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Herbal medicine use among pregnant women attending antenatal clinics in Lusaka Province, Zambia: A cross-sectional, multicentre study

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ABSTRACT

*Background **and purpose**:* The study of herbal medicine (HM) use which is related to maternal health, a public health priority in many sub-Saharan African countries including Zambia, has been limited. Accordingly, we aimed to determine the prevalence and patterns of HM use during pregnancy in Lusaka Province, Zambia.
Materials and methods: A survey-based (interviewer-administered), cross-sectional, multicentre study was conducted in 446 adult pregnant women attending antenatal clinics in June/July 2019.
Results: Overall, 57.8% of participants reported using HM during their current pregnancy, with a mean of 2.0 ± 1.5 remedies/woman. Logistic regression analysis showed that HM use was significantly associated with HM use in prior pregnancies ($p < 0.001$) and willingness to use HM in the future ($p < 0.001$). The most commonly used herbs were lemon for nausea/vomiting and common cold, soybean to boost energy, ginger for common cold and nausea/vomiting, and *Aloe vera* for skin care. The perceived safety of HM (37.6%) and its complementary action with conventional medicines (35.3%) were the main reasons for HM use.
Conclusion: HM use among pregnant women attending antenatal clinics in Lusaka Province, Zambia is common, and a wide range of herbs is used.

1. Background

In the past two decades, the use of herbal medicines has grown considerably worldwide, especially among pregnant women [1–3]. Herbal medicines are defined by the World Health Organisation as plant-derived material or preparations perceived to have therapeutic benefits, containing raw or processed ingredients from one or more plants [4]. They include herbs, herbal materials, herbal preparations, and finished herbal products that contain parts of plants or other plant materials as active ingredients [5]. The prevalence of herbal medicine use during pregnancy varies significantly across regions and countries [1]. A recently published systematic review assessing the prevalence of herbal medicine use among 22,404 pregnant or lactating women across Africa found an average prevalence rate of 32%–45% [6]. This systematic review [6] also identified a substantial variation in the use of herbal medicines by pregnant women in the African continent, from 2% as reported in a study conducted in the Tigray Region, Northern Ethiopia [7] to 100% according to another study in Machakos District, Eastern Kenya [8].

Pregnant women use herbal medicines for different purposes, which include pregnancy-related ailments such as nausea and vomiting, improvement of foetal growth, inducing labour, or pregnancy-unrelated ailments, such as cold and flu symptoms and skin problems as well as for nutritional benefits [3,6,9]. The popularity of herbal medicines among pregnant women can be mainly attributed to the belief that herbal products, being natural, are safe with fewer adverse events (AEs) compared to conventional drugs [10,11]. Moreover, pregnant women across Africa view herbal medicines as being more affordable and more easily accessed than conventional drugs [2,6,11]. Despite this common perception of safety, herbal medicines may have potent pharmacological actions, and can consequently produce AEs [12]. For instance, a recent systematic review [13], focusing on the safety of herbal medicines and

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which included 74 studies in a total of 1,067,071 pregnant or postnatal women, found that topical use of almond oil was significantly associated with preterm birth, oral raspberry leaf with caesarean delivery, and heavy liquorice consumption (greater than 500 mg/week) with early preterm birth [13]. In addition, the concomitant use of herbal remedies with conventional medicines can lead to potential synergistic effects or drug interactions resulting in increased toxicity and decreased efficacy of the conventional drug [14]. An example of this is the consumption of green tea concomitantly with folic acid yielding a diminished folic acid bioavailability [15]. Furthermore, herbal medicinal products are usually sold as unlicensed food or dietary supplements or as over-the-counter items, which are not regulated with the same scrutiny as conventional drugs, thus increasing the probability of contamination or adulteration with poisonous metals such as lead or mercury, non-declared herbs or conventional medicines [3,16].

In Zambia, there is a paucity of data on the use of herbal medicines among pregnant women. To our knowledge, only two studies have been conducted there to investigate the use of traditional medicine during pregnancy [17,18]. The first study, conducted by Banda et al. (2007) [17], found that 30% of 1228 pregnant women surveyed in Lusaka, Zambia reported visiting a traditional healer in the past and 21% during their current pregnancies. However, this study examined the use of traditional medicine as a whole and not specifically herbal medicine use, and it did not assess the types of medicinal plants used nor the reasons for their use [17]. The second study by Maluma et al. (2017) [18], conducted among 273 pregnant women, reported that 32% of study participants used herbal medicines mainly for inducing or accelerating labour. In this study, various local names of indigenous plants were mentioned, such as *"moono"* leaves and roots, *"makole"* roots and leaves, *"mulolo"* roots, and "*sope*" leaves [18]. However, these medicinal plants were not botanically identified, and the study was carried out in only two towns of Lusaka Province (Kanakantapa and Chawama). Thus, the findings may not be generalisable to the entire province [18]. Accordingly, the present study aimed at filling this knowledge gap by determining the prevalence of herbal medicine use, associated factors, and patterns of use among pregnant women attending antenatal care clinics in Lusaka Province. This study also aimed to identify the most frequently used medicinal plants in pregnancy and their indications.

