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ASSESSMENT OF ACCESS TO AND USE OF OBSTETRIC CARE SERVICES IN CAMBODIA

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Summary

Of the annual total of more than 500,000 maternal deaths that occur each year, and most happen in developing countries. Cambodia is one of the poorest countries and its maternal mortality rate is estimated to be high, it is 473 per 100,000 live births. To deal with this big burden, reproductive health programme has been established in Ministry of Health, Cambodia. However, unfortunately, no obvious improvement has been confirmed in terms of reduction in maternal death. The main obstacles in measurement of maternal death are its difficulty in data collection reliability of the data, and large statistical error. As an alternative to maternal mortality, process indicator, which can measure access to and use of obstetric care services using health facility-based data, has been highlighted and utilised.

Purpose of this study is to investigate possibility of assessing the current obstetric care services and measuring some process indicators using available hospital data, which can be used for planning and monitoring safe motherhood programme in Cambodia.

Target study sites were the capital, Phnom Penh city, and Kandal province that surrounds the capital. Using hospital data obtained from National Maternal and Child Health Center, Cambodia (NMCHC), characteristics of the deliveries, characteristics of the maternal deaths, risk factors of having or dying due to hypertensive disorders and obstetric haemorrhage, risk factors of stillbirth were examined. In addition, data on caesarean section obtained from the other four public health facilities in the target area at which caesarean section was conducted in 2001, process indicators of access to and use of obstetric care services in Phnom Penh city and Kandal province were estimated.

It is suggested that among NMCHC users, living outside the capital is a high risk of having obstetric operations (i.e. caesarean sections, vacuum extractions and craniotomy) for the complications, of hypertensive disorders and haemorrhage, of maternal death, preterm delivery, and stillbirth. It is also suggested that both access to and use of obstetric care services were much lower in Kandal province than in Phnom Penh; thus there would be some obstacles in receiving health care services even near the capital city.

This study results imply hospital based data can be useful for planning and monitoring safe motherhood programme in Cambodia. Further research on the process indicators should be carried out in order to know the current situation of health services clearly, and to monitor and evaluate progress of safe motherhood programme.

Abbreviations

AMI(s)	Absolute Maternal Indication(s)
BEOC	Basic
BMI	Body Mass Index
CEOC	Comprehensive
CI	Confidence Interval
EOC	Essential Obstetric Care
FPD	Foetopelvic Disproportion
GNI	Gross National Income
IUFD	Intrauterine Fetal Death
NMCHC	National Maternal and Child Health Center, Cambodia
OR	Odds Ratio
UNICEF	United Nations Children's Fund
WHO	World Health Organisation

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1. Introduction

A big burden of maternal death was presented in mid-eighties using a striking scenario as “*Every four hours, day in, day out, a jumbo jet crashes and all on board are killed. The 250 passengers are all women, most in the prime of life, some still in their teens. They are all either pregnant or recently delivered of a baby. Most of them have growing children at home, and families that depend on them*”.^[1] Since then enormous efforts have been done for improving maternal health.^[2,3] However it has been estimated that around 515,000 women died in 1995 due to pregnancy complications; therefore the burden still has not changed in terms of the number of maternal deaths.^[4]

Kingdom of Cambodia has been in development with a lot of international assistance since 1991, after the huge mischief of the Vietnam war, of the genocide executed by the extreme left party during the Pol Pot regime and of the more than twenty years internal conflict. However Cambodia is still one of the poorest countries in the world, its GNI per capita was 260 US\$ in year 2000.^[5] Current health conditions are also serious. Main health indicators are shown in Annex 1. The maternal mortality ratio estimated by sisterhood method in 1997 was 473 per 100,000 live births; therefore controlling the maternal morbidity and mortality is one of the prior health issues in Cambodia.^[4,6] For this purpose, “reproductive health national programme” was set up within the Ministry of Health. In this programme, the coordination of the four main pillars of safe motherhood strategies, which are provisions of “birth spacing”, “antenatal care”, “clean and safe delivery” and “essential obstetric care”, has been emphasised.^[3,7] However, actual implementation of the programme has mainly focused on birth spacing.^[8] Whereas contraceptive use has been improved, the other reproductive health indicators have not shown any improvement.^[7,8]

In order to plan and to monitor safe motherhood activities, recent and accurate data that can reflect the real health condition of the target population should be collected exhaustively. Although maternal mortality is an important measure and it indicates both women’s health status and the performance of health system, it may reflect a situation 10 or more years in the past. Moreover, the main problem of the maternal mortality is difficulty in its measurement especially in developing countries.^[9-11] Calculating maternal mortality requires vital registration system, population census, or household survey; therefore it is often costly.^[10,12,13] Since maternal deaths tend to be underreported and misclassified and are relatively rare events, the reliability becomes low and its error is often large.^[9] These are common limitations of population-based indicators.

Due to these difficulties in measuring maternal mortality, process indicators have been

highlighted as alternatives.^[11,14] Some of the process indicators measure access to and use of obstetric health services using health facility data. Since one of the critical pathways to reducing maternal mortality is improving the accessibility, utilisation and quality of services for the treatment of complications during pregnancy and childbirth, assessment of these processes provide information essential for guiding policies and programmes. The advantage of the facility-based data is that it is accurate in terms of the number of patients, classification of the disease, types of the treatments and prognoses of the patients. One of the process indicators is “caesarean section rate” at population level, which can show the extent to which pregnant women access obstetric care services.^[14-17] As a variation of the caesarean section rate, “major obstetric interventions for absolute maternal indications” has been proposed and utilised.^[18-20] It measures proportion of births assisted by some obstetric interventions (i.e. caesarean section, hysterectomy for unremitting uterine haemorrhage, laparotomy for ruptured uterus, and symphysiotomy or craniotomy for foetopelvic disproportion) for specific maternal indications that possibly lead a woman to death without the interventions. This could be a more accurate indicator of access to and use of “life-saving” obstetric care services.

National Maternal and Child Health Center, Cambodia (NMCHC) is located in the capital, Phnom Penh city. In April 1997, it was renovated with financial support from Japanese official development assistance. The functions of NMCHC are to provide clinical care services (i.e. antenatal care, vaccination, family planning, assistance for normal delivery case without any risk, emergency obstetric care), to train midwives both health centre and referral hospital levels, to train obstetricians at referral hospital and under- and post-graduates, and to carry out studies on obstetric and gynaecological issues. In year 2001, the number of deliveries and caesarean sections at NMCHC were 6471 and 571, respectively. Since NMCHC is a tertiary care facility specialised for obstetrics and gynaecology, utilisation of the hospital data should be considered for safe motherhood programme.

In this paper, assessment of the current obstetric care and measurement of some process indicators for planning and monitoring safe motherhood programme in Cambodia will be investigated by utilising available health facility based data. Specific objectives are i) to know the role of NMCHC in obstetric care through an investigation into characteristics of women receiving health services, ii) to find prevalence of major obstetric complications and their risk factors among NMCHC users, iii) to estimate caesarean section rate and met obstetric need at population level in the catchment area, and iv) to draw conclusions and possibly recommendations based on hospital data in order to reduce maternal death in Cambodia.

2. Methods

2-1. Study areas

This study intended to cover Phnom Penh city and Kandal province, which surrounds the capital (Map shown in Annex 2), since these two areas are considered as main catchment area of National Maternal and Child Health Center (NMCHC).

Phnom Penh has a population of 999,804 and an area of 290km².^[21] The expected number of births in 2001 was 37,965.^[22] All the area is within one hour drive distance to NMCHC. There are four public health facilities at which caesarean section was performed in 2001: NMCHC, Calmette hospital, Phnom Penh municipal hospital (Municipal), and National Norodom Sihanouk hospital (Sihanouk).

