Postpartum phytomedicine and its future in maternal healthcare in Prey Lang, Cambodia

Victoria H. GRAPE[1,*], Nerea TURREIRA-GARCIA[1], Lars HOLGER-SCHMIDT[1], CHHANG Phourin[2] & Prachaya SRISANGA[3]

[1] Department of Food and Resource Economics, University of Copenhagen, Rolighedsvej 25, 1958 Frederiksberg C, Denmark.

[2] Forest and Wildlife Research Institute, Forestry Administration, Hanoi Street 1019, Phum Rongchak, Sankat Phnom Penh Thmei, Khan Sen Sok, Phnom Penh, Cambodia.

[3] Queen Sirikit Botanic Garden, Herbarium, Chiang Mai, 50180, Thailand.

* Corresponding author. Email grapevictoria@gmail.com

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មូលន័យសង្ខេប

ប្រទេសកម្ពុជាបានកាត់បន្ថយនូវអត្រាស្លាប់របស់ម្តាយតាមរយៈការធ្វើទំនើបកម្មមណ្ឌលសុខភាព មន្ទីរពេទ្យបង្អែកនៅតាមខេត្ត និង ការហាមឃាត់ការនុវត្តន៍របស់ឆ្មបបុរាណ(TBA)។ ការហាមឃាត់នេះដោយសារតែគេពុំដែលបានស្គាល់នូវវប្បធម៌ និង ចំណេះដឹងក្នុងការប្រើប្រាស់រុក្ខជាតិរបស់ប្រជាជនក្នុងតំបន់នោះ។ ដោយសារតែការស្លាប់របស់ម្តាយក្រោយឆ្លងទន្លេរួចគឺជាបញ្ហាមួយធ្ងន់ធ្ងរខ្លាំងនៅកម្ពុជា ដូច្នេះការសិក្សានេះមានគោលបំណងចងក្រងឯកសារទាក់ទងនឹងចំណេះដឹង អំពីការប្រើប្រាស់រុក្ខជាតិបែបបុរាណសម្រាប់ការការពារ និង ព្យាបាលស្ត្រីក្រោយឆ្លងទន្លេរួច។ រុក្ខជាតិចំនួន៦៨ប្រភេទ ស្មើនឹង៣៣អំបូរ ត្រូវបានគេកត់ត្រា ក្នុងនោះមាន៖ អំបូរញRubiaceae(១០ប្រភេទ), អំបូរទេពទារូ Lauraceae(៥ប្រភេទ), អំបូរសណ្តែក Leguminosae(៥ប្រភេទ) និង អំបូរប៉ប្រើសSmilaceae(៣ប្រភេទ)។ ការប្រើប្រាស់ច្រើនបំផុតគឺទៅលើការធ្វើអោយហូបបាយបាន(៣៥%), សម្រួលសរសៃឈាម(២៥.៧%) និង សម្បូរទឹកដោះ(២២.៨%)។ ស្ត្រីជាម្តាយមកពីភូមិចំនួនពីរនៅភាគខាងជើងព្រៃឡង់បានស្គាល់រុក្ខជាតិ សម្រាប់ស្ត្រីឆ្លងទន្លេរួចពី៥០-៦០%ដែលប្រមូលដោយឆ្មបបុរាណនិងមិនមានភាពទាក់ទងគ្នាគួរអោយកត់សម្គាល់រវាងប្រភេទរុក្ខជាតិដែលប្រើប្រាស់ទៅនឹងអាយុរបស់ម្តាយឬជាមួយនឹងចំនួននៃការពរពោះនោះទេ។ តាមរយៈការអង្កេតនៅក្នុងភូមិពីរគឺភូមិចំពើន និង ភូមិស្តង់បានបង្ហាញថាមានការផ្លាស់ប្តូរពីការឆ្លងទន្លេនៅផ្ទះដោយឆ្មបបុរាណទៅឆ្លងទន្លេនៅមន្ទីរពេទ្យ។ មានភាពស្រដៀងគ្នា និង ខុសគ្នាមួយចំនួនទៅលើប្រភេទរុក្ខជាតិ និង វិធីប្រើប្រាស់សម្រាប់ស្ត្រីក្រោយឆ្លងទន្លេរួចនៅកម្ពុជា ធៀបទៅនឹងប្រទេសជិតខាងដូចជា ប្រទេសឡាវនិងប្រទេសថៃ។ យើងសូមស្នើអោយមានការបញ្ចូលនូវការប្រើប្រាស់ឱសថបុរាណដែលបានឆ្លងកាត់ទំនើបកម្មសម្រាប់ស្ត្រីក្រោយឆ្លងទន្លេរួចទៅក្នុងសេវាកម្មមាតុភាពដែលចាំបាច់ ព្រោះវាមិនត្រឹមតែរួមចំណែកក្នុងការការពារបេតិកភ័ណ្ឌជីវប្បធម៌បុណ្ណោះទេ តែវាក៏ជាសក្តានុពលនៃការស្រាវជ្រាវផ្នែកឱសថផងដែរ។

Abstract

Cambodia has reduced maternal mortality rates by modernizing provincial health centres and referral hospitals as well as by banning traditional birthing attendants (TBAs) from practicing. The implications this will have on ethnobotanical knowledge and the local culture are unknown. Because postpartum mortality is a dire reality in Cambodia, this study aimed to document knowledge on traditional phytomedicine for the prevention and treatment of postpartum compli-

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cations. Sixty-eight plant species belonging to 33 families were recorded, the most prevalent being Rubiaceae (*n*=10), Lauraceae (*n*=4), Leguminosae (*n*=4) and Smilaceae (*n*=3). The most common uses were appetite stimulation (34.2%), improving blood circulation (25.7%) and stimulating milk production (22.8%). Mothers from two villages in northern Prey Lang, Cambodia, recognized 50–60% of postpartum plants collected by TBAs and there was no significant correlation between plant recognition and the mother's age, nor with the number of pregnancies had. A shift from home births with TBAs towards hospital births in the villages of Chamraeun and Spong was observed. There are similarities and differences in the diversity of Cambodian postpartum plants and their uses compared to neighbouring Laos and Thailand. We suggest an integrative approach to maternity services is needed in which traditional medicine supplements modern postpartum healthcare, while preserving bio-cultural heritage and potential pharmacological discoveries.

Keywords

Ethnobotany, indigenous, Kuy, Kui, Kuoy, local ecological knowledge, midwifery, traditional ecological knowledge.