2. Materials and methods

2.1. Study design and setting

This was a facility-based, prospective, cross-sectional study, conducted from June 03 to July 09, 2019. Five antenatal clinics of public health facilities located across three districts of Lusaka Province, namely Lusaka District, Kafue District and Chongwe District, were selected. Although it is the smallest province, Lusaka Province is the most populated of all the ten provinces of Zambia, with a population of over 3 million [19]. At district level, Lusaka District is the most densely populated district in the province (4853.2 persons per km^2) followed by Kafue (24.2 persons per km^2) and Chongwe (22.2 persons per km^2) [20]. Hence, the three districts were selected as the study locations based on their population size, and because they provided a representation of urban (Lusaka), peri-urban (Kafue), and rural (Chongwe) communities of Lusaka Province.

In Zambia, expectant women with a normally progressing pregnancy are required to visit a health facility a minimum of four times: at 16 weeks, between 24 and 28 weeks, at 32 weeks, and at 36 weeks [21]. However, many pregnant women in the country are unable to meet the recommended four visits, partially due to the delayed initiation of antenatal care, lower education and income levels, the distances to the health facilities, and the poor road conditions [21]. During the antenatal care visits in the five study centres, pregnant women were usually attended by a female nurse or midwife.

The study was approved by the Regional Committee for Medical and Health Research Ethics in Norway (REC West; 2019/378), the University of Zambia Biomedical Research Ethics Committee (UNZABREC; 009-04-19), and the National Health Research Authority of Zambia. Permission to conduct the study was also obtained at each health centre. The study results were kept confidential, and all computerised data were handled and stored anonymously.

2.2. Study population and sampling procedure

The study population consisted of pregnant women, aged at least 18 years, attending the selected antenatal care clinics in Lusaka Province during the data collection period. Women who were not mentally or physically capable of being interviewed were excluded. Moreover, foreign women (i.e., non-Zambian citizens) were excluded from the study analysis, because they might have different health beliefs and practices, and should not be made to represent Zambian women. Written informed consent was obtained from all study participants.

The sample size for this study was calculated using the formula: $n = z^2pq/d^2$, where n = required sample size, z = standard normal deviate set at 1.96 (for a 95% confidence interval [CI]), p = estimated proportion of herbal medicine use among pregnant women, $q = 1-p$, and d = degree of desired accuracy set at 0.05. Taking p = 32% from the Maluma et al. (2017) study [18], the minimum sample size was estimated at 334. Assuming a non-response rate of 10%, the final required sample size was found to be 368. However, participant recruitment was continued even after reaching the desired sample size, since larger sample sizes lead to more reliable conclusions.

Pre-survey assessment was carried out to determine the average daily flow of pregnant women seeking antenatal care at the selected public health facilities. According to the expected number of women in the specified period of data collection, the sample size was proportionally allocated to each clinic. Given the disorganized and unstructured influx of women to the health facilities, we decided to consecutively recruit all women who met the inclusion criteria during the study period.

2.3. Data collection

After participants were briefed on the purpose of the study and informed consent was obtained, data were collected using a semi-structured, interviewer-administered questionnaire, based on a previous study by Nordeng and Havnen (2004) [22] describing herbal medicine use during pregnancy among 400 Norwegian women. Several questions in the questionnaire were also adapted from similar cross-sectional studies conducted in other sub-Saharan African countries [14,23,24]. The questionnaire was first prepared in English, then later translated into the local languages (Nyanja and Bemba), and then re-translated back to English to check for its consistency. The following definition of herbal medicine was included in the information sheet [25], and was given to the study participants at the beginning of the interview: "any kind of product, such as a tablet, a mixture, a cream or a herbal tea, which is produced from plants and used to acquire better health".

The questionnaire was initially pilot-tested in its English version, on a sample of 10 participants from Lusaka District, and based on the findings, a few questions were revised. The final version of the questionnaire took approximately 15 min to complete, and contained 31 questions divided into five sections. The first section captured socio-demographic information of the participants (i.e., age, marital status, educational level, religion, ethnicity, area of residence, and occupation). The second section included pregnancy-related questions (i.e., stage of pregnancy, number of pregnancies prior to this one, parity, smoking during pregnancy, and prescribed supplements or conventional medicines taken regularly). The third and fourth sections comprised questions regarding herbal medicine use among respondents, including herbal medicine use during current and past pregnancies, potential

herbal medicine use in the future, types of herbal medicines used and their indications, recommendation source(s), disclosure of use to health care professionals, reasons for use, preferred source of information, and sources to obtain herbal medicines. To reduce recall bias, the third section of the questionnaire also inquired about the use of five specific popular medicinal plants, namely ginger (*Zingiber officinale* Roscoe), garlic (*Allium sativum* L.), *Aloe vera* (*Aloe vera* (L.) Burm.f.), moringa (*Moringa oleifera* Lam.), and soybean (*Glycine max* (L.) Merr.). These plants were selected based on the available literature on herbal medicine use during pregnancy in Africa [6], and on the pilot-testing results. The fifth and final section asked about the women's experience with any medical condition, such as nausea/vomiting/morning sickness, abdominal pain/indigestion, malaria, urinary tract infection, and if they had used any treatment against it.

Data were collected by the principal investigator (M.E.H.) and by two trained female research assistants (a graduate student in public health and a medical student) fluent in the local languages. All filled copies of the questionnaire were checked daily by the principal investigator to promote consistency and to ensure completion of data. Data cleaning was conducted at the end of data entry.

