (L.f.) Wild & R.B.Drumm. can cause paralysis of the central nervous system and subsequent respiratory arrest. Another review identified many toxic plants such as *Eucomis autumnalis* (Mill.) Chitt. (abdominal pain, diarrhoea, renal failure), *Gnidia kraussiana* Meisn. (severe gastrointestinal irritation, death of stock), and *Scadoxus puniceus* (L.) Friis & Nordal (dizziness, visual disturbances, CNS excitation or depression) (Veale et al., 1992). In his review, Ernst (2002) identified several other MPs with potential adverse effects. In view of these risks from poisonous plants and added chemicals, the indiscriminate use of MPs by pregnant women is a major concern. Until convincing scientific evidence emerges, it is safest to consider all MPs contraindicated in pregnancy (Ernst, 2002).

With respect to simultaneous use of MPs and pharmaceuticals, ten of the reviewed studies indicated that women took both together, and this practice is more prevalent in Western Africa (Sam-Wobo et al., 2008; Omane-Adjekum, 2010; Yusuff and Omarusehe, 2011; Abasiubong et al., 2012; Oladeinde et al., 2012; Joseph et al., 2017) (Fig. 2D). In addition to producing adverse effects, in concomitant administration there is a threat of interaction between MPs and other medications, potentially making them less active or less safe. For instance, *A. sativum*, the second most commonly cited plant in this systematic review has been described to have strong potential drug interactions with antiplatelet and thyroid replacement therapy medications (Gall and Shenkute, 2009). Additionally, it has been shown to lower blood pressure and should not be taken simultaneously with antihypertensive medications (Auer et al., 1990). An interaction with the anticoagulant warfarin has also been reported (Izzo, 2012). Similarly, simultaneous consumption of *C. pepo* with warfarin was reported to have increased anticoagulant effects (Yue and Jansson, 2001). Thus, concurrent use warrants continuous consideration on the part of both expectant mothers and caregivers. In addition, health workers ought to remain watchful for potential interactions between MPs and orthodox medicines.

Another form of concomitant use, or failure to seek adequate treatment, is the management of malaria using MPs. One in five papers disclosed that parturient women use MPs to prevent or treat malaria. A recent review found that the principal reason for MP use was the perception of lower severity of malaria symptoms (Suswardany et al., 2015). Studies from Africa have reported various misconceptions concerning the causes of malaria, such as the belief that it can be caused by cloudy weather conditions, evil spirits, starvation, '*mitch*', and too much workload (Legesse et al., 2007; Mussa and Gedif, 2011a). These misconceptions, coupled with others, could contribute to delays in seeking adequate treatment. Owing to these misbeliefs, self-medication following self-diagnosis of malaria based on presumptive symptoms is commonplace in Africa (Mussa and Gedif, 2011b; Towns and van Andel, 2014). However, due to impaired immunity and a diminution of acquired immunity, malaria infection during parturition has a considerable risk for the mother, her unborn infant and the newborn (WHO, 2014). It can lead to anemia, which increases the risk for maternal and infant mortality and growth problems for babies (WHO, 2014; Suswardany et al., 2015). Hence, women should be encouraged to seek effective treatment from health facilities.

4.4. Parts of plant used, methods of preparation, and routes of administration

Steenkamp (2003) in her review of MPs used by South African women for gynaecological complaints found that roots were the dominant plant parts used to prepare remedies. Besides, a review by Alebie et al. (2017) reported that roots were the second most plant parts used as antimalarial agents. Contrary to those findings, in this study covering the entire African continent we found that leaves are the most commonly used plant parts to treat various pregnancy induced health problems. The frequent use of roots for medical purposes is problematic as sustainable harvesting of roots is often difficult and in some cases threatens popular species (Alebie et al., 2017). To avoid the loss of valuable medicinal plant species, use of leaves is much more sustainable than roots, tubers and rhizomes (Cordell, 2015).

Dosage forms and preparation methods of MPs are extremely important. Parturient women in Africa prepare MP formulations through various methods. The most frequently cited independent MP preparation approaches were decoctions, infusions, macerations, concoction, crude extracts (by squeezing) or chewing/eating plants (Table 1). The diversity of methods of preparation by African women may be due to the fact that different plant parts need different methods to extract the active plant ingredients. Studies from other parts of the world have also reported that decoction and infusion/maceration were the most frequently used methods of MP remedy preparation (Rodrigues, 2007; de Boer and Lamxay, 2009).

Although various routes are employed for the administration of MP preparations, this review found that oral intake was the predominant route (Table 2). This is consistent with other studies that reported oral as a popular route of administration (Steenkamp, 2003; Alebie et al., 2017). Oral administration is an effective, non-invasive and convenient method of administration (Verma et al., 2010). Moreover, most of the products of decoction, infusion, and maceration are liquids, and these are easily taken orally. These might be the basic reasons for its extensive employment by the African expectant mothers. Because it is convenient, cheap and amenable for a variety of dosage forms, all the top ten MPs identified in this review were exclusively administered orally (Table 2).

4.5. Some African MP concoctions

In African MP practice pregnant women used different treatment approaches not reported somewhere else. Some of the main indigenous approaches reported in the literature include '*isihlambezo*', and '*therapeutic meal*'. The first, '*isihlambezo*', is a mixture of MPs used by women in South Africa (Mabina et al., 1997a, 1997b; Varga and Veale, 1997; Mkize, 2015) as a preventative health tonic in pregnancy that is rich in essential minerals and vitamins. It is a mixture of around ten different plant species (Mabina et al., 1997a, 1997b; Varga and Veale, 1997; Mkize, 2015), and the mixture of species may produce additive, synergistic, or antagonistic effects. Varga and Veale (1997) studied this concoction of MPs extensively and have shown that many of the constituent species have in-vivo uterotonic properties. As a consequence, if used inappropriately it may lead to premature delivery. Mixed MPs remedies are also likely to include plant species with adverse effects, and Veale et al. (1992) and Mathee et al. (2014) both reported that several '*isihlambezo*' species were associated with detrimental pregnancy outcomes, such as death due to hepatorenal failure, low birth weight, meconium staining of the amniotic fluid and foetal distress. The constituent plant species of '*isihlambezo*' have yet to be scientifically evaluated and investigated whether they possess the claimed medicinal values and reported adverse effects.

