ORIGINAL ARTICLE

Consumption of Manjakani Among Postpartum Mothers and Risk of Heavy Metal Contamination

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ABSTRACT

Introduction: In Malaysia, herbal medicines are used for variety of reasons including health promotion and home remedies during pregnancy and postpartum with Manjakani (Quercus infectoria) as one of the most commonly consumed herbs. Herbal medicines consumption had been linked to heavy metals contamination and transfer from mother to infant and may affect infant's growth and development. This study aims to (i) determine Manjakani consumption among postpartum mothers, (ii) quantify its heavy metals level, namely lead, cadmium, arsenic and chromium, and (iii) determine health risk associated with its consumption. **Methods:** A cross-sectional study involving 106 postpartum mothers was carried out in Kuala Lumpur. Six samples of Manjakani were sampled and extracted using microwave digester and analysed using Inductively coupled plasma mass spectrometry (ICP-MS). Non-carcinogenic health risks for herbal medicine consumption were calculated using Hazard Quotient (HQ). **Results:** Manjakani was consumed by 16% of mothers (n=17). Highest level of the metals was shown by chromium with mean concentration of 4210 ± 1910 ug/kg, followed by lead (170.8 ± 193.2), arsenic (39.3 ± 27.1) and cadmium (7.7 ± 0.76). There were no significant non-carcinogenic health risks with lead, arsenic, chromium and cadmium contamination (HQ < 1). **Conclusion:** Manjakani is consumed by mothers during confinement period. Heavy metals were quantified in Manjakani although no significant association was observed with socio-demographic characteristics and birth outcomes.

Keywords: Manjakani, Postpartum mothers, Heavy metals exposure, Non-carcinogenic health risk, Malay herbal medicines

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INTRODUCTION

Consumption of herbal medicine have escalated throughout the world with the World Health Organisation (WHO) predicting that 80% of the world populations are consuming herbal remedies (1). A nation-wide surveillance in 2015 revealed that approximately 29.3% of Malaysians have used traditional and complementary medicine throughout their lives where females were significantly using more traditional and complementary medicine compared to males (2). Herbs-based products and herbs were two most commonly used complementary and alternative medicine modalities in Malaysia; in which 23.6% of Malaysians used herbs-based products while 17.1% used herbs to alleviate health problems (3). In addition, a recent study by Yeong and Choong in 2017 reported that 45.6% of Malaysians were herbal medicines users with evening primrose oil, ginkgo biloba and milk thistle as the top three herbal products used for various reasons (4).

Herbal medicines has been used in almost all parts of the world. Numerous studies had been done all around the globe to determine prevalence of herbal medicines usage among the world population. Malaysian population is among the major users of traditional medicine practices. With various cultural roots and ethnics, the Malaysian traditional practices saw a variety of modalities originating from Indonesian, Chinese, Indian and Orang Asli practices (5). Malaysian traditional herbal medicines utilises a variety of medicinal plants parts including leaves, roots and fruits for treatment of various ailments (5,6)

Herbal medicines are often linked to various indications and health claims which vary from general to specific indications. Users of herbal medicines mainly consumed herbs for health maintenance, muscle and body ache, health problems, spacing of children and sexual pleasure (7). On the other hand, maternal use of herbal medicines are mainly to facilitate labour, improve health of babies,

promote uterine involution, slim down, improve health and energy of mothers, increase breast milk production as well as abortion (7).

Heavy metals had been found in herbal medicines concoction all over the world. A study on different types of plants and herbs such as yarrow, chamomile, bearberry leaves, peppermint, hibiscus, thyme and oregano in Bulgaria revealed presence of cadmium, arsenic and lead in these medicinal plants (8). A study of heavy metals contamination in Chinese Herbal Medicines (CHMs) also revealed presence of heavy metals such as lead, cadmium and chromium in the sampled herbs (9). With detection of heavy metals in herbal medicines, concern arises for exposure of heavy metals and their possible effects to users. Chronic exposure to heavy metals could affect different organs in the body (10). For example, arsenic had shown strong relationship with hypertension and coronary disorders while cadmium was linked with renal damage (10,11). Lead on the other hand was found to be highly neurotoxic which could cause impaired brain development of fetus when ingested during pregnancy (11,12).

