

# Understanding forgotten exposures towards achieving Sustainable Development Goal 3: the case of herbal medicine use in Tanzania

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## Research article

**Keywords:** Herbal use, Pregnancy, SDG 3, Tanzania

**Posted Date:** December 17th, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-39829/v3>

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**Version of Record:** A version of this preprint was published at BMC Pregnancy and Childbirth on April 1st, 2021. See the published version at <https://doi.org/10.1186/s12884-021-03741-5>.

## Abstract

**Background:** In most sub-Saharan African countries, herbal medicines are widely used during pregnancy or delivery for various motives despite their unclear pharmacology and potential toxicity. All risky exposures, including use of herbs during pregnancy or delivery should be restricted in order to facilitate achieving Sustainable Development Goal (SDG) 3, which states: “ensure healthy lives and promote wellbeing for all including reduction of morbidity and mortality among mothers and newborns”. Thus, this study assessed use of herbal medicines during pregnancy or delivery and determined factors associated with the practice in Tabora, Tanzania.

**Methods:** This cross-sectional quantitative study gathered information from 340 women who delivered a live-born baby in the preceding two years. Using a two-stage-sampling technique, we selected and interviewed women attending reproductive, maternal and child health clinics in public health facilities in Tabora, central Tanzania. We compared proportions using chi-square test and performed Poisson regression analysis to determine independent correlates of herbal use.

**Results:** Of 340 recruited women, 208 [61.2 %; 95% confidence interval (CI): 55.4, 66.3%] used herbal medicines during pregnancy or delivery. Major reasons for use included shortening of labour duration, 81 (38.9%) and reducing labour pain, 58 (27.9%). The independent predictors of herbal use were number of antenatal visits and the stance of maternity health care providers on the use of herbs. Women who made less than four visits had 24% higher prevalence ratio of using herbal medicines as compared to those who made at least four visits [adjusted Prevalence Ratio (aPR):1.24; 95%CI: 1.02, 1.50, p=0.03]. Furthermore, the adjusted prevalence ratio of using herbs was 35% higher among women who were not discouraged by health care providers against using herbs versus those who were discouraged (aPR: 1.35; 95%CI: 1.13, 1.60, p=0.01).

**Conclusions:** Use of herbal medicines during pregnancy or delivery among women in Tanzania is high. This calls for comprehensive investigations on the effects of using herbs during pregnancy or delivery as a step towards understanding some of the challenges in achieving SDG 3. Additionally, maternity health care providers ought to strengthen provision of health education messages during antenatal visits on the undesirable effects of using herbs.

## Background

Recent global estimates indicate that pregnancy and childbirth-related complications claimed about 300000 lives of women annually and most were observed in sub-Saharan African countries [1]. Tanzania, like many other sub-Saharan African countries has unacceptably high rates of perinatal mortality, 39 deaths per 1000 pregnancies; neonatal mortality, 25 deaths per 1000 live births; and maternal mortality ratio of 556 per 100000 live births [2]. Most of these deaths are preventable subject to appropriate management and quality of health care during pregnancy, delivery and postpartum periods [3].

The world has unanimously adopted the Sustainable Development Goals (SDGs) as a joint response to the prevailing under development and high maternal mortality [1]. Among them, SDG 3 is to “ensure healthy lives and promote wellbeing for all including reduction of morbidity and mortality among women and newborns”. Since maternal, newborn and child deaths are caused by factors attributable to pregnancy, childbirth and poor quality of health services, achieving the SDG 3 planned targets in the reduction of maternal mortality will also bring to end most preventable deaths of children less than five years of age.

Despite the United Nation's SDGs and consequent national policy adaptation, there remains dearth of comprehensive information on possible exposures that could deter achieving SDG 3 by 2030. Thus, such information will facilitate evaluations of best practices and adoptions that will inform decisions leading to synergy and complement the ongoing efforts to promote maternal health by increasing facility delivery from the current 60% to 90% by 2030. This is with the understanding that facility delivery environment is conducive for supervised and hence safer births, at the same time minimize exposures to unsafe traditional systems, including use of herbal medicines (HMs) during pregnancy or delivery.

