RESEARCH ARTICLE

Antenatal care and its effect on risk of pregnancy induced hypertension in Lao PDR: A case-control study [version 1; peer review: 1 approved, 1 approved with reservations]

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V1 First published: 10 Aug 2018, 7:1236
<https://doi.org/10.12688/f1000research.15634.1>
Latest published: 10 Aug 2018, 7:1236
<https://doi.org/10.12688/f1000research.15634.1>

Abstract

Background: Pregnancy induced hypertension (PIH) is a global public health concern as a leading cause of maternal mortality. Lao PDR has a high prevalence of PIH, but little is known about its risk factors. This study aimed to identify risk factors of PIH relating to antenatal care (ANC) in Lao PDR.

Methods: This hospital-based age-matched case control study was carried out between July and December 2017 in tertiary and secondary hospitals in Lao PDR. A total of 258 pregnant women (86 hypertensive and 172 normotensive pregnant women) were recruited to join the study based specific inclusion criteria. For each case, two consecutive controls were included in the study with matched maternal age. Data was collected using a structured questionnaire interview to identify the risk factors of PIH relating to ANC. The association between the independent variables and PIH was assessed through bivariable and conditional multiple logistic regression analyses.

Results: Mothers with PIH had inadequate ANC (defined as <4 times) (adj. OR= 10.23 , 95%CI: 3.67 – 28.49, p<0.001), excessive maternal weight gain during pregnancy (>13kg) (adj. OR=7.35, 95%CI: 3.06 - 17.69, p<0.001), had a history of abortion (adj. OR=3.54, 95%CI: 1.30- 9.59, p=0.013), and had received inadequate information about PIH (adj OR= 2.58 , 95%CI: 1.03 – 6.46 , p=0.043).

Conclusion: Inadequate ANC and maternal factors were major risk factors of PIH in Lao PR. National PIH guidelines for effective counseling, ANC and treatment should be promptly developed and implemented at all levels in order to improve pregnancy outcomes.

Open Peer Review

Approval Status ? ✓

	1	2
version 1 10 Aug 2018	? view	✓ view

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Any reports and responses or comments on the article can be found at the end of the article.

Keywords

Pregnancy Induced Hypertension, Antenatal Care, Risk Factors

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Author roles: **Phengsavanh A:** Conceptualization, Data Curation, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Supervision, Validation, Writing – Original Draft Preparation; **Laohasiriwong W:** Formal Analysis, Methodology, Resources, Supervision, Writing – Review & Editing; **Suwannaphant K:** Data Curation, Formal Analysis, Software; **Assana S:** Data Curation, Formal Analysis, Software, Validation; **Phajan T:** Formal Analysis, Software, Validation; **Chaleunvong K:** Data Curation, Formal Analysis, Software, Validation

Competing interests: No competing interests were disclosed.

Grant information: Khon Kaen University provided the scholarship during AP's PhD.

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How to cite this article: Phengsavanh A, Laohasiriwong W, Suwannaphant K *et al.* **Antenatal care and its effect on risk of pregnancy induced hypertension in Lao PDR: A case-control study [version 1; peer review: 1 approved, 1 approved with reservations]**

F1000Research 2018, 7:1236 <https://doi.org/10.12688/f1000research.15634.1>

First published: 10 Aug 2018, 7:1236 <https://doi.org/10.12688/f1000research.15634.1>

Introduction

Pregnancy induced hypertension (PIH) is a major reproductive health concern, complicating 2–3% of pregnancies¹ and has an incidence of 6–8% for all pregnancies². PIH, including preeclampsia and eclampsia, was the second leading cause of maternal mortality and morbidity, especially in developing countries³. Globally, PIH was responsible for 16% of maternal deaths⁴.

The complications of PIH are severe in developing countries^{5,6}. Compared to postpartum hemorrhage and sepsis, PIH is quite difficult to prevent due to late presentation of symptoms^{7–9}. The causes of PIH are still unknown and the mechanism is yet to be elucidated¹⁰. Maternal mortality in Lao PDR still remains the highest in Southeast Asia. The direct causes of maternal mortality in Lao PDR were postpartum hemorrhage, PIH, obstructed labor and sepsis, of which PIH was the second leading cause of maternal mortality¹¹.

