Traditional Medicine Use during the Third Trimester of Pregnancy and Lower Birthweight in Rural Cambodia

by

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Abstract

Background: Prenatal use of traditional medicine (TM) is universal despite the inadequate evidence of its effectiveness of these therapeutic options. In Cambodia, most women prepare TM at the beginning of the 4^{th} or 5^{th} month of pregnancy with the belief that consuming TM improves the safety of delivery. Research has not adequately explored the use and effects of these maternal practices in Cambodia.

Objective: To describe the prenatal use of TM and identify associated birth outcomes.

Methods: A cross-sectional study of 117 postpartum women at a hospital in Cambodia was carried out employing a semi-structured questionnaire. Multivariate regression was used to identify the association between TM use during pregnancy and birth outcomes while adjusting for confounders.

Results: 59% of the participants used TM during pregnancy aiming to ease the delivery, improve their own and their fetus' well being, and follow the custom. In total, 30 medicinal plants and TM prepared by traditional healers (TH) were used by the participants. After adjusting for confounders, utilizing the unidentified TM prepared by TH in third trimester was significantly correlated with lower birthweight ($p<0.01$) compared to non TM users.

Conclusion: TM use during pregnancy was common in the study setting and was significantly associated with lower birthweight when compared to non TM users. It was not statistically associated with adverse obstetrical events or gestational age at birth. Nonetheless, women are advised caution regarding use of TM during pregnancy particularly in the third trimester.

Keywords: Traditional medicine, pregnancy outcomes, low birthweight, Cambodia

Introduction

In Cambodia, maternal mortality has been drastically reduced by 56.4 percent from 2000-2005 to 2006-2010. Factors contributing to this reduction include political stability, economic growth, improved education and roads, and enhanced accessibility of health information via media such as TV or radio. In particular, there has been improvement in health services, including more facility-based births and skilled birth attendants.(1)

Despite the increasing antenatal medical care (1), pregnant women in Cambodia resort to TM in order to ensure fetal development and facilitate delivery (2). TM in Cambodia and many other countries can be best defined as the use of crude plant materials such as leaves, flowers, fruits, seeds, stems, wood, bark, roots, rhizomes or other plant parts from single or multiple plants for healing purposes (2-6).

Research by the Cambodian-Australian Welfare Council through existing documents, search engines, Khmer history, and cultural handbooks showed that Cambodian pregnant women using TM prepare it at the beginning of the fourth or fifth month of pregnancy (2). The purpose of using TM during pregnancy are the beliefs that consuming TM improves the safety of delivery by enhancing the slipperiness of the birth passage and also promotes good health for both mother and infant (2). Pregnant women boil TM in water and drink it in the form of tea (2). Two common sources of TM are homemade and purchased in dried, pre-mixed form (2). Homemade TM is collected from home gardens or in the forest and prepared by elders in the family who have prior knowledge of making TM (2). Dried, pre-mixed TM is prepared by traditional healers who specialize in medicinal practices with a spiritual component (7).

TM plays an important role during pregnancy, birth and postpartum care in many countries (8-15). Regardless of the fact that there is insufficient data to demonstrate the safety of

TM (15-22), many studies have shown that women consider TM to be safer than biomedicine since TM is more natural, simpler, and familiar to them (6, 23-25). Some of the shared beliefs that cause women to prefer TM are related to their traditional philosophical views on life and health (3, 21, 26-30).

The safety of TM becomes particularly significant for pregnant women who are more vulnerable to the effects of drugs than are the general population (3). TM can cause potentially adverse reactions because TM is usually the mixture of active ingredients that can negatively interact (31-34). For instance, a study in South Africa found that the use of TM led to fetal distress (15), and another study in Taiwan confirmed that taking TM during the first trimester of pregnancy was associated with an increased risk of congenital malformations (19). The practice of using TM during pregnancy, therefore, has raised concerns among public health professionals regarding its benefits and risks (35-36).

Due to the global pervasive use of TM, the World Health Organization (WHO) has developed a policy to ensure its safety, efficacy and quality, and rational use (37). The policy involves expanding the knowledge of TM and providing guidance on regulatory and quality safety (37). However, researchers still have not adequately explored maternal TM use and the effects of these practices in Cambodia. Nor have there been studies demonstrating the safety patterns of TM use during pregnancy. Therefore, the present study was conducted to explore the effects of prenatal use of TM on birth outcomes in Ou Reang Ov district, Kampong Cham province, Cambodia. It was hypothesized that taking TM during pregnancy would be significantly associated with deleterious birth outcomes, such as low birthweight and other obstetric-related adverse events.

Methodology

Study Setting

The study was conducted at Ou Reang Ov Hospital, which is located in Ou Reang Ov district, Kampong Cham province, Cambodia approximately, 165 km Southeast of Phnom Penh, the capital city of Cambodia (38). Ou Reang Ov Hospital is part of a district-based health system, which is also known as the operational district (OD), serving approximately 100,000-200,000 people (39). The OD is composed of referral hospitals and health centers (40). Referral hospitals are expected to support primary care, including the resources and expertise available for district health services. The services in the health centers include initial consultations, primary diagnoses, emergency first aid, chronic disease care, maternal and child care (including normal delivery), birth spacing advice, immunization, health education and referrals (41).

Study Sample

Eligible participants were postpartum women who gave birth within one year and were able to understand the purpose of the study when they were given the oral consent form. A time period of one year or less after giving birth is commonly considered to be short enough to minimize recall bias (42) (43). A final sample of 117 postpartum women who were visiting the Ou Reang Ov Hospital for their infants' vaccinations were interviewed from July 10 to August 16, 2013. Although 118 postpartum women were eligible for the study, one woman was not able to complete the survey questions due to her crying baby.

Study Design

A questionnaire-based cross-sectional survey was conducted. This design was employed because of its ability to determine the associations between taking TM and birth outcomes in a short period of time.

The present study compared the birth outcomes among women who took TM during their most recent pregnancies and women who did not take TM during their most recent pregnancies. Both groups of women were sampled from a large population of women who went for prenatal check-ups and got advice from the same hospital. Consequently, the results from both the TM user and non-user groups were comparable, as the study design removed the potential confounders such as access to similar quality medical health care during pregnancy.

Format of Questionnaire

The questionnaire used in this study was a semi-structured questionnaire composed of both closed and open-ended questions designed based on the existing literature in this field of study. The questionnaire was created and planned according to the methodological literature of Boynton and Greenhalgh (44) (45). It was composed of six sections as described below:

Section 1*-Delivery Record:* This section asked about the baby's sex, age, birth weight, and method of delivery (normal birth, Caesarean section, and forceps or vacuum).

Section 2*-Demographic Information:* This section queried socio-demographic information of participants regarding age, number of children, weight before the most recent pregnancy, height, years of schooling, employment status, distance from the nearest health center to the participants' residences, the transportation used to access the health services and whether they found it easy to go for prenatal check-ups.

Section 3*-Most Recent Pregnancy Information:* This section, included the number of prenatal check-ups throughout the course of pregnancy; development of health conditions (hypotension, diabetes, anemia, pre-eclampsia, gestational diabetes or antepartum bleeding); whether they had a clear threat of miscarriage; their delivery date and place, alcohol intake during pegnancy, use of betel leaves, areca nuts or chewing tobacco during pregnancy, and the type of tasks they performed during pregnancy. This section also queried the perceived amount of breastmilk and postpartum morbidities.

Section 4*-Use of TM in Most Recent Pregnancy:* This section questioned the prenatal use of TM during the most recent pregnancy for only the users. The definition of TM was not explained in the introduction to the study interview because TM is common and a well understood term among pregnant women in Cambodia. Women were considered to be "TM users" if they used TM orally at any frequency, duration or amount during any trimester of the most recent pregnancy. They were asked about reasons for taking TM, to evaluate of whether TM was perceived as beneficial, their observations once TM was taken, purposes of consuming TM, specific names and dosage form of TM used, and the time of TM use.