Efforts by sub-Saharan countries geared towards attaining SDG 3 are however, focused at improving skilled attendance at delivery as end, without sufficiently considering some of the practices that have undocumented contribution to the observed maternal and newborn burden of disease. Increasing diversification in the causes of maternal mortality and morbidity calls for the importance of assessing and addressing not only the proximal causes of maternal death, but also the broad range of distal social determinants of health [4], including the use of herbs. In countries like Tanzania where the maternal mortality ratio remains high, antenatal education to increase birth preparedness and complication readiness is a priority. Such information includes birth plans during the antenatal period, such as the birthplace, birth attendant and transportation; health facility for complications, expenses and birth materials, as well as family coordination. Exposures, such as use of herbs during pregnancy or delivery are not part of the information, communication education package. Thus, the maternity health care providers only discuss about herbal medicine use at their own discretion. This study takes the first step towards contributing to understanding these exposures; starting with the use of HMs in pregnancy or delivery that may also be common in many other countries.

Existing evidence supports high magnitude of exposures to HMs whose safety is not known [5], subjecting women and newborns to potentially toxic substances before, during or after birth. For example, a recent systematic review of literature [6] focusing on use of HMs to induce labour by pregnant women revealed proportions of herbal use in the most recent pregnancy ranging from 6.5% in Ghana [7] to 80% in Uganda [8]. Similarly, high proportions (23%) of women in Tanzania use HMs during pregnancy and in inducing labour. The commonly used HMs include a wide variety of herbs such as ginger (*Zingiber officinale*), onions (*Allium cepa*) and Neem (*Azadirachta indica*) [9]. Ginger is likewise commonly consumed by pregnant women in Ethiopia [10] and the Middle East [11]

Use of HMs among pregnant women may depend upon social status, ethnicity and cultural tradition, and the indications for the use may vary across regions and can be mother or child-related [12]. Some of the reasons for using herbs during pregnancy or delivery include incidents of nausea and vomiting, strengthening pregnancy and health of the woman and the fetus; ensuring positive pregnancy outcomes and easing labour [9,13–16]. Others comprise of the conviction that HMs have the ability of inducing labour and shortening its duration, alleviating labour pains, enhancing removal of a retained placenta, as well as toning the uterine muscles post-delivery [13]. Furthermore, some women use herbs as remedies to protect the fetus from evil in-vitro [14] and to have a healthy baby [14,17].

Timing of intense exposures to the possible toxic materials coincides with very early stages of labour [9], posing risk to both mother and newborn. Use of herbs at this phase is aimed to stimulate uterine muscles resulting to stronger contractions and thus, hastening labour [8]. These herbs may be taken via the oral route in which they are most often consumed as a strong tea or chewed; rectal or vaginal routes and sometimes rubbing them on the pregnant abdomen [18].

Arguments of effectiveness of local herbs are, however, subjective and unjustified given the fact that HMs used across sub-Saharan Africa are associated with important research gaps as several of them have never been botanically identified [5]. Therefore, their use during pregnancy or delivery is a subject of concern since some plants might have parts that contain natural toxins that could be dangerous when they cross the placenta. Luckily, the modern health care system has readily available and safer interventions such as the use of oxytocin and artificial rupture of membranes to facilitate timely and safe deliveries.

With the imperative need to attain SDG 3 by the year 2030, exposure to herbs during pregnancy or delivery has to be restricted in order to improve maternal and newborn health. Henceforth, studying use of HMs in relation to maternal health is a public health priority in achieving SDG 3 in many countries including Tanzania. Thus, the objective of the study was to determine the current magnitude of exposure to herbs as an input towards efforts to achieving the goal of improving maternal health.

## Methods

### Study design and setting

This was a descriptive cross-sectional study, using quantitative methods. It involved women who delivered a live-born baby two years preceding the survey, between September 2016 and 2018.

The study was conducted in Tabora region, which is in central-western part of Tanzania. Tabora is one of the 31 administrative regions and the regional capital is the municipality of Tabora, which is one of the seven districts of the region. The most recent projected population of the municipality [19] based on the 2012 national population census is 262747 of whom women of childbearing age (15–49 years) constitute about 10%. Administratively, Tabora municipality has two divisions; namely Tabora North and South with 14 and 15 wards (administrative units) respectively. The health system comprises of 44

health facilities of which 36 are public. These include three hospitals, three health centers and 30 dispensaries. Of these public health facilities, 34 provide Reproductive, Maternal and Child Health (RMCH) services. Out of the 12020 women who attended antenatal care clinics in the municipality, 10450 (87%) delivered at health facilities.