Antenatal care (ANC) is a care of women during pregnancy by skilled health care providers. The components of ANC include: early high risk screening, prevention and care of pregnancy-related complications, including PIH, and provision of health education and health promotion¹². PIH can be detected by routine screening of blood pressure and presence of proteinuria during ANC^{12,13}. Adequacy of ANC is very useful in the early detection of PIH screening. Focussed ANC is recommended by the World Health Organization, who show using evidence-based intervention that there are 4 critical times for ANC during pregnancy¹⁴. Therefore, in the present study ≥ 4 times of ANC was defined as adequate or good ANC.

Current PIH risk factors and preventive strategies are still questionable. The prevention and management of PIH are unclear due to insufficient knowledge concerning influencing factors, screening methods and preventive strategies. There is limited research on PIH in Lao PDR. Consequently, this study was conducted to identify risk factors of PIH in Lao PDR as relating to ANC.

Methods

Participants

Postpartum women who had delivered a baby between July and December 2017 in eight hospitals in Vientiane capital were included in this study. Four tertiary hospitals: The Mother and Child, Mahosot, Mitaphab and Sethathirath hospitals. Four provincial secondary care hospitals: Oudomxay, Xiengkhouang, Luangnamtha and Sekong hospitals.

Sample size

Primigravida was considered as an exposure of PIH, however, there was no exact data available in Lao PDR for the proportions of primigravida among the subjects in this study. Therefore, the sample size was computed by using proportions of primigravida among cases and controls obtained by similar study in Thailand¹⁵. With 95% confidence level and 80% power of the study, the required minimum sample size was calculated to be

86 for cases and 172 for controls (case: control ratio of 1:2), 258 subjects in total.

Inclusion criteria

The subjects were selected based on specific inclusion criteria. Cases were screened for eligibility from medical record by physicians. Single pregnant women were eligible subjects. Cases were women with PIH diagnosed by physicians. PIH was defined as a pregnant women with systolic blood pressure of ≥ 140 mmHg and diastolic blood pressure of ≥ 90 mmHg measured on two occasions 6 hours apart, accompanied by proteinuria of ≥ 300 mg per 24 hours, or $\geq 1+$ on dipstick testing after 20 weeks.

Controls were selected based on age-matching with cases in the same hospital. Controls were normotensive pregnant women who had delivered a baby within 3 days in the same hospitals and matched ± 2 years to maternal cases. Pregnancy with abnormal fetus and hydrop fetalis were excluded.

Data collection

A structured questionnaire ([Supplementary File 1](#)) was used as a data collection tool for both cases and controls. The questionnaire consisted of four parts including: General information, socio-demographic characteristics, previous pregnancy history and present pregnancy history. The content of this questionnaire was reviewed by five experts for validity. From the total of five experts, four were obstetricians from central hospitals in Vientiane Lao PDR and members of the Laos Association of Obstetrics, and one was a public health specialist who had experience research reproductive health research and worked at the University of Health Sciences, Lao PDR, for fifteen years.

In total, 30 test subjects tested the reliability of the questionnaire at the Military Hospital in Vientiane Capital. The Cronbach's alpha coefficient of the questionnaire was 0.87.

All cases and controls were interviewed during their hospital admission by physicians from other hospitals who were blinded to the subjects' PIH status. Data were collected between July and December 2017.

This study is a case control study which is retrospective in nature; therefore it is subjected to information bias, including recall and investigator bias. To circumvent recall bias we limited the recruitment of the cases to mothers who recently gave birth within one week. To limit investigator bias as a result of awareness of PIH conditions, the investigators were blinded to PIH in cases or controls. Therefore the questions the investigators posed would be asked in the same way for both cases and controls.

Statistical analysis

Data analysis were done using STATA version 10.0¹⁶. Descriptive statistic was used to describe the characteristics of cases and controls presenting frequencies, percentage, means, and standard deviations, minimum and maximum. Simple logistic regression was used to identify the association between each independent

variable and PIH. The independent variables with p-value <0.25 were selected to proceed to the multivariable analysis. Since this is a matched case control design, the conditional logistic regression was administered to identify the risk factors of PIH presenting adjusted odd ratio (OR) with 95% Confidence Interval (95% CI) and p-value¹⁷.