The second is '*therapeutic meal*'. It is prepared from both animal and plant products, and consumed orally as meal or drunk as a liquid

preparation. African oil palm (*Elaeis guineensis* Jacq.) tree fruits are mixed with two or three plantains and cooked. Second, these cooked particular ingredients are crushed, with a little water, in a mortar and filtered. The filtrate is collected and cooked again with the common ingredients used for the preparation of sauces such as peppers, tomatoes, etc. Additionally, smoked freshwater catfish (*Chrysichthys nigrodigitatus*), or the dried legs of 'blue duiker' (*Cephalophus montícola*) are added to make this special sauce. The meal is consumed by pregnant women, from the end of the second trimester to delivery. Other medicinal plants such as *Ricinodendron heudelotii* (Baill.) Heckel, *Dracaena mannii* Baker, *Piper umbellatum* L., *Nephrolepis biserrata* (Sw.) Schott, *Solanecio biafrae* (Oliv. & Hiern) C.Jeffrey, *Ocimum gratissimum* L., or *Microdesmis keayana* J. Léonard can be ingredients of this special recipe. As divulged by Malan and Neuba (2011), the food is believed to make the children mainly strong and belligerent: '*After feeding, it is formally forbidden to wash the hands, rather it is wiped on the belly, from top to bottom, towards the loins, by saying the wish to have a beautiful baby and an easy labour*.' The meal is beneficial for the pregnant women for four reasons. Firstly, it is a rich source of calories, oligonutrients, lipids, and proteins essential to foetal growth. Secondly, it prevents women from suffering from malnutrition, avoiding foetal low birth weight and birth defects as well (Malan and Neuba, 2011). In addition to its benefit for the foetus, many of the component plant species of 'therapeutic meal' were also reported to strengthen women during pregnancy and facilitate delivery (Towns and van Andel, 2016). Finally, the closing ritual, which ends the meal, is a substantial psychological stimulant (Malan and Neuba, 2011).

4.6. Spiritual and cultural influences

Religion and spirituality are often interwoven with traditional healing in Africa, and many people turn to both in case of ailments (Mokgobi, 2014). In addition to their perceived pharmacological values, MPs are claimed to provide spiritual cleansing or protection from evil spirits. For example, Kaingu et al. (2011) indicated many pregnant women relied on prayers to ancestors (called by various names depending on one's ethnic origins) to handle delayed labour and they believed protracted labour resulted from either owing to witchcraft or the expectant women having offended their mother-in-law. In Africa the risk of maternal death is greatest during labour and the postpartum period (WHO, 1991; USAID, 2012; Say et al., 2014), and the major statistical causes of mortality are haemorrhage, sepsis/infections, and hypertensive disorders (Khan et al., 2006; Kinney et al., 2010; Haeri and Dildy, 2012; Tort et al., 2015). Culturally-sensitive introduction of modern healthcare practices have the potential to minimize barriers, enhances the utilization of skilled maternal health care services, improves health outcomes, and increases customer satisfaction with services (Anderson et al., 2003; USAID, 2012). In addition to treating diseases, African traditional medicine is also attentive to the protection and promotion of spiritual, social, psychological and physical wellbeing (Bishaw, 1991). The current finding explicitly indicates parturient women use religious rituals during labour and postpartum. Relying on religious beliefs instead of seeking effective healthcare is arguably more dangerous than putting faith in MPs as the former will definitely not be more effective than a placebo. Healthcare professionals should be aware of existing religious or cultural beliefs that may influence health-seeking behaviour of pregnant women, and targeted public education campaigns and collaborations with community and religious leaders can help prevent unnecessary mortality.

4.7. Predictors of MP use

Some of the factors significantly associated ($P = < 0.05$) with MP intake found here are different from previously reported studies. Generally, lower levels of education, marital status, rural residence, low socioeconomic class, unemployment, long distance to the nearest health facility, perception that MPs are effective, experience from previous pregnancy, self-employment, and large family size were found significantly associated with higher use of MPs during pregnancy. Contrary to our review findings, having higher education and better income levels, were indicated as predictors of MP usage in other places (Hall et al., 2011; Frawley et al., 2013; Kennedy et al., 2013). A study done among Australian pregnant women reported that MP users were more likely to be nulliparous (Forster et al., 2006). However, our review showed that large family size and MP treatment experience in previous pregnancy correlated with MPs use during pregnancy. Moreover, our review found that pregnant attendees of rural centers to use MPs significantly more and more frequently than their urban counterparts. In Africa, access to primary healthcare facilities is difficult. People in the rural area need to walk long distances to see health professionals (Makita-Ikouaya et al., 2010). On the other hand, traditional healers and medicines are accessible within a short walking distance. Traditional remedies are often less costly, delivered either free or with a relatively low cost. Besides, traditional medicines are thought to be safe and efficacious, follow holistic perceptions of disease and other human problems (Bishaw, 1991). Furthermore, the payment modality of healers is usually based on the ability of the patient (Gedif and Hahn, 2002) making them affordable and a reliable choice for large family size, the poor and unemployed women.

4.8. Strengths and limitations

This systematic review presents the first comprehensive review of studies on the use of MPs during pregnancy in the African continent. Furthermore, the review provides a valuable overview for health experts, researchers and policymakers. However, like any other review, this one has its own inherent limitations that must be kept in mind when interpreting the evidence. All articles are prone to publication bias, and thus any such bias may have been transferred to our review. It is important to note that the study approach does not yield an exhaustive review of literature reporting MPs for women's healthcare or pregnancy. The focus here was only on studies reporting actual prevalence of use of MPs during pregnancy, and this approach excluded a large body of qualitative and quantitative ethnobotanical literature reporting specific plant species for use during pregnancy and postpartum recovery without citing actual use (cf. van Andel et al., 2014). Additionally, the prevalence presented may not signify the real prevalence due to the differences in the reviewed studies. On the whole, this review provides useful and systematically compiled data for practitioners, policymakers and researchers interested in understanding and addressing the challenges of managing and treating ailments in pregnancy in Africa.

