Chapter 3

Study Results

In this chapter we present our findings from the two studies. Section 3.1 contains the findings from the study on the method on assessing complication-based risk factors for neonatal morbidity. Section 3.2 contains the findings from the study of demographic determinants for caesarean delivery in Pattani Hospital at Pattani Province, Thailand.

For each study, some informative preliminary analysis of the data is not included in the publication due to journal space limitations and is thus included in the thesis at the beginning of each section. Copies of the published papers are also included.

3.1 The first study

The first study is entitled "A method for assessing complication-based risk factors for neonatal morbidity with application to Pattani hospital deliveries". This paper was published in the *Global Journal of Health Science*, 1(1)60-68 (2009).

The subjects investigated in this study comprised 19,268 women who delivered singleton babies in Pattani Hospital and (a) had not given birth previously by caesarean section, and (b) were not referred or transferred from other hospitals during the period from 1 October 1996 to 30 September 2005. Mothers with multiple or previous caesarean-section births were excluded because none of the 60 specified complications were recorded for such deliveries. Referred or transferred cases were also excluded because this higher-risk status constitutes an intervening variable that

could seriously bias the association between the complication-based morbidity outcome and the demographic risk factors of interest in the study.

The roles of the variables and their data types are listed in Table 3.1. There were seven basic determinants. One of these determinants (religion) was binary, three (education, age group and gravidarum) of ordinal data type, and three (occupation, residence and budget year) were nominal.

The outcomes of interest in the study were the birth weight, coded as an ordinal variable with three levels (less than 2000 grams, 2000-2499 grams, and 2500 or more grams), Apgar scores after 1 minute, coded as an ordinal variables with six levels (0, 1-5, 6, 7, 8 and 9-10), and the complication-based risk score, coded as a binary variable with low risk (score 0-6.9) or high risk (score 7-9).

Variable	*Role*	*Type*
Religion	determinant	binary
Occupation	determinant	nominal (6)
Education	determinant	ordinal (5)
Age group	determinant	ordinal (5)
Gravidarum	determinant	ordinal (3)
Residence	determinant	nominal (15)
Budget year	determinant	nominal (9)
Birth weight	outcome	ordinal (3)
Apgar score at 1 minute	outcome	ordinal (6)
Risk score (Morbidity)	outcome	binary

Table 3.1: Roles and data types of variables for study of neonatal morbidity

Preliminary analysis

Based on a complication-based morbidity score of 7 or more, it was found that 1,416 babies (7.4%) were estimated to be at high risk. Figure 3.1 shows 95% confidence

intervals of the percentages of babies estimated to be at high risk based on the complications, for each level of each demographic risk factor. This graph shows the corresponding crude (*unadjusted*) percentages with respect to the various levels of each of the seven risk factors. This association was statistically highly significant (*p*-value=0.000). The financial year was not statistically significant.