Introduction

Indigenous communities' knowledge and use of medicinal plants is increasingly vulnerable in developing nations, its threat having both cultural and pharmacological repercussions (Bodeker & Kronenberg, 2002; Shanley & Lutz, 2003; Bolson *et al.,* 2015). Factors including deforestation, rural exodus, and modernisation of health services could potentially influence the way developing societies relate to and use their surrounding environments. Estimates from 2005 reveal that 70–95% of people living in Asia, Latin America, and the Middle East use traditional medicine as their main form of health care (Rocha *et al.,* 2016).

High maternal mortality is of major health concern in most developing countries. In 2010, an estimated 287,000 deaths worldwide were due to avoidable maternal complications, and most occurred in countries with living standards at or below middle-class, making it vital to focus attention on prevention and treatment of ailments related to pregnancy in these areas (Say *et al.,* 2014). Estimates also suggest that half of maternal deaths occur during the postpartum period, the time immediately following birth and extending up to six weeks afterwards, when a mother's body returns to its non-pregnant state. Similar trends have been observed in Cambodia, where high fertility and high maternal mortality indicates that motherhood encompasses risks and challenges across the nation. The World Health Organization (WHO, 2013) estimated a maternal mortality rate (MMR) of 170 deaths per 100,000 births in Cambodia, a 15% decrease since 2009. While a promising reduction in a short time period, this remains far higher than MMRs in developing countries which average 12 deaths per 100,000 births (WHO, 2014). In Cambodia, fertility is currently observed at 3.3 children per woman in rural areas compared to 2.2 in urban areas and this contributes to a higher risk of maternal mortality in the countryside (Kalaichandran & Zakus, 2007; Liljestrand & Sambath, 2012).

The unregulated nature and varying quality of traditional birthing practices in Cambodia led to a ban on traditional birthing attendants (TBAs) in 2006 and setting of national standards for obligatory midwife certification programs (Ith *et al.,* 2012; Wang & Hong, 2015). This effectively increased facility deliveries by trained personnel by 78.6% from 2006 to 2011, whereas births by TBAs decreased by 81.5%, contributing to the reduction in MMR nationally (Ir *et al.,* 2015). What has been ignored under this development, however, is how healthcare modernisation may influence future traditional knowledge on medicinal plants when TBAs abandon their practices or when mothers lose interest and trust in their use. Though the efficacy and safety of traditional medicine poses a concern, the cultural value of traditional medicine and its potential to supplement modern practices remains relevant in developing countries such as Cambodia. The risk that valuable information about traditional medicinal plants may vanish is pertinent because many people live far from modern facilities and are often dependent upon traditional medicine (Bodeker & Kronenberg, 2002; Lundh, 2007; Ansari & Inamdar, 2010; Bolson *et al.,* 2015). Integration of traditional medicinal practices in modern times has been documented in Ghana, Nicaragua, and China, and these studies provide insights on how the same could be achieved in Cambodia (Carrie *et al.,* 2015; Chan *et al.,* 2015; Boateng *et al.,* 2016).

Cultural beliefs regarding health often guide indigenous peoples in their choices of plants to prevent and heal ailments. In many cultures around the world, notably in Central America and Asia, there reigns a theory of hot and cold internal balance in the body. Traditional healers prescribe plant medicines according to their balancing effect upon the body's thermal state (Fishman *et al.,* 1988; Nestler, 2002; de la Cruz *et al.,* 2014; García-Hernández, 2015; Teixidor-Toneu *et al.,* 2016). This practice is also prevalent amongst the Khmer and Kuy ethnic groups in Cambodia, who deem preg-

nancy as a "hot" state and postpartum as a "cool" state and target the latter with traditional medicines that have a warming effect (Tea, 2002; White, 2004). Another cultural aspect of health referenced by TBAs is the belief in "toas", a form of relapse caused by foods or activities deemed inappropriate, particularly after giving birth. This state manifests in many ways including diarrhoea, nausea, loss of appetite, and general weakness, yet has no English translation (White, 2002). Medical explanations for toas are disputed, some deeming it a culture-bound syndrome comprising a combination of psychiatric and somatic symptoms (Tea, 2010).

Literature is sparse on the traditional use of phytomedicine (i.e. herbal medicine) to prevent and treat postpartum complications in Cambodia. Only a handful of articles on the postpartum traditions of the Khmer and Kuy ethnic groups can be found, and documentation on specific plants used in this regard is lacking (Hoban, 2002; White, 2002, 2004). More in-depth information on plants used can be gathered from neighbouring countries, particularly Laos (Lundh, 2007; Lamxay *et al.,* 2011; de Boer *et al.,* 2011), where ecological and demographic conditions are in several ways similar to Cambodia. Prey Lang Wildlife Sanctuary covers 431,683 ha in the Stung Treng, Stung Treng, and Kratie provinces and protects Cambodia's largest remaining area of lowland evergreen forest (Souter *et al.,* 2016). Social development and resource extraction has been detrimental to cultural and biological conservation at the site, with increasing pressure from illegal logging, resin tapping, economic land concessions and agricultural land conversion (Strange *et al.,* 2007). Multi-genus botanical surveys on postpartum plants in Preah Vihear and Stung Treng, two provinces that stretch across the north of the wildlife sanctuary, have yet to be published (Koung, 2007). Lamxay *et al.* (2011) referred to a French *materia medica* study from 1930 in their comparison of postpartum species from Laos to Cambodian equivalents, but did not specify their regional origins. Of medicinal plants used by the Kuy, an ethnic group in Prey Lang, almost 30% are used to treat postpartum ailments (Turreira-Garcia, 2015), thus such knowledge is an important part of the Kuy ethnobotanical heritage.

This study aimed to document postpartum medicinal plants and address their relation to health and cultural preservation by answering the following questions: 1) what plants are used for postpartum ailments by women and TBAs in northern Prey Lang; and, 2) does the changing healthcare system affect women's knowledge and use of postpartum medicinal plants?

Methods

Fieldwork took place at four villages within and near the forests of Prey Lang from 23 April to 11 May, 2015 (Fig. 1). The order of remoteness and proximity to old growth forest of the study villages from least to greatest was: Chamraeun, Thmea, Phneak Roluek, and Spong. The populations of these villages are roughly 940 people in Chamraeun, 578 people in Phneak Roluek, 497 people in Spong, and 2,024 in Thmea (NCSNDD, 2010). Local residents practice subsistence farming and mainly obtain their income from cultivation of rice and other staple products as well as tapping resin. Most of the population is of Kuy descent (62%), either fully or with one Kuy parent.