4.9. Identified gaps

Despite emerging focus upon MP use in the course of pregnancy throughout Africa, the review has identified several gaps in the scientific literature relating to MP use. Our review indicates a general lack of research focus on the extent of MP use in Africa during pregnancy. For example, only one study is retrieved from the Central Africa region. It also indicates existence of critical research evidence gaps with regard to potential medicinal plant toxicities, possible medicinal plant–pharmaceutical drug interactions and adverse effects. The detailed reasons and determinants for greater reliance on MP among African women also need further exploration. Besides, there is little information regarding the types of African MPs and users' profiles.

5. Conclusions and recommendation

The prevalence of MP use by African pregnant women was found to be high. *Z. officinale*, *A. sativum* and *C. pepo* were the most commonly cited MP species, and these commonly used plant species are not known

to have detrimental effects during pregnancy. However, many of the species are poorly studied and teratogenic effects cannot be ruled out. The review also reveals the use of several species that are known to have uterine contracting and harmful effects. Our review indicates that MP use studies during pregnancy across Africa are limited. Although African pregnant women use different medicinal plants for their healthcare, there is a dearth of information regarding their ethnopharmaceutical, ethnobotanical and ethno-medical characteristics, determinants and reasons of use. The review also showed that it is not uncommon for pregnant women to take modern and MPs concurrently, hence research focusing on its extent, its untoward effects and management strategies are timely for investigation. Moreover, though several African MPs used for the treatment of pregnant women's disorders were claimed to be safe and effective, in most cases their safety and efficacy is not compiled and scientifically established. Thus, further evaluation and classification of the safety of MPs used among African pregnant women is important. More research on MP use during pregnancy is required to fully inform all stakeholders engaged in preventing maternal mortality and treating morbidity. Primary healthcare providers should be the first-line of information for pregnant women, but there is also a need for training on the potential benefits and dangers of MP use during pregnancy to enable these professionals to provide culturally sensitive and objective advice. Further research and collaboration with traditional practitioners on the safe use of MPs in pregnancy may promote safer pregnancies and better health outcomes for women and their unborn foetus in Africa.

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Review concept and design: SMA and HN; Literature search: SMA, HN and HDB; Analysis and interpretation of data: SMA and HDB; Drafting of the manuscript: SMA, HN and HDB. Critical revision of the manuscript for important intellectual content: SMA, HN, JS, YAA, and HDB. All authors have read and approved the final version.

Definition of terms:

Adverse drug reaction. A response to a drug which is noxious and unintended, and which occurs at doses normally used in man for the prophylaxis, diagnosis, or therapy of disease, or for the modification of physiological function (World Health Organization).

Agbo Iba. A multi-medicinal plant extract and the component species are *Cajanus cajan* (L.) Millsp., *Euphorbia lateriflora Schumach* ., *Mangifera indica* L., *Cymbopogon giganteus Chiov.* , *Sarcocephalus latifolius* (Sm.) E.A.Bruce, and *Uvaria chamae* P.Beauv.

Church-made coffee. A collection of concoctions and beverages with undisclosed ingredients given to women to fend off 'malicious spirits' or to widen the birth canal to make childbirth safer and easier. This is common among certain religious beliefs and church organizations that believe in spiritual management of health and pregnancies.

Efficacy. The capacity of the MP to produce the desired therapeutic effect.

Isihlambezo. A herbal decoction used among the Zulu women in South Africa as a preventative health tonic during pregnancy. Most common Isihlambezo plants: *Agapanthus africanus* (L.) Hoffmanns.; *Asclepias fruticosa* L.; *Callilepis laureola* DC.; *Clivia miniata* (Lindl.) Bosse; *Combretum erythrophyllum* (Burch.) Sond.; *Crinum macowanii* Baker; *Gunnera perpensa* L.; *Pentanisia prunelloides* (Klotzsch) Walp.; *Rhoicissus tridentata* (L.f.) Wild & R.B.Drumm.; *Scadoxus puniceus* (L.) Friis & Nordal; *Typha capensis* (Rohrb) N.E Br.; *Gymnanthemum corymbosum* (Thunb.) H.Rob.; *Ruta graveolens* L.; *Dioscorea dregeana* (Kunth) T.Durand & Schinz; *Eucomis comosa* (Houtt.) Wehrh.; *Gnidia kraussiana* Meisn.; *Cyrtanthus obliquus* (L.f.) Aiton.; *Gladiolus sericeovillosus* Hook.f.; *Grewia occidentalis* L.; *Plantago major* L.. *Isihlambezo* is generally prepared by boiling the plant materials in water for approximately 30-40 minutes to produce a decoction.

Mitch. A febrile illness believed to be caused by excessive sunlight and manifested by swelling and/or formation of sores on parts of the human body. It is almost similar to cold sore.

Safety. The freedom from potential adverse effects related to the administration of MPs.

Therapeutic meal. A preparation of mixed medicinal plants (e.g. *Elaeis guineensis* Jacq.) and animal (e.g. *Chrysichthys nigrodigitatus*) products.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jep.2018.05.032.