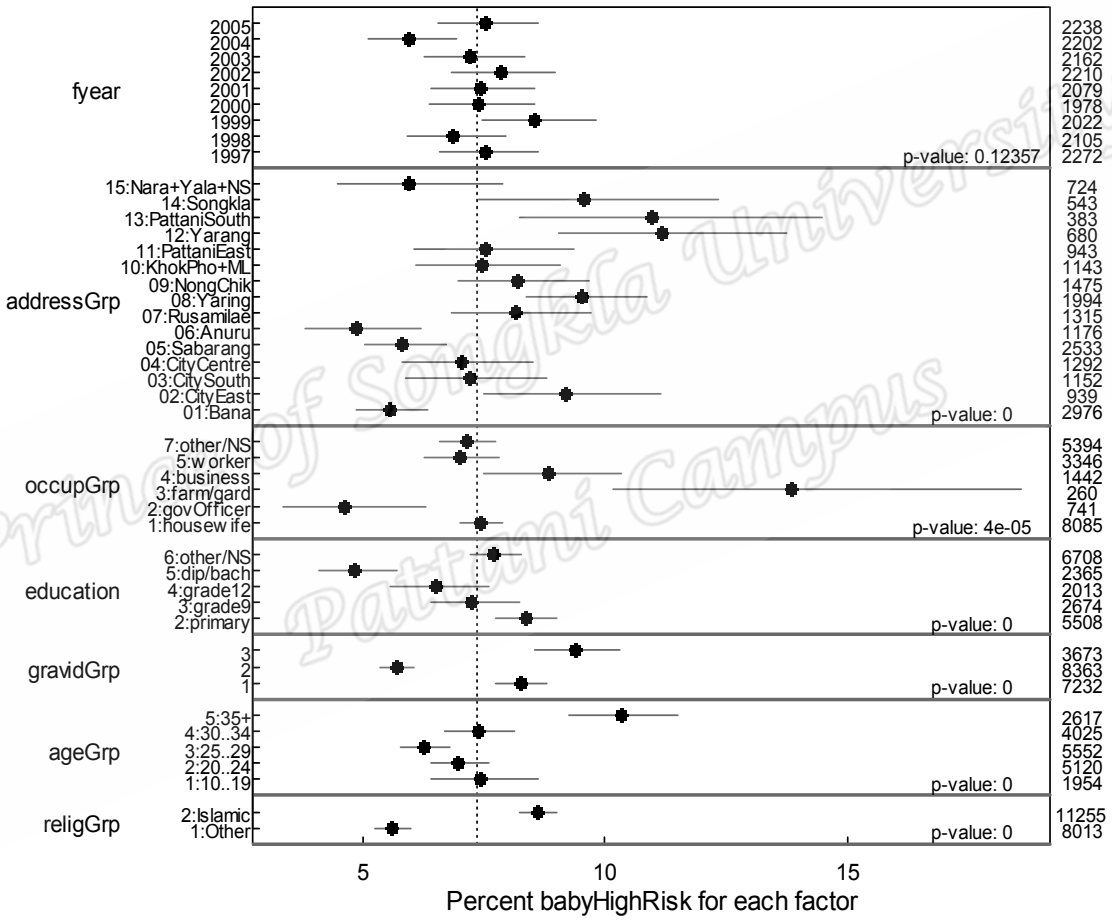

Figure 3.1: 95% confidence intervals of the percentages of baby high risk

Figure 3.2 shows 95% confidence intervals of the percentages of babies estimated to be at high risk based on the complications and the conventional neonatal morbidity including Apgar score at one minute (quantified six groups) and birth weight

(quantified three groups) (See Table 5 in first article). Describing the associations one minute Apgar score is regarded as an indication of risk signaling that special care.

This graph in Figure 3.2 shows the associations between high risk score based on complication and the conventional outcome.

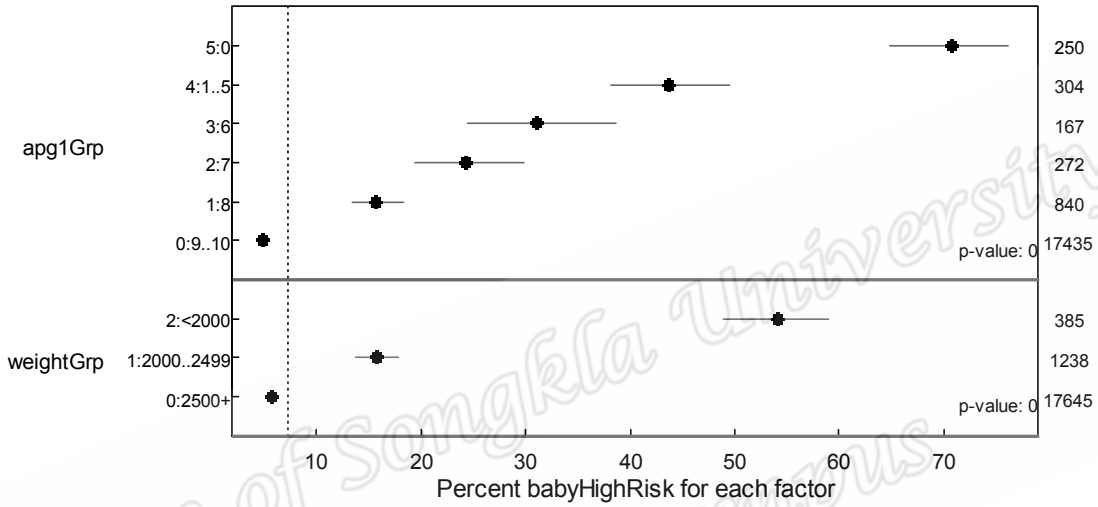

Figure 3.2: 95% confidence intervals of the percentages of baby high risk and conventional neonatal morbidity

Moreover, we further examined the individual association between the determinants and the risk baby outcome using the logistic regression model as shown in the first article.