2.4. Statistical analysis

Data were presented as descriptive statistics. Categorical variables were summarised as counts and percentages, whereas continuous variables as mean, standard deviation (SD), median, range, and interquartile range. Prevalence was calculated as the proportion of study participants who used herbal medicines, with the denominator being all pregnant women enrolled in the study. Pearson's Chi-square test and Fisher's exact test were used to determine the association between herbal medicine use (dependent variable) and sociodemographic and pregnancy-related characteristics (independent variables). A forward stepwise logistic regression was also performed to identify factors independently associated with the use of herbal medicine. The variables tested in the logistic regression were: age, educational level, area of residence, employment status, having already children, being previously pregnant, the use of conventional medicines in the current pregnancy, herbal medicine use in prior pregnancies, and willingness to use herbal medicine in the future. All statistical tests were two-sided and were performed at a 0.05 significance level. Statistical analyses were conducted using IBM SPSS Statistics for Windows, version 25 (IBM Corp, Armonk, NY, USA).

3. Results

3.1. Study participants and prevalence of herbal medicine use

Out of 497 pregnant women invited to participate, 461 completed the questionnaire giving a response rate of 92.8%. A total of 15 women were excluded because they did not meet the study eligibility criteria (i.e., 8 were foreigners and 7 were underage), leaving 446 women between the ages of 18 and 49 in the final analysis. More than half of the study participants (258/446; 57.8%) reported using herbal medicines during their current pregnancy, while 122 (27.4%) reported the use of herbal medicines in past pregnancies. Overall, 209 women (46.9%) reported intending to use herbal medicines in the future (after giving birth or in future pregnancies).

Table 1 presents the sociodemographic and pregnancy-related characteristics of the overall study population and stratified by herbal medicine use in the current pregnancy. Most study participants resided in urban or peri-urban areas (77.8%), were younger than 30 years (64.8%), were married (85.2%), and had at least one child (67.3%). Half of the study population attained a secondary level of education. As for the number of pregnancies, 28.5% were primigravidae. Only 14 women (3.1%) self-reported being HIV-positive. Overall, 371 (83.2%) study participants reported using prescribed supplements or conventional

Table 1
Sociodemographic and obstetric characteristics and their association with herbal medicine use during pregnancy.

Variable	Total (N = 446)	Users of HM (N = 258)	Non-users of HM (N = 188)	Chi-square	p-value[a]
District					
Lusaka	237 (53.1)	130 (50.4)	107 (56.9)	5.322	0.07
Kafue	110 (24.7)	74 (28.7)	36 (19.1)		
Chongwe	99 (22.2)	54 (20.9)	45 (23.9)		
Mean ± SD age (median; IQR) – years	28.1 ± 6.1 (28.0; 23.0–32.0)	27.7 ± 6.0 (27.0; 23.0–32.0)	28.6 ± 6.1 (29.0; 24.0–32.5)	–	–
Age groups – years					
<25	133 (29.8)	81 (31.4)	52 (27.7)	2.630	0.621
25–30	156 (35.0)	93 (36.0)	63 (33.5)		
31–36	119 (26.7)	63 (24.4)	56 (29.8)		
≥37	38 (8.5)	21 (8.1)	17 (9.0)		
Marital status					
Married	380 (85.2)	213 (82.6)	167 (88.8)	3.393	0.065
Not married[b]	66 (14.8)	45 (17.4)	21 (11.1)		
Ethnicity					
Bemba	127 (28.5)	79 (30.6)	48 (25.5)	35.871	0.074
Tonga	67 (15.0)	39 (15.1)	28 (14.9)		
Chewa	66 (14.8)	33 (12.8)	33 (17.6)		
Other[c]	186 (41.7)	107 (41.5)	79 (42.0)		
Religion					
Protestant	310 (69.5)	180 (69.8)	130 (69.1)	3.774	0.287
Catholic	83 (18.6)	43 (16.7)	40 (21.3)		
Jehovah's witness	24 (5.4)	14 (5.4)	10 (5.3)		
Other[d]	29 (6.5)	21 (8.1)	8 (4.3)		
Education level					
No formal education	12 (2.7)	3 (1.2)	9 (4.8)	5.517	0.138
Primary education	48 (10.8)	28 (10.9)	20 (10.6)		
Secondary education	223 (50.0)	130 (50.4)	93 (49.5)		
College or university	163 (36.5)	97 (37.6)	66 (35.1)		
Residential area					
High-density (low-income)	211 (47.3)	120 (46.5)	91 (48.4)	0.156	0.925
Medium-density (middle-income)	138 (30.9)	81 (31.4)	57 (30.3)		
Low-density (high-income)	97 (21.7)	57 (22.1)	40 (21.3)		
Employment status					
Formally employed	154 (34.5)	92 (35.7)	62 (33.0)	3.058	0.217
Informally employed	42 (9.4)	19 (7.4)	23 (12.2)		
Unemployed	250 (56.1)	147 (57.0)	103 (54.8)		
Trimester of pregnancy					
First	46 (10.3)	20 (7.8)	26 (13.8)	4.421	0.11
Second	204 (45.7)	120 (46.5)	84 (44.7)		
Third	196 (43.9)	118 (45.7)	78 (41.5)		
Prior pregnancies					
None	127 (28.5)	80 (31.0)	47 (25.0)	4.951	0.763
1	112 (25.1)	65 (25.2)	47 (25.0)		
2	77 (17.3)	44 (17.1)	33 (17.6)		
3	75 (16.8)	42 (16.3)	33 (17.6)		
≥4	55 (12.3)	27 (10.5)	28 (14.9)		
Parity					
No child	146 (32.7)	89 (34.5)	57 (30.3)	7.800	0.351
1 child	120 (26.9)	72 (27.9)	48 (25.5)		
2 children	92 (20.6)	50 (19.4)	42 (22.3)		
3 children	58 (13.0)	33 (12.8)	25 (13.3)		
≥4 children	30 (6.7)	14 (5.4)	16 (8.5)		
Conventional drug use					
Yes	371 (83.2)	223 (86.4)	148 (78.7)	4.622	**0.032**
No	75 (16.8)	35 (13.6)	40 (21.3)		
HM use in prior pregnancies					