Section 5*-Prior History of TM Use:* The women were asked whether they had ever used TM in their earlier pregnancies. If they said yes, for those who did not use TM during their most recent pregnancy, they were asked why they had not continued. For those who did use TM during their most recent pregnancy, they were asked why they continued using TM. They were also asked whether they had ever used TM before they became pregnant in case they would have been exposed during pregnancy.

Section 6-Information regarding history of child death experiences, miscarriage, and the presence of chronic diseases.

Data Collection Preparation

The questionnaire was translated from English into Khmer language and the results were re-translated into English. Before being adopted as the study's data collection tool, the questionnaire was pretested among 6 women who had similar demographic characteristics to ensure face and content validity and clarity. According to the results obtained, a few terms had to be revised, and some questions were rephrased to improve their clarity. The interviews lasted about 20 minutes.

Written notes were taken instead of using voice recording devices because participants might have felt uncomfortable sharing information when their voice was being recorded. As almost all questions were closed ended questions, this lack of recording did not result in a reduction in results accuracy or inability to capture all information.

Obtaining Access to Participants

Before conducting the interview, the purpose of the study was explained to all personnel who were involved, such as the hospital chief, village chief, and postpartum women. Also, to seek their approval to conduct the interviews in the hospital and at the postpartum women's homes, approvals were obtained from the hospital and the village chief, respectively.

Data Collection

Data collection was conducted from Monday to Friday, starting from 9:00 AM until 11:30 AM in the hospital. Fifteen women were interviewed at home at their own request because they were too busy to talk at the hospital. Among the fifteen participants that were interviewed at home, five were TM users.

Variables

This study focused on the impact of prenatal use of TM on the pregnancy outcomes. The main outcomes measures were birthweight, gestational age at birth, and mode of delivery (normal birth and complication during birth). Birthweight was treated as both continuous variable and categorical variable (low-birth-weight: infant weighing <2500g, and normal birthweight: infant weighing ≥2500g). Gestational age at birth was also treated as continuous variable (days).

Covariates

According to a previous study regarding the associations between prenatal use of TM and birth outcomes (19), the following factors were identified as potential confounders for this study:

- **Characteristics of the mothers**: age, education, employment status, height, pre-pregnancy body weight and body mass index (BMI).
- **Characteristics of the infants themselves**: sex, parity, gestational age, and birthweight.

The WHO low birthweight cut off of less than 2500g was considered low birthweight as below this birth-weight infant mortality begins rising rapidly (47).

- **Obstetric history and maternal exposures during pregnancy**: previous histories of gynaecological diseases, previous spontaneous abortion, chronic diseases, diabetes, hypotension, antepartum haemorrhage or medicines used during pregnancy and other diseases.

Coding, Data Entry and Management

A codebook was created that listed each variable name and type including responses and value labels. Data from open-ended question were read carefully and categorized either according to the most frequently mentioned responses, and the least frequently mentioned responses were put in an "other" category. Data were entered in the Statistical Package for the Social Sciences (SPSS) software (version 16) (SPSS Inc., Chicago, IL, USA). Then the quantitative data were analyzed using Stata version 12. Each participant was given an ID number in the database to protect her privacy.

Statistical Analysis

Simple descriptive methods and cross-tabulations were performed to check the validity of data. Means and standard deviations were computed for continuous data. Continuous data were also checked to determine whether they were normally distributed using the One-Sample Kolmogorov-Sminow test. Frequencies and percentages were calculated for categorical and ordinal variables.

Logistic regression was used to explore the demographic variables that were more likely to affect TM use during pregnancy. Chi-square test was used to analyze univariate associations between prenatal use of TM and categorical variables of birthweight (low and normal birthweight) and mode of delivery (normal and complication birth). For the cell which has less than five responses, the p-value was chosen based on the Fisher's Exact Test; otherwise the p-value from Pearson Chi-square was used. Student's *t*-test was employed to identify the association between TM use during pregnancy and continuous variables of gestational age at birth (days) and birthweight (gram).

Finally, multivariate regression analysis was used to generate models in order to evaluate the associations between pregnancy outcomes and prenatal use of TM while adjusting for potential confounders and effect modifiers. All the demographic variables that might have been associated with adverse pregnancy outcomes and prenatal use of TM were checked to identify for both confounders and effect modifiers. If the β value showed relative changes greater than 10 percent after adjustment for confounders, those variables were considered as confounders. Notably, baby's sex, maternal education, employment status, mode of delivery and gestational age at birth were always put in the model because they were known to be confounders though β value did not show changes more than 10 percent. β value and their confidence intervals were obtained from the multivariate regression. The statistical significance was set at $p<0.05$.

Since only five infants had low birthweight and all of them had their mothers took TM during pregnancy, further sensitivity analysis were performed by excluding the five low birthweight.

Ethical Considerations

This study was approved by the Asian University for Women Institutional Review Board, Bangladesh. Verbal informed consent was obtained from all participants who agreed to participate voluntarily after the study had been explained to them. The participants were asked where they would be most comfortable being interviewed. They were also told that they had the right to withdraw from their interview at anytime if they did not feel comfortable with the questions. Furthermore, the interviewees were informed that the information they provided would remain anonymous in the study reports. All files would be password-protected to maintain confidentiality. They would only be identified by code number. The report would not reveal any

individual participant identity information, but only statistical information about the group that was interviewed.

There was a possibility that the participants would feel obliged to participate in this interview since it was conducted in the hospital with the permission from the hospital chief. Similarly, this also happened at postpartum women's homes because of the presence of the village chief. To handle the issue, I repeatedly reminded participants that I was not a person of authority; I was a student who was doing research for my own academic learning. I also reassured them that they had the right to refuse to be interviewed.

Furthermore, there existed the potential that the interviews could affect participants emotionally when they were asked whether they experienced miscarriage, or any chronic diseases making interviewees emotionally tense. To handle the problems, before I asked them these questions, I told them that I would ask them these types of questions and whether they were comfortable in answering them. If not, I would not ask them and they had the right not to answer. All the participants agreed to carry on with the interview.

For the hospital-based interviews, the participants were not given any incentives. However, for the home-based interviews, each participant was provided a bar of soap. Ethically, the small gift was considered as compensation to the participants for spending time participated in the study.

Results

Demographic Characteristics

The final sample size was 117 (99.15% response rate). Participants were all from the Khmer ethnic group and were Buddhists. Their ages ranged from 18-45 years old with an average age 27.2 ± 5.6 years (Table 1). All took iron supplements during their pregnancies, and the majority took approximately 80-90 iron tablets. During their most recent pregnancy, participants experienced gestational diabetes (3.4%), had slight antepartum haemorrhage (12.8%), smoked (2.6%), drank beer (3.4%), delivered babies at home (20%), and delivered babies at health facilities (80%). Their characteristics that could have been associated with birth outcomes were summarized in Table 1 along with the p-values to indicate the significant associations with prenatal use of TM.

The demographic variables among the selected sample did not differ between TM users and non-TM users, with the exception of women who had used TM in the past also used TM during their most recent pregnancy, BMI less than 18.5, and women who had 2 children were significantly higher among TM users (p= 0.05, 0.00, and 0.05 respectively).

Prenatal Use of TM

In all, 69 (59%) of the participants reported as TM users during their most recent pregnancy with a mean of 2.8 medicinal plants per women (range: 1-6). In total, 30 herbs and unknown TM prepared by TH were utilized among the selected women.