Use of herbal medicines among mothers were of concern due to possible heavy metals exposure towards mothers and infants due to herbal medicines ingestion and the effects of consumption on infants (12,13). Previous studies had shown that presence of toxic metals such as lead and cadmium in breast milk could be transferred to infants. One such study detected lead and cadmium in breast milk of mothers at two months postpartum period and reported negative correlation of breast milk cadmium levels with head circumference, and birth weight in newborns (12). Another previous study on the other hand reported higher percentage of neonatal jaundice for infants of mothers consuming herbs during postpartum period (13). These findings raises possibilities of influence from herbal medicines consumption among mothers on growth and health of their fetus and newborns.

Manjakani, ketam uri, ubat periuk and kacip Fatimah are some of the commonly used herbs during pregnancy and confinement among Malay mothers are (7,14). Manjakani, or its scientific name Quercus infectoria, are round-shaped galls in young branches of oak tree mainly found in Asia, Greece and Iran (15-17). This herb are rich in tannins such as gallic acid and syringic acid and is proposed to possess antioxidative and anti-inflammatory properties used for treatment of inflammatory ailments including aphthous ulcers, skin inflammation and gingivitis (18). This herb is also reported to be used medically and claimed to be beneficial as antidiabetic and antipyretic agents, used in the treatment of impetigo, eczema and diarrhea and also used as local anaesthetic (15,19-21).

Earlier studies among Arabs, Persians, Indians, Malays and Chinese reported use of this herb after childbirth in the treatment of vaginal discharge and infections (16,22). In Malaysia, the galls had been studied over the years and accepted as health supplement for postpartum care (16,17). A study among Malay Kelantanese women revealed that Manjakani was thought to be beneficial to re-energize the body and to recover reproductive organ functions (23).

Being one of the commonly used herbs during pregnancy and postpartum, this study aims to determine Manjakani's consumption among mothers and its heavy metals level namely lead, cadmium, arsenic and chromium as well as the assessment of health risk associated with its consumption.

MATERIALS AND METHODS

Study design

A cross-sectional study was carried out in Kuala Lumpur, Malaysia. Being the capital district of Malaysia, Kuala Lumpur consists of a mixture of mothers from various socio-demographic backgrounds.

Participants were required to complete a set of questionnaire which included questions on socio-demographic, maternal, pregnancy, postpartum and infant characteristic, as well as frequency and usage of herbal medicine. Convenient sampling of participants in public area around Kuala Lumpur was conducted. Only participants aged between 19 to 64 years old and within 100 days of postpartum were recruited in the study regardless of breastfeeding status. All participants were given information sheet which included information on purpose and benefits of participating in the research. All participants were required to sign the informed consent before participating in the study. Ethical approval for this study was granted by Malaysian Research Ethics Committee (MREC) [Ref: NMRR-15-990-25727(IIR)]. Participants were recruited via convenient sampling in public places all around Kuala Lumpur from October 2016 to August 2019. All participants were invited to Faculty of Medicine and Health Sciences, UCSI University to complete the questionnaire.

Manjakani was sampled randomly from six local herbal stores located within different districts in Kuala Lumpur namely Segambut, Seputeh, Cheras, Bandar Tun Razak, Bukit Bintang and Lembah Pantai.

Microwave digestion

A total of six samples were analysed. Sampled herbs were grinded to produce a powder form and kept at room temperature before further analysis. Approximately 0.5 gram of powdered sample were digested with 5 mL of nitric acid and 1 mL of hydrogen peroxide. The samples were radiated in microwave digester for 15 minutes (24). Upon cooling, the solutions were diluted to 50 ml with 1% nitric acid.

Sample extraction analysis

Four heavy metals were analysed in this study, namely lead, cadmium, chromium and arsenic. Quantification of heavy metals was done using Inductively coupled plasma mass spectrometry (PerkinElmer ICP-MS). For method performance validation, quantification of certified reference material was carried out. Blank sample was injected for each batch of sample analysis throughout the entire sample preparation and analytical process (25).

Quantitative Health Risk Assessments

Non-carcinogenic health risk was expressed using hazard quotient (HQ) which is defined as ratio of chronic chemical daily intake (mg/kg/day) to the reference dose (RfD) (mg/kg/day) (26). ADD refers to average daily exposure to heavy metals (mg/kg/day) and RfD refers to reference dose for heavy metals (mg/kg/day) (27). ADD was estimated according to Eq. 1.

$$ADD = C \times CR \times EF \times ED / BW \times AT \quad \text{Eq. 1}$$

whereby C refers to concentration of heavy metals in food (mg/kg), CR refers to consumption rate (kg/day), EF is exposure frequency (days/year), ED is exposure duration (years), BW refers to average body weight of the receptor over the exposure period (kg) and AT refers to averaging time (days) (27).