Kandal province has a population of 1,075,125, and 94.6% of the residents live in its rural area.^[21] The area is 3572km². This province is surrounded by the other five provinces, and is bordered on the south by Vietnam. Expected number of births in 2001 was 43,947.^[22] The province is divided into 9 districts, and each district has referral hospital, which has been run by the government. However, there is only one facility (Takhmao district hospital) at which caesarean section was performed in 2001.

2-2. Data source and collection

2-2-1. Data from NMCHC

2-2-1-1. Source of data

All patients admitted to NMCHC have been registered in a computer file by staff members of health information system office since 1997. Three following data sets were obtained from this registration and patient medical files from October 2001 to April 2002.

2-2-1-2. Data set 1: Delivery cases and newborns at NMCHC

Using the patient registration, twenty percent of pregnant women who were admitted to NMCHC for delivery during year 2001 were selected randomly. From the selected delivery cases, following information was collected: parish of residence, date of delivery, age, gestational age of foetus at delivery, parity, body height and weight, body temperature at admission, mode of delivery, number of newborn, presentation of the foetus at delivery, newborn status, and birth weight. In this study, woman who had not given birth before the admission was defined as a woman with parity one.

Whether or not she had any complications during the admission was assessed by a senior doctor in NMCHC according to the diagnosis and the record in a medical file. Selected complications were as follows: preeclampsia, eclampsia, obstetric haemorrhage, cardiopathy and pneumopathy. Preeclampsia referred to the development of hypertension with proteinuria or oedema during pregnancy. Hypertension referred to systolic blood pressure higher than 140 mmHg and/or diastolic blood pressure higher than 90 mmHg. Eclampsia referred to convulsions, not caused by any coincidental neurological disease, which developed in a woman who also had the criteria for preeclampsia. Obstetric haemorrhage included placenta praevia, abruptio placentae, uterine rupture, and postpartum haemorrhage. Cardiopathy referred to any cardiac failure (i.e. congestive heart failure, valvular disease, myocardial infarction, etc.). Pneumopathy referred to dyspnoea or respiratory failure primary caused by respiratory tract or lung disease (i.e. severe pneumonia, tuberculosis, primary lung oedema). Fever more than 38 °C at the time of admission was also regarded as a complication.

2-2-1-3. Data set 2: Maternal death cases at NMCHC

From the patient registration, all maternal deaths observed from January 1999 until December 2001 were identified. Maternal death referred to a woman who died during pregnancy or within 42 days following termination of pregnancy.^[23] For all identified maternal death cases, information on parish of residence, age, parity and identified cause of the death was collected. Causes of the deaths were subdivided into hypertensive disorders (eclampsia or preeclampsia), obstetric haemorrhage, infection, and indirect obstetric causes.

2-2-1-4. Data set 3: Caesarean sections at NMCHC

All caesarean sections and hysterectomies carried out at NMCHC during 2001 were identified using the patient registration, and then information on type and indication of the intervention and parish of residence was collected from the registration.

2-2-2. Data from other public health facilities

The number of caesarean sections and hysterectomies at Calmette, Municipal, and Sihanouk, and Takhmao hospital in 2001 was obtained from patient registration at each health facility and National Health Statistics Report.^[22] Information on type and indication of the intervention and parish of residence was collected at each facility (except Takhmao).

2-3. Descriptive analysis of delivery cases at NMCHC and risk factor analysis of hypertensive disorders and obstetric haemorrhage

Using the data set 1, characteristics of the delivery cases at NMCHC were described and prevalence of each complication was calculated.

To identify risk factors of hypertensive disorders and obstetric haemorrhage among the delivery cases, comparison between the cases with hypertensive disorder or obstetric haemorrhage, and those without the both complications was carried out using the data set 1. Crude and adjusted odds ratios were calculated for each risk factor according to the method described in 2-7.

2-4. Descriptive analysis of maternal death cases at NMCHC and risk factor analysis of maternal death due to hypertensive disorders and obstetric haemorrhage

Using the data set 2, characteristics of the maternal death cases at NMCHC were described.

Two case-control studies were carried out in order to identify risk factors of maternal death caused by hypertensive disorders and obstetric haemorrhage. Cases were identified in the data set 2, and controls were selected in the data set 1. Prior to the control selection, death cases in the data set 1 were excluded.

In one study, cases were maternal deaths due to hypertensive disorders, and controls were delivery cases with hypertensive disorders. In another, cases were maternal deaths due to haemorrhage and controls were delivery cases with haemorrhage. Risk factors tested were parish of residence, age, parity, and eclampsia. Crude and adjusted odds ratios were calculated for each risk factor according to the method described in 2-7.

2-5. Descriptive analysis of newborns at NMCHC and risk factor analysis of stillbirth

Using the data set 1, characteristics of babies who were born at NMCHC in 2001 were described. To identify risk factors of stillbirth, comparison between stillbirth cases and live births was carried out using the data set 1. Risk factors tested were maternal conditions (i.e. age, parish of residence, body height, body mass index, parity and previous intrauterine foetal death (IUFD)), maternal complications (preeclampsia, eclampsia, haemorrhage, fever at the admission and wound infection), and foetal conditions (number of foetus, gestational age, birth weight and presentation). Crude and adjusted odds ratios were calculated for each factor according to the method described in 2-7.

2-6. Indicators of access to and use of obstetric care services in Phnom Penh and Kandal

2-6-1. Indicator of access to the services: caesarean section rate

The number of caesarean sections (including hysterectomies) at NMCHC, Calmette, Municipal, and Sihanouk, and Takhmao in 2001 was counted according to parish of residence. Population-based estimates of the proportion of births with cesarean section for Phnom Penh and Kandal were calculated using as a denominator the expected number of births reported from the Ministry of Health.^[22]

2-6-2. Indicator of use of the services: caesarean section and hysterectomy for absolute maternal indications

As an indicator of use of the obstetric care services, proportion of births conducted by caesarean sections including hysterectomies for absolute maternal indications for Phnom Penh and Kandal residents were calculated. Total number of the interventions at the five facilities mentioned above during 2001 was gathered and classified according to the indication and the parish of residence, and then the number of the interventions for absolute maternal indications for Phnom Penh and Kandal residents were counted. Absolute maternal indications (AMIs) referred to complications during late pregnancy, delivery and early postpartum period, which probably require the obstetric intervention in order to save the mother's life.^[18] Complications which were regarded as AMIs in this study were uterine rupture, abruptio placentae, placenta praevia, foetopelvic disproportion (FPD), abnormal presentation (transverse, frontal, and facial), and unremitting postpartum haemorrhage. Population-based estimates of the proportion of births with the interventions for AMIs for Phnom Penh and Kandal residents were calculated using the same denominator.^[22]

2-7. Statistical analysis

All the data were analysed using either EpiInfo 6 (Center for Disease Control and Prevention, Georgia, USA) or STATA 6.0 (Stata Corporation, Texas, USA) software.

Associations between risk factors and outcome (hypertensive disorders, haemorrhage, maternal death, or stillbirth) were expressed as odds ratios (OR) with their 95% confidence intervals (CI). To control for confounders, all potential risk factors were incorporated into a logistic regression model, and a backward selection (at $p=0.10$) was used to arrive at the final model.

2-8. Ethics

A proposal of this study was submitted to the director of NMCHC and use of the data was approved. As for the data obtained from the other facilities, oral approval was obtained from a responsible person at each health facility.

3. Results

3-1. Descriptive analysis of delivery cases at NMCHC

3-1-1. Characteristics

From the patient registration, 6471 delivery cases were identified during year 2001. 4.9% (314/6417) were excluded from the randomisation because their medical files were already lost at the time of registration. 20.1% (1235/6157) were selected randomly and the medical files were collected. 2.4% (29/1235) of the files could not be found; therefore information from 1206 cases, which accounted for 18.6% of all delivery cases at NMCHC in 2001 were collected and analysed.