The most common TM used among participants were baby coconut (36.2%), *Ocimum basilicum* (20.3%), ripe coconut (23.2%), *Shorea robusta* (47.8%), *Tamarindus indica* (20.3%), and unidentified TM prepared by TH (36.2%) (Table 2). TMs were frequently used only during

Table 1: Demographic Features of the Selected Women according to Prenatal TM Use (n=117)

Characteristics	**TM User n (%)**	**Non-TM User n (%)**	***P*-value**
Total	69 (59)	48 (41)	
Use of TM in the earlier pregnancy and the most recent pregnancy			0.05
No previous pregnancy (ref)	37 (53.6)	15 (31.3)	
No	3 (4.3)	4 (8.3)	0.15
Yes	29 (42.1)	29 (60.4)	0.03
Age (year)			0.48
≤24 (ref)	27 (39.1)	16 (33.3)	
25-29	23 (33.3)	19 (39.6)	0.45
30-34	12 (17.4)	5 (10.4)	0.57
≥35	7 (10.2)	8 (16.7)	0.28
Body height (cm)			0.92
>156 (ref)	27 (39.1)	18 (37.5)	
≤150	20 (29.0)	13 (27.1)	0.92
151-155	22 (31.9)	17 (35.4)	0.74
Pre-pregnancy weight (kg)			0.44
≤45 (ref)	25 (36.2)	13 (27.1)	
46-50	25 (36.2)	17 (35.4)	0.56
≥51	19 (27.6)	18 (37.5)	0.21
Body mass index (kg/m^2)			<0.01
≥18.5 (ref)	48 (69.6)	44 (91.7)	
<18.5	21 (30.4)	4 (8.3)	0.01
Education (year)			<0.01
≤6 (ref)	44 (63.8)	15 (31.3)	
7-9	22 (31.9)	19 (39.6)	0.03
≥10	3 (4.3)	14 (29.1)	<0.01
Occupation			0.11
Business (ref)	23 (33.3)	25 (52.1)	
Household	17 (24.6)	7 (14.6)	0.07
Farmer	29 (42.1)	16 (33.3)	0.11
Number of children			0.05
1 (ref)	37 (53.6)	15 (31.3)	
2	19 (27.5)	21 (43.7)	0.02
≥3	13 (18.8)	12 (25.0)	0.10
Number of prenatal check-up			0.93
3-5 (ref)	36 (52.2)	24 (50.0)	
6-8	28 (40.6)	21 (43.8)	0.76
9-10	5 (7.2)	3 (6.2)	0.89
Distance to hospital (km)			0.80
2.5-5 (ref)	37 (52.2)	28 (58.3)	
≤2	23 (33.3)	14 (29.2)	0.56
≥5.5	10 (14.5)	6 (12.5)	0.65
History of miscarriage			0.24
No (ref)	53 (76.8)	41 (85.4)	
Yes	16 (23.2)	7 (14.6)	0.25

Table 1Continued- Demographic Features of the Selected Women according to Prenatal TM Use (n=117)

Characteristics	**TM User n (%)**	**Non-TM User n (%)**	***P*-value**
Chronic diseases			_***
Gastritis	9 (13.0)	5 (10.4)	
Heart disease	1 (1.4)	1 (2.1)	
**Infectious disease	5 (7.2)	0 (0)	
Baby Sex			0.66
Male	33	21	0.67
Female (ref)	36	27	

*P<0.05 =significant; **Infectious diseases include lung infection, intestinal infection, bladder infection and womb infection; _***Not enough observations to test for significance;
(ref) = reference category; Logistic regression employ dummy variable

the second and third trimesters of pregnancy. Participants used TM with the aim of easing the delivery, improving their own and their fetus' health, and following the custom.

Table 2: List of the Medicinal Plants most Commonly Utilized among the Study Sample in Pregnancy by Trimester

Types of Medicinal Plants	**Trimester Used**	**User n (%)***
Baby coconut	2	6 (8.7)
	3	21(30.4)
Unidentified TM prepared by TH	2	5 (7.2)
	3	23 (33.3)
Ocimum basilicum	2	6 (8.7)
	3	13 (18.8)
Ripe coconut	2	3 (4.3)
	3	15 (21.7)
Shorea robusta	2	13 (18.8)
	3	28 (40.6)
Tamarindus indica	2	3 (4.3)
	3	12 (17.4)
Other[a]	2	12 (17.4)
	3	42 (60.9)

***Some of women had used more than 1 type of TM; therefore, the sum of percentage is >100%.

[a] Other types of TM used during:

2nd trimester of pregnancy: Ampong Kronging (n=1), *Nelumbo nucifera* (n=1)

2nd and 3rd trimester of pregnancy: Ziziphus Zizyphus (n=2), *Zingiber zerumbet* (n=1), *Largerstromia floribunda* (n=4), *Milingtonia hortensis* (n=3), *Nelumbo nucifera* (n=1), kapok stem (n=1)

3rd trimester of pregnancy: Ziziphus Zizyphus (n= 5), *Sida acuta* (n=4), *Zingiber zerumbet* (n= 3), *Cayratia trifolia* (n=4), *Largerstromia floribunda* (n=1), *Milingtonia hortensis* (n=3), *Nelumbo nucifera* (n=1), *Ocimum basilicum* seed (n=6), *Shorea siamensis* (n=1), Kdoung Cchring (n=3), kapok stem (n=5), *Cassytha filiformis* (n=1), Kampong cchring (n=3), *Sterculia foetida* (n=1), Xtom stem (n=1), *Gmelina asiatica* (n=2), Porn stem (n=1), bambuseae leaf (n=1), *Gardenia obtusifolia* (n=2), Cchrolong tree (n=1), *Dimocapus longan* (n=1), Bgnir kgek (n=2), kapok leaf (n=2)

Perceived Benefits and Risks of TM

After taking TM, the majority (71%) of TM users reported that they did not perceive benefit. However, some TM users responded that taking TM during pregnancy was associated with increasing their appetite (6%), maintaining body temperature (11%), increasing appetite plus maintaining body temperature (3%), and reducing lower back pain (2%). Interestingly, 7% of them observed that there was a negative impact due to taking TM during their most recent pregnancy as it increased body temperature and made them feel uncomfortable (Figure 1).