HQ is calculated according to Eq. 2. HQ greater than 1 (HQ > 1) indicates presence of non-carcinogenic health risk.

$$HQ = ADD/RfD \quad \text{Eq. 2}$$

Statistical analysis

Statistical Package for the Social Sciences (SPSS) software version 20 was utilized for statistical analysis. Data analysis was done with descriptive analysis and Chi-square cross tabulation test. A code was applied to identify each participant upon database entry. In view of the study question, all data were organized to analyze the characteristics of all participants. Significance level at 0.05 was used for all statistical measures.

RESULTS

Herbal medicines and Manjakani consumption among mothers

Among 106 of the participants, 60.4% (n=64) consumed herbal medicines during pregnancy or postpartum while 39.6% (n=42) of participants were non-consumers. All participants are Bumiputera (n = 106). Majority of the participants are between age 26 to 35 years old (76.4%, n=81), followed by 36 years old or more (12.3%, n=13) and 25 years old or less (11.3%, n=12). Participants' household income are ≤MYR5,000 (52.8%, n=56) and >MYR5,000 (47.2%, n=50) while their education level are tertiary level (37.7%, n=40) and secondary level or lower (62.3%, n=66). Participants were mostly housewives (41.5%, n=44), government employee (42.5%, n=45) or working in private sector (16.0%, n=17). Table I shows participants' socio-demographic characteristics. Manjakani was found to be consumed during confinement (16%, n=17). Majority of Manjakani consumers were within 26 to 35 years old (88.2%, n=15) while the remaining were aged 36 years or older (11.8%, n=2). In addition, 47.1% (n=8) had education level of Bachelor degree and higher while 52.9% (n=9) had education at secondary level. More mothers were employed (64.7%, n=11) compared to unemployed (35.3%, n=6). Most had household income of >MYR5,000 (58.8%, n=10) compared to ≤MYR5,000 (41.2%, n=7). In addition, one mother had only one child (5.9%), while others had two children (29.4%, n=5) or more (64.7%, n=11). No significance association was observed between Manjakani consumption and socio-demographic characteristics.

Table I: Socio-demographic characteristics of participants

	Overall (n=106) n (%)	Consumed herbal medicines (n=64) n (%)	Did not consume herbal medicines (n=42) n (%)	p value
Age				0.264
25 years old and less	12 (11.3)	5 (7.8)	7 (16.7)	
26 to 35 years old	81 (76.4)	52 (81.3)	29 (69.0)	
36 years old and more	13 (12.3)	7 (10.9)	6 (14.3)	
Education level				0.421
Tertiary education	40 (37.7)	24 (37.5)	16 (38.1)	
Secondary level or below	66 (62.3)	40 (62.5)	26 (61.9)	
Occupation				0.624
Housewife	44 (41.5)	23 (35.9)	21 (50)	
Private sector employee	17 (16)	12 (18.8)	5 (11.9)	
Government employee	45 (42.5)	29 (45.3)	16 (38.1)	
Monthly household income				0.427
≤MYR5000	56 (52.8)	28 (43.7)	28 (66.7)	
>RM5000	50 (47.2)	36 (56.2)	14 (33.3)	

Purpose of herbal medicines consumption among the participants who consumed Manjakani was to improve health and energy (58.8%, n=10), facilitate wound healing (47.1%, n=8), slim down (23.5%, n=4), increase breast milk production (23.5%, n=4) and facilitate labour (17.6%, n=3) (Table II) while main source of information for herbal medicines among Manjakani consumers was parents or in-laws (41.2%, n=7). Table III outlines the source of information on herbal medicines among participants who consumed Manjakani.