Data collection was undertaken through interviews with mothers, focus group discussions with TBAs, interviews with personnel at a provincial health centre, and collection of voucher specimens of postpartum plants. In group and individual interviews, practices for harvesting and preparation of medicinal plants were explored. As the sensitive nature of the study warranted attention to participant willingness to collaborate, consideration for their privacy was of the utmost importance. All participants were informed of the objective of the study and agreed to share their knowledge. Respondent ages in the Chamraeun and Spong villages ranged from 19 to 80 years old and the mean age of respondents was 42 years (Appendix 1). Both the interviewer and translator were female.

Focus group discussions were held with three former TBAs in Chamraeun village and one former TBA in Spong village. In these villages, TBAs were asked to collect as many as five of the most common postpartum plant species used. These were then used in a knowledge pattern analysis whereby mothers were asked to state their ethnospecies name (common name) and describe their use. This allowed cross-checking of their knowledge with information provided by TBAs. Five plant species were collected from Chamraeun village (ampil, lermeet kerbal pous, ploosbart, protiel tlem kmov, and teab buy) and four from Spong village (ampil, kandangbay, potrea, and teab buy). Forty plant recognition interviews were undertaken with mothers (Chamraeun: n=22; Spong: n=18). Additionally, 47 women, including three former TBAs (Appendix 1), were interviewed about their birthing experiences and future preferences. Selection of women for interviews was random, the only criteria being that they had to have given birth at least once.

Free listings, whereby participants drew upon their memory of postpartum medicinal plants to create a list of useful species, were held in each village and plant collec-

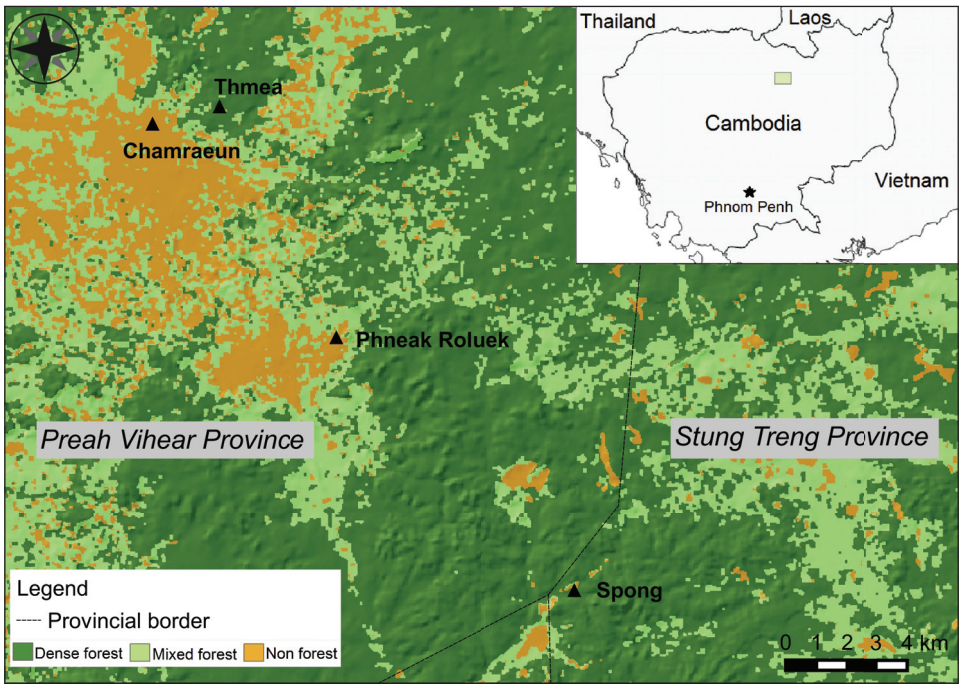

Fig. 1 Location of study sites in Prey Lang Wildlife Sanctuary (main map) and Cambodia (inset map). Created using forest cover (Open Development Cambodia, 2014) and natural earth data in QGIS.

tion started from villages into the surrounding vegetation. The collection from Chamreun was unfortunately lost in transportation. Several nights were also spent in the forest to obtain species in less accessible areas. The overall goal was to collect all plants mentioned during the free listings, and any other postpartum medicinal plants recognised in the field. Voucher specimens were collected and initially retained in the Forest and Wildlife Research Institute, Forestry Administration in Phnom Penh, Cambodia. These were later transferred to the Queen Sirikit Botanic Garden (QSBG) in Chiang Mai, Thailand for secondary inspection and identification. All permits required for the study were in accordance with the Nagoya Protocol on Access and Benefit Sharing.

Paired T-tests were undertaken using RStudio© (Version 0.99.441, 2015) to assess whether number of plants recognized by respondents differed between age groups or numbers of pregnancies carried to term by mothers.

Results

Postpartum phytomedicine in Prey Lang

Sixty-eight species used for the postpartum period were collected belonging to 33 families, with Rubiaceae (ten species), Lauraceae (four species), Leguminosae (four species), and Smilaceae (three species) being the most represented (Table 1). Preparation of these was primarily as an infusion in tea (61 species, 89.7%), and four plant species were also taken as a tincture in rice wine. Preparation practices for the remaining plant species were not specified. Villages differed on ethnospecies names, uses and/or application methods for seven plant species. Plants used for their postpartum effects in addition to supporting uterine (18 species, 26.5%) and general health (five species, 7.4%) included: orexigenic (i.e. stimulating appetite, 24 species, 35.3%); improving blood circulation including building "stronger" veins (17 species, 25%); galactagogue (i.e. stimulating milk production, 16 species, 23.5%); treating pain (i.e. body, joint, uterine) or a cold feeling in the uterus (nine species, 13.2%); uterotonic (i.e. inducing contraction of the uterus, in some cases reducing postpartum haemorrhage, seven species, 10.3%); and toas (three species, 4.4%). Three plant species (4.4%) were used for stopping blood loss, while two species were used to improve skin health and improve sleep/rest (2.9% for each category respectively). Lastly, one plant species was used to treat uterine prolapse, food poisoning, joint dislocation, boost the immune system, improve strength and flexibility, and provide refreshment (1.5% for each category respectively) (Fig. 2).