Characteristics of the cases are shown in Table 1. 68.2% of the cases live in the capital city, 17.8% live in Kandal province. Median and interquartile range of age were 26 and from 22 to 32 years old, respectively. 47.2% was primipara, and 9.7% was grand multipara (more than 5 times of deliveries).

Table 1. Characteristics of delivery cases, NMCHC, Cambodia, 2001 (n=1206)

		n	%
Residence	Phnom Penh	822	68.2
	Kandal province	215	17.8
	Others	169	14.0
Age	15-19	82	6.8
	20-29	697	57.8
	30-39	365	30.3
	40-49	62	5.1
	[Median] (IQR)	[26]	(22-32)
Parity	1	566	47.2
	2-4	518	43.2
	5+	116	9.7
	[Median] (IQR)	[2]	(1-3)

3-1-2. Mode of delivery

Modes of deliveries are shown in Table 2. Overall rates of normal vaginal delivery with cephalic presentation and caesarean section were 77.7% and 10.0%, respectively. 17% of the cases received obstetric interventions that are caesarean section, vacuum extraction, and craniotomy. There were significant differences between Phnom Penh, Kandal, and other regions in rates of vaginal cephalic delivery ($p<0.001$, χ^2 -test), vaginal delivery of twin ($p<0.01$), vacuum extraction ($p<0.001$), and caesarean section ($p<0.05$).

Table 2. Proportions of mode of delivery by parish of residence, NMCHC, Cambodia, 2001

	Residence (n)	Phnom Penh (822)	Kandal (215)	Others (169)	All regions (1206)
Vaginal	Cephalic ^a	82.7	69.3	63.9	77.7
	Breech	3.4	4.7	2.4	3.5
	Twin ^b	1.0	2.3	4.7	1.7
	Vacuum extraction ^a	4.3	12.1	11.8	6.7
Caesarean section ^{c,d}		8.5	11.2	16.0	10.0
Craniotomy		0.1	0.5	1.2	0.3
Total		100	100	100	100

a-c. The rates were significantly different between the regions. (a: $p < 0.001$, b: $p < 0.01$, c: $p < 0.05$, χ^2 -test)

d. Caesarean section included caesarean hysterectomy.

3-1-3. Obstetric and non-obstetric complications

Table 3 shows prevalence of maternal complications of the delivery cases. 13.9% of women had any complications listed. Hypertensive disorders (preeclampsia and eclampsia) accounted for around half of the complications. Of 7 pneumopathy cases, 3 were confirmed HIV positive; therefore respiratory problem might relate with pneumonitis or tuberculosis.

Table 3. Prevalence of complications among delivery cases, NMCHC, Cambodia, 2001

Complication	n	Prevalence (%)	Per all complications (%)
Preeclampsia	79	6.6	47.0
Eclampsia	10	0.8	5.9
Haemorrhage ^a	46	3.8	27.4
Fever at admission ^b	24	2.1	14.3
Pneumopathy	7	0.6	4.2
Cardiopathy	2	0.2	1.2
Total	168	13.9	100

a. Haemorrhage included placenta praevia, abruptio placentae, uterine rupture and postpartum haemorrhage.

b. Fever: Body temperature more than 38.0 °C.

3-1-4. Risk factors of hypertensive disorders and obstetric haemorrhage

Risk factors of having hypertensive disorders and haemorrhage are shown in Table 4 and 5, respectively. Living in other than the capital city and Kandal province (OR=2.0), age group between 30 and 39 years (OR=2.1), primipara (OR=1.9) and grand multipara (OR=2.2) were risk factors of hypertensive disorders.

Living in Kandal (OR=3.3) and in other areas (OR=4.4), season between July and December (OR=2.4), and multipara (2-4 OR=2.2, 5+ OR=4.5) were risk factors of having haemorrhage. The number of foetus was not a risk factor both of hypertensive disorders and of haemorrhage.

Table 4. Prevalence of hypertensive disorders a and odds ratios for the risk factors, NMCHC, Cambodia, 2001

Factor		(Case/n)	Prevalence (%)	Crude odds ratio		Adjusted odds ratio ^b	
Residence	Phnom Penh	(48/822)	5.8	1		1	
	Kandal	(20/214)	9.4	1.7	[0.9-2.9]	1.5	[0.8-2.6]
	Others	(20/169)	11.8	2.2 ^c	[1.2-3.8]	2.0	[1.1-2.6]
Age	15-19	(5/82)	6.1	1.1	[0.4-2.9]	NS ^d	
	20-29	(39/696)	5.6	1		1	
	30-39	(36/365)	9.9	1.8	[1.1-3.0]	2.1	[1.2-3.7]
	40-49	(8/62)	12.9	2.5	[1.1-5.6]	2.0	[0.7-5.3]
Parity	1	(42/566)	7.4	1.4	[0.8-2.3]	1.9	[1.1-3.3]
	2-4	(28/517)	5.4	1		1	
	5+	(17/116)	14.7	3.0	[1.6-5.7]	2.2	[1.0-5.5]

a. Hypertensive disorders included preeclampsia and eclampsia.

b. Adjusted for all confounders listed in method 2-4.

c. Bold character shows statistically significant result. ($p < 0.05$)

d. NS: Adjusted odds ratio could not be obtained because the factor was removed from the final logistic regression model. ($p > 0.1$)

Table 5. Prevalence of haemorrhage a and odds ratio for the risk factors, NMCHC, Cambodia, 2001

Factor		(Case/n)	Prevalence (%)	Crude odds ratio		Adjusted odds ratio ^b	
Residence	Phnom Penh	(18/822)	2.2	1		1	
	Kandal	(14/214)	6.5	3.1 ^c	[1.5-6.4]	3.3	[1.6-6.8]
	Others	(14/169)	8.3	4.0	[2.0-8.3]	4.4	[2.1-9.3]
Season	Jan.-Jun.	(14/595)	2.4	1		1	
	Jul.-Dec.	(32/610)	5.2	2.3	[1.2-4.4]	2.4	[1.2-4.6]
Age	15-19	(2/82)	2.4	1.1	[0.2-4.7]	NS ^d	
	20-29	(16/696)	2.3	1		1	
	30-39	(21/365)	5.8	2.6	[1.3-5.1]	NS	
	40-49	(7/62)	11.3	5.4	[2.1-13.8]	NS	
Parity	1	(12/566)	2.1	1		1	
	2-4	(22/517)	4.3	2.1	[1.0-4.2]	2.2	[1.1-4.5]
	5+	(11/116)	9.5	4.8	[2.1-11.4]	4.5	[1.9-10.6]

a. Haemorrhage included placenta praevia, abruptio placentae, uterine rupture, and postpartum haemorrhage.

b. Adjusted for all confounders listed in method 2-4.

c. Bold character shows statistically significant result. ($p < 0.05$)

d. NS: Adjusted odds ratio could not be obtained because the factor was removed from the final logistic regression model. ($p > 0.1$)

3-2. Descriptive analysis of maternal death cases in the NMCHC

3-2-1. Characteristics

One hundred and one death cases were identified in the patient registration at NMCHC from January 1999 to December 2001. 7.9% (8/101) were excluded from further analysis, because information on pregnancy or delivery was not available from seven cases, and one case was not a maternal death.

Characteristics of 93 maternal death cases are shown in Table 6. Cases coming from Phnom Penh, Kandal, and other regions were 29.0%, 29.0%, and 41.9%, respectively. The median age was 31 years old. Primipara accounted for 33.3%.

The death cases were more in other than Phnom Penh and Kandal, older in age, and higher in parity compared to delivery (i.e. non-death) cases shown in Table 1. Significant statistical differences were observed between the death cases and the delivery cases in distribution of residence, age and parity ($p < 0.001$ for each, χ^2 -test).