(*continued on next page*)

Table 1 (*continued*)

Variable	Total (N = 446)	Users of HM (N = 258)	Non-users of HM (N = 188)	Chi-square	p-value[a]
Yes	122 (27.4)	103 (39.9)	19 (10.1)	70.004	**<0.001**
No	188 (42.2)	70 (27.1)	118 (62.8)		
Unsure/ don't remember	10 (2.2)	5 (1.9)	5 (2.7)		
Not applicable[e]	126 (28.3)	80 (31.0)	46 (24.5)		
Willingness to use HM in the future					
Yes	209 (46.9)	164 (63.6)	45 (23.9)	81.835	**<0.001**
No	113 (25.3)	31 (12.0)	82 (43.6)		
Unsure	124 (27.8)	63 (24.4)	61 (32.4)		

Data are expressed as n (%), unless otherwise indicated. Percentages are calculated as n/N.
Abbreviations: HM, herbal medicine; IQR, interquartile range; SD, standard deviation.
[a] $p < 0.05$ is considered statistically significant.
[b] "Not married" includes: single, divorced, and separated.
[c] Other ethnicities include: Chikunda, Ila, Kalubale, Kaonde, Lala, Lamba, Lenje, Lozi, Luba, Lunda, Lungu, Luvale, Mambwe, Namwanga, Ndebele, Ngoni, Nsenga, Senga, Shona, Soli, Tumbuka, Ushi, and Zulu.
[d] Other religions include: New Apostolic Church, Zion Christian Church, Old Apostolic Church, and Islam.
[e] "Not applicable" in cases of first pregnancy.

medicines during their current pregnancy, with the most commonly used supplements or medications being folic acid for the prevention of neural tube defects (342/371; 92.2%), ferrous sulphate for the prevention or treatment of iron-deficiency anaemia (256/371; 69.0%), and sulfadoxine–pyrimethamine for the prevention of malaria (172/371; 46.4%).

Chi-square analysis detected no statistically significant differences between herbal medicine users and non-users in relation to socio-demographic factors as well as pregnancy-related characteristics (Table 1). Only conventional medicine use ($p = 0.032$), herbal medicine use in prior pregnancies ($p < 0.001$), and willingness to use herbal medicine in the future ($p < 0.001$) were found to have a significant association with herbal medicine use during the current pregnancy. However, logistic regression analysis found no statistically significant association between herbal medicine use during the current pregnancy and conventional medicine use (odds ratio [OR], 1.71; 95% CI, 0.90–3.22; $p = 0.10$). In contrast, women who used herbal medicines in their previous pregnancies were five times more likely to use herbal medicines in their current pregnancies (OR, 5.27; 95% CI, 2.77–10.01; $p < 0.001$). Similarly, women who expressed a willingness to use herbal medicine in the future were seven times more likely to use herbal medicines in their current pregnancies (OR, 7.28; 95% CI, 4.01–13.22; $p < 0.001$).

3.2. Most commonly used herbal medicines and their indications

Table 2 presents the most commonly used herbal remedies in pregnancy and their indications. More than 40 different types of herbs were cited. The most frequently reported ones were *Citrus limon* (L.) Osbeck (lemon) (41.1%) mostly taken for nausea/vomiting/morning sickness and common cold, *G. max* (L.) Merr. (soybean) (31.0%) mainly used as an energy booster, *Z. officinale* Roscoe (ginger) (27.9%) mostly to treat common cold and nausea/vomiting/morning sickness, and *A. vera* (L.) Burm.f. (*A. vera*) (19.4%) primarily used topically to hydrate and moisturise the skin. Of the 258 herbal medicine users, six (2.3%) reported using herbal mixtures without knowing the ingredients.

The majority of herbal medicine users (167/258; 64.7%) used at least two types of herbs. The mean ± SD number of used herbal remedies in pregnancy was 2.0 ± 1.5 (median, 2.0; range, 1–11). The oral route was the most common route of administration of herbal medicines (213/

Table 2
Overview of the most frequently used herbal preparations during pregnancy and their indications among the 258 herbal medicine users.