Table 1 Medicinal plants at Prey Lang with reported preparation methods and uses during the postpartum period. Voucher specimen numbers are given in parenthesis and voucher specimens are deposited in the Queen Sirikit Botanic Garden, Chiang Mai, Thailand. Village: PR – Phneak Roluek; SP – Spong; TH – Thmea. * Plant species used in knowledge pattern analysis.

Scientific name	Ethnospecies Name (Voucher No.)	Village	Postpartum Uses	Parts Used	Preparation
ACHARIACEAE					
Hydnocarpus anthelminthicus Pierre ex Laness.	Krorbao (130)	PR, SP	Galactagogue, uterine pain	Bark & wood	Infusion
ANNONACEAE					
Dasymaschalon macrocalyx Finet & Gagnep.	Cheungchab (40)	SP	Galactagogue, orexigenic, sleep/rest	Root	Infusion
Goniothalamus repevensis Pierre ex Fin. & Gagnep.	Krovan (136)	PR	Not specified	Not specified	Not specified
Goniothalamus tamirensis Pierre ex Finet & Gagnep.	Moom (160)	PR, SP	Orexigenic, uterotonic, blood circulation	Root	Infusion
APOCYNACEAE					
Holarrhena curtisii King & Gamble	Tekdors (302)	PR	Blood circulation, galactagogue	Bark & wood	Infusion with Ploosbart
ARECACEAE					
Calamus viminalis Willd.	Chongpdao (63)	SP, TH	Pain	Root	Infusion
ASPARAGACEAE					
Dracaena angustifolia (Medik.) Roxb.	Angraedaek (5)	PR, SP	Galactagogue, orexigenic, general health	Leaves & flower	Infusion
Peliosanthes teta Andrews	Tbaldaek (301)	SP	Uterotonic	Root	Infusion: roots of Angraedaek & Skun
ASPHODELACEAE					
Dianella ensifolia (L.) DC.	Kontoykror-per (114)	SP	Orexigenic, refreshment	Root & leaf base	Roast, then infusion
Markhamia stipulata (Wall.) Seem.	Dakpor (74)	PR	Uterine health	Not specified	Not specified
BORAGINACEAE					
Heliotropium indicum L.	Chompussek (61)	PR	Uterine health	Root	Infusion
CAPPARACEAE					
Capparis micracantha DC.	Kounh Chur beay dach (120)	PR	Not specified	Not specified	Not specified
CELASTRACEAE					
Euonymus cochinchinensis Pierre	Koomouy (115)	PR, SP	Galactagogue, orexigenic	Bark, root & wood	Infusion
Salacia chinensis L.	Rorveay (247)	PR, SP	Uterine prolapse	Wood & nodes	Infusion
Salacia cochinchinensis Lour.	Vor Kondabchongae (351)	PR	Not specified	Bark & wood	Infusion
CLUSIACEAE					
Garcinia merguensis Wight	Kres (126)	PR	Not specified	Bark	Not specified
Garcinia sp. 2	Yeam (381)	PR, SP	Blood circulation	Bark, root & wood	Infusion

Table 1 (Continued)

Scientific name	Ethnospecies Name (Voucher No.)	Village	Postpartum Uses	Parts Used	Preparation
CONNARACEAE					
Ellipanthus tomentosus Kurz	Kd Komprok (96)	PR, SP	Orexigenic	Root	Infusion with Reum
DILLENIACEAE					
Dillenia hookeri Pierre	Ploosbart* (187)	PR, TH	Galactagogue, general health, food poisoning	Root	Infusion
EBENACEAE					
Diospyros ehretioides Wall. ex G. Don	Mormeang (161)	PR	Blood circulation	Bark & root	Infusion
Diospyros sylvatica Roxb.	Khanhchas (98)	PR	Uterine health	Root	Infusion
Diospyros undulata Wall. ex G. Don	Chherplerng (44)	SP	1. Galactagogue; 2. Pain & cold in uterus	1. Root (best) or bark; 2. Bark & wood	
ERYTHROXYLACEAE					
Erythroxylum cambodianum Pierre	Chompussek (60)	PR, SP	Blood circulation, orexigenic	Root	Infusion
EUPHORBIACEAE					
Antidesma ghaesembilla Gaertn.	Dongkeabk-dam (82)	PR, SP	General health	Bark & wood	Infusion
Croton sp.	Montek (159)	PR	Toas	Root	Infusion
Suregada multiflora (A. Juss.) Baill.	Tronoumseik (321)	PR, SP	Galactagogue, orexigenic, blood circulation	Bark, root & wood	Infusion
LAMIACEAE					
Gmelina asiatica L.	Anhcharnh (7)	PR, SP	Joint dislocation	Root	Dry, then infusion
Vitex pinnata L.	Porpool (200)	PR, SP, TH	Galactagogue, orexigenic, general health	Bark & wood	Infusion
Vitex sp.	Protespray (223)	PR	Not specified	Not specified	Not specified
LAURACEAE					
Cinnamomum bejolghota (Buch-Ham.) Sweet	Sroumdav (293)	PR, TH	Blood circulation, uterine health	Root, bark & wood	Infusion
Cinnamomum polyadelphum (Lour.) Kosterm.	Slapok (267) Tepproo (303)	PR, SP, TH	Not specified, Pain & cold feeling in uterus, joint & body pain	Root	Infusion, infusion with bark & Chherplerng wood, or tincture
Cinnamomum sp.	Sromday (284)	PR	Not specified	Root & bark	Infusion
Ocotea lancifolia (Schott) Mez	Krolor (127)	PR	Galactagogue, orexigenic	Root	Infusion
LEGUMINOSAE					
Acacia sp.	Vor Torleng (376)	PR	Orexigenic	Bark & wood	Infusion or rice wine tincture
Tadehagi triquetrum (L.) H.Ohashi	Angkrorng (4)	PR	Joint or bone pain, orexigenic	Whole plant	Infusion

Table 1 (Continued)