Table 6. Characteristics of maternal death cases, NMCHC, Cambodia, 1999-2001 (n=93)

		n	%	p-value ^a
Residence	Phnom Penh	27	29.0	<0.001
	Kandal province	27	29.0	
	Adjacent provinces	39	41.9	
Age	15-19	5	5.4	<0.001
	20-29	32	34.4	
	30-39	39	41.9	
	40-49	17	18.3	
	[Median] (IQR)	[31]	(25-38)	
Parity	1	24	33.3	<0.001
	2-4	27	37.5	
	5 +	21	29.2	
	[Median] (IQR)	[4]	(2-6.5)	

a. p-value: χ^2 -test, compared to the data of non-death cases shown in Table 1.

3-2-2. Cause of maternal death

Causes of the maternal deaths are shown in Table 7. Direct obstetric causes, which are hypertensive disorders, haemorrhage, infection and uterine rupture, accounted for 72.0%. Of 26 hypertensive disorders, 21 cases were eclampsia. Of 25 haemorrhage cases, 6, 7, and 12 occurred during postabortum, antepartum, and postpartum period, respectively. Of 14 infections, 7 were postabortum and 7 were postpartum. Thus, abortion related maternal deaths were 14% ((6+7)/93). However attribution of induced abortion was not known.

The indirect obstetric causes varied. 9 cases were respiratory failure. 4 and 2 cases were diagnosed as malaria and heart failure, respectively. The others were liver cancer, hepatitis, haemorrhage from digestive tract, or haemolysis after blood transfusion (one case for each).

Unclassified referred to the maternal deaths without identified causes.

Table 7. Causes of maternal deaths, NMCHC, Cambodia, 1999-2001

Cause	n	%
Hypertensive disorders	26	28.0
(Eclampsia) ^a	(21)	
(Preeclampsia)	(5)	
Haemorrhage	25	26.9
(postabortum)	(6)	
(ante partum)	(7)	
(postpartum)	(12)	
Infection	14	15.1
(postabortum)	(7)	
(postpartum)	(7)	
Uterine rupture	2	2.2
Indirect	19	20.4
Unclassified	7	7.5
Total	93	100

a. Causes and numbers in brackets show subdivisions of each cause.

3-2-3. Risk factors of maternal death by hypertensive disorders and obstetric haemorrhage

Out of the factors tested, only eclampsia for hypertensive disorders (OR=41.0 (95%CI=10.7-156.5)) and parity more than 5 for haemorrhage (OR=6.5 (95%CI=1.1-42.4)) were confirmed as the risk factor. As for residence and age, there was no association with death due to hypertensive disorders or haemorrhage.

3-3. Descriptive analysis of newborns at NMCHC

3-3-1. Characteristics

The number of delivered babies was 1232 in 2001. As for 1.9% of babies (24/1232), information was not available. Characteristics of the 1208 babies are shown in Table 8. Multifoetal pregnancy, stillbirth and preterm delivery accounted for 2.2%, 3.5% and 3.8%, respectively. Mean birth weight was 2975g. Proportion of low birth weight (less than 2500g) was 12.7%.

There were significant differences in proportions of twins, stillbirth, and low birth weight between the three regions.

Table 8. Characteristics of babies born at NMCHC, Cambodia, 2001

Residence (n)	Phnom Penh (817)	Kandal (221)	Others (170)	All regions (1208)
Singleton	97.4	93.8	90.7	97.8
Twins ^a	2.6	6.2	9.3	2.2
Stillbirth ^a	1.5	7.9	7.6	3.5
Preterm birth	2.9	5.4	5.9	3.8
Birth weight (g)	<2500 ^b	11.0	18.1	14.0
	2500-4000	85.8	80.6	83.1
	4000<	3.2	83.1	2.9
	[Mean] (SD)	[3021] (524)	[2878] (564)	[2881] (590)
Total	100	100	100	100

a, b. The rates were significantly different between the regions. (a: $p < 0.001$, b: $p < 0.05$, χ^2 -test)

3-3-2. Risk factors for stillbirth

Forty-three stillbirth cases were compared with 1188 live births. The results are shown in Table 9. No interaction was observed between residence and the other risk factors. After adjusting for all confounders, living in Kandal (OR=5.7) and other areas (OR=10.8), preterm birth (OR=16.0), and non-cephalic presentation (OR=14.6) were confirmed as risk factors of stillbirth. Thinness (body mass index (BMI) <22.0), obesity (BMI>30.0), short body height (less than 145cm), and twin pregnancy were not identified as the risk factors.

Table 9. Prevalence of stillbirth and crude and adjusted odds ratios by potential risk factors

Factor	(Case/n)	Prevalence (%)	Crude odds ratio	Adjusted odds Ratio ^a
Residence	Phnom Penh	(12/830)	1.5	1
	Kandal	(18/227)	7.9	5.9 [2.8-12.5]
	Others	(13/172)	7.6	5.6 [2.5-12.6]
Age	15-19	(1/83)	1.2	1
	20-29	(18/707)	2.6	2.1 [0.3-16.3]
	30-39	(18/375)	4.8	4.1 [0.5-31.6]
	40-49	(6/64)	9.4	8.5 [0.9-75.3]
Parity	1	(17/574)	3.0	1.3 [0.6-2.8]
	2-4	(12/530)	2.3	1
	5+	(12/119)	10.1	4.8 [2.1-11.2]
Previous IUFD ^b	-	(37/1177)	3.1	1
	+	(4/37)	10.8	3.7 [1.3-11.1]
Eclampsia	-	(40/1217)	3.3	1
	+	(3/11)	27.3	11.0 [2.8-43.6]
Haemorrhage ^c	-	(40/1201)	3.3	1
	+	(3/28)	10.7	3.5 [1.0-12.0]
Fever ^d	-	(32/1148)	2.8	1
	+	(4/25)	16.0	6.6 [2.1-20.6]
Gestational age	Term	(28/1159)	2.4	1
	Preterm	(9/46)	19.6	9.8 [4.3-22.6]
Presentation	Cephalic	(28/1111)	2.5	1
	Others	(14/66)	21.2	10.4 [5.1-21.4]

a. Adjusted for all confounders listed above.

b. IUFD: Intrauterine foetal death.

c. Haemorrhage included placenta praevia, abruptio placentae and uterine rupture.

d. Fever: Body temperature more than 38.0 °C at admission.

e. NS: Adjusted odds ratio could not be obtained because the factor was removed from the final logistic regression model. (p>0.1)

3-4. Indicators of access to and use of obstetric care services in Phnom Penh and Kandal

3-4-1. Indicator of access to the services: caesarean section rates

At NMCHC, the number of caesarean sections in 2001 was 591. Of the cases, the numbers for Phnom Penh and Kandal residents were 323 and 145, respectively. At Calmette, the number of caesarean sections in 2001 was 359. Of the cases, the numbers for Phnom Penh and Kandal residents were 327 and 24, respectively.

As to Municipal, Sihanouk and Takhmao, the numbers of caesarean sections in 2001 were 37, 35, and 8, respectively. However, data regarding the parish of residence could not be obtained from these three facilities, and therefore following assumptions were made.

It was assumed that 68% of caesarean sections were for Phnom Penh residents, and 14% were for Kandal residents at Municipal and Sihanouk. The applied proportions here were those of all caesarean sections for each residents at Sihanouk in the first half of 2002. These proportions at Municipal were regarded as similar to those observed at Sihanouk. Thus, the estimated number of caesarean sections for Phnom Penh residents at Municipal and Sihanouk in 2001 were 25 and 24, respectively, and for Kandal residents at Municipal and Sihanouk in 2001 were 5 and 5, respectively. As for Takhmao, it was assumed that all caesarean sections were for Kandal residents. Because the number of caesarean sections at Takhmao was very small, so that the activity was considered to be very low; therefore it was unlikely that residents living in other areas had visited there to receive the intervention.

The results are shown in Table 10. The total numbers of caesarean sections performed at the five public health facilities were 699 and 187 for Phnom Penh and Kandal residents, respectively. Proportions of caesarean sections to the expected number of births were 1.84% and 0.43% for Phnom Penh and Kandal, respectively.