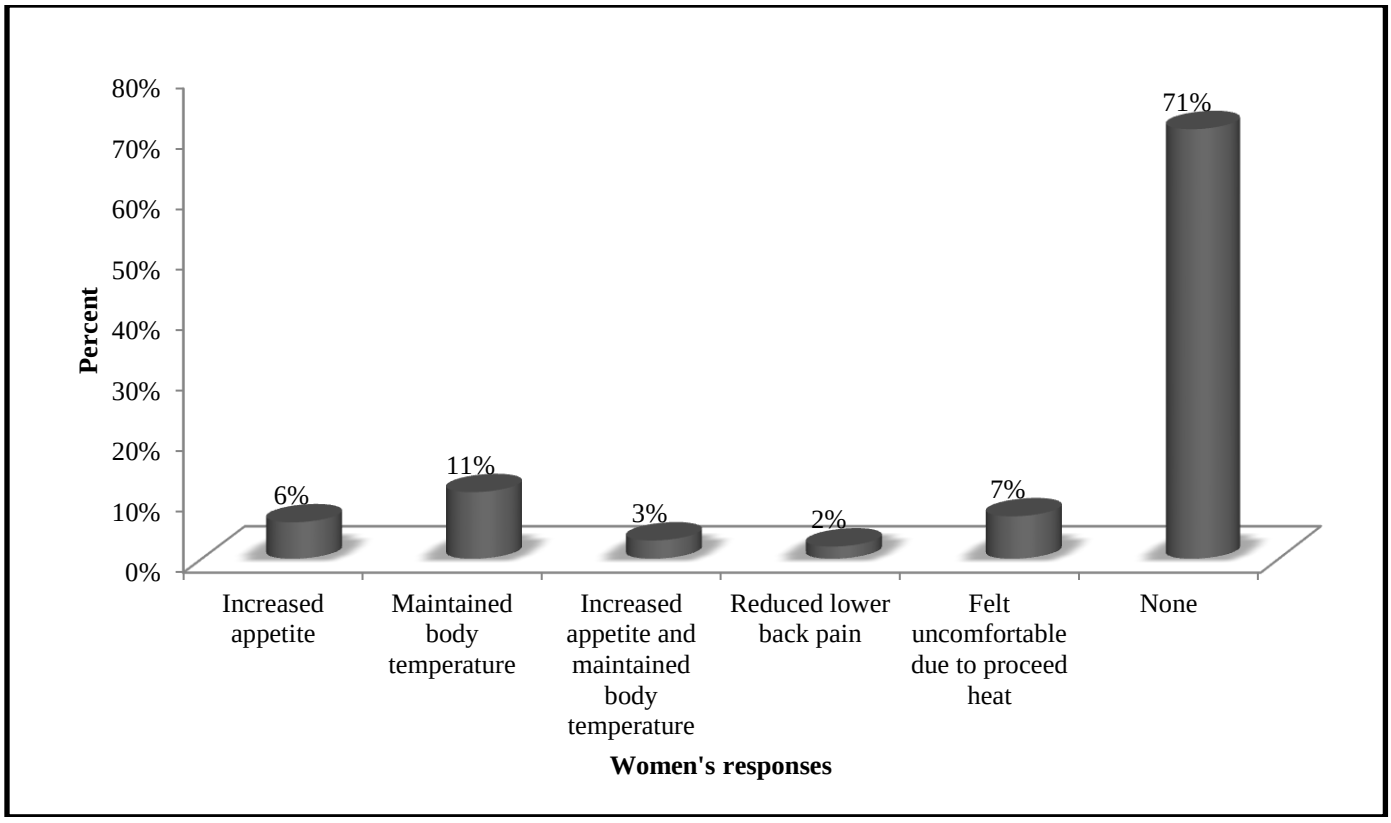

Figure 1. Participants' observations about the results of using TM during pregnancy

History of Medicinal Used during Prior Pregnancy

Both TM users and non-TM users were further asked whether they had used TM during their prior pregnancies. Twenty-nine women used TM during their previous pregnancies, but they stopped using TM during their most recent pregnancy, and became part of the non-users group in this research. Seven percent of them (n=2; 7%) did not continue using TM during their most recent pregnancy because TM was not available. Almost half (n=14; 48%) of them thought that taking TM during pregnancy was not helpful; therefore, they responded that there was no use continuing using TM during pregnancy. About a third (n=9; 31%) also stopped using TM during their most recent pregnancies because the medical midwife advised them not to take it. Interestingly, fourth of them (n= 4; 14%) reported of having negative side effects from taking

TM during pregnancy and they decided not to use TM again during their most recent pregnancy. (Figure 2)

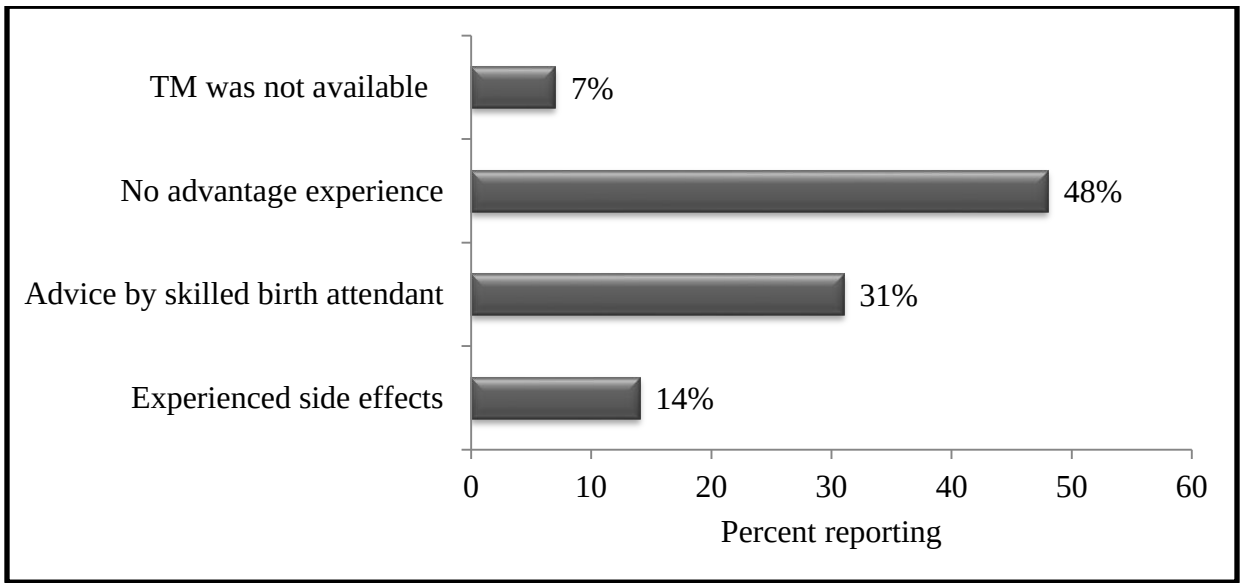

Figure 2. Participants' reasons for not continuing to use TM during their most recent pregnancy

An additional 28 of the women had used TM during their prior pregnancy, and continued using TM during their most recent pregnancy becoming TM users in this research. Two of them continued using TM because elders in their family and village advised them to do so. Two others continued to take TM during the most recent pregnancy because of its effectiveness, in that the women thought that taking TM during pregnancy was helpful for their wellbeing and the delivery processes. The vast majority (n=24; 86%) of them; however, decided to use TM again because of their belief in TM as a naturopathic medicine (Figure 3).

Associations between Prenatal Use of TM and Birth Outcomes

The birthweight of infants (3010 ± 292g) whose mothers used TM during pregnancy was statistically significantly lower compared to birthweight of infants (3154 ± 306g) belong to non-TM users (p=0.04). There was no statistically significant association between prenatal use of TM and gestational age at birth (p= 0.11) (Table 3).

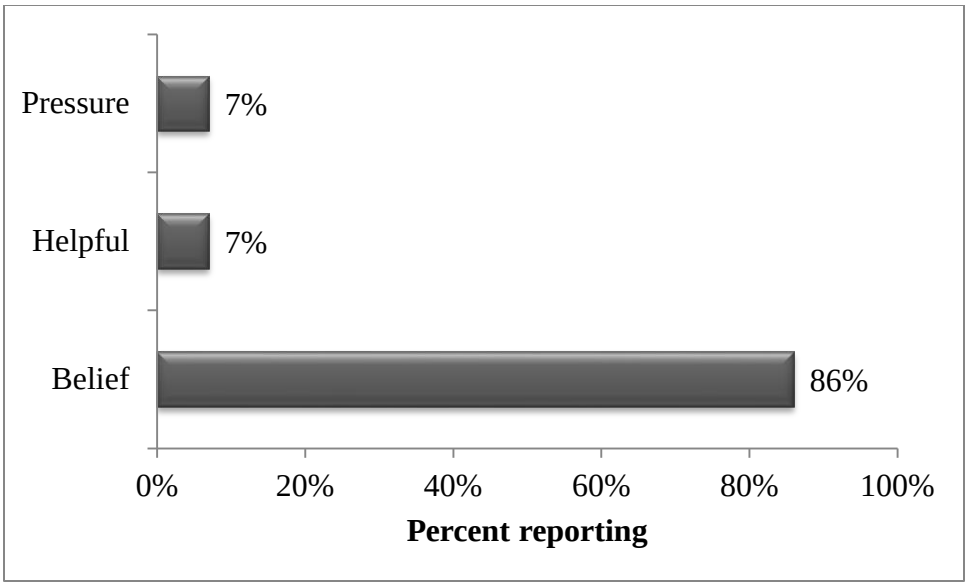

Figure 3. Participants' reasons for continuing use of TM during their most recent pregnancy

Most participants utilized TM during two periods, either both 2nd and 3rd trimesters or for the 3rd trimester only. Therefore, one-way ANOVA was carried out to compare means of birthweight among infants of mothers who were exposed to TM for these different periods. TM users during the third trimester of pregnancy only were found to give birth to a lower birthweight infant when compared with non-TM users and TM users in both 2nd and 3rd trimesters (Table 4).