Herb type: Binomial name — common name	No. (%) of women reporting usage[a]	Preparation (no. of women reporting usage)[b]	Most common indication(s) (no. of women reporting usage)[b]
Citrus limon (L.) Osbeck — Lemon	106 (41.1)	Lemon tea (n = 62) Lemons (n = 38) Infusion of lemon leaves (n = 3) Lemon juice (n = 2) Lemon porridge (n = 1)	Nausea/vomiting/ morning sickness (n = 40) Common cold (n = 36) To increase appetite (n = 16) Cough (n = 4) General well-being (n = 4)
Glycine max (L.) Merr. — Soybean	80 (31.0)	Soybean porridge (n = 75) Roasted soybeans (n = 4) Fried soybeans (n = 1)	Energy boosting (n = 55) Weight gain (n = 15) Nutrition or as a dietary supplement (n = 10) To promote foetal growth (n = 8)
Zingiber officinale Roscoe — Ginger	72 (27.9)	Ginger tea (n = 57) Chewing raw ginger (n = 15)	Common cold (n = 33) Nausea/vomiting/ morning sickness (n = 25) Cough (n = 10) General well-being (n = 2)
Aloe vera (L.) Burm.f. — *Aloe vera*	50 (19.4)	*Aloe vera* lotion (n = 34) *Aloe vera* topical gel (n = 7) *Aloe vera* soap (n = 5) *Aloe vera* juice (n = 4) *Aloe vera* tea (n = 2)	Skin hydration and moisture (n = 37) To reduce stretch marks (n = 5) As an antibiotic (n = 1), antifungal (n = 1), or disinfectant (n = 1) Abdominal pain (n = 2)
Amaranthus spp. L. — Wild spinach (known locally in Zambia as "bondwe")	40 (15.5)	Leaves are boiled in water and infusion is drank (n = 40)	To treat or prevent anaemia (n = 40)
Beta vulgaris L. — Beetroot	29 (11.2)	Beetroot cooked as a vegetable (n = 28) Beetroot tea (n = 1)	To treat or prevent anaemia (n = 29)
Persea americana Mill. — Avocado	21 (8.1)	Infusion of avocado leaves (n = 13) Avocados (n = 8)	To treat or prevent anaemia (n = 21) Energy boosting (n = 1)
Brassica napus L. — Rapeseed	19 (7.4)	Leaves are boiled in water and infusion is drank (n = 19)	To treat or prevent anaemia (n = 19)
Allium sativum L. — Garlic	19 (7.4)	Eating raw garlic (n = 10) Garlic tea (n = 9)	Common cold (n = 7) Cough (n = 4) Sore throat (n = 2) High blood pressure (n = 2) As an antibiotic (n = 1), or as an antifungal (n = 1)
Soil[c]	10 (3.9)	Eating dirt or clay bought from local markets (n = 10)	Nausea/vomiting/ morning sickness (n = 8) Hypersalivation (n = 1) Energy boosting (n = 1)

(*continued on next page*)

Table 2 (*continued*)

Herb type: Binomial name — common name	No. (%) of women reporting usage[a]	Preparation (no. of women reporting usage)[b]	Most common indication(s) (no. of women reporting usage)[b]
Telfairia occidentalis Hook.f. — Fluted pumpkin (known locally in Zambia as "chibwabwa")	9 (3.5)	Pumpkin leaves cooked as a vegetable (n = 9)	To treat or prevent anaemia (n = 9)
Ficus sycomorus L. — Sycamore fig (known locally in Zambia as "mukuyu")	8 (3.1)	Infusion of leaves (n = 7) Boiled decoction of bark (n = 1)	To treat or prevent anaemia (n = 8)
Moringa oleifera Lam. — Moringa	7 (2.7)	Moringa powder tea (n = 3) Moringa leaf oral supplement (n = 2) Moringa powder for hair (n = 1) Decoction of moringa roots (n = 1)	General well-being (n = 2) To boost the immune system (n = 1) High blood pressure (n = 1) Bloating and gas (n = 1) To stimulate hair growth (n = 1) To induce labour (n = 1)
Rhynchosia heterophylla Hauman — Munkoyo	6 (2.3)	Munkoyo beverage[d]	Energy boosting (n = 6) To promote foetal growth (n = 1)
Corchorus olitorius L. — Bush okra (known locally in Zambia as "delele")	6 (2.3)	Infusion of bush okra leaves (n = 3) Bush okra cooked as a relish (n = 3) Decoction of bush okra roots (n = 1)	To induce labour (n = 4) To increase appetite (n = 3)

[a] Percentages are based on the number of women who used herbal medicines during their current pregnancy (N = 258).
[b] More than one answer was possible.
[c] Soil is not a herbal medicine, but its use for therapeutic purposes was reported by several study participants. This was hence included in the study analysis due to soil's potential health risks.
[d] Munkoyo is a spontaneously fermented drink made from pounded roots of *R. heterophylla* Hauman mixed with bits of maize.

258; 82.6%), followed by the topical (45/258; 17.4%) and the intravaginal (1/258; 0.4%) routes. Diverse plant parts were reported by the women who used herbal medicines, namely leaves, roots, barks, flowers, fruits or whole plants.

Five out of 258 herbal medicine users (1.9%) reported AEs: nausea (n = 2) following oral infusion of avocado leaves (n = 1) and after drinking ginger tea (n = 1), vomiting (n = 2) after eating raw garlic (n = 1) and after drinking ginger tea (n = 1), and rash following topical application of *Aloe vera* gel (n = 1).

3.3. Patterns of herbal medicine use during pregnancy

Patterns of herbal medicine use among respondents are described in Table 3. Two-thirds of users (172/258; 66.7%) reported taking herbal medicines in at least two trimesters of pregnancy. Nearly half (47.7%) reported using herbal medicines occasionally. The use of herbal remedies was most commonly initiated on the woman's own initiative (53.1%) and/or after recommendations from family members (32.2%). Only two women (0.8%) had been recommended the use of herbal medicines by a traditional healer. Herbal remedies were mainly purchased from market places (57.8%) or gathered from the bushes (34.1%). For six women, soybeans were given to them free of charge by nurses at the antenatal clinics to gain weight.

Table 3
Patterns of herbal medicine use during pregnancy (N = 258).