Scientific name	Ethnospecies Name (Voucher No.)	Village	Postpartum Uses	Parts Used	Preparation
Uraria sp.	Chang Kesang Kreang (36)	PR	Blood circulation	Root & bark	Dry, then infusion
Xylia xylocarpa (Roxb.) Taub.	Chkrom (56)	SP, TH	Skin health	Root	Infusion
LYTHRACEAE					
Lagerstroemia speciosa (L.) Pers.	Kraol (123)	PR, SP, TH	Orexigenic, boost immune system, skin health	Bark	Infusion
MALVACEAE					
Colona auriculata (Desf.) Craib	Preal (208)	PR, SP	Uterotonic, uterine pain	Root	Infusion with Dakun root (*Tetracera loureiri*)
Waltheria indica L.	Preash Proa Veal (211)	TH	Uterine health	Root	Infusion
MELASTOMATACEAE					
Melastoma malabathricum L.	Baynhenh (20)	PR	Orexigenic	Root	Infusion
Melastoma saigonense (Kuntze) Merr.	Baynhenh (22)	SP	"Stronger" veins, galactagogue, orexigenic	Root	Infusion with root of male plant
Melastoma sanguineum Sims	Baynhenh (21)	PR, SP	"Stronger" veins, galactagogue, orexigenic	Root	Infusion with root of female plant
MORACEAE					
Ficus racemosa L.	Lovear (149)	PR	Galactagogue	Outer part of seed	Infusion
MYRTACEAE					
Syzygium zeylanicum (L.) DC.	Smarch (271)	PR, SP, TH	Not specified	Bark & wood	Infusion
OCHNACEAE					
Ochna integerrima (Lour.) Merr.	Angkea (3)	PR, SP	Blood circulation, orexigenic, uterotonic	Root, bark & wood	Infusion
PHYLLANTHACEAE					
Hymenocardia punctata Wall. ex Lindl.	Komkhneang (107)	PR, SP	1. Blood circulation; 2. Galactagogue, orexigenic, general health	1. Bark; 2. Root	1. Infusion or rice wine tincture; 2. Infusion
PINACEAE					
Pinus merkusii Jungh. & de Vriese	Srorl (286)	SP	Body pain	Root & bark	Infusion
RHAMNACEAE					
Ventilago cristata Pierre (unresolved name)	Vor Tonlueng (375)	SP	Blood circulation	Vine	Infusion
Ziziphus oenopolia (L.) Mill.	Vor Sangkher, also Vor Sangkhouch or Sangkher (367)	PR, SP, TH	Galactagogue, orexigenic, stop blood loss, strength & flexibility	Root & vine	Infusion with other plants (not specified)

Table 1 (Continued)

Scientific name	Ethnospecies Name (Voucher No.)	Village	Postpartum Uses	Parts Used	Preparation
RUBIACEAE					
Coptosapelta flavescens Korth.	Tonling (313)	PR	Blood circulation	Bark & wood	Infusion or rice wine tincture
Ixora nigricans R. Br. ex Wight & Arn.	Pkamuchol (185)	PR	Pain	Root	Infusion
Lasianthus hirsutus (Roxb.) Merr.	Skun (265)	PR, SP	Orexigenic, uterotonic	Root	Infusion with Tbaldaek & Angraedaek root
Mitragyna hirsuta Hav.	Ktom, Ktomtom (137)	PR	Not specified	Root	Infusion with Roleay
Mitragyna sp.	Kvav (142)	PR, SP	Blood circulation	Not specified	Not specified
Mitragyna speciosa (Korth.) Havil.	Ktumphnom (141)	PR	Not specified	Root & bark	Infusion
Nauclea orientalis (L.) L.	Kdol (97), Ktom Roleay (138), Roleay (223)	PR, SP, TH	Orexigenic, blood circulation, stop blood loss, uterotonic, uterine health	Root (or bark)	Infusion or rice wine tincture
Oxyceros horridus Lour.	Thnungkan-hchos (310)	PR	Not specified	Root	Infusion or rice wine tincture
Prismatomeris filamentosa Craib	Romdenh-meas (238)	PR, SP	Orexigenic, sleep/rest, general health	Root	Infusion with other plants (not specified)
Prismatomeris memecyloides Craib	Romdenh (237)	PR, SP	Stop blood loss	Root	Infusion
RUTACEAE					
Murraya siamensis Craib (unresolved name)	Brohoung-arkas (28)	PR, SP	Toas	Root	Infusion
SIMAROUBACEAE					
Brucea javanica (L.) Merr.	Bromatmunus (30)	PR, TH	Not specified	Root	Infusion
Eurycoma longifolia Jack	Angtongsor (6)	PR, SP	Uterotonic	Root	Infusion
SMILACACEAE					
Smilax lanceifolia Roxb.	Porpreus (201)	PR	Not specified	Root	Infusion
Smilax megacarpa A.DC.	Porpreus Vor Rombers (362)	PR, SP	Blood circulation, hip pain	Root	Infusion with Chongpdao root
Smilax sp.	Porpreus (203)	SP	Orexigenic, uterotonic	Root	Infusion with Moom root
VIOLACEAE					
Rinorea anguifera Kuntze (unresolved name)	Dom dek pro ma (78)	PR	Uterine health	Root	Infusion
VITACEAE					
Leea indica (Burm. f.) Merr.	Kandangbay* (90)	SP	Galactagogue, orexigenic, toas	Root	Infusion