Table 3: Pregnancy Outcome according to TM Use: Continuous Variables (n= 117)

Characteristics	**User (n=69)**	**Non-user (n=48)**	***P*-value**
Gestational age at birth (days)	276 ± 10	278 ± 9	0.11
Birthweight (g)	3010 ± 292	3154 ± 306	0.04

Data are expressed as the mean ± standard deviation;
Student's t-test with **P*-value < 0.05 =significant

Table 4: Pregnancy outcomes according to Prenatal Use of TM in Different Trimester (n= 116)

Characteristics	**No TM N=48**	**TM during 2nd & 3rd trimester (n=19)**	**TM during 3rd only trimester (n=49)**	***P*-value**
Birthweight (g)	3150 ± 340	3130 ± 330	2970 ± 410	0.04
Gestational age at birth (days)	277 ± 9	276 ± 10	276 ± 8	0.6

Data are expressed as the mean ± standard deviation;
One-way ANOVA with **P*-value < 0.05 =significant

Since the means of birthweight among infants belong to non-TM users and TM users during both 2nd and 3rd trimesters were similar (3150 and 3130 respectively) (Table 4), the two groups was combined and student's *t*-test was further used in order to assess the mean of birthweight in this group with the infants' mean of birthweight of those who used TM during the third trimester only. The mean of birthweight among the TM users during third trimesters only was found to be statistically significantly lower compared to birthweight among non-TM users and TM users in both 2nd and 3rd trimesters (Table 5).

Table 5: Pregnancy Outcomes according to Prenatal Use of TM in Different Trimester (n= 117)

Characteristics	**No TM or TM during both 2nd and 3rd trimesters (n=68)**	**TM during 3rd trimester only (n=49)**	***P*-value**
Birthweight (g)	3142 ± 331	2967 ± 4125	0.01
Gestational age at birth (days)	277 ± 10	276 ± 8	0.66

Data are expressed as the mean ± standard deviation;
Student's t-test with **P*-value < 0.05 =significant

Birthweight was categorized into two groups: low birthweight (birthweight <2500g) and normal birthweight (birthweight ≥ 2500g). Also, mode of delivery was grouped into two categories: normal (women who gave birth naturally) and with complications (women who underwent caesarean section or forceps or vacuum as they were not able to give birth naturally). Chi-square tests were employed in to test for associations between prenatal use of TM with

birthweight and mode of delivery. There was a marginally statistically significant correlation (p= 0.058) between taking TM during pregnancy and low-birth-weight (Table 6). In addition, TM users were 1.9 times greater, compared to non TM users, to have complications during birth. There was no statistically significant association between prenatal use of TM and complication during birth (p=0.18) (Table 6).

Table 6: Pregnancy Outcome according to TM use: Categorical Variables (n= 117)

Characteristics	**TM Users n (%) N= 69**	**Non-TM Users n (%) N= 48**	**Odd ratio (95% CI)**	***P*-value**
Birthweight (g)				
< 2500	5 (7)	0 (0)	1.7	0.058
≥ 2500	64 (93)	48 (100)		
Mode of delivery				
Complication	17 (25)	7 (15)	1.9 (0.7, 5.0)	0.18
Normal	52 (75)	41 (85)		

Pearson Chi-Squares with *P value <0.05 =significant
When n<5 in the cells, Fisher's Exact Test was used; otherwise

As the majority of participants used TM bought from TH (36.2%) and the type of medicinal plants were unknown, we also assessed the influence of prenatal use of TM from TH on the pregnancy outcomes. Newborns among the regular users of TM bought from TH were more likely (p= 0.03) to have lower birthweight compared with newborns non-users and homemade remedies TM users (Table 7).

Table 7: Pregnancy Outcomes according to TM Prepared by TH: Continuous Variables (n= 117)

Characteristics	**TM users (n= 25)**	**Non-users and homemade TM users (n= 92)**	***P*-value**
Gestational age at birth (days)	275 ± 11	276 ± 9	0.43
Birthweight (g)	2932 ± 399	3107 ± 362	0.04

Student's t-test; Data are expressed as the mean ± standard deviation;
**P*-value < 0.05= significant

Birthweight was highly statistically significantly (p=0.01) lower among infants whose mothers took TM by TH in the third trimester only (Table 8).

Table 8: Pregnancy Outcomes according to TM Prepared by TH according to Different Trimester (n=117)

Characteristics	**No TM or TM during both 2nd and 3rd trimesters (n=98)**	**TM during 3rd trimester only (n=19)**	***P*-value**
Birthweight (g)	3111 ± 358	2853 ± 402	0.01
Gestational age at birth (days)	276 ± 10	278 ± 4	0.43

Student's t-test; Data are expressed as the mean ± standard deviation;
**P*-value < 0.05= significant

Prenatal use of TM prepared by TH was not statistically significant associated with either low-birth-weight or complication during delivery. However, women who utilized TM from local practitioners were 2.6 and 1.7 times more likely to have low birthweight baby had complication during birth, respectively, compared to non-TM users and homemade TM users (Table 9).

Table 9: Pregnancy Outcome according to TM Prepared by TH (n= 117)

Characteristics	**TM by TH Users (n=25)**	**TM by TH Non-users users(n=92)**	**Odd ratio**	***P*-value**
Birthweight (g)				
< 2500	2 (8)	3 (3)	2.6	0.23
≥ 2500	23 (92)	89 (97)		
Mode of delivery				
Complication	7 (28)	17 (18)	1.7	0.29
Normal	18 (72)	75 (82)		

Chi-square test; *P value <0.05 =significant

Multivariate regression

In bivariate analysis, prenatal use of TM was negatively associated with lower birthweight when compared to non TM users (p=0.04) (Table 3). In the first model, a possible association between birthweight and TM used during pregnancy was employed, adjusting for baby's sex, maternal education, maternal occupation, BMI, gestational age at birth and mode of delivery. Prenatal use of TM was marginally statistically significantly associated with lower birthweight compared to birthweight among no TM use (p=0.06) (Table 10). The lower birth

weight remained significantly associated with gestational age at birth and mode of delivery ($p<0.01$ and $p=0.02$ respectively) (Table 10).