3-4-2. Indicator of use of the services: caesarean sections for absolute maternal indications

The numbers of the interventions for AMIs at NMCHC in 2001 for Phnom Penh and Kandal residents were 122 and 108, respectively.

As for Calmette, the number of the interventions for AMIs was 105 in 2001, however information on parish of residence could not be obtained. As for Municipal, Sihanouk and Takhmao, information on residence and indication of the interventions could not be obtained.

In order to calculate the number of the interventions for AMIs for Phnom Penh and Kandal

residents, following assumptions were made. For Calmette hospital, it was assumed that 91% of the interventions for AMIs were for Phnom Penh residents, and 7% for Kandal residents. The applied proportions here were those of all the interventions (both for AMIs and non-AMIs) at the same hospital for each resident in 2001. Estimated numbers of the interventions for AMIs for Phnom Penh and Kandal residents at Calmette in 2001 were 96 and 7, respectively.

As for Municipal and Sihanouk, it was assumed that 84% of all the interventions were for AMIs. The applied proportion here was that of the interventions for AMIs at Municipal in the first half of 2002. The estimated numbers of the interventions for AMIs for Phnom Penh and Kandal residents at Municipal and Sihanouk in 2001 were 41 and 8, respectively. It was assumed that all eight caesarean sections were for AMIs for Kandal residents at Takhmao.

The results are shown in Table 10. The numbers of caesarean sections for AMI performed at the five public health facilities were 259 and 131 for Phnom Penh and Kandal residents, respectively. Proportions of caesarean sections for AMI to the expected number of births were 0.68% in Phnom Penh, and 0.30% in Kandal.

Table 10. Rate of Caesarean sections and Caesarean sections for absolute maternal indications b by parish of residence, performed at the public hospital in Phnom Penh and Kandal, Cambodia, 2001

	Caesarean Section ^a		Caesarean section ^a for absolute maternal indications ^b	
	Phnom Penh	Kandal	Phnom Penh	Kandal
NMCHC	323	145	122	108
Calmette	327	24	96 ^d	7 ^d
Municipal and Sihanouk ^c	49 ^d	10 ^d	41 ^d	8 ^d
Takhmao	0 ^d	8 ^d	0 ^d	8 ^d
Total	699	187	259	131
Expected number of births ^e	37,965	43,947	37,965	43,947
Rate at population (%)	1.84	0.43	0.68	0.30

a. Caesarean section included caesarean hysterectomy.

b. Absolute maternal indications (AMIs) included uterine rupture, placenta praevia, abruption placenta, foetopelvic disproportion, abnormal presentations (transverse, frontal and facial) and postpartum haemorrhage.

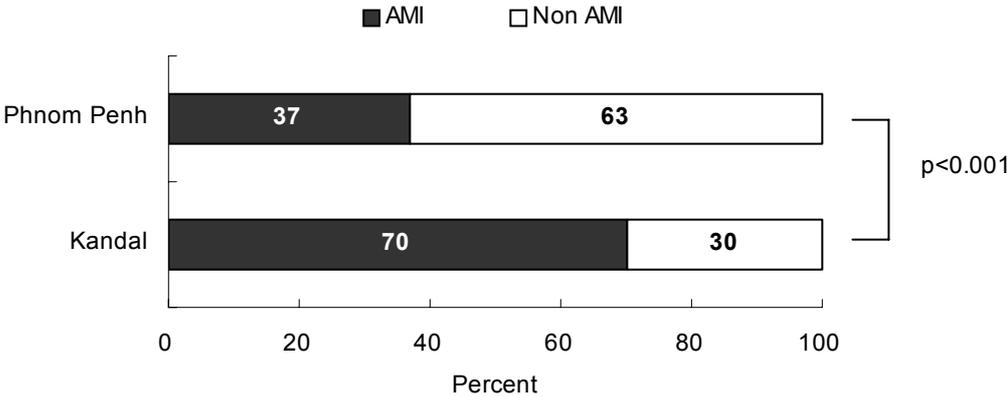
c. The numbers from the two facilities were gathered.

d. Numbers were estimated based on some assumptions. (see 3-4-1 and -2)

e. Reported from Ministry of Health^[22].

Figure 1 shows proportions of AMIs and non-AMIs in caesarean sections in the two regions. Non-AMIs was dominant in Phnom Penh (63%), while AMIs accounted for 70% in Kandal. The difference in the proportion between the two regions was statistically significant ($p < 0.001$, χ^2 -test).

Figure 1. Proportions of absolute maternal indications and non-absolute maternal indications to caesarean sections in Phnom Penh and Kandal, Cambodia, 2001.



4. Discussion

4-1. Delivery service users of NMCHC

4-1-1. Quality of data

Medical files could not be found in 4.9% of registered cases and in 2.4% of randomised cases, due to inappropriate registration or storage. It is impossible to know for which reason this occurred; therefore this could introduce a selection bias.

4-1-2. Characteristics and mode of delivery

Dominant part of the NMCHC users was Phnom Penh residents. In addition, about one-fifths were Kandal residents. These two regions were confirmed as a catchment area of NMCHC.

Overall caesarean section rate at NMCHC was 10.0%. It is known that caesarean section rate at hospital level varies according to its setting. Previous studies have revealed that it ranges from 0.3 to 26.0% at referral hospital in Cambodia, 0.3 to 37.7% in Kenya, and 4.4 to 10.3% in Nepal.^[16,17,22] Since the hospital-based rate is difficult to interpret, the rate should be discussed with the indications of operation, and ideally translated into population-based rate in order to calculate coverage of obstetric care.

The distribution of mode of delivery was significantly different by the three residential areas. Obstetric intervention rate, which are sum of caesarean section, vacuum extraction and craniotomy rates, were 12.9% for Phnom Penh residents, 23.8% for Kandal residents, and 29.0% for the residents from the other area, respectively. This result may suggest that occurrence of the complications during delivery were more frequent among the users outside the capital. It also implies that appropriate obstetric care services, which can deal with complications, might not be available outside.

4-1-3. Complications during pregnancy and delivery

About half of the investigated complications were hypertensive disorders, its hospital-based prevalence was 7.4% at NMCHC. It has been reported that prevalence of preeclampsia ranged from 2 to 8 percent.^[24] Although it cannot be comparable the hospital-based prevalence with the population-based one directly, prevalence among Cambodian women might be at the higher end. Previous studies conducted in Senegal and Uganda have revealed hospital-based prevalence were

2.3% and 2.2%, respectively.^[25,26] Although diagnostic criteria of preeclampsia varies among countries, hospital, and even physicians, preeclampsia seems to be bigger problem in Cambodia than in some African countries.

Prevalence of haemorrhage at NMCHC (3.8%) was probably underestimated, since women who had referred due to postpartum haemorrhage after the delivery were excluded from the analysis. However it is still higher than that reported from Uganda (1.4%) and Benin (2.3%), and similar to that from Senegal (3.6%).^[25-27]

4-1-4. Risk factors of hypertensive disorders and haemorrhage

As for hypertensive disorders, living other than Phnom Penh and Kandal was confirmed as a risk factor. For haemorrhage, living outside Phnom Penh was a risk factor. The effect of parish of residence on these two complications was perhaps due to a selection bias. According to the demographic health survey conducted in 2000, 70.7% of delivery cases were carried out at a health facility as for Phnom Penh residents. However country average of facility deliveries were much lower (14% or less).^[28] Therefore, healthy women would be dominant among the NMCHC users who live in Phnom Penh. This could cause the difference in prevalence of the complication between the regions.

Another possible explanation is that residence could be a proxy, which indicates poor maternal health, adverse social conditions, and inadequate care during pregnancy, delivery and postpartum period. These factors lead rural women to delay in receiving appropriate obstetric care services, which might increase the prevalence of severe complication in pregnancy and childbirth.