The first article

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A Method on Assessing Complication-Base Risk Factors for Neonatal Morbidity: Application for Pattani Hospital Delivery

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Abstract

We investigated risk factors for neonatal morbidity based on a database of 19,268 singleton maternal deliveries at Pattani Hospital during the period from 1 October 1996 to 30 September 2005 inclusive. This database includes demographics of the mother and delivery outcomes including birth weight, one- and five-minute Apgar scores, and at most one complication selected from a list of 62 by the deliverer. In our study the neonatal risk associated with a complication was defined by averaging the results given by 11 obstetricians who independently scored each complication on a scale from 0 to 9 (highest risk to baby). Using logistic regression to adjust for demographic and pregnancy-history factors, we found risk that Muslim women have higher neonatal morbidity risks, particularly those associated with severe pregnancy-induced hypertension, eclampsia and thick meconium stain.

Keywords: Neonatal morbidity, Demographic factors, Ethnicity, Logistic regression analysis

1. Introduction

The World Health Organization estimated that more than nine million infants die each year before birth or in the first few weeks of life, with nearly all of these deaths occurring in developing countries. Most of these deaths were caused by pregnancy related complications such as placenta previa and abruption placenta, and delivery related complications including intraparum mortality (WHO, 1999). In their review of maternal health in poor countries, Filippi et al. (2006) pointed out that 2.4% of neonates are stillborn and another 3% die within 30 days with many due to obstetric complications, and that mother and child outcomes are closely linked. A systematic international review of causes of maternal death by Khan et al. (2006) found abortion and complications leading to hemorrhage, hypertensive disorders and sepsis as leading factors, depending on the region.

In developed countries the maternal mortality risks are now quite low, although a study by Berg et al. (2005) found that 40% of deaths due to pregnancy complications were potentially preventable. Wen et al. (2005) suggested that in

industrialized countries such as Canada maternal morbidity based on delivery complications including venous thromboembolism and uterine rupture should be used instead of mortality as a health care measure.

If a pregnancy complication is assessed as high, preventative medical practices to assist the newborn's survival could be undertaken. Early detection of risk factors in pregnant women is important. Identifying neonatal morbidity risk can help health officers to ensure that pregnant women receive proper care, thereby significantly decreasing maternal and neonatal morbidity and mortality rates (Dangal, 2007). However, assessing the pregnancy complication risk based on the mother's demographic and pregnancy history has not been seriously addressed, especially in developing countries.

In Thailand the major important causes of maternal death in 2003 were hemorrhage (27.8%), indirect cause (21.4%), hypertension (16.7%), amniotic fluid embolism (11.9%), sepsis (8.7%), and direct cause (8.7%) (Ministry of Public Health, 2004).

Located in southern Thailand with population 85% Muslim, Pattani province had perinatal mortality rates 11.4 and 13.0 per 1,000 total births in 2004 and 2005 respectively (Pattani Public Health Provincial Office, 2005). Although perinatal morbidity in the three Muslim majority southern provinces of Thailand is relatively high compared to the predominantly Buddhist provinces to the north, it is difficult to get precise estimates of the underlying relative risks for two reasons. First, birth certificates do not routinely record data other than the birth weight and length, 1-minute and 5-minute Apgar scores, the mother's age and the location of the hospital (rather than the mother), and hospital records of perinatal morbidity including complications are not routinely reported to Public Health authorities. Second, the morbidity rates, even for the less serious complications, are too low to accurately compute relative risks unless the sample size is very large.