References

Abasiubong, F., Bassey, E.A., Udobang, J.A., Akinbami, O.S., Udoh, S.B., Idung, A.U., 2012. Self-Medication: potential risks and hazards among pregnant women in Uyo, Nigeria. Pan Afr. Med. J. 13, 15.
Abdullahi, A.A., 2011. Trends and challenges of traditional medicine in Africa. African. J. Tradit. Complement. Altern. Med. 8, 115–123.
Abeje, G., Admasie, C., Wasie, B., 2015. Factors associated with self medication practice among pregnant mothers attending antenatal care at governmental health centers in Bahir Dar city administration, Northwest Ethiopia, a cross sectional study. Pan Afr. Med. J. 20, 276.
Aboyeji, A.P., Ijaiya, M.A., Fawole, A.A., Adesina, K.T., Ologe, M.O., Adewara, A.A., Olarinoye, A.O., 2014. Pharmacological exposure of pregnant mothers in Ilorin, Nigeria. Tropical. J. Obstet. Gynaecol. 31, 17–22.
Addo, V.N., 2007. Herbal medicines: socio-demographic characteristics and pattern of use by patients in a tertiary obstetrics and gynaecology unit. J. Sci. Technol. 27, 149–155.
Adnan, M., Gul, S., Batool, S., Fatima, B., Rehman, A., Yaqoob, S., Shabir, H., Yousaf, T., Mussarat, S., Ali, N., Khan, S.N., Rahman, H., Aziz, M.A., 2017. A review on the ethnobotany, phytochemistry, pharmacology and nutritional composition of *Cucurbita pepo* L. J. Phytopharm. 6, 133–139.
Adusi-Poku, Y., Vanotoo, L., Detoh, E.K., Oduro, J., Nsiah, R.B., Natogmah, A.Z., 2015. Type of herbal medicines utilized by pregnant women attending Ante-Natal Clinic in Offinso North District: are orthodox prescribers aware? Ghana Med. J. 49, 227–232.
Agyei-Boateng, R., 2015. Self-Medication Practices among Pregnant Women in Ejisu-Juaben Municipality (M.Sc. Thesis). Kwame Nkrumah University of Science and Technology, Kumasi, Ghana (Unpublished).
Alaku, I.A., Abdullahi, A.G., 2015. Epidemiology of malaria parasites infection among pregnant women in some part of Nasarawa State, Nigeria. Dev. Ctry. Stud. 5, 30–34.
Alebie, G., Urga, B., Worku, A., 2017. Systematic review on traditional medicinal plants used for the treatment of malaria in Ethiopia: trends and perspectives. Malar J. 16, 307.
Alor, S.K., 2015. The Use of Traditional Medicine among Pregnant Women in Agotime-Ziope District (M.Sc. Thesis). University of Ghana, Accra, Ghana (Unpublished).
Anderson, L.M., Scrimshaw, S.C., Fullilove, M.T., Fielding, J.E., Normand, J., 2003. Culturally competent healthcare systems: a systematic review. Am. J. Prev. Med. 24, 68–79.
Auer, W., Eiber, A., Hertkorn, E., Hoehfeld, E., Koehrle, U., Lorenz, A., Mader, F., Merx, W., Otto, G., Schmid-Otto, B., 1990. Hypertension and hyperlipidaemia: garlic helps in mild cases. Br. J. Clin. Pract. 69, 3–6.
Bayisa, B., Tatiparthi, R., Mulisa, E., 2014. Use of herbal medicine among pregnant women on Antenatal care at Nekemte Hospital, Western Ethiopia. Jundishapur J. Nat. Pharm. Prod. 9, 1–5.
Bello, F.A., Morhason-Bello, I.O., Olayemi, O., Adekunle, A.O., 2011. Patterns and predictors of self-medication amongst antenatal clients in Ibadan, Nigeria. Niger. Med. J. 52, 153–157.
Bello, U.L., Isah, J., 2015. Use of Herbal Medicines and Aphrodisiac Substances among Women in Kano State, Nigeria. IOSR J. Nurs. Health Sci. 4, 41–50.
Bishaw, M., 1991. Promoting traditional medicine in Ethiopia: a brief historical review of government policy. Soc. Sci. Med. 33, 193–200.
Black, R.A., Hill, D.A., 2003. Over-the-counter medications in pregnancy. Am. Fam. Phys. 67, 2517–2524.
Boel, M.E., Lee, S.J., Rijken, M.J., Paw, M.K., Pimanpanarak, M., Tan, S.O., Pratap Singhasivanon, P., Nosten, F., McGready, R., 2009. Castor oil for induction of labour: not harmful, not helpful. Aust. N.Z. J. Obstet. Gynaecol. 49, 499–503.
de Boer, H.J., 2009. African plants as antipathogen agents: efficacy and clinical evidence. In: Watson, R., Preedy, V. (Eds.), Botanical Medicine in Clinical Practice. CABI, UK, pp. 3–12.
de Boer, H.J., Cotingting, C., 2014. Medicinal plants for women's healthcare in southeast