### **Sample size estimation**

The sample size was calculated using the formula for estimating a single proportion,  $Z^2 p(1-p)/m^2$ ; whereby Z is the critical value of the normal distribution at 5% level of significance, p is an estimated proportion (23%) of pregnant women using HMs [9]; and 5% for m, an estimated margin of error. Allowing for a non-response rate of 20%, the ultimate sample size was 342 women attending RMCH clinics.

### **Sampling technique**

Tabora North and South divisions have 18 and 16 health facilities respectively, providing RMCH services. Proportionately, we estimated nine and eight health facilities from Tabora North and South divisions respectively. The first stage involved selecting health facilities from each of the two divisions using systematic sampling technique. In the second stage, we randomly selected women who met the study criteria from the clinics. The number of women selected in each facility was based on the proportion a facility contributed to maternal attendances in all selected facilities in a division put together in the previous month.

### **Study procedure and data collection**

A pre-coded and pre-tested semi-structured questionnaire was used to collect information on individual's demographic characteristics, availability and accessibility of HMs, use of HMs during the most recent pregnancy or delivery and the reasons for use. Also we asked about distance to the nearest public health facility, awareness of any untoward effects of using HMs for obstetrical purposes and whether or not the health care providers discouraged use of herbs during their antenatal clinic (ANC) attendance. The questionnaire was initially developed in English and later translated into Kiswahili which is the national medium of communication. It was then re-translated back to English. When consistency was achieved, the Kiswahili version was adopted for the interviews. A team of four registered nurses, not working in their respective clinics where we collected data were recruited as interviewers. They were initially trained on interviewing techniques, purpose of the study and ethical aspects. The research team administered the questionnaire to women in a calm environment within the health facility on exit.

We assumed that all selected women were most likely to remember use of HMs during their most recent pregnancy or delivery, thus, in position to give a self-report. For content validity of the tool and other methodological issues as described by Castillo-Montoya [20], we ensured interview questions aligned with the research questions; and discussed the protocol with an obstetrician. We used the feedback to improve the interview questions. In order to improve the face validity, we pre-tested the instrument among

10% of the estimated sample size of women in a near-by health facility that was not earmarked for the main study. The questionnaire was modified as necessary based on the pre-test findings.

## Inclusion criteria

The study only included women who had delivered a live-born baby between September 2016 and September 2018 and attending RMCH services in the municipal health facilities. Only women consenting were interviewed.

## Study variables and measurements

The dependent variable was HM use during the last pregnancy or delivery, responded as Yes or No. Socio-demographic characteristics of interest included 1) *age* (in completed years); 2) *current marital status* (never in union, currently in union, previously in union); 3) *highest education level attained* (none/primary incomplete, primary complete, secondary and above); and 4) *occupation of respondent/spouse* (housewife/peasant, self-employed, formerly employed). Others included 5) *distance to the nearest health facility* 6); *number of antenatal clinic visits*; 7) *perceived availability of herbs* (easily available, not easily available); 8) *perceived safety of herbs* (safe, not safe); and 9) *stance of maternity health care provider on the use of HMs* (did not discourage use, discouraged use). Quantitative independent variables were categorized as: age of the mother (16 to 25; 26 to 35, 36+ years); distance to the nearest health facility (> 5 km, ≤ than 5 km); and number of antenatal visits (less than 4, 4 or more visits).

## Statistical analysis

We analysed data using computer software, the Statistical Package for Social Sciences, Version 24. Initially, by running frequencies of all variables, we were able to detect possible out-of-range values that were corrected. We then performed bivariate analysis and used Pearson's Chi-square test to assess the association of the selected independent variables with mother's HMs use during the most recent pregnancy or delivery. To assess independent predictors of use of herbs, factors with p-value <0.2 in the binary analyses were selected to enter into a modified Poisson regression model [21] with robust standard error estimation. Factors that were loaded into the model included occupation, frequency of ANC visits, distance to the nearest facility, perceived safety of HMs and the stance of health care providers regarding use of herbs in pregnancy or delivery. Effect sizes of the different factors on use of HMs are presented as Adjusted Prevalence Ratios (aPR) and their corresponding 95% confidence intervals (CI); and the significance level was set at 5%.