However, if a complete record of delivery complications and full demographic information about the mother is recorded consistently by birth attendants at a major hospital over a period of several years, these data can be used to estimate the risk of a serious complication, and to compare these risks with respect to demographic and pregnancy history factors. Provided the risk associated with each complication is known, this can be done even if the actual morbidity events themselves are not recorded at the time, as is often the case when such problems manifest themselves much later. To do this, it is necessary to have estimates of the risk of perinatal morbidity associated with each recorded complication. These estimates can then be applied to estimate the risk itself based on the complication that occurred.

2. Materials and methods

2.1 Selection of data

We selected Pattani Hospital for our study because it has an ongoing well-maintained computerized database with case-by-case records containing birth outcomes including complications as well as 1- and 5-minute Apgar scores and birth weights, and demographic and pregnancy history data for the mother, for all deliveries since 1 October 1996. Our study included deliveries before 30 September 2005. This sample does not reflect births in Pattani Province as a whole, because there are other hospitals, and not all births occur in hospitals. Of the 12,587 births recorded in Pattani province in 2003 and 2004 respectively, 14.4% and 19.0% of mothers delivered in Pattani Hospital, 61.7% and 64.0% in community hospitals and 23.9% and 17.0% with traditional birth attendants (Pattani Public Health Office, 2005).

We excluded women having multiple births (329 deliveries) or previous caesarean births (3,311 deliveries) because no complication was recorded for such deliveries even if one existed. Transferals from another ward and referrals from another hospital (3,250 deliveries) were also excluded because they tend to have much higher morbidity than new cases. The data were entered into a database by nurses at Pattani Hospital, based on information in the hospital records system, giving a study sample of 19,268 for the nine-year period.

2.2 Determinant and outcome variables

The main outcome variable was the risk to the baby, based on the expert opinions of a panel of 11 obstetricians who gave a score from 0 to 9 for each of 62 complications specifying the condition of the infant after birth. These 62 complications were gathered from the existing maternal delivery records in computerized database for 10 years (1996 – 2005). Therefore, all possible mothers' complications were included in this study. A serious complication was defined as one given a score of 7 or more. Other outcomes of interest were one-minute and 5-minute Apgar scores and birth weight. Seven categorical determinants associated with the mother were considered, classified as follows: religion (Islamic or other), education (primary school, junior high school, senior high school, diploma/bachelor's degree, or other), occupation (housewife, government officer, farmer/gardener, business, worker, or other), number of previous pregnancies (gravidity: 0, 1, or more than 1), mother's age (less than 20, 20-24, 25-29, 30-34, or 35 or more), budget year of delivery (defined as the period from 1 October in the preceding calendar year to 30 September in the current year) from 1997 to 2005 inclusive, and residence (15 regions comprising seven based on sub-districts of Pattani city, six based on other districts of Pattani province, Songkla province, or other). In each of these categories 'other' includes 'not stated'.

2.3 Severity score for complications

For reasons stated earlier the study did not use an observed outcome because mortality was rare. While manual guidelines are used for detecting possible complications based on the mother's obstetric history there is no objective measure of morbidity based on all the delivery complications that routinely occur. We used a score for predicting the morbidity risk based on the assessments of eleven obstetricians personally known to the first author and working in three hospitals: Pattani Hospital (4), Chiang Mai Hospital (4) and Trang Hospital (3). All eleven agreed to provide their assessments when approached.

The obstetricians were asked to assess on a scale from 0 (no risk) to 9 (most serious risk), the risk to the baby for each of the 62 delivery complications listed in Table 1. These 62 complications were the ones routinely recorded at the hospital, largely by the same delivering personnel over the period of data collection. Although some of them are associated with very low risk and arguably could be omitted from consideration, and others were not defined as accurately as they could be, and the list could be expanded to more accurately reflect changes in medical practice, all were included without any further redefinition, in the same order as on the hospital's list, to ensure that the opinions of the obstetricians were not preempted or biased by any factors other than their own personal judgments.

The average for the 11 assessors – also given in Table 1 – was then taken as the risk score for each complication. For each complication, the average range (disagreement) in scores between the 11 assessors was 4.2. The complications whose associated risks they agreed on most were DFIU (complete agreement), anancephalus, eclampsia, prolapsed cord, and uterine rupture (range 1), and fetal distress, oligahydramios, and thalasemia in pregnancy (range 2). The complications whose associated risks differed most between assessors were transverse lie (range 8), low fetal movement and placenta previa (range 7) and anemia, asthma, appendicitis, condyloma, gut obstruction, epilepsy, fever, myoma uteri, prolong stage 2, trauma, and VDRL positive (range 6).