Asia: a meta-analysis of their traditional use, chemical constituents, and pharmacology. J. Ethnopharmacol. 151, 747–767.
de Boer, H.J., Lamxay, V., 2009. Plants used during pregnancy, childbirth and postpartum healthcare in Lao PDR: a comparative study of the Brou, Saek and Kry ethnic groups. J. Ethnobiol. Ethnomed. 5, 25.
de Boer, H.J., Lamxay, V., Björk, L., 2012. Comparing medicinal plant knowledge using similarity indices: a case of the Brou, Saek and Kry in Lao PDR. J. Ethnopharmacol. 141, 481–500.
Boltman-Binkowski, H., 2016. A systematic review: are herbal and homeopathic remedies used during pregnancy safe? Curationis 39, 1514.
Camou-Guerrero, A., Reyes-García, V., Martínez-Ramos, M., Casas, A., 2008. Knowledge and use value of plant species in a Rarámuri Community: a gender perspective for conservation. Hum. Ecol. 36, 259–272.
Charlson, M., McFerren, M., 2007. Garlic: what we know and what we don't know. Arch. Intern. Med. 167, 325–326.
Chukwurah, J.N., Idowu, E.T., Adeneye, A.K., Aina, O.O., Agomo, P.U., Otubanjo, A.O., 2016. Knowledge, attitude and practice on malaria prevention and sulfadoxine - pyrimethamine utilisation among pregnant women in Badagry, Lagos State, Nigeria. Malar. World J. 7, 1–6.
Ciganda, C., Laborde, A., 2003. Herbal infusions used for induced abortion. J. Toxicol.: Clin. Toxicol. 41, 235–239.
Cordell, G.A., 2015. Ecopharmacognosy and the globalization of traditional medicines. Indian J. Tradit. Knowl. 14, 595–604.
Dante, G., Pedrielli, G., Annessi, E., Facchinetti, F., 2013. Herb remedies during pregnancy: a systematic review of controlled clinical trials. J. Matern.-Fetal Neonatal. Med. 26, 306–312.
Dante, G., Bellei, G., Neri, I., Facchinetti, F., 2014. Herbal therapies in pregnancy: what works? Curr. Opin. Obstet. Gynecol. 26, 83–91.
Duru, C.B., Uwakwe, K.A., Chinomnso, N.C., Mbachi, I.I., Diwe, K.C., Agunwa, C.C., Iwu, A.C., Merenu, I.A., 2016a. Socio-demographic determinants of herbal medicine use in pregnancy among Nigerian women attending clinics in a tertiary hospital in Imo State, South-East Nigeria. Am. J. Med. Stud. 4, 1–10.
Duru, C.B., Nnebue, C.C., Uwakwe, K.A., Diwe, K.C., Agunwa, C.C., Achigbu, K.I., Iwu, C.A., Merenu, I.A., 2016b. Prevalence and pattern of herbal medicine use in pregnancy among women attending clinics in a tertiary hospital in Imo State, South East Nigeria. Int. J. Curr. Res. Biosci. Plant Biol. 3, 5–14.
Emmanuel, A., Achema, G., Afoi, B.B., Maroof, R., 2014. Self medication practice among pregnant women attending antenatal clinic in selected hospitals in Jos, Nigeria. Int. J. Nurs. Health Sci. 1, 55–59.
Ernst, E., 2002. Herbal medicinal products during pregnancy: are they safe? BJOG: Int. J. Obstet. Gynaecol. 109, 227–235.
Ernst, E., Pittler, M.H., 2000. Efficacy of ginger for nausea and vomiting: a systematic review of randomized clinical trials. Br. J. Anaesth. 84, 367–371.
Fakeye, T.O., Adisa, R., Musa, I.E., 2009. Attitude and use of herbal medicines among pregnant women in Nigeria. BMC Complement. Altern. Med. 9, 53.
Fischer-Rasmussen, W., Kjaer, S.K., Dahl, C., Asping, U., 1991. Ginger treatment of hyperemesis gravidarum. Eur. J. Obstet. Gynecol. Reprod. Biol. 38, 19–24.
Forster, D.A., Denning, A., Wills, G., Bolger, M., McCarthy, E., 2006. Herbal medicine use during pregnancy in a group of Australian women. BMC Pregnancy Childbirth 6, 21.
Frawley, J., Adams, J., Sibbritt, D., Steel, A., Broom, A., Gallois, C., 2013. Prevalence and determinants of complementary and alternative medicine use during pregnancy: results from a nationally representative sample of Australian pregnant women. Aust. N.Z. J. Obstet. Gynaecol. 53, 347–352.
Fwacs, O.A., Fwacs, A.T.A., 2013. Use of herbal medicines in Pregnancy in Aminu Kano teaching hospital–Myth or Reality? Tropical. J. Obstet. Gynaecol. 30, 80–88.
Gall, A., Shenkute, Z., 2009. Ethiopian Traditional and Herbal Medications and Their Interactions with Conventional Drugs. 〈https://ethnomed.org/clinical/pharmacy/ethiopian-herb-drug-interactions〉 (Accessed 15 October 2016).
Garry, D., Figueroa, R., Guillaume, J., Cucco, V., 2000. Use of castor oil in pregnancies at term. Altern. Ther. Health Med. 6, 77–79.
Gebremedhin, G.L., Gomathi, P., 2014. Assessment of drug use and effect in pregnant women attending antenatal care in hospitals of Mekelle, Tigray, Ethiopia. J. Drug Deliv. Ther. 4, 75–82.
Gedif, T., Hahn, H.-J., 2002. Herbalists in Addis Ababa and Butajira, central Ethiopia: mode of service delivery and traditional pharmaceutical practice. Ethiop. J. Health Dev. 16, 191–197.
Gharoro, E.P., Igbafe, A., 2000. Pattern of drug use amongst antenatal patients in Benin City, Nigeria. Med. Sci. Monit. 6, 84–87.
Gibson, P.S., Powrie, R., Star, J., 2001. Herbal and alternative medicine use during pregnancy: a cross-sectional survey. Obstet. Gynecol. 97, S44–S45.
Glover, D.D., Amonkar, M., Rybeck, B.F., Tracy, T.S., 2003. Prescription, over-the-counter, and herbal medicine use in a rural, obstetric population. Am. J. Obstet. Gynecol. 188, 1039–1045.
Godlove, M.J., 2011. Prevalence of Herbal Medicine Use and Associated Factors among Boer, Pregnant Women Attending Antenatal Clinic at Mbeya Refferal Hospital in 2010 (M.Sc. Thesis). Muhimbili University of Health and Allied Sciences, Dar es salaam, Tanzania (Unpublished).
Govaerts, R., 2001. How many species of seed plants are there? Taxon 50, 1085–1090.
Guh, J.-H., Ko, F.-N., Jong, T.-T., Teng, C.M., 1995. Antiplatelet effect of Gingerol isolated from Zingiber officinale. J. Pharm. Pharmacol. 47, 329–332.
Haeri, S., Dildy, G.A., 2012. Maternal mortality from hemorrhage. Semin. Perinatol. 36, 48–55.
Hall, H.G., Griffiths, D.L., McKenna, L.G., 2011. The use of complementary and alternative medicine by pregnant women: a literature review. Midwifery 27, 817–824.
Hanafy, S.A., Sallam, S.A., Kharboush, I.F., Wahdan, I.H., 2016. Drug utilization pattern during pregnancy in Alexandria, Egypt. Eur. J. Pharm. Med. Res. 3, 19–29.