Table 10: Associations of Birthweight and Prenatal use of TM adjusting for Confounders (n=117)

Characteristics	**Unadjusted β (95%CI)**	**Unadjusted *P*-value**	**Adjusted β (95%CI)**	**Adjusted **P*-value**
Prenatal use of TM	-144 (-282, -6)	0.04	-138 (-280, 5)	0.06
Baby's sex	-61 (-199, 78)	0.39	-55 (-187, 77)	0.41
Maternal education	-2 (-27, 23)	0.85	-14 (-41, 13)	0.31
Maternal occupation	51 (-27, 129)	0.19	43 (-38, 124)	0.30
Maternal BMI	25(-3, 53)	0.08	19 (-8, 46)	0.16
Gestational age at birth	11 (3, 18)	<0.01	10 (3, 17)	<0.01
Mode of delivery	190 (29, 363)	0.02	198 (34, 363)	0.02

The β value with 95% confidence interval from the multivariate regression model
*P value <0.05= significant

In the second model, a possible association between birthweight and different types of TM used (homemade TM and TM from TH) during pregnancy was evaluated, controlling for prenatal used of homemade TM, baby's sex, maternal education, maternal occupation, mode of delivery, and gestational age at birth. Women who took TM from TH, their babies had significant lower birthweight ($p<0.01$) comparing to baby birthweight of whom were non TM users (Table 11). There was no significant difference in birthweight among infants whose mothers took homemade TM compared to birthweight of infants among non TM users ($p=0.17$) (Table 11). The birthweight was lower among mothers who had smaller gestational age at birth and complication during birth ($p=0.01$ and $p=0.02$ respectively). (Table 11)

Table 11: Associations of Birthweight and Types of Prenatal Use of TM adjusting for Confounders (n=117)

Characteristics	**Unadjusted β (95%CI)**	**Unadjusted *P*-value**	**Adjusted β (95%CI)**	**Adjusted **P*-value**
TM from TH	-175 (-340, -9)	0.04	-249 (-428, -71)	<0.01
TMHM	-24 (-166, 119)	0.74	-106 (-259, 47)	0.17
Baby's sex	-61 (-199, 78)	0.39	-36 (-167, 94)	0.58
Maternal education	-2 (-27, 23)	0.85	-16 (-43, 10)	0.24
Maternal occupation	51 (-27, 129)	0.19	59 (-23, 140)	0.16
Mode of delivery	196 (29, 363)	0.02	201 (37, 365)	0.02
Gestational age at birth	11 (3, 18)	<0.01	10 (3, 17)	0.01

The β value with 95% confidence interval from the multivariate regression model
*P value <0.05= significant

to assess whether type of TM used in different trimesters has different results on birthweight, we analyzed the data using TM specific variables. The birthweight whose mothers took TM from TH in third trimester only was highly significantly lower ($p<0.01$) compared to birthweight of infant whose mothers did not utilize TM during pregnancy (Table 12). There was no statistically significant difference in birthweight among infants whose mothers used homemade TM during the third trimester, mothers used either homemade TM or TM from TH in both second and third trimesters when compared to birthweight of infants whose mothers did not used TM during pregnancy ($p=0.25, 0.57, 0.37$ respectively) (Table 12).

Table 12: Associations of Birthweight and Prenatal Use of TM from TH and HM in different Trimesters of Pregnancy (n=117)

Characteristics	**Unadjusted β (95%CI)**	**Unadjusted *P*-value**	**Adjusted β (95%CI)**	**Adjusted **P*-value**
TMTH in 3rd trimester	-259 (-439, -77)	0.01	-339 (-527, -151)	<0.01
TMHM in 3rd trimester	-39 (-197, 119)	0.62	-96 (-263, 69)	0.25
TMTH in 2nd and 3rd	120 (-192, 433)	0.45	93 (-225, 410)	0.57
TMHM in 2nd and 3rd	19 (-194, 232)	0.86	-96 (-301, 117)	0.37
Maternal education	-2 (-27, 23)	0.85	-14 (-41, 12)	0.29
Maternal occupation	51 (-27, 129)	0.19	61 (-19, 141)	0.13
Baby's sex	-61 (-199, 78)	0.39	-54 (-184, 74)	0.41
Mode of delivery	196 (29, 363)	0.02	171 (8, 334)	0.04
Gestational age at birth	11 (3, 18)	<0.01	12 (5, 19)	<0.01

The β value with 95% confidence interval from the multivariate regression model
*P value <0.05= significant

Gestational age at birth was one of the main birth outcomes to be tested in respond to the research question. In univariate analysis, a *t*-test between prenatal use of TM and gestational age at birth showed that these two variables were not statistically significantly associated with each other. Maternal age, number of children and history of miscarriage were shown to be confounding factors in this relationship. After adjusting for the confounders, there was still no statistically significant association between prenatal use of TM and gestational age at birth. Gestational age at birth was shown to be significantly associated only with history of miscarriage (p=0.01) (Table 13).

Table 13: Associations between Gestational Age at Birth and Prenatal Use of TM adjusting for Confounders (n=117)

Characteristics	**Unadjusted β (95%CI)**	**Unadjusted *P*-value**	**Adjusted β (95%CI)**	**Adjusted **P*-value**
Prenatal use of TM	-2.15 (-5.60, 1.31)	0.22	-1.26 (-4.72, 2.19)	0.47
Maternal age	0.22 (-0.08, 0.53)	0.15	0.25 (-0.15, 0.65)	0.22
Number of children	0.92 (-0.84, 2.69)	0.30	0.40 (-1.95, 2.77)	0.73
History of miscarriage	-4.96 (-9.17, -0.75)	0.02	-5.73 (-10.09, -1.38)	0.01

The β value with 95% confidence interval from the multivariate regression model;
P value <0.05= significant

A multivatiate regression model was also constructed in order to identify the association between the gestational age at birth and TM used in different trimesters. After adjusting for the known confounders, there was so statistically significant association between prenatal use of TM in either third trimester only or the gestational age at birth. However, the gestational age at birth according to TM used in third trimester was marginally significantly associated with maternal age and significantly associated with history of miscarriage (p=0.05 and 0.01, respectively) (Table 14).

Table 14: Gestational Age at Birth according to Prenatal Use of TM in Different Trimester adjusting for Confounders (n= 117) {No TM or TM during both 2nd and 3rd trimester and TM during 3rd only}

Characteristics	**Unadjusted β (95% CI)**	**Unadjusted *P*-value**	**Adjusted β (95%CI)**	**Adjusted **P*-value**
Prenatal use of TM	-0.26 (-1.41, 0.90)	0.66	-0.13 (-1.29, 1.02)	0.82
Maternal height	-4.87 (-38.64, 28.88)	0.78	-3.00 (-36.05, 30.04)	0.85
Maternal age	0.22 (.08, 0.53)	0.15	0.30 (.00, 0.62)	0.05
Maternal education	0.11 (-0.51, 0.73)	0.73	0.09 (-0.53, 0.72)	0.77
History of miscarriage	-4.95 (-9.17, -0.75)	0.02	-5.74 (-10.07, -1.42)	0.01

The β value with 95% confidence interval from the multivariate regression model
*P value <0.05= significant

After controlling for confounding factors, there was so significant association between prenatal use of TM and mode of delivery. Furthermore, no other variables found to be significantly associated with mode of delivery (Table 15).

Table 15: Factors Associated with Mode of Delivery according to Multivariate Logistic Regression (n= 117)

Characteristics	**Unadjusted OR (95%CI)**	**Unadjusted *P*-value**	**Adjusted OR (95%CI)**	**Adjusted **P*-value**
Prenatal use of TM	1.91 (0.72, 5.05)	0.19	1.21 (0.39, 3.64)	0.74
Education	0.41 (0.19, 0.89)	0.02	0.47 (0.19, 1.09)	0.08
Age	1.29 (0.83, 1.98)	0.24	1.46 (0.78, 2.72)	0.24
Height	0.89 (0.51, 1.55)	0.68	0.87 (0.48, 1.59)	0.65
BMI	0.58 (0.21, 1.62)	0.29	0.51 (0.16, 1.64)	0.26
Number of child	1.04 (0.58, 1.86)	0.87	0.83 (0.35, 1.99)	0.68
Prenatal check-up	0.72 (0.33, 1.53)	0.39	0.84 (0.35, 2.00)	0.69
History of miscarriage	1.09 (0.36, 3.33)	0.87	0.75 (0.22, 2.56)	0.65

The β value with 95% confidence interval from the multivariate regression model;
*P value <0.05= significant

I was also concerned about the mothers' pre-existing diseases that could be the confounding factors in the relation to obstetric complications or low birthweight. However, the prevalence of chronic diseases in this study was very low so I could not detect the significant difference between TM users and non users (Table 1). Also, when I perform tabulation between low birthweight and chronic diseases, only one women who delivered a low birthweight infant had gastritis. The remaining four low birthweight infants mother had no chronic diseases. Therefore, chronic diseases were not confounding factors associated with the relationship between lower birthweight and prenatal used of TM. Additionally, none of the four women who reported drinking alcohol infrequently in small amount during their pregnancies had low birthweight infants. For smoking, only one women who smoked a few cigarettes during her pregnancy had a low birthweight infant (birthweight=2100g). Therefore, smoking and drinking status were not a major concern in this study, nor were any associations able to be assessed.