As to hypertensive disorder, residence and age might relate to essential hypertension. It has been known that the prevalence of hypertension is higher in rural area than in urban.^[29] Older women tend to have hypertension mainly due to arteriosclerosis. Primipara has been known as a risk factor of hypertensive disorder, this is confirmed also among the NMCHC users.^[30]

Another known prediction factor of preeclampsia is blood pressure. However it was not analysed in this study, because hypertension was one of the diagnostic and inclusion criteria for the cases. It has been known that high blood pressure at antenatal care is an effective marker for detecting preeclampsia and eclampsia.^[30,31] Some abdominal symptoms, such as nausea, vomiting and epigastric pain, have been known as prognosis indicators for severe preeclampsia, too.^[32] Thus, these signs and symptoms should be checked as soon as after admission for all pregnant women in

order to find preeclampsia and to prevent further complications.

As for haemorrhage, it is difficult to find the reason why season was its risk factor. It is rainy season from June to early November in Cambodia. Many regions are seriously damaged by flood during the season; therefore accessibility to hospital is usually hampered. However after controlling other factors, such as residence area, age, parity, season still remained as a risk factor. The number and activity of other hospital in Phnom Penh were not changed during 2001. It should be investigated that this trend is observed every year in order to confirm if season really affects the prevalence of obstetric haemorrhage, although it is unlikely.

After controlling other confounding factors, age did not remain as a risk factor of haemorrhage at NMCHC. This result is different from a previous study conducted in Bangladesh, which has revealed that age more than 34 years old is a risk marker of intra- or postpartum bleeding.^[30] Older age usually relates to parity, therefore the effect of age might be adjusted mainly by parity in this study, and then could not be identified as a risk factor. In fact, multipara, especially grand multipara, remained as a risk factor of haemorrhage. However these identified factors are not so helpful in obstetric practice to predict haemorrhage, especially after the onset of labour. Appropriate and immediate management seems to be only solution to deal with obstetric haemorrhage.

4-2. Maternal death at NMCHC

4-2-1. Quality of data

Information regarding pregnancy or delivery could not be obtained from 7 cases out of 101 deaths occurred from 1999 to 2001; therefore this could be a source of a selection bias. There might be misclassification of the causes, especially in indirect obstetric deaths. Of 9 respiratory failure cases some may be due to amniotic fluid embolism, which can be classified as a direct obstetric cause, because it has been known that the proportion of embolism (both thrombotic and amniotic) is the highest among direct obstetric deaths in developed countries.^[33] Unclassified were so-called “dead on arrival” cases. Information, which provides possible etiology of the death, was not inquired for the cases. This could be a source of misclassification of the causes, too.

4-2-2. Comparison of maternal death causes

Proportion of the direct obstetric causes to all maternal deaths at NMCHC was 72%. It is consistent with the fact that approximately 80% of maternal deaths worldwide are estimated to be owing to

direct causes.^[34] According to WHO estimates, proportions of each direct obstetric cause are as follows: haemorrhage (25%), infection (15%), unsafe abortion (13%), hypertensive disorders (12%), obstructed labour (8%), and others (8%).^[34] Compared with the world data, proportion of hypertensive disorders at NMCHC seems to be higher (28%). This finding may correspond to high prevalence of hypertensive disorders at NMCHC. A research conducted in a refugee camp at Cambodia and Thailand border during 80's has revealed high prevalence of preeclampsia among the Cambodian women living there.^[35] Hypertensive disorders are less responsible to improvements in basic delivery care, whereas there was significant reduction in maternal death by hypertensive disorders in Thailand through better patients' education, antenatal care and labour management.^[36,37] When the poor situation of health care and environment in Cambodia is taken into account, the high prevalence of hypertensive disorders may be true. However it is difficult to conclude it from the current data because hospital data do not always reflect morbidity and mortality at population level.

Proportion of maternal deaths due to uterine rupture at NMCHC (2.2%) seems to be lower than that due to obstructed labour or uterine rupture reported by WHO (8%) and by other population-based studies (12% in Vietnam, 12.7% in 6 west African countries, 13.3% in Mali, and 5.6% in The Gambia).^[34,38-41] Misclassification of the cases at NMCHC was not likely to be the reason of the difference because the diagnosis of uterine rupture is quite easy for obstetricians. If population-based maternal mortality due to uterine rupture in Cambodia is as high as in Vietnam, it means that Cambodian women who suffered and eventually died from uterine rupture could not manage to arrive at hospital. However there was not so much difference in haemorrhage proportion between NMCHC (26.9%) and WHO estimates (25%).^[34] If uterine rupture cases could not arrive at hospital in Cambodia, the number of deaths caused by haemorrhage should be much lower than observed. Because obstetric haemorrhage, especially which occurs during early postpartum period, kills the patient within a few hours.^[14] However the reason behind the difference in the proportion between the counties is not clear.

4-2-3. Risk factors of death by hypertensive disorders and haemorrhage

After the adjustment, confirmed risk factors of maternal death were eclampsia and grand multipara for hypertensive disorders and for haemorrhage, respectively. These findings are consistent with common knowledge. Since prediction of eclampsia is almost impossible, and proportion of grand multipara is relatively high in developing countries, screening of high risk group would not work

well. Therefore, appropriate management of eclampsia and haemorrhage is main issue for prevention of maternal death.

Maternal mortality caused by eclampsia can be decreased by using magnesium sulphate.^[42-44] It has been revealed that the administration of magnesium sulphate to eclampsia patient significantly reduces further convulsions after the first attack.^[42,44,45] Moreover, magnesium sulphate reduces a risk of eclampsia when it is administered to preeclampsia patient as the prophylaxis.^[46] In many health facilities in Cambodia, diazepam has been used as the first and only anticonvulsant for eclampsia. However, effectiveness of diazepam has been proved to be less than that of magnesium sulphate.^[44] Standard regimen of magnesium sulphate use for severe preeclampsia and eclampsia patients was already established at NMCHC in 1999 and it has been advocated.^[47] As a result of an enormous effort of NMCHC, with the evidence proved by previous randomised control trials,^[42,44,45] magnesium sulphate is now on a list issued from a central medical supply office in the Ministry of Health. It means that the government ensures to provide the drug for all the referral hospital. However the availability of magnesium sulphate is still extremely low. Since it is one of the promising tools for improving maternal health, it should be completely implemented both at referral and at health centre levels as soon as possible.

As for haemorrhage, it has been estimated that about half of maternal deaths due to haemorrhage could be avoidable through primary and secondary prevention offered by skilled health personnel with appropriately functioning health facilities, even in a context of developing countries.^[48] Antenatal haemorrhage due to placenta praevia and abruptio placentae requires intensive observation and immediate obstetric intervention. It should be ensured for the purpose of reducing deaths due to antenatal haemorrhage: detection of warning and preceding clinical features, such as silent vaginal haemorrhage in the third trimester and preeclampsia, at the primary health care level; referral of suspected case for early diagnosis and pertinent management of the cases; and patient, family and community education. To reduce deaths due to postpartum haemorrhage, same strategies are required as antepartum haemorrhage management. In addition, prophylactic use of oxytocin in the third stage of labour has been shown to significantly reduce the risk of postpartum haemorrhage.^[49,50] WHO has promoted active management^[51] of the third stage, which consists of oxytocin use just after confirmation of no more foetus in the uterus, clamping and cutting of the umbilical cord immediately after delivery of the infant, and either fundal or suprapubic pressure with cord traction after signs of placental separation.^[51] In order to implement this management, ideally all deliveries should be attended by skilled health personnel who knows the procedure well.