Heitmann, K., Nordeng, H., Holst, L., 2013. Safety of ginger use in pregnancy: results from a large population-based cohort study. Eur. J. Clin. Pharmacol. 69, 269–277.
Hepner, D.L., Harnett, M., Segal, S., Camann, W., Bader, A.M., Tsen, L.C., 2002. Herbal medicine use in parturients. Anesth. Analg. 94, 690–693.
Hillary, N.C., 2013. Utilization of Herbal Medicine during Pregnancy, Labour and Postpartum Period among Women at Embu Provincial General Hospital (M.Sc. Thesis). Nairobi University, Nairobi, Kenya (Unpublished).
Hollyer, T., Boon, H., Georgousis, A., Smith, M., Einarson, A., 2002. The use of CAM by women suffering from nausea and vomiting during pregnancy. BMC Complement. Altern. Med. 2, 5.
Holst, L., Wright, D., Nordeng, H., Haavik, S., 2009. Use of herbal preparations during pregnancy: focus group discussion among expectant mothers attending a hospital antenatal clinic in Norwich, UK. Complement. Ther. Clin. Pract. 15, 225–229.
Holst, L., Wright, D., Haavik, S., Nordeng, H., 2011. Safety and efficacy of herbal remedies in obstetrics-review and clinical implications. Midwifery 27, 80–86.
Izzo, A.A., 2012. Interactions between herbs and conventional drugs: overview of the clinical data. Med. Princ. Pract. 21, 404–428.
John, L.J., Shantakumari, N., 2015. Herbal medicines use during pregnancy: a review from the middle east. Oman Med. J. 30, 229–236.
Joseph, B.N., Ezie, I.J., Aya, B.M., Dapar, M.L.P., 2017. Self-medication among pregnant women attending ante-natal clinics in Jos-North, Nigeria. Int. J. Trop. Dis. Health 21, 1–7.
Kaingu, C.K., Oduma, J.A., Kanui, T.I., 2011. Practices of traditional birth attendants in Machakos District, Kenya. J. Ethnopharmacol. 137, 495–502.
Kamatenesi-Mugisha, M., Oryem-Origa, H., 2007. Medicinal plants used to induce labour during childbirth in western Uganda. J. Ethnopharmacol. 109, 1–9.
Kebede, B., Gedif, T., Getachew, A., 2009. Assessment of drug use among pregnant women in Addis Ababa, Ethiopia. Pharmacoepidemiol. Drug Saf. 18, 462–468.
Kennedy, D.A., Lupattelli, A., Koren, G., Nordeng, H., 2013. Herbal medicine use in pregnancy: results of a multinational study. BMC Complement. Altern. Med. 13, 355.
Khan, K.S., Wojdyla, D., Say, L., Gülmezoglu, A.M., Van Look, P.F., 2006. WHO analysis of causes of maternal death: a systematic review. Lancet 367, 1066–1074.
Kinney, M.V., Kerber, K.J., Black, R.E., Cohen, B., Nkrumah, F., Coovadia, H., Nampala, P.M., Lawn, J.E., 2010. Sub-Saharan Africa's mothers, newborns, and children: where and why do they die? PLoS Med. 7, e1000294.
Laelago, T., Yohannes, T., Lemango, F., 2016. Prevalence of herbal medicine use and associated factors among pregnant women attending antenatal care at public health facilities in Hossana Town, Southern Ethiopia: facility based cross sectional study. Arch. Public Health (74:7).
Legesse, Y., Tegegn, A., Belachew, T., Tushune, K., 2007. Knowledge, attitude and practice about malaria transmission and its preventive measures among households in urban areas of Assosa Zone, Western Ethiopia. Ethiop. J. Health Dev. 21, 157–165.
Maats, F.H., Crowther, C.A., 2002. Patterns of vitamin, mineral and herbal supplement use prior to and during pregnancy. Aust. N.Z. J. Obstet. Gynaecol. 42, 494–496.
Mabina, M.H., Pitsoe, S.B., Moodley, J., 1997b. The effect of traditional herbal medicines on pregnancy outcome. S. Afr. Med. J. 87, 1008–1010.
Mabina, M.H., Moodley, J., Pitsoe, S.B., 1997a. The use of traditional herbal medication during pregnancy. Trop. Dr. 27, 84–86.
Makita-Ikouaya, E., Mombo, J.B., Rudant, J.P., Milleliri, J.M., 2010. Availability and access to the public healthcare facilities in sub-Saharan Africa: situation in Libreville, Gabon. Med. Trop. 70, 123–129.
Malan, D.F., Neuba, D.F., 2011. Traditional practices and medicinal plants use during pregnancy by Anyi-Ndenye women (Eastern Côte d'Ivoire). Afr. J. Reprod. Health 15, 85–93.
Mathee, A., Naicker, N., Kootbodien, T., Mahuma, T., Nkomo, P., Naik, I., de Wet, T., 2014. A cross-sectional analytical study of geophagia practices and blood metal concentrations in pregnant women in Johannesburg, South Africa. S. Afr. Med. J. 104, 568–573.
Mbarambara, P.M., Songa, P.B., Wansubi, L.M., Mututa, P.M., Minga, B.B.K., 2016. Self-medication practice among pregnant women attending antenatal care at health centers in Bukavu, Eastern DR Congo. Int. J. Innov. Appl. Stud. 16, 38–45.
Mbura, J.S., Mgaya, H.N., Heggenhougen, H.K., 1985. The use of oral herbal medicine by women attending antenatal clinics in urban and rural Tanga District in Tanzania. East Afr. Med. J. 62, 540–550.
McKay, D.L., Blumberg, J.B., 2006. A review of the bioactivity and potential health benefits of peppermint tea (*Mentha piperita* L.). Phytother. Res. 20, 619–633.
Mkize, G.T., 2015. An Assessment of Use of Traditional Medicine in Pregnancy & Associated Factors Among Black South African Women Delivering in Bertha Gxowa Hospital (M.Sc. Thesis). University of the Witwatersrand, Johannesburg, South Africa (Unpublished).
Mokgobi, M.G., 2014. Understanding traditional African healing. Afr. J. Phys. Health Educ. Recreat. Dance 20, 24–34.
Mothupi, M.C., 2014. Use of herbal medicine during pregnancy among women with access to public healthcare in Nairobi, Kenya: a cross-sectional survey. BMC Complement. Altern. Med. 14, 432.
Moussally, K., Oraichi, D., Be´rard, A., 2009. Herbal products use during pregnancy: prevalence and predictors. Pharmacoepidemiol. Drug Saf. 18, 454–461.
Mugomeri, E., Chatanga, P., Seliane, K., Maibvise, C., 2015. Identifying promoters and reasons for medicinal herb usage during pregnancy in Maseru, Lesotho. Afr. J. Nurs. Midwifery 17, 4–16.
Mureyi, D.D., Monera, T.G., Maponga, C.C., 2012. Prevalence and patterns of prenatal use of traditional medicine among women at selected harare clinics: a cross-sectional study. BMC Complement. Altern. Med. 12, 164.
Mussa, S., Gedif, T., 2011b. Knowledge About Malaria, and Coverage and Utilization Pattern of Mosquito Nets in Pawe Woreda, Northwest Ethiopia: A Community Based Survey. Ethiop. Pharm. J. 29, 68–78.