## Results

We recruited 340 women (recruitment rate of 99.4%). A large proportion of women, 208 (61.2%; 95%CI: 55.4, 66.3%) used HMs during their most recent pregnancy or delivery. While the majority, 138 (66.3%), used herbs for obstetrical reasons at least on three different occasions, 16 (7.7%) and 54 (26.0%) used herbs on either one or two occasions respectively. Of the 208 women who used HMs, 57 (27.4%) viewed

them as easily available and 83 (39.9%) considered them safe. The main modes of administration included oral 135 (64.9%) and intra-vaginal 59 (28.4%) routes. The main perceived benefits of using herbs among the 208 women who used them included shortening of duration of labour, 81 (38.9%) and alleviating labour pains, 58 (27.9%) as displayed on **Figure 1**.

Less than half, 164 (48.2%) of the 340 respondents were aware of adverse effects of using HMs in pregnancy or delivery. Significantly more women, 93.3% (153/164), who were aware of the adverse effects of using HMs used them as compared to 31.3% (55/176) who were not aware ( $p < 0.01$ ). Regardless of herbal use status, 70 (20.6%) mentioned uterine rupture, 51 (15.0%) excessive vaginal bleeding, while 21 (6.2%) pointed out the possibility of death of the mother and/or the baby as untoward consequences of using herbs. The main perceived benefits of using herbs among the 208 women who used them included shortening of duration of labour, 81 (38.9%) and alleviating labour pains, 58 (27.9%) as displayed on **Figure 1**.

In the bivariate analyses (**Table 1**), herbal medicine use was significantly associated with distance to the nearest health facility ( $p=0.021$ ), number of antenatal visits ( $p = 0.011$ ), perceived safety of herbs ( $p < 0.01$ ) and the stance of health care providers ( $p < 0.01$ ). However, there was no significant association between use of HMs and maternal age, marital status and education level; occupation and perceived availability of herbs.

**Table 1:** Bivariate analysis of selected characteristics with herbal medicine use in the most recent pregnancy or delivery among women in Tabora, Tanzania

Characteristic	Total	Herbal use Number (%)	Chi-square, p- value*
<b>Age group (years)</b>			1.62, 0.431
16-25	83	46 (55.4)	
26-35	142	88 (62.0)	
36+	115	74 (64.3)	
<b>Marital status</b>	25	14 (56.0)	0.67, 0.717
Never in union	285	174 (61.1)	
Currently in union	30	20 (66.7)	
Previously in union	87	50 (57.5)	
<b>Education level</b>	175	104 (59.4)	2.86, 0.239
None/prim incomplete	78	54 (69.2)	
Primary complete			
Secondary and above	177	108 (61.0)	
<b>Occupation of mother</b>	127	73 (57.5)	3.63, 0.163
Peasant/housewife	36	27 (75.0)	
Self-employed	159	103 (64.8)	
Formerly employed	91	59 (64.8)	
<b>Occupation of spouse<sup>†</sup></b>	78	40 (51.3)	4.59, 0.101
Peasant	85	61 (71.8)	
Self employed	255	147 (57.6)	
Formerly employed			
<b>Distance to nearest facility (km)</b>	199	133	5.35, 0.021
> 5	141	(68.8)	
≤ 5		75 (53.2)	
<b>No. of ANC visits</b>	283	39 (68.4)	6.47, 0.011
< 4 visits		169 (59.7)	
≥4 visits	83		
<b>Perceived availability of herbs</b>	257	64 (77.1)	1.51, 0.219
Easily available		144 (56.0)	
Not easily available	131		
<b>Perceived safety of herbs</b>	209	96 (73.3)	11.74, <0.01
Safe		112 (53.6)	
Not safe			
<b>Health care provider's stance towards use of herbs</b>			13.15, < 0.01
Did not discourage			
Discouraged use			

\* Pearson's chi-square

† 12 missing values

In Table 2, we present independent factors associated with HM use during the most recent pregnancy or delivery. Significant predictors of herbal use were number of ANC visits and maternity health care provider's advice against the use of herbs. The adjusted prevalence ratio of using HMs was 24% higher among women who made less than four visits to the ANC as compared to women who made four or more visits (aPR: 1.24; 95%CI: 1.02, 1.50, p=0.03). Furthermore, the aPR of using HMs was 35% higher among women who were not discouraged by the maternity health care providers against using herbs during pregnancy or delivery versus those who were discouraged (aPR: 1.35; 95%CI: 1.13, 1.60, p=0.01).