Sensitivity Analysis

In this study, there were five infants found to have low birthweight. One of them weighed 1700g; two of them weighed 2100g and other two weighed 2400g. I further did sensitivity analysis in order to check the robustness of the findings. I excluded the five low birthweight

infants from the multivariate regression model (Table 16). After taking the five low birthweight infants out from the model, the association between prenatal use of TM and birthweight was drastically changed as the adjusted β-value changed from -140 (Table 10) to -67 (Table 16). It is important to note that all these five low-birth-weight infants belonged to only mothers who used TM during their pregnancies. Therefore, the validity of the finding needs to be carefully examined.

Table 16: Associations of Birthweight and Prenatal Use of TM adjusting for Confounders excluding of the 5 Low Birthweight infants (n= 112)

Characteristics	**Unadjusted β (95%CI)**	**Unadjusted *P*-value**	**Adjusted β (95%CI)**	**Adjusted **P*-value**
Prenatal use of TM	-76 (-198, 46)	0.22	-67 (-193, 59)	0.29
Maternal education	2 (-21, 25)	0.87	5 (-19, 28)	0.67
Maternal BMI	22 (-2, 47)	0.08	18 (-6, 42)	0.14
Gestational age at birth	0.06 (-2, 13)	0.13	7 (, 14)	0.07
Mode of delivery	227 (83, 371)	0.02*	112 (0.11, 403)	<0.01

The β value with 95% confidence interval from the multivariate regression model;
P value <0.05= significant

Similarly, I also tested the sensitivity of the relationship between taking TM prepared by TH and lower birthweight. Initially, after controlling for confounding factors, lower birthweight was highly significantly associated with prenatal use of TM by TH. When the five low birthweight infants were excluded, the adjusted β-value increased from -209 (Table 12) to -139. Therefore, the validity of the findings was robust because even after performing the sensitivity analyses, the adjusted β-value only slightly changed.

Discussion

The Prevalence of TM Use during Pregnancy

About 59% of 117 women utilized at least one herbal medicine during their most recent pregnancy, which was relatively high compared to previous studies (Table 18).

Table 17: Associations of birthweight and prenatal use of TM prepared by TH adjusting for confounders and exclude the 5 low-birth-weight (n= 112)

Characteristics	**Unadjusted β (95%CI)**	**Unadjusted *P*-value**	**Adjusted β (95%CI)**	**Adjusted **P*-value**
Prenatal use of TM	-128 (-277, 198)	0.09	-139 (-285, 7)	0.06
Mode of delivery	227 (833, 371)	0.00	238 (95, 381)	0.00
Maternal height	370 (-839, 1579)	0.55	239 (-935, 1.413)	0.69

The β value with 95% confidence interval from the multivariate regression model;
P value <0.05= significant

This difference might be explained by the different geographical areas, sample size, data collection methods and differences in characteristics of the study population such as maternal age, education, occupation, and numbers of child women have. It is also important to note that if the prevalence of TM use were low, there might have been potential of underestimation due to nonresponsive bias or social desirability bias as TM is not a part of health system in most countries. Therefore, women might be less likely to admit that they took TM during their pregnancy.

Association between the Use of different Types of TM and Birthweight

Thirty different herbals and unidentified TM mixtures prepared by local practitioners were used. The most commonly known TM used during pregnancy in this study were baby coconut and ripe coconut (*Cocos nucifera),* O*cimum basilicum, Shorea robusta,* and *Tamarindus indica*.

Customarily, C*ocos nucifera* (coconut) is a plant widely used for diabetes, diarrhea or pneumonia (49). Coconut husk possesses medicinal properties to treat several inflammatory disorders (49). Additionally, different parts of *Ocimum sanctum Linn* (leaves, stem, flower, root, seeds and whole plant) have been suggested for treatment of bronchitis, asthma, diarrhea or skin diseases (50). Also, S*horea robusta* has been used to treat circulatory, digestive, endocrine, respiratory and skeletal systems including infectious diseases. The therapeutic benefit of *Shorea*

robusta has been shown (51). *Tamarindus indica* is used for treatment of cold, fever, stomach disorder or diarrhea. Research has demonstrated that this medicinal plant possesses antibacterial activity and that can be a potential source of antibiotics useful for infectious disease control (52). Consequently, these medicinal plants provide possible benefit for treatment illness in general population. However, research has not yet shown the benefit and safety of these medicinal plants for pregnant women.

Furthermore, some women used the unknown TM prepared from local practitioners and they sometimes mixed homemade remedies with TM prepared by TH. There is no documentation of efficacy and safety of these unknown TMs for using during pregnancy. The interaction of known herbs with TM by TH and TM by TH itself is the major concern for prenatal use of these therapeutic medicines. The present study found a high prevalence use of TM during pregnancy particularly unidentified TM prepared by TH. Statistical tests showed that there was a significant association between prenatal use of TM by TH and lower birthweight when compared to birthweight of infants whose mothers were non TM users.

Besides the most common TM used during pregnancy there were additionally 24 medicinal plants were taken by participants. Those herbs might provide side effects during pregnancy. They were not analyzed because diverse of the small proportion of participants using these in this sample. Future research with a larger sample size should be conducted so that the prevalence of prenatal use of those medicines can also be determined and any birth outcomes associations explored.

We found that compared to non TM users, infants whose mothers used TM from TH had significant lower birthweight. However, there was no significant difference between birthweight

of the baby belonging to homemade TM users and non TM users. The possible explanation for this was that there might be harmful chemicals in the TM from TH that could potentially affect fetal development. However, in epidemiological study, we cannot prove the causal relationship. This finding needs to be confirmed with the pharmacological research, which is capable of identifying the chemical compounds in the TM from TH and evaluate whether those compound has any side effect on fetal development.

Effect of TM Use according to Trimester of Pregnancy

Pregnancy is divided into three different trimesters, with each trimester unique in its support of different fetal growth and development stages. Therefore, exposure to TM during different trimesters of pregnancy may be associated with different effects. In this study, almost all TM was used during the second and third trimesters of pregnancy. Therefore, it could potentially increase the risk of experiencing adverse obstetrical events or fatal distress related problems. We found women who used TM from TH in the third trimester only had infants who were born with significantly lower birthweight compared to baby birthweight whose mothers did not use TM during pregnancy.

If taking TM from TH was really significantly associated with lower birthweight, women who took TM from TH in both second and third trimesters would also deliver to babies who had significantlt lower birthweight when compared to non TM users. However, there was no statistically significant association between birthweight of whom mothers took TM from TH in second and third trimesters when compared to non TM users. A possible explanation for this finding might be due to different TM intake. TH might provide different TM to women who took TM in different trimesters of pregnancy. TM from TH intake during the third trimester only might be associated with adverse effect on pregnancy outcome.