2.4 Statistical methods

Preliminary statistical analysis involved examining the frequency distributions of the determinants and their univariate associations with the outcome.

We used logistic regression (Kleinbaum and Klein, 2002) to estimate odds ratios and their 95% confidence intervals to compare the high-risk outcome with respect to each determinant both before and after adjusting for the six other factors. For each risk factor the referent category for the odds ratio was taken to be the one with the largest frequency, thus minimizing the widths of confidence intervals for individual odds ratios.

All relevant data were stored in a MySQL database and the R statistical system (Venables and Smith, 2002) was used for the statistical analysis.

3. Results

3.1 Preliminary results

We graded the severity of a complication as high, medium or low if its average obstetrician-judged rank was 7 or more, 6 to 6.99, or less than 6, respectively. We then created 16 categories of complications by including complications observed on more than 120 occasions individually, and grouping the less frequently occurring complications within each severity group. Table 2 shows the prevalences of these 16 complication groups and the demographic risk factors.

No complication was recorded for 13,511 (70.1%) of the 19,268 deliveries. The most common complications were cephalopelvic disproportion (1,244 cases, 6.5%) and breech presentation (719, 3.7%).

The most common places of residence of the mother were Bana and Sabarang subdistricts of Pattani City (15.4% and 13.1%, respectively), and the most common age groups were 25-29 (28.8%) and 20-24 (26.6%). With respect to gravidity, 43.4% were second pregnancies. Most of the mothers were Islamic (58.4%). In 34.8% of cases education was either not stated or not one of the given categories on the form. Of the remainder, primary school was most common (28.6%). Nearly half of the mothers (42.0%) were housewives. The proportions of cases changed very little from year to year, ranging only from 10.3% in 2000 to 11.8% in 1997.

Table 3 shows the associations between each demographic risk factor and the binary high-risk outcome. Factors associated with high risk delivery complications were mothers aged 35 or more, having two or more previous pregnancies, Islamic religious affiliation, only primary school education and occupation farmer or gardener.

3.2 Logistic regression

Table 4 shows the same odds ratios for each risk factor as those in Table 3, together with corresponding 95% confidence intervals, after adjusting for the other risk factors using logistic regression. With respect to the residence of the mother, the risks were found to be generally lower for mothers living in Pattani City with the exception of its central and eastern sub districts. Mothers aged 30 or more had higher risks than younger mothers, whereas those in delivering for the first time were also at higher risk than others. Women who had completed senior high school were at lower risk

than others, whereas farmers and gardeners had higher risk of complications. There was no evidence of a trend over the period 1997-2005.

Adjusting for all the measured socioeconomic factors reduced the odds ratios for Islamic mothers compared to those of other religious affiliation from 1.6 to 1.4, respectively, but the relative risks remained highly statistically significant and substantially greater than 1, with lower bound 1.26 for the 95% confidence interval.

3.3 Association between outcomes

In most maternal morbidity studies a one-minute Apgar score of 7 or less is regarded as an indication of risk signaling that special care is required (Chandra, 1997).

Table 5 shows odds ratios describing the associations between the risks based on the complication severity score and the conventional neonatal morbidity measures 1-minute Apgar score and birth weight group. It shows how the risks based on the Apgar-1 scores may be quantified into six groups with decreasing Apgar-1 score and higher complication-based risk; whereas those based on the very low, low and normal birth weight groups also neatly separate into three complication-based severity groups.

4. Discussion

The present study confirms the accepted wisdom Graham (1998) that the highest risks to newborns arise from specific pregnancy related complications: severe pregnancy-induced hypertension, eclampsia and thick meconium stain. The study showed that rural residence, age, first pregnancy, Islamic mothers, lower educational completion and strenuous occupation are risk factors.

The higher risk among rural residence mothers may be due to the longer distance to access health care services or the difficulty of transportation from living place to the hospital. This result supports a European study finding that rural populations have higher maternal and perinatal mortality than corresponding urban populations (WHO, 2005).