Ethical statement

The research proposal, questionnaire and reliability test of the questionnaire were submitted and approved by the Research Ethical Committee of Khon Kaen University, Thailand (Reference No: HE 602069) and University of Health Sciences, Vientiane, Lao PDR (Reference No: 012/17). Ethical approval from both institutions was obtained prior to the validity test and the study data collection. Patient information (demographic, socioeconomic, reproductive health and pregnancy

history, ANC) and written informed consent for participation was obtained from all women, including those who took part in the validity test.

Results

A total sample of 258 postpartum women comprising 86 cases and 172 controls were included in the analysis. There was no significant differences between cases and controls regarding ethnicity, religion, educational attainment, occupation, type of health insurance, family size, number of pregnancies and number of deliveries (Table 1).

Excessive maternal weight gain (>13 kg) was higher among cases (65.1%) when comparing with controls (25.8%). History of abortion was higher in controls (35.5%) compared to cases (22.1%). Cases receiving adequate information about PIH

Table 1. Socio-Demographic, medical and behavioral characteristics of subjects (n = 258).

Characteristics	Cases (n=86)		Controls (n=172)	
	N	%	N	%
Maternal age (years)				
<20	8	9.3	16	9.3
20 – 35	69	80.2	138	80.2
>35	9	10.5	18	10.5
Mean	(27.5±5.8)		(27.5±5.8)	
Median (IQR)	28 (16:42)		28 (16:42)	
Ethnicity				
Lao-Dhai	70	81.4	157	91.3
Hmong-Mien	10	11.6	14	8.1
Mone-Khmer	6	7.0	1	0.6
Religion				
Buddhism	71	82.6	161	93.6
Others	15	17.4	11	6.4
Education				
No formal	5	5.8	2	1.2
Elementary	54	62.7	114	66.3
Professional	27	31.5	56	32.5
Occupation				
Housewife	40	46.6	69	40.1
Farmer	24	28	29	16.9
Business	7	8.1	25	14.5
Government officer	15	17.4	49	28.5
Monthly family income (Kips)				
< 2,000,000	4	4.6	13	7.5
2,000,000-4,000,000	75	87.2	131	76.1
> 4,000,000	7	8.1	28	16.2
Mean	(3,334,884 ±1,040,336)		(3,204,651.5 ±1,268,227)	
Median	3,000,000(1,500,000:6,000,000)		3,000,000(1,000,000:10,000,000)	

Characteristics	Cases (n=86)		Controls (n=172)	
	N	%	N	%
Health insurance				
Government	11	12.7	26	15.1
State Enterprise	2	2.3	18	10.5
Community based	18	21	9	5.2
Health equity fund	1	1.1	0	0
Private	0	0	3	1.7
Out of pocket payment	54	62.8	116	67.4
Family size (individuals)				
< 5	64	74.4	127	73.8
≥ 5	22	25.6	45	26.2
Number of pregnancies				
Primigravida	37	43	66	38.4
Multigravida	49	57	106	61.6
History of abortion				
Yes	19	22.1	61	35.5
No	67	77.9	111	64.5
Gestational age				
Term	69	80.3	161	93.6
Preterm	17	19.7	11	6.4
Pre-pregnancy body mass index				
Under weight (<18.5)	10	11.6	18	10.4
Normal (18.5–24.9)	61	71	138	80.2
Over weight (≥25.0)	15	17.4	16	9.3
Weight gain during current pregnancy (kg)				
Poor (<9)	11	12.7	43	25
Normal (9–13)	19	22	88	51.1
Excessive (>13)	56	65.1	41	23.8
Received adequate information about pregnancy induced hypertension				
Yes	16	18.6	75	43.6
No	70	81.4	97	56.4
Antenatal care attendance (number of visits)				
Inadequate (<4 visits)	43	50	11	6.4
Adequate (≥4 visits)	43	50	161	93.6

was lower (18.6%) in comparison to controls (43.6%). Only 50% of cases had adequate ANC (≥ 4 times) whereas it was 93.6% among controls (Table 1).

In the multivariable analysis using conditional multiple logistic regression, the final model showed that factors significantly association with PIH were: ANC attendance at <4 times (adj. OR= 10.23, 95%CI: 3.67 – 28.49, p<0.001), excessive maternal weight gain during pregnancy (>13 kg) (adj. OR=7.35, 95%CI: 3.06 -17.69, p<0.001), history of abortion (adj. OR=3.54, 95%CI: 1.30-9.59, p=0.013), and received inadequate information about PIH (adj OR= 2.58, 95%CI: 1.03 – 6.46, p=0.043) (Table 2).