4-3. Newborns at NMCHC

After the adjustment of all confounders, confirmed risk factors of stillbirth were residence outside Phnom Penh, preterm birth, and non-cephalic presentation. There was significant difference in proportions of twins, stillbirth, and low birth weight (less than 2500g) between the three regions. In general, these outcomes relate to maternal health status and complications during pregnancy. As observed in the risk analysis of hypertensive disorders and haemorrhage, the effect of residence on the poor newborn outcome could be due to a selection bias, or by social, cultural, and economical differences, which affect maternal health condition.

Preterm delivery has been proved as an important risk factor of stillbirth.^[30,52,53] This is also confirmed in this study. Preterm birth cases might include full-term baby with intrauterine foetal growth retardation, because diagnosis of gestational age of foetus is problematic issue in developing countries. In fact, only 47% of women who were admitted to NMCHC for delivery remembered the last menstruation period. However, it can be concluded that prematurity of baby has big impact on prevalence of stillbirth.

Short maternal body height was not confirmed as a risk factor of stillbirth in this study. This factor could be a proxy of prolonged or obstructed labour, which have been also known as one of the risk factors of stillbirth.^[52-54] However, it has been known that prediction of the occurrence of preterm and obstructed labour beforehand is almost impossible; therefore careful observation and management during labour both for mother and for baby seems to be a solution for improving outcome of newborn. Collaboration between midwives, obstetricians and paediatricians and between health facilities should be achieved so as to decrease perinatal deaths.

Non-cephalic presentation, either breech or transverse, was a risk factor for stillbirth in this study, as confirmed in previous studies.^[52,53] It has been shown by a randomised controlled clinical trial that elective well-prepared caesarean section improves perinatal death of breech baby significantly compared to vaginal delivery.^[55] Based on this evidence, delivery of breech presentation has been shifted toward caesarean section in many developed countries. On the other hand, a study conducted in United Kingdom has revealed that caesarean section, both elective and emergency, increases maternal deaths.^[56] In developing countries contexts, mortality and morbidity of caesarean section cases would be higher than vaginal deliveries due to poor quality of operation and lower maternal health status; thus easygoing application of the caesarean section for breech presentation should be avoided. External cephalic version for breech at term, which has been advocated by WHO

recently, would be an alternative choice for a pregnant woman with breech foetus. It has been shown that external version decreases both non-cephalic births and caesarean section rate, however there is no evidence to reduce perinatal outcome until now.^[57] In order to reduce unfavourable outcome of baby, mode of delivery should be discussed between physicians and pregnant women in case of breech presentation.

4-4. Indicators of access to and use of obstetric care services in Phnom Penh and Kandal

4-4-1. Quality of data

4-4-1-1. Bias

The number of caesarean sections including hysterectomies was regarded as reliable data, since the patient registrations were fulfilled by a responsible physician either in maternity ward or in health information section.

There was a recruitment bias of the cases because data were collected only from five public health facilities in Phnom Penh and Kandal. It is unlikely that Phnom Penh residents tend to have obstetric service more outside their living area, however it might happen for Kandal residents. There were some referral health facilities in five adjacent provinces of Kandal at which caesarean section was performed in 2001. Some Kandal residents might get obstetric care services in other provinces, however the number was probably small. All private clinics in the two regions were not taken into account; therefore this was also a source of underestimation. It was confirmed that there were at least 13 private obstetric clinics in Phnom Penh at which caesarean section was done. The number of private clinics in Kandal was not known.

There was also possibility of a selection bias. Because data were collected relatively large referral hospital, which tend to receive severe and complicated patients compared to small clinics. There might be more number of haemorrhage patients who require immediate intervention and blood transfusion.

4-4-1-2. Misclassification

Regarding FPD, it could be changeable with mere prolonged labour. The diagnosis of FPD was usually made by combinations of clinical presentation of prolonged labour, clinical or radiographic estimation of contracted pelvic inlet, ultrasonographic measurement of biparietal diameter, and absence of foetal head engagement.^[58] However utilisation of x-ray pelvimetry has been questioned

because of its poor predictive value for FPD.^[59] Moreover, clinical estimation of pelvic inlet measurement is painful to the patient, and often introduces an error of 0.5 to 1cm.^[60] In practice, careful observation of labour course is only diagnostic tool for FPD, so that etiological differentiation of prolonged labour seems to be done subjectively.

4-4-2. Caesarean sections in the two regions

Proportions of caesarean sections to the expected number of births were 1.84% and 0.43% for Phnom Penh and Kandal residents, respectively. These proportions were much lower than 5%, which is proposed by UNICEF as a minimum caesarean section rate in developing countries.^[14] However, if every private clinic in Phnom Penh conducted 120 caesarean sections per year for the capital residents (although this assumption might be maximum number), there would be 1560 caesarean deliveries (13 clinics times 120 operations) in 2001. Adding this to the number of caesarean section by public hospital (699), total number of the interventions for Phnom Penh would be about 2300 cases; it is equivalent to more than 5% of all expected births. As for Kandal residents, it is unlikely that such a huge number of caesarean sections were performed at private clinics in the two regions. It implies that the UNICEF indicator for caesarean section rate might be achieved for Phnom Penh residents, but not for Kandal residents. Therefore, there would be some obstacles in access to obstetric care services in Kandal province.

The validity of this UNICEF indicator has been questioned since there seems to be no reasonable justification for the target percentage.^[11] Because the number of caesarean sections is often inflated by supply or induced demand rather than by need. It has been estimated that an appropriate caesarean section rate at population level in west Africa ranges 3.6 to 6.5% based on literature review and prevalence of obstetric complications derived from a cohort study.^[61] This is similar to the minimum limit of UNICEF indicator. However using the same cohort data, a range of 1.3 to 4.7% has been suggested as a relevant cesarean section rate for life-threatening maternal complications.^[62] In addition, historical data from England and Wales had shown that maternal mortality ratio as low as 60 per 100,000 live births was achieved with less than 2% of caesarean section rate.^[11] These data suggests that merely increasing caesarean section rate may not reduce maternal morbidity and mortality. Although caesarean section is one of the important tools for safe motherhood, the indication of the intervention and quality of care should be considered with the caesarean section rate.^[63]

4-4-3. Caesarean sections for absolute maternal indications in the two regions

Population based estimation of the proportion of caesarean sections for absolute maternal indications (AMIs) were 0.68% and 0.30% in Phnom Penh and Kandal, respectively. It has been suggested that relevant rate of caesarean sections for AMIs ranges between 1.1 to 1.3% in order to save mother's life.^[20] If 1.1% is taken as a reference level, the difference with the measured rate in Phnom Penh was 0.42%, this corresponds to 159 deliveries in 2001. This residual number of deliveries could be managed at the 13 private clinics in Phnom Penh, if each conducted 12 caesarean sections for AMIs in the year. As for Kandal province, the difference between the reference (1.1%) and measured rates was 0.8%, which is 2.7 times as high as the measured. The charge for caesarean section at private clinics in Phnom Penh ranges from 450 to 700US\$. It means that this intervention at a private clinic is provided only for relatively rich people. Although actual situation was not known, it is likely that contribution of the private clinics to dealing with AMIs is much smaller than that of public hospital. This study result implies that caesarean sections for AMIs in Kandal province could be lower than the ideal situation; therefore there would be a problem not only in access to but also in use of obstetric services.

As shown in Figure 1, proportions of AMIs and non-AMIs to caesarean sections were significantly different between Phnom Penh and Kandal. It means that women in urban area received more number of caesarean section, simultaneously, majority of the intervention were conducted for not absolutely necessary indications in terms of saving mother's life. Since caesarean section itself could be a risk of maternal death, it should be carefully examined if there is any tendency of overmedicalisation for the capital resident.

5. Conclusion and recommendation

Utilising hospital data, some crucial issues in obstetric care services both at population level and at hospital level in Cambodia could be drawn.