**Table 2:** Poisson regression analysis of predictors of herbal medicine use during the most recent pregnancy or delivery in Tabora, Tanzania (N=340)

Factor	Herbal use Number (%)	Prevalence Ratio (95% CI)		
		Crude	Adjusted	p-value
Occupation of mother				
Peasant/housewife	108 (61.0)	0.81 (0.65, 1.02)	0.83 (0.64, 1.07)	0.14
Self-employed	73 (57.5)	0.77 (0.60, 0.98)	0.89 (0.69, 1.17)	0.42
Formerly employed	27 (75.0)	Reference	Reference	
Occupation of spouse				
Peasant	103 (64.8)	1.26 (0.99, 1.61)	1.17 (0.90, 1.51)	0.24
Self employed	59 (64.8)	1.26 (0.97, 1.65)	1.15 (0.88, 1.49)	0.32
Formerly employed	40 (51.3)	Reference	Reference	
<b>No. of ANC visits</b>				
< 4 visits	133 (68.8)	1.26 (1.05, 1.51)	1.24 (1.02, 1.50)	0.03
≥ 4 visits	75 (53.2)	Reference	Reference	
Distance to nearest health facility (km)				
> 5	61 (71.4)	1.25 (1.05, 1.48)	1.09 (0.90, 1.31)	0.37
≤ 5	147 (57.6)	Reference	Reference	
Perceived safety of herbs				
Safe	64 (77.1)	1.38 (1.17, 1.61)	1.12 (0.87, 1.42)	0.40
Not safe	144 (56.0)	Reference	Reference	
Health care provider's stance towards herbs use				
Did not discourage	96 (73.3)	1.37 (1.16, 1.61)	1.35 (1.13, 1.60)	0.01
Discouraged use of herbs	112 (53.6)	Reference	Reference	

## Discussion

In this study, we determined the magnitude of use of herbal medicines (HMs) during pregnancy or delivery. We also examined factors associated with the use of herbs among women who delivered a live-

born baby between September 2016 and 2018, in Tabora, central Tanzania. Findings show that use of HMs during pregnancy or delivery is high (60%).

Worldwide, use of HMs has grown considerably among pregnant women, and particularly in sub-Saharan Africa [5]. Similar to the findings in Tabora, the level of use of HMs is high in other areas of sub-Saharan Africa, Asia and Middle East, where the proportions of use range between 20% to 80% [9,11,22–24]. For many years, women use HMs for remedial of several conditions during pregnancy and in the delivery process. Findings from our study are consistent with reports from other countries that pregnant women use herbs for different purposes, including easing pain, accelerating labour, increasing milk production, and aiding postpartum uterine involution [13,22,25]. The grounds for the high usage of herbs could be attributed to their easy accessibility and the general lack of awareness of their potential side effects [26–28].

Women who perceive HMs as safe during pregnancy or delivery tend to use them more than those who perceive the herbs as unsafe [10,24,29]. In the current study, the prevalence ratios of using herbs were between 10% and 40% higher among women who perceived herbs as safe versus those who perceived them as unsafe. Despite the lack of significant association between perceived safety and use of HM during pregnancy, the assertion women have about safety of these herbs will only make scientific sense when the herbs are authentically tested, standardized, and quality controlled [30]. Thus, the high-unchecked use of herbs especially in relation to pregnancy should invite a concern. It is even more serious as the unproven perceived safety can lead to rapid increase in promotion of traditional medicines in the society as well as the media. It is common to see posters advertising traditional medicines and herbalists in various parts of Tanzania. In such advertisements, HMs are often promoted as natural and safe, attracting their wide use, especially among pregnant women who are concerned about the whole process of childbirth and health of the unborn child.