Mussa, S., Gedif, T., 2011a. Antimalarial drug use pattern in pawe special Woreda, North West Ethiopia: a community based survey. Ethiop. Pharm. J. 29 (2), 121–136.
Nergard, C.S., Ho, T.P.T., Diallo, D., Ballo, N., Paulsen, B.S., Nordeng, H., 2015. Attitudes and use of medicinal plants during pregnancy among women at health care centers in three regions of Mali, West-Africa. J. Ethnobiol. Ethnomed. 11, 73.
Njamen, D., Mvondo, M.A., Djiogue, S., Wanda, G.J.M.K., Nde, C.B.M., Vollmer, G., 2013. Phytotherapy and women^s reproductive health: the Cameroonian perspective. Planta Med. 79, 600–611.
Nordeng, H., Havnen, G.C., 2004. Use of herbal drugs in pregnancy: a survey among 400 Norwegian women. Pharmacoepidemiol. Drug Saf. 13, 371–380.
Nordeng, H., Bayne, K., Havnen, G.C., Paulsen, B.S., 2011. Use of herbal drugs during pregnancy among 600 Norwegian women in relation to concurrent use of conventional drugs and pregnancy outcome. Complement. Ther. Clin. Pract. 17, 147–151.
Nordeng, H., Al-Zayadi, W., Diallo, D., Ballo, N., Paulsen, B.S., 2013. Traditional medicine practitioners' knowledge and views on treatment of pregnant women in three regions of Mali. J. Ethnobiol. Ethnomed. 9, 67.
Nyeko, R., Tumwesigye, N.M., Halage, A.A., 2016. Prevalence and factors associated with use of herbal medicines during pregnancy among women attending postnatal clinics in Gulu district, Northern Uganda. BMC Pregnancy Childbirth 16, 296.
Oladeinde, B.H., Omoregie, R., Odia, I., Oladeinde, O.B., 2012. Prevalence of malaria and anemia among pregnant women attending a traditional birth home in Benin city, Nigeria. Oman Med. J. 27, 232–236.
Olowokere, A.E., Olajide, O., 2013. Women's perception of safety and utilization of herbal remedies during pregnancy in a local government area in Nigeria. Clin. Nurs. Stud. 1, 9–22.
Omane-Adjekum, W., 2010. Medicines Usage in Pregnancy (M.Sc. thesis). Kwame Nkrumah University of Science and Technology, Kumasi, Ghana (Unpublished).
Onyiapat, J.L.E., 2014. Complementary and Alternative Medicine Use among Pregnant Women in Udi Local Government Area of Enugu State, Nigeria (M.Sc. thesis). University of Nigeria, Enugu Campus, Nigeria (Unpublished).
Opaneye, A.A., 1998. Traditional medicine in Nigeria and modern obstetric practice: need for cooperation. Cent. Afr. J. Med. 44, 258–261.
Orief, Y.I., Farghaly, N.F., Ibrahim, M.I.A., 2014. Use of herbal medicines among pregnant women attending family health centers in Alexandria. Middle East Fertil. Soc. J. 19, 42–50.
Pfeiffer, J.M., Butz, R.J., 2005. Assessing cultural and ecological variation in ethnobiological research: the importance of gender. J. Ethnobiol. 25, 240–278.
Pinn, G., Pallett, L., 2002. Herbal medicine in pregnancy. Complement. Therap. Nurs. Midwifery 8, 77–80.
Posadzki, P., Watson, L.K., Ernst, E., 2013. Adverse effects of herbal medicines: an overview of systematic reviews. Clin. Med. 13, 7–12.
Rahman, A.A., Ahmad, Z., Naing, L., Sulaiman, S.A., Hamid, A.M., Daud, W.N.W., 2007. The use of herbal medicines during pregnancy and perinatal mortality in Tumpat District, Kelantan, Malaysia. Southeast Asian J. Trop. Med. Public Health 38, 1150–1157.
Rasch, V., Srensen, P.H., Wang, A.R., Tibazarwa, F., Jger, A.K., 2014. Unsafe abortion in rural Tanzania - the use of traditional medicine from a patient and a provider perspective. BMC Pregnancy Childbirth 14, 419.
Rodrigues, E., 2007. Plants of restricted use indicated by three cultures in Brazil (Caboclo-river dweller, Indian and Quilombola). J. Ethnopharmacol. 111, 295–302.
de Sa, R.Z., Rey, A., Argañaraz, E., Bindstein, E., 2000. Perinatal toxicology of *Ruta chalepensis* (Rutaceae) in mice. J. Ethnopharmacol. 69, 93–98.
Sam-Wobo, S.O., Akinboroye, T., Anosike, J.C., Adewale, B., 2008. Knowledge and practices on malaria treatment measures among pregnant women in Abeokuta, Nigeria. Tanzan. J. Health Res. 10, 226–231.
Say, L., Chou, D., Gemmill, A., Tunçalp, Ö., Moller, A.B., Daniels, J., Gülmezoglu, A.M., Temmerman, M., Alkema, L., 2014. Global causes of maternal death: a who systematic analysis. Lancet Glob. Health 2, e323–e333.
Skouteris, H., Wertheim, E.H., Rallis, S., Paxton, S.J., Kelly, L., Milgrom, J., 2008. Use of complementary and alternative medicines by a sample of Australian women during pregnancy. Aust. N.Z. J. Obstet. Gynaecol. 48, 384–390.
Spolarich, A.E., Andrews, L., 2007. An examination of the bleeding complications associated with herbal supplements, antiplatelet and anticoagulant medications. J. Dent. Hyg. 81, 67.
Steenkamp, V., 2003. Traditional herbal remedies used by South African women for gynaecological complaints. J. Ethnopharmacol. 86, 97–108.