Dataset 1. Raw data supporting the presented results is provided. Dataset includes socio-demographic, reproductive and medical variables, such as maternal age, ethnicity, religion, education, occupation, monthly family income. Type of health insurance, family size, number of pregnancy, history of abortion, gestational age, pre-pregnancy BMI, maternal weight in current pregnancy, number of ANC, and receiving of information are also detailed

<http://dx.doi.org/10.5256/f1000research.15634.d213379>

Discussion

This is first hospital-based matched case control study aiming at identifying risk factors of PIH in Lao PDR. We found that

Table 2. Multivariable analysis of factors associated with pregnancy induced hypertension (PIH) in Lao PDR (n = 258).

Variables	PIH		Crude OR (95%CI)	Adjusted OR (95% CI)	P-value
	Case N (%)	Control N (%)			
Antenatal care attendance (number of visits)					<0.001
Adequate (≥4 visits)	43 (50)	161 (93.6)	1	1	
Inadequate (<4 visits)	43 (50)	11 (6.4)	13.26 (5.62 to 31.28)	10.23 (3.67 to 28.49)	
Maternal weight gain					<0.001
Non excessive weight gain	30 (34.8)	131 (76.1)	1	1	
Excessive weight gain	56 (65.1)	51 (23.8)	7.76 (3.77-15.97)	7.35 (3.06-17.69)	
History of abortion					0.013
No	67 (77.9)	111 (64.5)	1	1	
Yes	19 (22.1)	61 (35.5)	2.28 (1.15 to 4.55)	3.54 (1.30 to 9.57)	
Received adequate information about PIH					0.043
Yes	16 (18.6)	75 (43.6)	1	1	
No	70 (81.4)	97 (56.4)	4.04 (1.98 to 8.21)	2.58(1.03 to 6.46)	

inadequate ANC had a strong association with PIH. It was found that 93.6% of controls received ≥ 4 times of ANC whereas only half of cases had ≥ 4 times ANC. This is also supported by other associated factors, including excessive weight gain, which were found among 65.1% of cases but only 23.4% of controls, and only 18.6% of cases received adequate information about PIH whereas almost half of the controls did. Quality ANC should include physical checkup, treatment, health education, and counselling and improving health behaviors. With adequate ANC (≥ 4 times), pregnant women would be monitored and have better pregnancy outcomes and a reduction in complications. This finding supports the results of other similar studies^{18–20}. In addition, a study in Ethiopia also identified a lack awareness on the risk of hypertension as one of a risk factors of PIH²¹.

We also found that a history of abortion is a protection factor for PIH, which was similar to a study in Iran and Norway, as indicated that pregnant women who had history of abortion had lower incidence of PIH^{22,23}. In addition, some studies in the US and Norway reported that a history of abortion was a protective factor for PIH^{24,25}.

Other factors that could have been risk factors for PIH such as gravida, pre-pregnancy body mass index and other socio-economic factors did not show any association with PIH in this study.

There were some limitations of this study since it is a case control study. However, we have minimized information bias from investigators during interview by blinding the investigators to the PIH status of the cases and controls. Therefore, the investigators asked the questions to both case and control groups similarly.

Conclusion

Inadequate ANC is a major risk factor of PIH in Lao PDR, leading to poor access to information related to PIH. These put pregnant women at risks of other risk factors such as excessive maternal weight gain. Promotion of attending of ANC at least 4 times during pregnancy and developing national guidelines for PIH, including proactive strategies of antenatal screening, early detection, counseling, provision of health education, ANC and treatment, should help improve pregnancy outcomes in Lao PDR.

Data availability

F1000Research Dataset 1: Raw data supporting the presented results is provided. Dataset includes socio-demographic, reproductive and medical variables, such as maternal age, ethnicity, religion, education, occupation, monthly family income. Type of health insurance, family size, number of pregnancy, history of abortion, gestational age, pre-pregnancy BMI, maternal weight in current pregnancy, number of ANC, and receiving of information are also detailed. DOI, [10.5256/f1000research.15634.d213379](https://doi.org/10.5256/f1000research.15634.d213379)²⁶

Competing interests

No competing interests were disclosed.