Variable	Number (%)[a]
Trimester of pregnancy during which herbal medicines were used	
First trimester only	42 (16.3)
Second trimester only	31 (12.0)
Third trimester only	13 (5.0)
First and second trimesters	75 (29.1)
Second and third trimesters	35 (13.6)
First and third trimesters	2 (0.8)
All trimesters	60 (23.3)
Frequency of use	
Only once	9 (3.5)
Occasionally	123 (47.7)
Weekly	3 (1.2)
Twice or more per week	27 (10.5)
Daily	96 (37.2)
Source(s) of recommendation[b]	
Own idea	137 (53.1)
Family	83 (32.2)
Health professionals[c]	46 (17.8)
Friends or neighbours	34 (13.2)
Seventh-day Adventist Church	4 (1.6)
Magazine or on social media	3 (1.2)
Traditional healers	2 (0.8)
Source(s) of herbal medicine[b]	
Market places	149 (57.8)
Gathered from the bushes	88 (34.1)
Family and/or friends	29 (11.2)
Staff at the antenatal clinic	6 (2.3)
Traditional healers or herbalists	2 (0.8)
Preferred source of information about herbal medicines	
Family or friends	121 (46.9)
Health professionals[c]	87 (33.7)
Google	31 (12.0)
Traditional healers or herbalists	10 (3.9)
Unsure	5 (1.9)
Religious leaders	4 (1.6)
Disclosed use of herbal medicines to doctor/nurse/pharmacist	
Yes	72 (27.9)
No	179 (69.4)
Partially	7 (2.7)
Reason(s) for using herbal medicines[b]	
Herbal medicines are safe in pregnancy	97 (37.6)
Herbal medicines complement conventional medicines	91 (35.3)
Herbal medicines are more accessible than conventional medicines	49 (19.0)
Herbal medicines are much cheaper than conventional medicines	44 (17.1)
Herbal medicines taste nice	42 (16.3)
Herbal medicines are more effective than conventional medicines	30 (11.6)
It is in my culture to use herbal medicine	21 (8.1)
Herbal medicines are more effective blood boosters than conventional medicines	13 (5.0)
Conventional medicines cause more side effects compared to herbal medicines	8 (3.1)
I use herbal medicine when conventional medicine fails	6 (2.3)

[a] Percentages are based on the number of women who used herbal medicines during their current pregnancy (N = 258).
[b] More than one answer was possible.
[c] Health professionals included: doctors, pharmacists, nurses, and nutritionists.

When asked about the preferred source of information about herbal medicines in pregnancy, 46.9% of users preferred to seek advice from family or friends and 33.7% from health professionals. The majority of pregnant women who used herbal medicines (69.4%) did not disclose this use to their medical providers, and seven women (2.7%) disclosed the use of some herbs while not revealing the use of other herbal remedies because they were afraid of their medical provider's response.

Users of herbal medicines during pregnancy had several reasons for consumption of these products. The two most commonly stated reasons for using herbal medicines were "herbal medicines are safe in pregnancy" (37.6%) followed by "herbal medicines complement conventional medicines" (35.3%).

3.4. Common medical conditions in pregnancy and their treatment

Most study participants reported experiencing one or more medical conditions during their pregnancy, most commonly nausea/vomiting/morning sickness (67.3%), abdominal pain/indigestion (55.6%), and urinary tract infections (16.4%) (Table 4). These conditions were treated in different ways and to a variable extent. Study participants who reported experiencing back pain (81.8%), abdominal pain/indigestion (77.4%), nausea/vomiting/morning sickness (70.0%), or vaginal problems (50.0%) did not receive any treatment in at least half of the cases. Cough (81.3%) was the condition most commonly treated by herbal medicines (by ginger, lemon, and/or garlic), followed by common cold (72.5%) (by ginger, lemon, and/or garlic). The highest proportion of women using conventional medicines for the treatment of medical conditions was found for urinary tract infections (75.3%), hypertension (72.7%), malaria (70.2%), and headache (52.3%). Simultaneously, herbal remedies were not or barely administered to treat these four conditions.

4. Discussion

The findings of the present study indicate that herbal medicine use among pregnant women attending antenatal clinics in Lusaka Province is common, and that a wide range of herbal medicines is used. Herbal remedies were found to be used by 57.8% of the study participants. This prevalence is quite high, especially given that more than three-quarters of the study population resided in urban or peri-urban areas in proximity to health care facilities. However, we believe that this figure can even be much higher, particularly in the Kafue and Chongwe Districts, given that previous studies have shown that rural residence is significantly associated with herbal medicine use during pregnancy [6]. Moreover, there is an information bias associated with a lack of disclosure of herbal medicine use to researchers, particularly when a respondent is interviewed in a health care setting [23]. This is supported by the fact that more than two-thirds of users admitted that they did not disclose their use of herbal medicine to their health care providers.

Although the use of herbal medicines among pregnant women varied widely across different studies conducted in various sub-Saharan African countries, most studies from the region reported a relatively high prevalence of use [6]. For instance, all studies carried out in Zambia's bordering countries found a prevalence rate above 40%. In a study from Harare, Zimbabwe conducted in 248 pregnant women at 12 antenatal clinics, a 52% prevalence was noted [26]. In a more recent study from rural Zimbabwe in 398 women, 69.9% reported to have used traditional medicine during pregnancy and at childbirth [27]. Similarly, a study from Mbeya, southwest Tanzania conducted in 400 pregnant women found a 55% prevalence [28]. Likewise, a large study from Bukavu, eastern Democratic Republic of the Congo in 920 pregnant women reported a 45% prevalence of herbal medicine use [29]. Hence, the high herbal medicine use noted in our study is consistent with previous findings from Zambia's neighbouring countries. Nevertheless, it is difficult to ascertain whether the differences in prevalence across studies are caused by variability in study design, setting, data collection, and sampling techniques or whether they represent true differences in herbal medicine use [30–32].