From the NMCHC data, it is confirmed that following problems or complications were significantly frequent among the NMCHC users who live outside the capital: caesarean section and obstetric operation, risk of hypertensive disorders and haemorrhage, risk of maternal death, twin pregnancy, preterm births and stillbirth. These all imply that a pregnant woman living in rural area could not receive appropriate health care in her region, and she had to go to a health facility in the capital city, which is relatively far from her home. These also imply that the rural women may have a higher risk of having complications during pregnancy and childbirth, and even a risk of dying due to the complications. Moreover, once all public hospital data were gathered and then population based indicators were calculated, it suggests that there would be serious deficit in access to and use of obstetric care services outside Phnom Penh city, and there would be considerable inequity of health care services between regions.

UNICEF has defined a short list of “signal functions” as Essential Obstetric Care (EOC) with which to measure the care provided for obstetric complications in a given setting (Annex 3).^[14] There are two tiers of facilities, which are “Basic EOC services” and “Comprehensive EOC services”. The minimum number of EOC facilities has been also defined: for every 500,000 population, there should be at least four basic EOC facilities and one comprehensive EOC facility within 3 hours and 12 hours travel distance for women, respectively.^[14] It means that there should be eight BEOC and two CEOC facilities both in Phnom Penh and in Kandal. The criteria seem to be satisfied in Phnom Penh, however it is questionable in Kandal not in terms of the number of facilities but their functions. The other issues are whether there are any problems of the accessibility to the facilities and of the quality of the care. The number of functioning health facilities, and the types and quality of provided care at each facility should be examined carefully, together with measurement of indicator of access to and use of service in order to plan and monitor safe motherhood programme.

Some suggestions could be drawn concerning obstetric care at hospital level through the health facility data analyses. It is confirmed that 14% of pregnant women had at least one of the serious complications at NMCHC, which cannot be detected beforehand. It is also revealed that prediction of maternal death and stillbirth is quite difficult. Thus, all pregnant women together with their babies

should be paid careful attention through entire labour course. Collaboration between midwives and medical doctors should be ensured in order to provide optimised care to an individual case.

NMCHC accounted for 61% of all caesarean sections conducted in all public hospital in Phnom Penh city. Therefore relatively high prevalence of the obstetric complications is considered to be logical for a well-functioning referral hospital. The number of patients treated for the complications may be used not only as a process indicator but also as a performance indicator of hospital.

Patient registration is an important source both for hospital management and for planning and monitoring safe motherhood programme. Because only hospital data can provide concrete information on obstetric complications and interventions in many developing countries. It has been known that private facilities also provide an important proportion of EOC procedures in some countries. Thus, data both from public health facilities and from private clinics regarding obstetric care should be collected on regular basis.

There are some promising tools for reduction of maternal deaths in a context of developing country. Use of magnesium sulphate for preeclampsia and eclampsia, and active management of the third stage for all delivery cases should be implemented correctly. Because wrong use of the drugs can do more harm than good. For instance, high dose of magnesium sulphate induces respiratory depression, and oxytocin administration during the first and second stage of labour can cause uterine rupture. Therefore, all birth attendants should be skilled enough in management of normal delivery and of complications during pregnancy and childbirth.

This study suggests that there would be obstacles to access to and use of obstetric care services in rural Cambodia. Further research on the process indicators should be carried out in order to know the current situation of health services clearly, and to monitor and evaluate progress of safe motherhood programme.

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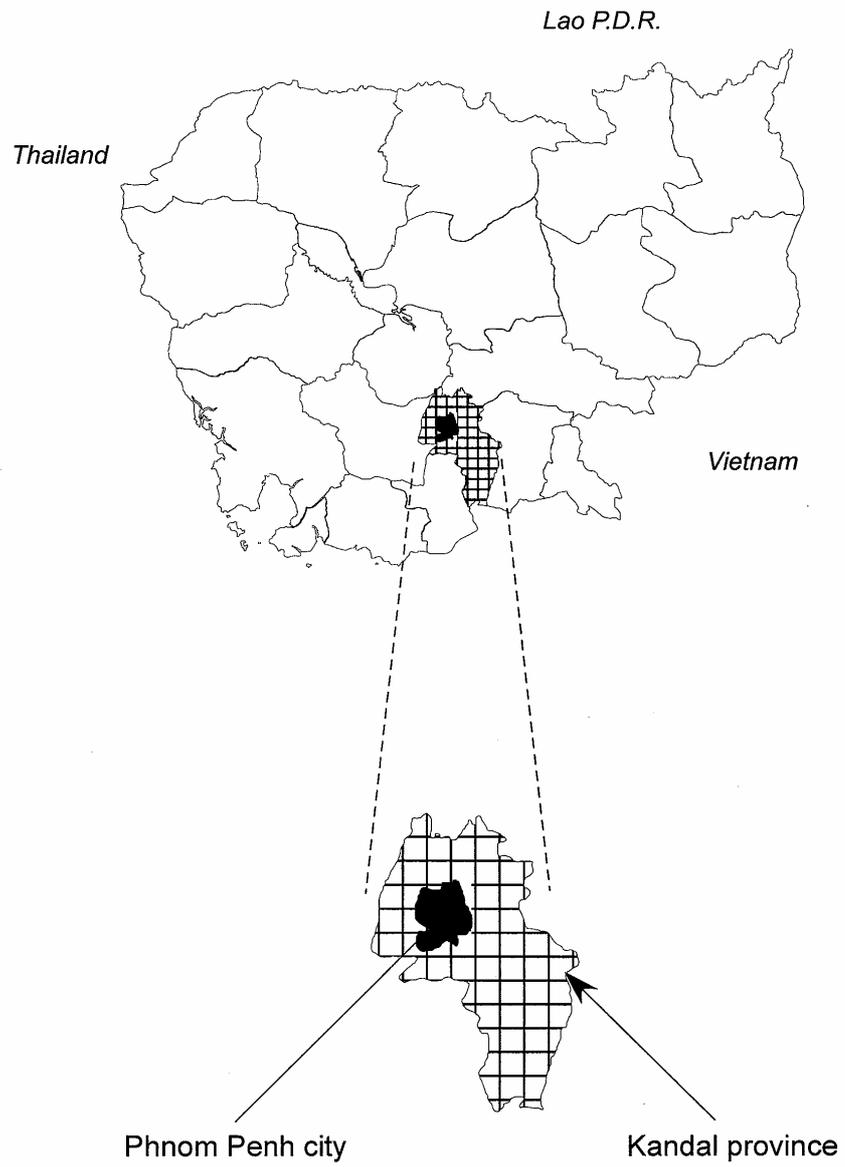
Annex 1. Main health indicators in Cambodia

Population	11,437,656	a
Crude birth rate	38/1000	b
Crude death rate	14/1000	b
Population growth rate	2.4%	b
Life expectancy	52 (Male)	b
	55 (Female)	
Infant mortality rate	89/1000	b
Total fertility rate	4.3	b

Source.

- a. National Institute of Statistics (Cambodia). General population census of Cambodia. Phnom Penh: The Institute; 1998.
- b. National Institute of Public Health (Cambodia). National Health Survey 1998. Phnom Penh: The Institute; 1999.

Annex 2. Map of Cambodia



Annex 3. Signal functions used to identify Basic and Comprehensive EOC

Basic EOC services

- (1) Administer parenteral antibiotics
- (2) Administer parenteral oxytocic drugs
- (3) Administer parenteral anticonvulsants for pre-eclampsia and eclampsia
- (4) Perform manual removal of placenta
- (5) Perform removal of retained products (e.g., manual vacuum aspiration)
- (6) Perform assisted vaginal delivery

A Basic EOC facility is one that is performing all of functions 1–6.

Comprehensive EOC services

- (1–6) All of those included in Basic EOC
- (7) Perform surgery (Caesarean section)
- (8) Perform blood transfusion

A Comprehensive EOC facility is one that is performing all of functions 1–8.

Source.

UNICEF/WHO/UNFPA. Guidelines for monitoring the availability and use of obstetric services. 2nd ed. New York: United Nations Children's Fund; 1997.