Approximately 77.4% of participants reported incidence of neonatal jaundice in their infants (n=82), in which 39.6% of the infants received phototherapy (n=42) and 3.8% had undergone exchanged transfusion (n=4). Among participants who consumed Manjakani, 82.4% reported neonatal jaundice in their infants (n=14), with 41.2% of them received phototherapy

Table II: Purpose of herbal medicines consumption among mothers who consumed Manjakani

	Number of participants consuming Manjakani (n=17)	
	n	%
Improve health and energy	10	58.8
Facilitate wound healing	8	47.1
Slim down	4	23.5
Increase breast milk production	4	23.5
Facilitate labour	3	17.6
Manage muscle and body ache	3	17.6

Table III: Source of herbal medicines information among mothers who consumed Manjakani

	Number of participants consuming Manjakani (n=17)	
	n	%
Parents or in-laws	7	41.2
Traditional medical practitioner	3	17.6
Husband, friends, siblings	3	17.6
Online information	3	17.6
Articles and adverts in health magazines	2	11.8
Commercial adverts	2	11.8

(n=7) and 5.9% required exchanged transfusion (n=1). For participants who did not consume herbal medicines throughout pregnancy and confinement, 78.6% reported neonatal jaundice in their infants (n=33), 35.7% received phototherapy (n=15) and 2.4% had exchanged transfusion (n=1). Participants who consumed other types of herbal medicines reported neonatal jaundice incidence in 74.5% of the infants (n=35), 42.6% (n=20) required phototherapy and 4.3% (n=2) required exchanged transfusion (Table IV). No significant association was observed between Manjakani consumption and all three parameters.

Heavy metals concentration and quantitative health risk assessment

This study reported highest level of heavy metals by chromium with mean concentration of 4210 ± 1910 ug/kg, followed by lead (170.8 ± 193.2), arsenic (39.3 ± 27.1) and cadmium (7.7 ± 0.76) following a descending order of chromium > lead > arsenic > cadmium.

Non-carcinogenic health risks due to heavy metals exposure were calculated using Hazard Quotient (HQ). Average daily exposure (ADD) was compared to reference dose (RfD) of lead at 0.004 mg/kg/day (26,27), cadmium at 0.001 mg/kg/day (26,27), chromium at 1.5 mg/kg/day (26,27) and arsenic at 0.0008 mg/kg/day (26,27). Hazard quotient was calculated by referring to the mean concentration of chromium, lead, arsenic and cadmium, while CR depicted as 0.023 kg/day which was the mean consumption of Manjakani reported by the participants, with EF at 22 days/year, ED at one year,

Table IV: Comparison between infants born to participants who consumed Manjakani versus participants who did not consume herbal medicines

	Overall (n=106) n (%)	Manjakani consumers (n=17) n (%)	Consumed other herbal medicines (n=47) n (%)	Did not consume herbal medicines (n=42) n (%)	p value
Had neonatal jaundice					0.778
Yes	82 (77.4)	14 (82.4)	35 (74.5)	33 (78.6)	
No	24 (22.6)	3 (17.6)	12 (25.5)	9 (21.4)	
Received phototherapy					0.797
Yes	42 (39.6)	7 (41.2)	20 (42.6)	15 (35.7)	
No	64 (60.4)	10 (58.8)	27 (57.4)	27 (64.3)	
Had exchanged transfusion					0.794
Yes	4 (3.8)	1 (5.9)	2 (4.3)	1 (2.4)	
No	102 (96.2)	16 (94.1)	45 (95.7)	41 (97.6)	

average BW of 60.92 kg and AT of 365 days; hazard quotient for all metals were calculated to be less than 1 (HQ < 1). These results indicated no significant non-carcinogenic health risks with lead, arsenic, cadmium and chromium contamination. Table V outlines heavy metals concentration and hazard quotient for Manjakani.

Table V: Heavy metals concentration and hazard quotient for Manjakani

	Heavy metals in Manjakani			
	Chromium (Cr)	Lead (Pb)	Arsenic (As)	Cadmium (Cd)
Mean ± SD (mg/kg)	4.21 ± 1.91	0.17 ± 0.19	0.04 ± 0.03	0.008 ± 0.0008
Hazard Quotient	0.0000638	0.00095	0.001125	0.0001

DISCUSSION

Herbal medicines consumption among mothers

This study found that only a fraction of the participants consumed Manjakani, in which the usage was limited to confinement period. However, more than half of the participants used herbal medicines during both pregnancy and postpartum. Similarly, a study done by Bayisa et al. in Western Ethiopia reported that more than half of the research participants use herbs during pregnancy (28).