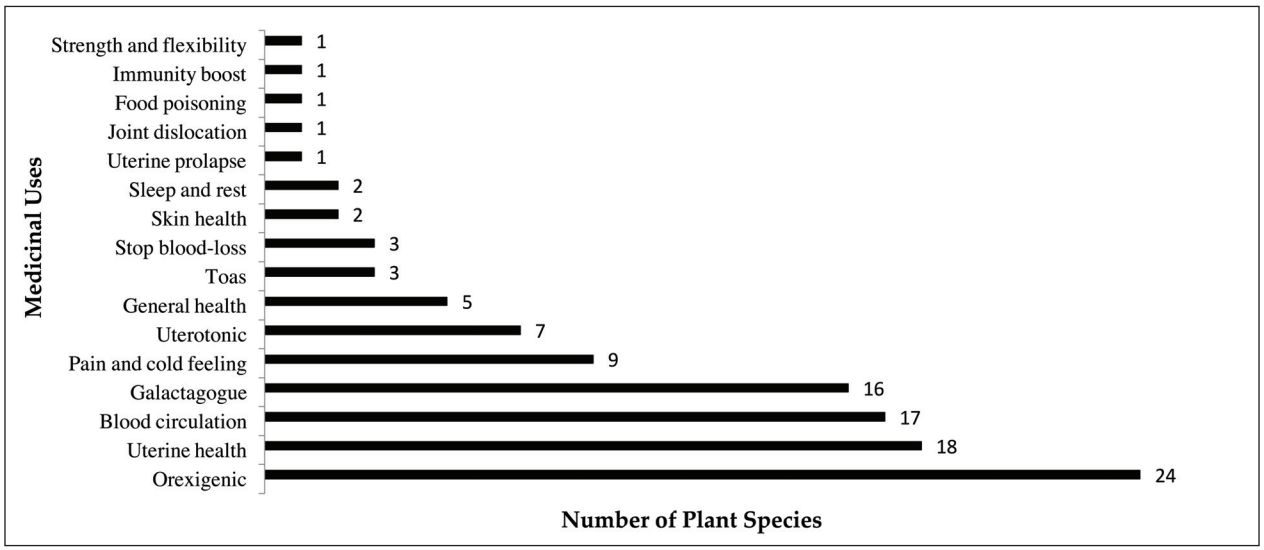

Fig. 2 Numbers of plant species employed for different postpartum uses at Prey Lang Wildlife Sanctuary. (Some species have multiple uses).

Toas and other postpartum ailments

An emic postpartum ailment that proved difficult to translate biomedically was related to consumption of "wrong" foods after delivery as well as resuming physical labour too quickly. There was little coherence in the recogition of different foods as "wrong" between respondents, yet the symptoms described were the same. These included "lock-jaw", which inhibits opening of the mouth to eat, and muscle tightness and pain over the whole body. Skin rash was also mentioned. Some respondents indicated that women should abstain from eating meat (specifically chicken and beef) and eggs after delivery. Others explained that prohibited foods vary according to personal preferences and tolerances. *Leea indica* was reported to alleviate skin rash, whereas *Croton* sp. and *Murraya siamensis* helped lock-jaw. *Neonauclea sessifolia* and *Prismatomeris memecycloides* were used for treating blood-loss after birth. Information about the cause of blood-loss (e.g., haemorrhage, mechanical tear) in women was not known or described in further detail. One respondent prescribed making a paste out of Teab buy seed (not collected, but used in the plant recognition analysis) and applying it directly to the breast to treat mastitis (inflammation of the breast tissue). Others reported experiencing mild pain, but regarded this sensitivity as normal in breastfeeding.

Women's knowledge and use of postpartum medicinal plants

Ethnospecies (local) names provided by TBAs were used as controls when investigating recognition of postpartum plants by mothers. Five plant species (ampil, lermeet kerbal pous, ploosbart, protiel tlem kmov, and teab buy) were used for recognition pattern analysis in Chamreun, whereas four (ampil, kandangbay, potrea, and teab buy) were used in Spong. Two plant species (ampil and teab buy) encountered in Chamraeun were also found and collected in Spong. These seven species were common according to the TBAs and there was agreement about their local names. Sixty percent of plant species (three out of five species) were identified correctly by the mothers in Chamraeun, whereas 50% (two out of four species) were correctly identified in Spong. No significant differences were found in terms of the number of plants recognised by different age groups (p=0.1547), or according to the number of pregnancies carried to term (p=0.2563).

Birthing experiences

No mothers reported miscarriages, yet four reported complications after birth, with one experiencing blood-loss and the others experiencing general weakness and mastitis. The remaining 43 respondents reported no complications in previous births.

Table 2 Frequencies of birthing experiences and future preferences among study respondents.

Group	Age	No of Respondents	No of Births	Previous Birthing Assistance			Future Birthing Preference			
				PHC/RH	TBA	Own	PHC/RH	TBA	Own	No comment
A	19–33	15	21	9, 62%	6, 38%		11, 73%	1, 7%	3, 20%	
B	34–38	10	32	1, 9%	9, 91%		6, 60%	4, 40%		
C	39–80	21	93		20, 97%	1, 3%	10, 48%	9, 43%	1, 5%	1, 5%

Mothers specified the number of successful births they had previously had, what kind of birthing assistance they had received (provincial health centre [PHC], referral hospital [RH], TBA, own family or other) and what their future preference would be if they could theoretically choose the next time they had a child (Table 2), as follows:

Group A: These mothers were younger (19–33 years of age, *n*=15) and had 1.3 successful births on average, 13 of which had occurred at a PHC or RH and eight with a TBA. Of the 15 respondents, 11 preferred PHC/RH delivery, three preferred to give birth at home with their family and one preferred to give birth with TBA assistance.

Group B: Mothers between 34 and 38 years of age constituted 21.3% of our sample (*n*=10/47) and had collectively experienced 32 births. Twenty-nine of these births had occurred with TBA assistance, while the remaining three took place at a PHC or RH. The ratio of preference for giving birth at a PHC/RH to TBA was 3:2. None preferred to give birth at home.

Group C: All respondents (*n*=21) 39 years of age and above had not given birth at a PHC or RH. All but one had received assistance from a TBA for their deliveries. The exception was the only study respondent who had given birth (on three occasions) with assistance of family members each time. She was also the only respondent in her age group who preferred to this manner of giving birth if she were to have another child. Ten of the remaining respondents preferred to give birth at a PHC/RH, whereas nine preferred to give birth with a TBA.

Discussion

Plants used for postpartum ailments

The plant species collected in this study and used for postpartum ailments by women and TBAs in northern Prey Lang represent a wide range of botanical families. These are compared below to those ecountered in studies of postpartum health in Laos (Lundh, 2007; de Boer & Lamxay, 2009) and Thailand (Panyaphu *et al.*, 2011; Srithi *et al.*, 2012) (Grape & Turreira-Garcia, 2015).

The genus *Psychotria* is common in Southeast Asia, and phytochemical analyses have shown that several species within the genus contain analgesic compounds, relieving afterpains and acting as a uterotonic, inducing contraction of the uterus and in some cases reducing postpartum haemorrhage (Lundh, 2007). The Mien (Yao), 15th–19th century migrants from middle and southern China who settled in Thailand and Laos, use *Psychotria* to aid the secretion of waste products from the vagina (Panyaphu *et al.*, 2011). In contrast, *Psychotria* species mentioned by Khmer and Kuy ethnic groups of Cambodia are described as having orexigenic (appetite stimulating) properties.