Another rationale behind this finding could be due to the small sample size. There were only 6 participants whomtook TM from TH in second and third trimesters which did not provide enough power to detect the significance. Future studies need a large sample size to address this research question.

Low birthweight is a serious issue as it is a main predictor of infant mortality and morbidity development later in life. A study in Italy showed the risk of low birthweight was statistically higher among regular TM users compared to non TM users (48). In this study, I observed a marginally significant association between low birthweight (birthweight <2500 g) and prenatal use of TM ($p=0.058$) (Table 6). The results showed 5 babies had birthweight less than 2500g, and all had mothers who used TM during pregnancy. As mentioned in the Result section multivariate logistic models were not able to be constructed to adjust for confounders and effect modifiers because one cell equaled to zero. Therefore, further study with the necessary large sample size should be conducted in order to detect whether there is a significant association between prenatal use of TM and low birthweight.

Similar study conducted in South Africa found prenatal use of TM during trimester was significantly associated with fetal distress which led to a higher rate of cesarean section (15). The present study found women who used TM during their most recent pregnancy were 1.9 times more likely to have complications during birth in which cesarean section and forceps or vacuum were required to facilitate the delivery. In order to detect whether there was significant correlation between TM intake during pregnancy and complication during birth, a larger sample size is needed.

Table 18. Studies measuring prevalence of use of herbal medicine in pregnancy

Author (Year), Country	Study Design	Sample	Trimester use of TM	Prevalence of TM used	Most common herbs
Tabatabaee M (2011), Iran (2)	Cross-sectional, structured questionnaire	513/530 (96.8%) women 2 days postpartum	1 (36.7%), 2 (15.2%), 3 (32.0%), any time during pregnancy (17.1%)	30.8%	Ammi, Saatar, Sweet Basil
Rahman et. al. (2008), Malaysia (4)	Cross-sectional, structured questionnaire	210 mothers	1 (4.6%), 2 (0.0%), 3 (79.6%), 1 &3 (2.8), 2 & 3 (2.8), all trimesters (3.7%)	51.4%	Unidentified TM by aborigines and traditional midwives, most common: Coconut oil
Forster et. at. (2006), Australia (8)	Cross-sectional survey, self completed questionnaire	588/705 (83%) Consecutive women at 36-38 weeks gestation	N/A	36%	Most common: raspberry leaf, ginger, chamomile, cranberry juice, Echinacea
Holst et. at. (2009), England (9)	Survey, self completed questionnaire	Pregnant women 20 weeks gestation onwards 578/1037 (55.7%)	N/A	57.8%	Ginger, cranberry, raspberry leaf
Dabaghian et. at. (2012), Iran (10)	Cross-sectional, semi-structured questionnaire	600 women in third trimester of pregnancy and one week after delivery	1 (TM was commonly used), 2, 3	67%	48 different herbs, most common: peppermint, olibanum
Mabina & Moodley (1997), South Africa (15)	Cross-sectional, interview based standard questionnaire	229 patients in labor	3 (97.6%)	55%	Not described
Chuang et. at. (2006), Taiwan (19)	Cross-sectional analysis of data from a prospective, structured questionnaire	14 551 live births Pregnant women of ≥ 26 weeks of gestation	1	31%	Huanglian and An-Tai-Yin
Mureyi et. at. (2012), Zimbabwe (20)	Cross-sectional survey	248 of six weeks postpartum women	3	52%	Holy water, soil burrowed, Pouzolzia mixta root, elephant dung, cocktails of unknown

					herbs
Nordeng and Havnen (2004), Norway (29)	Cross-sectional, structured interview	3 days postpartum women 400	1 (20.8%), 2 (22.5%), 3 (26%)	36%	249 TMs common: Echinacea, iron-rich herbs, ginger, chamomile, cranberry, aloe, horsetail, black elderberry, wheat germ oil
Amasha and Jarrah (2012), Jordon (34)	Cross-sectional, semi-structured questionnaire	332 pregnant women	1 (15.5%), 2 (20.4%), 3 (64.1%)	73.8%	Home remedies
Lapi et. at. (2008), Italy (36)	Preliminary survey	150/172 (87.2%) third trimester women	N/A	48%	Almond oil, propolis, Fennel, mauve, fennel, arnica, St John's Wort
Facchinetti et. at. (2012), Italy (48)	Multicenter retrospective cohort	700/725 (97%) 3 days postpartum women	1 (10%), 2 (18%), 3 (47%)	42%	Almond oil, chamomile, fennel, valerian, and echinacea

The most common TMs used during pregnancy in this study were not described in other studies except for basil seeds. A study in Iran found 6.8% among TM users used basil seeds in all three trimesters of pregnancy for respiratory infection (10). It is the fact that herbal medicines vary across regions as well as the belief of TM used.

Strengths

Data collection method plays important role to the research findings. This study employed a semi-structure interview technique through a face-to-face interview which is a major strength compared to the data obtained from a self-administered questionnaire, mail questionnaire or national registry. Women had the chance to clarify questions at once if there was confusion or misunderstanding.

In addition, I was the only one who conducted the interviews for all the 117 samples. With my previous experiences interviewing people for my group project and internship including formal training from academic course, I believe that there was no bias.

This study also provided strength in hypothesis testing regarding whether taking TM during pregnancy was significantly related to pregnancy outcomes. In most instances, women in this study utilized TM during pregnancy because they believed and were advised by the elders that taking TM during pregnancy would facilitate a smoother delivery and better well being. However, most of the previous studies found that pregnant women purposely used TM for pregnancy related reasons. For example, a survey among 400 Norwegian women found that most common indications of prenatal use of TM were cold, respiratory tract illness, nutritional supplementation and skin problems (35). In the present study, most women did not possess any significant chronic diseases or morbidities during pregnancy, and together with the very low prevalence of smoking and drinking, this study can clearly estimate the correlation between prenatal use of TM and birth outcomes.

Additionally, the prevalence of low birthweight (birthweight <2500 g) (4.3%) in this study is consistent with another study in Cambodia (3.8%) (53). Therefore, it is clear that the sample is representative of the percentage of infants with low birthweight in Cambodia.

Limitation

The findings, however, require consideration of the study's limitations. Primarily, the present study targeted postpartum women whose children all survived. If there had been a case of stillbirth due to taking TM during pregnancy, we would not have captured that. To address

whether perinatal mortality is statistically significantly associated with prenatal use of TM, a case-control study should be carried out.

A second limitation was the measurement of infant birthweight. There might be a concern of measurement error with the instrument that midwife used to measure baby birthweight. Further research needs to make sure that baby birthweight are measured accurately.

Also, there might be also potential recall bias on gestational age at birth. This study could not capture the time once women missed their last menstruation due to pregnancy. Commonly, 9 months and 10 days is the gestational age for delivery and everyone in the region knows about this. Women were asked to recall their gestational age at birth. Women seem to remember well the number of months and days of their gestational age because most women had just delivered their infants within the last four months. In addition, both TM users and non-users received the same prenatal care; therefore, they kept track of their gestational age.

Conclusion

The use of TM during pregnancy was found to be common in Cambodia. Sixty-nine (59%) of the participants reported using TM during the second and third trimester of their most recent pregnancies with the belief that taking TM would help them with their delivery processes, would provide wellbeing for both mothers and fetus and of course fulfill their belief. Thirty different medicinal plants and unidentified TM reportedly bought from TH were used by the participants. The use of TM particularly during pregnancy is a concern because those medicinal plants were taken without laboratory testing of their safety during pregnancy. The findings showed that prenatal use of TM from TH in the third trimester resulted in lower birthweight compared to birthweight of infants whose mothers did not used any TM during their most recent

pregnancy. These findings indicate that more research is needed in this field in order to have more robust findings to better protect the health of Cambodian mothers and their infants.

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