This study found no significant difference between Manjakani consumption and level of education, number of pregnancy or age. Interestingly, a study by Forster et al. in Australia reported that women who had not completed a degree and were pregnant with their second pregnancy or more were less likely to consume herbs. On the other hand, they found that older women tend to use herbs during pregnancy (29). It appears that age seemed to determine frequency of herbs use while higher education level does not necessarily translates to a more informed decision on usage of herbs during pregnancy. It is disturbing to find that despite inconsistent evidence

on safety of herbal medicines used during pregnancy and postpartum period, mothers all over the world persist to use herbal medicines during this critical period. Source of information of herbal medicines seemed to include health care providers, natural/alternative medicine practitioners or pharmacists, or via recommendations by friends or family (29). This is alarming due to the possible misleading information given by healthcare professionals which provides unintended safety blanket and propels the consumers to continue or increase the use of herbal medicines.

No significant finding was found on reported neonatal jaundice incidence between participants who consumed Manjakani and non-consumers in this study. Interestingly, this is different from the findings by Teoh et al. in their study among mothers recruited from University Kebangsaan Malaysia Medical Centre, Kuala Lumpur (13). Their findings showed significance of neonatal jaundice development in infants of mothers who consumed herbs during confinement compared to mothers who did not consume herbs during this period.

Neonatal jaundice is caused by bilirubin accumulation in the blood which could be a result of overproduction or failure to metabolise and excrete bilirubin in the body (30). Different types of prolonged jaundice in infants could also be observed in cases of glucose-6-phosphate dehydrogenase deficiency in which the body is not able to produce this enzyme, leading to oxidative stress and hemolysis in red blood cells causing development of neonatal jaundice (30,31). Another type of commonly seen neonatal jaundice is breast milk jaundice which is associated with unconjugated hyperbilirubinemia in breastfed infants (32,33). The aetiology is unclear however, activity of beta-glucuronidase has been linked as one of the possible mechanisms leading to jaundice in breastfed infants (30,34). CHMs-associated hepatotoxicity has also been reported by researchers in China who reported incidence of jaundice among children ingesting CHMs that are used to treat diseases such as upper respiratory tract infection or vitiligo (35). In addition, heavy metals such as As could also lead to liver toxicity which leads to development of jaundice (36). With presence of heavy metals in the herb, there is a risk of heavy metals transfer to infants which may lead to development of neonatal jaundice.

Although this study did not find any significant association between incidence of jaundice among infants of Manjakani consumers versus non-consumers, this result could be attributable to the low number of Manjakani consumers among the participants when comparing to the participants in other studies. Therefore, it is still worthwhile to further expand the study and explore the link of neonatal jaundice development with Manjakani consumption among mothers.

This study found that Manjakani was consumed during confinement with the main purpose of improving mothers' health and energy, followed by to facilitate wound healing, slim down, increase breast milk production and facilitate labour. This result shows consistency with previous studies in Malaysia by Rahman et al. and Teoh et al. which listed labour facilitation, increase breast milk production, reduction of weight, improvement of health and energy of mothers as well as improvement of infants' health as purpose of herbal medicine consumption (7,13). Bayisa et al. also reported use of herbal medicines to treat nausea and morning sickness (28). Populations around the globe also showed use of herbal medicines for various ailments. McIntyre et al. reported that more than 70% of patients with anxiety disorders in Australia used herbal medicines to relieve their anxiety without consulting their physicians (37). A study by Peltzer and Pengpid in Thailand saw a prevalence of approximately 36% on herbal medicines used with indications ranging from improvement of well-being, long term health condition and treatment of acute illness (38).

Heavy metals contamination and associated health risk

This study reported presence of all four heavy metals tested in Manjakani. To date, limited data is available of presence of heavy metals in this herb. However, other studies had quantified heavy metals in different types of plants and herbs around the world which showed presence of heavy metals. Detection of heavy metals had been detected in various medicinal herbs as well as commonly consumed food and drink such as tea leaves (40,41).

Studies on different herbs in various parts of the world had revealed a mixture of both positive and negative results for non-carcinogenic health risks upon consumption (39,40). One such study done by researchers in Yunnan, China reported no non-carcinogenic health risks from aluminium, lead, cadmium, mercury, zinc, copper and arsenic in Puerh tea despite the authors' concerns on arsenic levels in the tea (40). Another study conducted in Romania on the other hand reported a combined HQ > 1 for parsley, carrot roots, cabbage and lettuce in highly toxic metals contaminated areas and no health risks in other investigated areas (39). This indicates that cumulative effects of different herb usage might pose a significant health risk if taken at the same period of time. For this study, health risk imposed is low probably due to limited time of exposure whereby the participants reported consumption of Manjakani at the average of 22 days during postpartum period. The risk might accumulate to a higher degree if duration of exposure is increased due to longer duration of consumption or increased number of pregnancies.