Species mentioned by Lundh (2007) such as *Croton roxburghii* had a galactagogue (stimulating milk production) and drying effect on the uterus, while the *Croton* sp. in our study was prescribed for toas related to improper food consumption. Differences in beliefs and biomedical causes and effects render categorisation of postpartum ailments and prescriptions ambiguous. For instance, the toas symptoms described as "lock-jaw" are strikingly similar to the warning signs of tetanus infection. Tetanus bacteria typically enter through a wound and as exposure of the compromised birth canal could provide such an entrance (Hassel, 2013), this warrants further investigation.

Three species of *Melastoma* (*M. malabathricum*, *M. saigonense*, and *M. sanguineum*) were reported to have orexigenic and galactagogue effects in our study, and also to improve blood circulation. Lundh (2007) referred to uterotonic properties of species in the same genus (*M. candidum*) that were verified on guinea pigs. *Melastoma candidum* was also described by Lao informants as having a contraceptive effect. Though no literature was found to this effect, stimulatation of contractions in the early stages of pregnancy could perhaps instigate abortion.

No *Melastoma* species where reported by Panyaphu *et al.* (2011), yet *M. malabathricum normale* is used by Hmong women in northern Thailand to treat dysmenorrhea, painful cramps and leucorrhea (in cases of abnormal vaginal discharge: Srithi *et al.,* 2012).

Ficus racemosa was prescribed by the women of Prey Lang as a galactagogue, and this may have some relation to Lundh's report of *F. hispida* treating an unspecified disease causing fatigue and weight loss. If a woman is malnourished, she is unlikely to produce enough milk, and it could be that *F. hispida* improves weight gain and the strength and ability to absorb nutrients. In contrast, the Mien of Thailand use *F. auriculata* to treat urinary infections (Panyaphu *et al.,* 2011). *Ochna* cf. *integerrima* was also noted by Lundh (2007) as having galactagogue properties and a drying effect on the uterus, whereas this reportedly had had orexigenic and uterotonic effects in our study. Inadequate food consumption can have marked effects on lactation, as demonstrated on rats (Teixeira *et al.,* 2002), and orexigenic and galactagogue properties may be related.

Ziziphus oenoplia has been reported to relieve pain in Laos and Thailand (Lundh, 2007; Panyaphu *et al.,* 2011), whereas in Prey Lang it is reportedly used as a galactagogue and orexigenic, and also for its ability to stem blood-loss and improve postpartum strength and flexibility. Two accounts also mention pain relief for *Smilax* sp. from Laos (Lundh, 2007), which accords with accounts for *S. megacarpa* in Cambodia, although the specimen we collected of *Smilax* sp. was reported to have orexigenic and uterotonic properties. The Mien in Thailand also use *S. lanceifolia* to treat peptic ulcers (Panyaphu *et al.,* 2011). *Leea indica* was reported by them to eliminate waste matter and improve blood flow (Panyaphu *et al.,* 2011), whereas Khmer and Kuy in Prey Lang reported galactagogue and orexigenic properties for the species, as well as effects upon toas ailments during the postpartum period. In Prey Lang, *Gmelina asiatica* is used in for supporting joint health. Another species in the same genus, *G. arborea*, is used to treat infected wounds and peptic ulcers by Mien in Thailand (Panyaphu *et al.,* 2011).

In related studies in Laos and Thailand (Lundh, 2007; de Boer & Lamxay, 2009; Panyaphu *et al.,* 2011; Srithi *et al.,* 2012), postpartum was unanimously the phase of pregnancy for which each ethnic group had the greatest knowledge and use of medicinal plants. Despite differences in specific uses, our study indicates that the communities of Prey Lang share this tendency. While herbal steam baths seems to be the most prevalent method of plant preparation elsewhere, Khmer and Kuy women in Prey Lang almost exclusively administer these as an infusion in tea.

Modernisation and its effects upon traditional knowledge

Traditional phytomedicine has been widely used by indigenous cultures long before the advent of modern medicine (Shanley & Lutz, 2003; Srithi *et al.,* 2009). However, modernisation has eroded traditional ecological knowledge worldwide, raising concerns for its continued existence (Gómez-Baggethun *et al.,* 2013). Given the short study period, the large number and range of species encountered in this study indicates the importance of Khmer and Kuy knowledge of postpartum plants at Prey Lang. Rapidly changing conditions such as forest degradation and agricultural land conversion will likely change the way people interact with their surrounding environments. The national ban on TBAs in 2006 and continued modernisation of healthcare services could also diminish traditional knowledge and use of phytomedicine in future. In this context, in serving as a reference point for future comparisons, this study may facilitate understanding of such effects.

Despite the contested efficacy of traditional medicine, botanical remedies are relevant due to their cultural importance, affordability and inherent potential for future discovery of new medicines (Laval *et al.,* 2011; de Boer & Cotingting, 2014). The many generations worth of traditional phytomedicinal knowledge at Prey Lang therefore has intrinsic value and ought to be documented given the potential for its disappearance in future. Integration of such knowledge with modern science may also be an efficient way to retain and honour community traditions. The forests of Prey Lang consequenty warrant further ethnobotanical research. Further pharmacological studies on the beneficial and adverse effects of postpartum plants at Prey Lang should attempt to identify the genera and species with the greatest efficacy and be integrated into modern healthcare to realise their benefits in reducing maternal mortality. Efficient integration of traditional medicine ought to encompass regulation, comprehensive educational campaigns, and capacity building. This would honour, and perhaps strengthen, cultural values were traditional medicine to compliment modern medicine in a holistic and individualized prevention and treatment regime (Bodeker & Kronenberg, 2002).

The present study merely touches the surface of what remains to be learned about traditional phytomedical methods of treating and preventing ailments after childbirth. Further ethnobotanical investigations will likely reveal parallels in Kuy culture in Laos and Thailand and

phytochemical analysis may verify reported applications of plants with their true biophysical effects. Given their botanical diversity, the forests of Prey Lang present a metaphorical, and at times literal, lifeline for the people of Cambodia. Further study and use of medicinal plants at Prey Lang may be key to continued conservation of this lowland evergreen forest and ensuring sustained benefits to local people. Whether the union of traditional and modern medicine will be adopted to help reduce maternal mortality is something coming years of developing community involvement and healthcare modernization will likely reveal.

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About the Authors

VICTORIA H. GRAPE is a Norwegian botanist studying a Masters at the University of Copenhagen, Denmark. She has held workshops in Botany for undergraduate students and worked at the University herbarium, assisting transfer of collections to the National Museum of Natural History in Copenhagen. Her interests lie in conservation biology and ethnobotany.