In the present study, we found that sociodemographic characteristics were not associated with the use of herbal medicine in pregnancy. This is in line with other studies from sub-Saharan Africa [14,27,30], including the Maluma et al. (2017) study [18] conducted in the Kanakantapa and Chawama towns of Lusaka Province, in which herbal medicine use among pregnant women was not associated with area of residence, age, or educational level. This might be due to low statistical power to detect true differences in sociodemographic characteristics between users and non-users, or indicate that herbal medicine use is so common in Lusaka Province that sociodemographic factors do not impact on the use of herbal medicines.

Different herbal remedies were cited in the present study, with the most commonly used herbal medicines during pregnancy being lemon, soybean, ginger, and *Aloe vera*. The frequent use of lemon to treat nausea or vomiting, as found in our study, has been reported in previous studies from Bangladesh [33] and Pakistan [34]. Moreover, a double-blind, randomised, four-day study from Iran in 100 pregnant women found that inhaling the aroma of lemon essential oil was safe and more effective than placebo in reducing nausea and vomiting [35]. Similarly, several previous studies have shown that ginger is commonly used by pregnant women all over the world for nausea and vomiting during pregnancy [6,24,25,32,33]. A systematic review of 12 randomised controlled trials [36] involving 1278 pregnant women found that ginger significantly improved the symptoms of nausea when compared to placebo ($p < 0.001$). However, it did not have a significant impact on vomiting episodes, nor did it pose a risk for negative pregnancy outcomes [36]. Although the consumption of ginger in amounts used in food preparations was shown to be safe for both the mother and the foetus [36], using doses of dried ginger higher than 2.0 g per day is not recommended for pregnant women [37]. *Aloe vera* is perhaps one of the most widely used herbal remedies for topical skin conditions. *Aloe vera* extract improves skin moisture by a humectant mechanism [38], and prevents skin ulcers as it contains mucopolysaccharides, amino acids, zinc and water [39]. Although the topical application of *Aloe vera* is associated with infrequent AEs [39], orally ingested *Aloe vera* whole leaf extract has shown clear evidence of carcinogenic activity in rats, and was classified by the International Agency for Research on Cancer as a possible human carcinogen [40]. In addition, pregnant women are generally not advised to take oral preparations of *Aloe vera* because its

Table 4
Frequent medical conditions reported during pregnancy and their treatment status.

Medical condition	Women with condition n (% of total)	No treatment n (% of women with condition)	Pharmaceutical treatment only n (% of women with condition)	Treatment with herbs only n (% of women with condition)	Concomitant herbal and pharmaceutical treatment n (% of women with condition)
Nausea, vomiting or morning sickness	300/446 (67.3)	210/300 (70.0)	16/300 (5.3)	66/300 (22.0)	8/300 (2.7)
Abdominal pain or indigestion	248/446 (55.6)	192/248 (77.4)	49/248 (19.8)	6/248 (2.4)	1/248 (0.4)
Urinary tract infection	73/446 (16.4)	18/73 (24.7)	55/73 (75.3)	0/73 (0.0)	0/73 (0.0)
Headache	65/446 (14.6)	30/65 (46.2)	34/65 (52.3)	1/65 (1.5)	0/65 (0.0)
Common cold	51/446 (11.4)	7/51 (13.7)	6/51 (11.8)	37/51 (72.5)	1/51 (2.0)
Malaria	47/446 (10.5)	14/47 (29.8)	33/47 (70.2)	0/47 (0.0)	0/47 (0.0)
High blood pressure	22/446 (4.9)	3/22 (13.6)	16/22 (72.7)	1/22 (4.5)	2/22 (9.1)
Cough	16/446 (3.6)	0/16 (0.0)	2/16 (12.5)	13/16 (81.3)	1/16 (6.3)
Back pain	11/446 (2.5)	9/11 (81.8)	2/11 (18.2)	0/11 (0.0)	0/11 (0.0)
Vaginal problems (i.e., itching, bleeding, abnormal discharge, infection)	10/446 (2.2)	5/10 (50.0)	4/10 (40.0)	0/10 (0.0)	1/10 (10.0)

cathartic property might result in stimulating uterine contractions, thereby increasing the risk for premature labour or miscarriage [40]. Regarding the frequent use of soybean that was reported in the present study, no previous study to our knowledge has identified soybean as a commonly used herbal medicine by pregnant women. This might be partially due to the fact that some plants that are defined as medicinal plants are not regarded as such by many women [30]. During the course of the interviews for our study, we made sure to name several herbal medicines to capture their use by the study participants. Although there are possible health benefits associated with soy consumption [41], soy use during pregnancy was shown to alter the epigenome in mouse offspring [42]. Caution should therefore be practiced when some of these herbal medicines are being used, especially given that reliable, human data on the safety of most herbal medicines are currently lacking and often contradictory [6]. Nevertheless, the fact that some plant species are used by different societies could indicate their effectiveness and is pertinent for prioritising future studies on efficacy and safety [6].