Heavy metals are naturally present in the environment and had been used in many industries for many years. Chromium for example is a common result of leather processing and finishing processes, involves in refractory

steel production and electroplating, as well as used for wood preservation and other chemicals and cleaning agents (42). This made this heavy metal to be abundant in the ecosystem. Another commonly found heavy metal is lead which is usually found in fertilizers and pesticides, exhaust from automobiles, as well as a result of mining, smelting, fuel and explosives usage (42,43). Arsenic is often found in drinking water and also from mining, fossil and fuel combustion as well as arsenic-based pesticides and wood preservatives usage while cadmium is a by-product of zinc production and is often used in rechargeable batteries (43).

These heavy metals persist and accumulate in water and soil; as well as bioaccumulate in living organisms. Toxicity occurs when intermediate compound is not excreted and remains inside the cell. One example of this is monomethylarsonic acid III (MMA III) accumulation in the body due to chronic arsenic exposure; which was highly toxic and could eventually give rise to arsenic-induced carcinogenesis in the long run (43). Another mechanism of heavy metal toxicity in living cells is oxidative stress which raises reactive oxygen species level and reduces antioxidant levels in the body (43).

Human heavy metals exposure from the environment occurs in a wide range of pathways including inhalation, surface water, dermal contact and soil (44). For those non-occupationally exposed, diet has been identified as one of the major source of heavy metal to human, contributing more than 90% of the exposure (44). Exposure of heavy metals towards lactating mothers may influence development and growth in infants due possible transfer of toxic metal in maternal blood to infants via breast milk which is the main source of nutrition for newborns (45).

Traditional medicine preparations in Malaysia is governed under the Control of Drugs and Cosmetics Regulation 1984 (39,46,47). One criteria to register traditional medicine products is compliance to Good Manufacturing Practice. This must be fulfilled by all manufacturers to enable them to be licensed by the Drug Control Authority (46,47). In addition, quality requirement for traditional medicine goods manufacturing mandated permissible level of heavy metals concentration in a product such as lead, mercury, arsenic and cadmium concentration to be less than 10 parts per million (ppm), 0.5 ppm, 5 ppm and 0.3 ppm respectively; which also amounted to 10000 ug/kg, 500 ug/kg, 5000 ug/kg and 300 ug/kg correspondingly (48). This study found that the heavy metals concentration still within permissible level for manjakani with lead level of 170.8 ± 193.2 ug/kg, arsenic of 39.3 ± 27.1 ug/kg and cadmium of 7.7 ± 0.76 ug/kg. Other researchers in Malaysia had previously detected heavy metals in herbal preparations such as “Tongkat Ali”, “Serapat angin”, “Delima sudip”, “Petai belalang”, “Hempedu bumi”, “Misai kucing” (47,49). One such study by Ang et al. studied Malaysian Tongkat Ali products available in the market and found incompliance of commercially available products with Malaysian regulation. Their study tested 100 samples of Tongkat Ali products available in Malaysian markets and found that eight of the products had lead level of more than 10 ppm, one of which was registered with the Drug Control Authority, DCA, Malaysia (47). Although this study itself showed acceptable heavy metals concentration in Manjakani, presence of high level of heavy metals in other herbal medicines products calls the need for further analysis of commercially available herbal products in the market and possibility for more stringent monitoring to ensure optimum safety of the public. This study is limited whereby not all 11 districts in Kuala Lumpur were sampled for Manjakani. Further study should be done to analyse Manjakani in all 11 districts to better represent the population of Kuala Lumpur.

CONCLUSION

More than half of the participants consumed herbal medicines during pregnancy and postpartum period. Among them, 16% consumed Manjakani in which the consumption was limited to confinement period. Main purpose of herbal medicines consumption amongst Manjakani consumers was to improve health and energy while the main source of information was parents or in-laws. No association was observed between Manjakani consumption and socio-demographic characteristics and presence of jaundice. Heavy metals namely arsenic, cadmium, chromium and lead were quantified in Manjakani whereby the highest level of heavy metals was shown by chromium with mean concentration of 4210 ± 1910 ug/kg, followed by lead (170.8 ± 193.2), arsenic (39.3 ± 27.1) and cadmium (7.7 ± 0.76). No significant health risk was observed with Manjakani consumption, however presence of heavy metals and potential transfer from mother to fetus and infant raises concerns on safety of consumption during pregnancy and postpartum period.

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