Plants used for herbal remedies are less expensive as compared to modern medicines and they have been culturally considered as being effective and an acceptable option even when modern health facilities are available [31]. Notwithstanding their easy availability and perceived effectiveness, many countries with high usage of herbs have also poor quality of health services and lower hygienic standards than countries with lower usage of herbs. However, some of these countries with high usage of HMs are also reporting high maternal and new born morbidity and mortality, suggesting a connection between use of herbs and adverse pregnancy outcomes. In rural Malawi for instance, where 25.7% of pregnant women used a popular herb, *mwanamphepo*, the odds of maternal morbidity were 28% higher among self-reported users than non-users of *mwanamphepo*. Furthermore, the probabilities of neonatal morbidity or death were 22% higher among neonates whose mothers reported use of the *mwanamphepo* than those who did not [28]. Significantly higher odds of having postnatal complications have also been observed among women in Tanzania who reported use of local herbs during pregnancy or delivery versus those who did not [17]. A report from Northern Italy also suggests an increased risk of giving birth to preterm babies among women who regularly rub almond oil on the pregnant abdomen compared with non-users [18]. Although we cannot completely rule out the effect of pressure exerted on a pregnant abdomen

through rubbing with herbs, the safety of any drug, including herbs, cannot be guaranteed in pregnancy because of the possible teratogenic effects [32].

Physical accessibility to health care facilities is an important attribute to using herbs during pregnancy [6,16,24,27,33]. In this study, women who reside far away (5 km or more) from the nearest health facility have almost 10% adjusted prevalence ratio of using HMs compared to women living closer to health facilities. However, the association between use of herbs and distance to facility in this study was not statistically significant, most probably due to the fact that participants were from an urban setting where health care facilities are concentrated. Despite this, long distances may contribute to women delivering under the care of unskilled attendants and hence exposure to the use of medicinal herbs. However, there might also be silent exposures even when a birth takes place in a health care facility. For instance, a study among healthcare professionals in Scotland revealed that a third of the respondents, significantly more midwives recommended use of complementary and alternative therapies to pregnant women [34].

Whereas response to high exposures to herbs during pregnancy or delivery is essential, the most important concern is lack of awareness and knowledge among pregnant women [15] and the community about potential side effects of using HMs on the mother and the fetus [6,35]. Findings from this study are similar to observations from other countries where self-medication with herbs during pregnancy or delivery is common but very few women attending antenatal care services receive information on their adverse effects. In Kenya for instance, merely 14% of pregnant women received health advice from healthcare workers [36]. In the current study, compared to women who were advised by the maternity health care providers against the use of herbs during pregnancy or delivery, significantly ( $p=0.01$ ) more women who did not receive such advice used herbs. This may suggest that if women get appropriate information during pregnancy they will greatly evade the use of herbs. In Tabora, all women received ANC services at least ones during the most recent birth, therefore presenting an opportunity to discuss the use of HM.

This study has several potential limitations that readers must consider when interpreting the findings. First, although we assumed that women who gave birth within the preceding two years were likely to remember use of HMs in their most recent pregnancy or delivery; we are unable to completely rule out the possibility of recall bias. If some women were unable to remember, this bias could have contributed to the low estimates. Second, some women were aware that use of HMs during pregnancy was discouraged by health care providers. Therefore, due to social desirability bias, there is a possibility that some respondents concealed reporting use of HMs, thus leading to under-estimating the proportion of HMs use. Third, there is possibility that the variables we considered as independent may not be exhaustive. Despite all these, to the best of our knowledge, this is the first study to attempt assessing use of HMs during pregnancy or delivery as a forgotten exposure when adopting strategies to attain the SDG 3 target on reduction of maternal and newborn mortality.

## Conclusions

The results point out that as high as 60% of women possibly in most of the urban settings in Tanzania use herbs for various reasons during pregnancy or delivery. Frequency of attending antenatal clinic services and the health care providers' stance towards of HMs were significant predictors of use of herbs. The study forms basis for designing intervention programs to address use of herbs during pregnancy or delivery. Findings also underscore the important role of maternity health care providers; given the high prevalence of the use of herbs in our community amidst lack of evidence of their safety. Thus, understanding the magnitude of herbal use and addressing its predictors is a fundamental step towards achieving SDG 3. Therefore, first, we recommend further research on the extent and patterns of use of HMs among women during pregnancy or delivery, in both urban and rural settings. Second, maternity health care providers need to compulsorily include strong health education messages on the undesirable effects of using herbs in the routine sessions they provide to pregnant women.