Suswardany, D.L., Sibbritt, D.W., Supardi, S., Chang, S., Adams, J., 2015. A critical review of traditional medicine and traditional healer use for malaria and among people in malaria-endemic areas: contemporary research in low to middle-income Asia-Pacific countries. Malar. J. 14, 98.
Tamuno, I., Omole-Ohonsi, A., Fadare, J., 2011. Use of herbal medicine among pregnant women attending a tertiary hospital in Northern Nigeria. Internet J. Gynecol. Obstet. 15, 2.
Tardío, J., Pardo-de-Santayana, M., 2008. Cultural importance indices: a comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). Econ. Bot. 62, 24–39.
Tate, S., 1997. Peppermint oil: a treatment for postoperative nausea. J. Adv. Nurs. 26, 543–549.
Tongo, O.O., Orimadegun, A.E., Akinyinka, O.O., 2011. Utilisation of malaria preventive measures during pregnancy and birth outcomes in Ibadan, Nigeria. BMC Pregnancy Childbirth 11, 60.
Tort, J., Rozenberg, P., Traoré, M., Fournier, P., Dumont, A., 2015. Factors associated with postpartum hemorrhage maternal death in referral hospitals in Senegal and Mali: a cross-sectional epidemiological survey. BMC Pregnancy Childbirth 15, 235.
Towns, A.M., van Andel, T., 2014. Comparing local perspectives on women's health with statistics on maternal mortality: an ethnobotanical study in Bénin and Gabon. BMC Complement. Altern. Med. 14, 113.
Towns, A.M., van Andel, T., 2016. Wild plants, pregnancy, and the food-medicine continuum in the southern regions of Ghana and Benin. J. Ethnopharmacol. 179, 375–382.
Tsui, B., Dennehy, C.E., Tsourounis, C., 2001. A survey of dietary supplement use during pregnancy at an academic medical center. Am. J. Obstet. Gynecol. 185, 433–437.
USAID, 2012. Cultural Barriers to Seeking Maternal Health Care in Ethiopia: A Review of the Literature. 〈http://pdf.usaid.gov/pdf_docs/PA00JSN8.pdf〉 (Accessed 15 November 2017).
van Andel, T., de Boer, H.J., Barnes, J., Vandebroek, I., 2014. Medicinal plants used for menstrual disorders in Latin America, the Caribbean, sub-Saharan Africa, South and Southeast Asia and their uterine properties: a review. J. Ethnopharmacol. 155, 992–1000.
Varga, C.A., Veale, D.J.H., 1997. Isihlambezo: utilization patterns and potential health effects of pregnancy-related traditional herbal medicine. Social. Sci. Med. 44, 911–924.
Veale, D.J.H., Furman, K.I., Oliver, D.W., 1992. South African traditional herbal medicines used during pregnancy and childbirth. J. Ethnopharmacol. 36, 185–191.
Verma, P., Thakur, A.S., Deshmukh, K., Jha, A.K., Verma, S., 2010. Routes of drug administration. Int. J. Pharm. Stud. Res. 1, 54–59.
Viljoen, E., Visser, J., Koen, N., Musekiwa, A., 2014. A systematic review and meta-analysis of the effect and safety of ginger in the treatment of pregnancy-associated nausea and vomiting. Nutr. J. 13, 20.
Wen, S.W., Yang, T., Krewski, D., Yang, Q., Nimrod, C., Garner, P., Fraser, W., Olatunbosun, O., Walker, M.C., 2008. Patterns of pregnancy exposure to prescription FDA C, D and X drugs in a Canadian population. J. Perinatol. 28, 324.
Westfall, R.E., 2003. Herbal healing in pregnancy: women's experiences. J. Herbal. Pharmacother. 3, 17–39.
WHO, 1991. Maternal Mortality: A Global Factbook. 〈http://www.popline.org/node/331283〉 (Accessed 01 November 2017).
WHO, 2000. General Guidelines for Methodologies on Research and Evaluation of Traditional Medicine. 1. WHO, Geneva, pp. 1–74. 〈https://doi.org/WHO/EDM/TRM/2000.1〉 (accessed 03 October 2016).
WHO, 2002. WHO Traditional Medicine Strategy 2002—2005. World Health Organization, Geneva, Switzerland.
WHO, 2014. WHO policy brief for the Implementation of Intermittent Preventive Treatment of Malaria in Pregnancy Using Sulfadoxine-Pyrimethamine (IPTp-SP). 〈https://doi.org/WHO/HTM/GMP/2014.4〉 (Accessed 10 October 2017).
WHO, 2015. Trends in maternal mortality: 1990 to 2015: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. World Health Organization, Geneva. 〈http://apps.who.int/iris/bitstream/handle/10665/194254/9789241565141_eng.pdf;jsessionid = 64E023BC4DE93EDB3A075E4E67F47DB5?Sequence = 1〉 (Accessed 13 October 2017).
Wills, G., Forster, D., 2008. Nausea and vomiting in pregnancy: what advice do midwives give? Midwifery 24, 390–398.
Yue, Q.Y., Jansson, K., 2001. Herbal drug curbicin and anticoagulation effect with and without warfarin: possibly related to the vitamin E component. J. Am. Geriatr. Soc. 49 (838–838).
Yusuff, K.B., Omarusehe, L.D., 2011. Determinants of self medication practices among pregnant women in Ibadan, Nigeria. Int. J. Clin. Pharm. 33, 868–875.
Zhang, Y., Xu, H., Chen, H., Wang, F., Huai, H., 2014. Diversity of wetland plants used traditionally in China: a literature review. J. Ethnobiol. Ethnomed. 10, 72.