Grant information

Khon Kaen University provided the scholarship during AP's PhD.

Acknowledgement

We would like to express sincere thanks and deep appreciation to all subjects, doctors, nurses, directors in participating hospitals.

Supplementary material

Supplementary File 1: Data collection form in English used in this study.

[Click here to access the data.](#)

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Current Peer Review Status:

Version 1

Reviewer Report 04 October 2018

<https://doi.org/10.5256/f1000research.17058.r38566>

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Vitaya Titapant

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1. The title of this study is misleading to focus on effect of number of antenatal care (ANC) on the other risk factors for developing of Pregnancy induced hypertension (PIH). In fact, number of ANC in this study was also just one risk factor. No results in this study that showed the correlation of ANC and other risk factors.
2. The title of this study should be changed to **Risk factors of Pregnancy Induced Hypertension in Lao PDR** as in the Questionnaire.
3. More risk factors such as new partner in multiparous pregnant women, Several medical conditions (Chronic hypertension, Diabetes Mellitus, Renal disease), Pregnancy with increased placental mass should be included in the questionnaire.
4. At the present time, new 2016 WHO antenatal care model with a minimal eight contacts is used instead of the previous one with only four visits because the latter resulted in a 15% excess of perinatal deaths (some may be from PIH) compared with former one (Dowswell et al¹). So, using the previous WHO ANC recommendation may give some misleading results.
5. The methodology of this study is technically sound and easily replicated by others.
6. In the discussion section, please explain why gravidarum, pre-pregnancy BMI, socio-economic factors were not the risk factors of PIH in this study.
7. Please define the difference between **Received adequate information about PIH** and **Received Inadequate information about PIH**.

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Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 07 September 2018

<https://doi.org/10.5256/f1000research.17058.r37478>

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Ounjai Kor-anantakul

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1. The heading of the article should be "***The risk factors of pregnancy induced hypertension in Lao PDR: A case-control study***" because there were other three risks factors in the article that significantly effect on PIH (as shown in the Table 2. Not only the numbers of antenatal care.
2. There are some **mistakes** in the discussion part: "We also found that a history of abortion is a **protection factor** for PIH, which was similar to a study in Iran and Norway" Ref 22 - From Norway: The effect of recurrent miscarriage and Infertility on the risk of pre eclampsia. Trostad L1, Magnus P, Moffett A, Stoltenberg C.
 - RESULTS: An increased risk of pre-eclampsia, although not statistically significant, was found for women with recurrent miscarriages (adjusted OR 1.51, 95% CI 0.80-2.83). Women who had ever been treated for infertility also had increased risk (adjusted OR 1.29, 95% CI 1.05-1.60). When these two risk factors were combined, the adjusted odd ratio for pre-

eclampsia was 2.40 (95% CI 1.11-5.18)

- Ref 23 -Sepidarkish M, Almasi-Hashiani A, Maroufizadeh S: Association between previous spontaneous abortion and pre-eclampsia during a subsequent pregnancy. *Int J Gynaecol Obstet.* 2017; 136(1): 83–86.

Results:

In total, 5170 patients were interviewed and 252 had experienced pre-eclampsia. The number of previous spontaneous abortions was found to be associated with pre-eclampsia, and a higher number of previous spontaneous abortions was associated with **increased odds** of patients having experienced pre-eclampsia (adjusted odds ratio 1.28, 95% confidence interval 1.03-1.59; P=0.025).

Conclusion:

A history of spontaneous abortion was associated with increased odds of pre-eclampsia during a subsequent pregnancy. Both studies showed that the history of abortion increased odds ratio of PIH.

In the discussion part should add some explanations in each factor

1. **The inadequate ANC numbers** – how to explain for the increase PIH such as an early ANC can give some medication for prophylaxis (calcium supplementation in high risk pregnant women), etc.
2. **The excessive weight gained** – how to clarify the pathophysiology or from an inadequate nutrition? (or may correlated with other medical diseases such as GDM).
3. **Received adequate information about PIH** – please give more detail about the information that can help to protect the event of early detection for PIH.

4. The result should include the delivery method, length of hospital stays (which will show the indirect way of other complications that occurred to the mother) and newborns' outcome.

Were there any differences outcome between the two groups that had the significant risk factors?

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Maternal Fetal Medicine

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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