NEREA TURREIRA-GARCIA is a Spanish PhD candidate at Copenhagen University. She studied environmental sciences at the University of the Basque Country and forest and nature management in Copenhagen. Her research interests include local ecological knowledge and forest monitoring and she has worked in Cambodia, Vietnam, Guatemala, Spain, and The Netherlands.

LARS HOLGER-SCHMIDT is a Danish ethnobotanist and associate professor and senior advisor at Copenhagen University. He has 22 years of experience, ten of which relate to forestry projects in Asia and Africa. He teaches agroforestry and researches Allanblackia oil in Africa and forest conservation strategies in Asia.

PHOURIN CHHANG is a Cambodian botanist who works as herbarium curator and professor at the Forest and Wildlife Research Institute, Forestry Administration in Phnom Penh, Cambodia.

PRACHAYA SRISANGA is a curator at Queen Sirikit Botanic Garden Herbarium, Chiang Mai, Thailand. His research focusses on plant species diversity in mainland Southeast Asia (Laos, Myanmar, and Thailand) and and ethnobotanical practices of ethnic groups in the region.

Appendix 1 Summary of study respondents

Village: CH – Chamraeun; SP – Spong. Job: F – Farmer; H – Healthcare; L – Logger; T – Resin tapper; S – Shop keeper. Income: Ag – Agricultural work; C – Corn; Cm – Child-minding; Ff – Food collection in forest; Lo – Logging; M – Meatballs; P – Potatoes; Re – Resin; Ri – Rice; Se – Sesame; Ss – Small shop; V – Vegetables; Wh – Wheat; Wi – Wine. [1]CAD – Complications after delivery. [2]TPT – Total pregnancies carried to term.

#	Village	Age	Ethnicity	Job	Income	Birthing Experience					Birthing Preference	
						CAD[1]	TPT[2]	Own	TBA	PHC	Choice	Reason, Comments
1	CH	58	Khmer	F	Ri		6		6		TBA	Familiar (former TBA)
2	CH	33	Kuy	F	Re		2		2		PHC	Easier than at home
3	CH	47	Kuy	F	Ri, P		4		4		TBA	Easier, hospital far away
4	CH	64	Kuy	F	Ri, Ss		2		2		TBA	No comment
5	CH	44	Kuy	F	Ri		5		5		PHC	Effective medicine
6	CH	58	Kuy	F	Ri, P, M, Wi		3	3			Own	Don't trust strangers at hospital (former TBA)
7	CH	80	Kuy	F	Ri		3		3		PHC	Reliable facilities
8	CH	57	Khmer	S	Ss	1	4		4		PHC	TBAs illegal
9	CH	55	Khmer	F	P		3		3		TBA	Easier, close to home
10	CH	23	Kuy	F	Ri, P		1			1	PHC	Easier, TBAs not educated
11	CH	35	Kuy	F	Ri		4		3	1	TBA	No comment
12	CH	74	Half	F	Ri		4		4		PHC	Better facilities
13	CH	19	Khmer	F	Ri		1			1	PHC	Safer
14	CH	52	Kuy	F	Ag		5		5		TBA	TBA experienced
15	CH	30	Kuy	F	Ri, V		1		1	1	PHC	Safer
16	CH	20	Kuy	F	Ri		1		1		PHC	Safer, many nurses
17	CH	27	Kuy	F	Ri, C, Wh		1			1	PHC	Safer
18	CH	42	Kuy	F	Ri		3		3		TBA	Easier, close to home
19	CH	21	Khmer	L	Lo		1			1	PHC	Better facilities, trustworthy
20	CH	60	Kuy	F	Ri, P		2		2		PHC	Doctor more qualified for complications
21	CH	67	Kuy	F	Ff		9		9		TBA	Easier, but TBAs illegal (former TBA)
22	CH	33	Kuy	F	P, Se		1			1	PHC	Safer, children healthier
23	CH	24	Khmer	F	Ri		2		1	1	Own	Hospital & TBAs both good
24	CH	20	Khmer	F	Ri		2			2	Own	Unsure
25	CH	25	Khmer	F	Ri		2		1	1	PHC	Safer, continual care
26	CH	35	Kuy	F	Ri		3		3		PHC	Safer
27	CH	25	Khmer	F	Ri		1		1		PHC	Safer
28	CH	35	Khmer	F	Ri		2		2		TBA	Prefers Khmer medicine
29	SP	55	Half	T	Re		7		7		PHC	Safer
30	SP	62	Kuy	F	Ss		5		5		PHC	Safer, doctors work together, TBAs work alone
31	SP	30	Half	T	Re		2			2	TBA	Easier, hospital far away

Appendix 1 (Continued)

#	Village	Age	Ethnicity	Job	Income	Birthing Experience					Birthing Preference	
						CAD[1]	TPT[2]	Own	TBA	PHC	Choice	Reason, Comments
32	SP	38	Khmer	T	Re		3		2	1	PHC	Safer, more doctors and effective medecine
33	SP	40	Khmer	F	Ri		6		6		PHC	Safer if complications
34	SP	36	Half	T	Re		3		3		TBA	Hospital too far
35	SP	50	Khmer	F	Ri	1	3		3		PHC	Safer
36	SP	21	Khmer	F	Ri, Re		1		1		Own	No comment
37	SP	49	Kuy	T	Re	1	5		5		PHC	No comment
38	SP	38	Kuy	F	Ri, Re		4		4		PHC	Safer, but far away
39	SP	38	Khmer	F	Ss, Re		2		2		PHC	Safer, especially in wet season, but not accessible
40	SP	38	Kuy	F	Ri, Re		4		4		TBA	Easier, nice to share knowledge
41	SP	45	Kuy	F	Ri, Re		5		5		TBA	Familiar, have good experience with TBAs
42	SP	37	Khmer	F	Ri		4		4		PHC	Safer
43	SP	50	Khmer	F	Ri, Re	1	5		5		TBA	Prefers Khmer medicine to pills
44	SP	35	Kuy	F	Ri, Re		3		2	1	PHC	Safer, if complications
45	SP	20	Khmer	F	Ri		1			1	PHC	No comment
46	SP	68	Kuy	F	Ri		4		4			No comment
47	SP	58	Khmer	H, S	Cm, Ss		6		6		PHC	TBA, Went to midwifery school, >100 births assisted, 14 years of practice