## Abbreviations

ANC: antenatal clinic; aPR: adjusted prevalence ratio; CI: confidence interval; cPR: crude prevalence ratio; HMs: herbal medicines; RMCH: reproductive, maternal and child health; SDG: Sustainable Development Goal

## Declarations

### Ethics approval and consent to participate

The Muhimbili University of Health and Allied Sciences (MUHAS) Institutional Review Board reviewed and approved the protocol (Ref . No. DA.287/298/01/A/). We explained the purpose and benefits of the study to each participant. We emphasized voluntary participation such that each participant was free to respond or not, to each question and to stop responding to any question at any point regardless of the services she was expecting to get. We assured strict anonymity and confidentiality to all participants. Before the interviews, we requested each potential respondent to sign (or thumbprint) the consent form.

### Consent for publication

Not applicable.

### Availability of data and materials

All data generated or analyzed during this study are included in this article and are available upon request from the corresponding author.

### Competing interests

The authors declare that they have no competing interests.

### Funding

Centers for Disease Control and Prevention (CDC) through Muhimbili University of Health and Allied Sciences partially supported data collection. However CDC had no role in the study or decision to publish.

### **Authors' contributions**

ATK and GCM conceptualized and developed the protocol. ATK guided data collection. GCM supervised field activities. ATK and GCM analyzed and interpreted the data. GCM drafted the manuscript. ATK revised the manuscript. ATK and GCM read and approved the final manuscript.

### **Acknowledgements**

We are thankful to the Tabora Municipal Executive Director and Medical Officer of Health for permission to conduct the study in the study area. We thank all the women who volunteered to participate in the study.

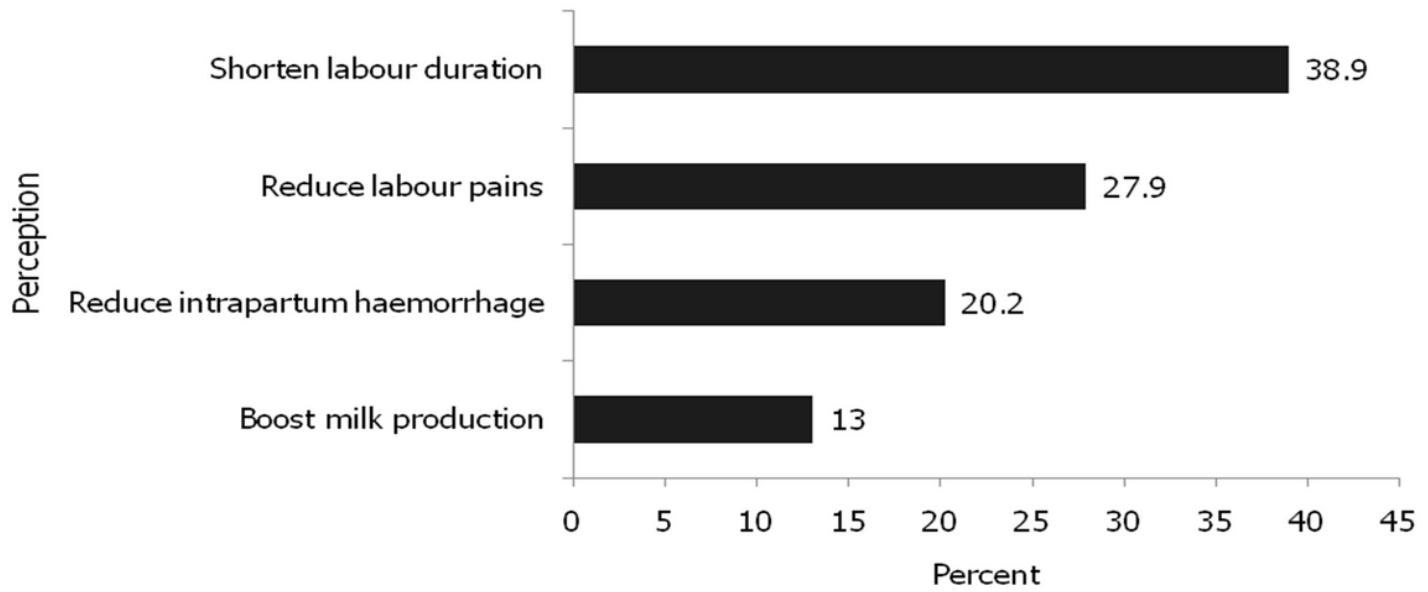
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## Figures



**Figure 1**

Most perceived benefits of using herbal medicines during pregnancy or delivery