Of great concern was the finding that 3.9% of herbal medicine users regularly ate soil mainly to treat nausea and vomiting of pregnancy. The deliberate consumption of soil, known as geophagy, is a traditional health practice that is prevalent among pregnant women across sub-Saharan African countries, such as Kenya, Zimbabwe, the Democratic Republic of the Congo, and Tanzania [26,27,43–45]. In the present study, it is very likely that underreporting of geophagy occurred for a variety of reasons, including embarrassment regarding the behaviour [44]. Although its health impacts remain controversial and inconclusive [44], geophagy was shown to be significantly associated with an increased risk of anaemia and lower concentrations of haemoglobin, haematocrit, and plasma zinc [46]. Moreover, African geophagic soil samples purchased from markets in sub-Saharan Africa, Europe and the United States were found to be highly contaminated with microbes (particularly aerobic bacteria and fungi) and contained potentially toxic heavy metals such as lead [47]. Lead exposure of pregnant women is dangerous for both the mother and the foetus, because this metal easily crosses the placenta resulting in adverse effects in child neuro-development and physical growth even at relatively low exposure levels [44,47]. Hence, geophagy is a major public health problem across the entire sub-Saharan African region, and particularly among pregnant women. Antenatal educational interventions are thus needed to improve pregnant women's understanding of the dangers of geophagy. The high use of herbal medicines during the first trimester of pregnancy as found in the present study (179/258; 69.4%) is another source of concern, as this is the most critical period of organogenesis, and taking herbs during the first trimester was found to be significantly associated with an increased risk of major congenital malformations [14,48].

The perceived safety of herbal medicines was posited as the most common reason for herbal medicine use in the present study. A similar finding was reported in studies from Kenya [23], Sierra Leone [31], Nigeria [49], Ethiopia [9], and Bangladesh [33]. Such perception may be related to the implicit belief that herbal products, being natural, are necessarily safe [14]. The belief that herbal medicines complement conventional medicines, which was the second most commonly cited reason for herbal medicine use in our study, is also concerning, given that the concurrent use of conventional medicines and herbal preparations might pose a potential drug interaction hazard. In the present study, however, very few clinically significant interactions between the cited herbal products and prescribed supplements/conventional medicines were identified. An example of a moderate herb-drug interaction that was found was between garlic or ginger and sulfadoxine. Both ginger and garlic may enhance the hypoglycaemic effect of sulfadoxine, resulting in additive hypoglycaemic activity [50]. A more serious interaction that must be mentioned is between garlic and ginger. Both herbs have antiplatelet properties; thus, their concomitant use may increase the risk of bleeding [51,52].

Alarmingly, more than 20% of respondents reported not receiving any treatment for serious diseases, such as malaria and urinary tract infections. This might be related to the economic burden of these infections or to inadequate evaluation of their symptoms. For instance, it has been shown that it is common for some patients not to visit health care facilities when they first feel characteristic malaria symptoms, such as fever [53]. Nevertheless, there remains an urgent need to improve the screening strategies and management practices of such potentially dangerous conditions among pregnant women in Lusaka Province.

There are some limitations to the present study which must be acknowledged. As this study was based on self-reported data obtained through interviews, it is prone to an interviewer bias and to a recall bias, and underreporting is very likely. However, we tried to reduce recall bias by the use of a semi-structured interview and by confining the enquiry to the current pregnancy. We also attempted to reduce interviewer bias by the use of more than a single interviewer (the principal investigator and a local research assistant) in the study. Moreover, since this study was conducted in three districts of Lusaka Province and pregnant minors were excluded, its findings may not be generalisable to other settings. Furthermore, this study adopted a non-probability sampling method and did not take clustering into account, which could introduce bias in the selection of interviewed subjects. Nevertheless, these limitations were balanced by several strengths, including the high response rate (92.8%), the absence of missing data, and the exploration of some herbs that were not previously studied. The specific naming of several different medicinal plants during the course of the interviews contributed to making the women aware that plants they did not regard as herbal medicines were indeed defined as such.

5. Conclusion

More than half of women attending antenatal clinics in Lusaka Province, Zambia reported using herbal medicines during pregnancy. A wide range of herbal remedies were cited by the study participants, with the most commonly reported being lemon, soybean, ginger, and *Aloe vera*. Two-thirds of users also admitted taking herbal remedies in at least two trimesters of pregnancy. Given this high prevalence of herbal medicine use and the low disclosure rate found in the present study, it is necessary for health care providers to discuss the use of herbal medicines with their pregnant patients in an open and non-judgmental way. There remains a dearth of information on the pharmacological and ethnobotanical characteristics of the different medicinal plants used during pregnancy in Zambia. Thus, further research and classification of the safety of herbal medicines used among pregnant women across Zambia are warranted.

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Ethics approval and consent to participate

The study was approved by the Regional Committee for Medical and Health Research Ethics in Norway (REC West; 2019/378), the University of Zambia Biomedical Research Ethics Committee (UNZABREC; 009-04-19), and the National Health Research Authority of Zambia. Permission to conduct the study was also obtained at each health centre. Written informed consent was obtained from all study participants.

Declaration of competing interest

The authors declare that they have no competing interests.

CRediT authorship contribution statement

Magalie El Hajj: Conceptualization, Funding acquisition, Investigation, Methodology, Formal analysis, Visualization, Writing - original draft. **Doreen Chilolo Sitali:** Validation, Project administration, Supervision, Writing - review & editing. **Bellington Vwalika:** Validation, Project administration, Supervision, Writing - review & editing. **Lone Holst:** Conceptualization, Funding acquisition, Methodology, Resources, Supervision, Formal analysis, Project administration, Writing - review & editing.

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Abbreviations

AE	adverse event
CI	confidence interval
HIV	human immunodeficiency virus
HM	herbal medicine
IQR	interquartile range
OR	odds ratio
SD	standard deviation

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