Mothers aged 30 or more had higher risks than younger mothers. This confirms results reported by Uma (2006), Srisomboon (1994) and the Public Health, University of California (1994). Mothers delivering for the first time were at higher risk than others. This result agrees with a study conducted by Islam et al. (2004).

Women who had completed senior high school were at lower risk than others. A similar result was reported by Grjibovski (2002). More highly educated mothers may know how to better take care of themselves during pregnancy. This result is consistent with Raum et al. (2001).

Farmers and gardeners comprised only a small proportion of the study sample but had higher risk of complications. This could be due to their lower income or inferior nutrition.

Islamic mothers had higher risk than others, even after adjusting for all other recorded socio-demographic factors.

Since mothers who had had previous caesarean births were excluded from our study because a complication was not recorded for them even if one existed, it is possible that the omission of these women from our study could have given rise to a selection bias, which could account at least in part for our result. This question is being examined in a separate study.

The result from this study can be applied for screening of pregnant women who are at risk of complications in public health. Education on good practice during pregnancy to prevent complication from developing should be implemented, for institutional early detection and quality of management of antenatal care. We found risk that Muslim women have higher neonatal morbidity risks, particularly those associated with severe pregnancy-induced hypertension, eclampsia and thick meconium stain. Future more women aged over 30 years, lower education, being gardener or farmer and having first gravidity had higher risk of having neonatal morbidity.

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Table 1. Complication frequencies and average severities recorded by 11 obstetricians

Complication	Count	Score	Complication	Count	Score
None	13511	0	Birth before admission	16	6.00
Cephalopelvic disproportion	1244	6.18	Prolapsed cord	15	8.82
Breech presentation	719	5.90	Anemia	15	4.36
Post term labour	443	6.72	Gestational edema	15	1.45
Pre-term labour	370	7.36	Herpes	15	5.90
Prolong stage 1	367	5.09	Oligahydramios	15	7.36
Premature membrane rupture	352	6.27	Abruption placenta	14	8.36
Prolong stage 2	319	7.00	Asthma	14	4.27
Severe PI hypertension	232	7.36	Anancephalus	13	8.73
Mild PI hypertension	218	5.45	Hydrocephalus	12	7.91
Placenta previa	172	5.55	Polyhydramios	10	5.81
Fetal distress	161	8.36	Home birth with midwife	10	4.00
Not stated	133	3.50	Myoma uteri	9	4.36
Dead fetus in utero	123	9.00	Condyloma	7	5.09
Low fetal movement	119	6.36	Epilepsy	6	5.82
Membrane leak > 24 hrs	55	6.91	Shoulder dystosia	5	8.27
Postpartum hemorrhage	55	1.36	Fetal anomaly	4	8.00
Transverse lie	54	5.27	Uterine rupture	4	8.91
Retain placenta	49	0.36	Acute diarrhea	4	3.36
Gestational diabetes	43	6.18	UTI in pregnancy	3	5.00
Thick meconium stain	41	8.09	Chronic HT + Accrevate	3	7.10
Eclampsia	38	8.55	Gastroenteritis	3	3.18
Occiput presentation	31	2.36	Gestational hypertension	2	4.63
Overt diabetes	30	7.27	Pyelonephritis	1	5.64
Hyperthyroid in pregnancy	29	4.81	Pulmonary edema	1	6.91
Thalasemia in pregnancy	26	6.10	Trauma	1	5.91
Antepartum hemorrhage	24	6.00	Gestational proteinurea	1	1.50
Heart disease	20	6.27	Amniotic embolism	1	8.20
Chronic hypertension	20	6.36	Malaria in pregnancy	0	7.45
VDRL positive	19	6.18	Appendicitis	0	5.09
Face presentation	16	7.36	Gut obstruction	0	5.00
Fever	16	5.36			

Table 2. Distributions of complication outcome and demographic factors

Variable	Cases Count (%)	Variable	Cases Count (%)
Complication group:		Age group:	
None	13511(70.1)	less than 20	1954 (10.1)
Prolong stage 1	367 (1.9)	20-24	5120 (26.6)
Mild PI hypertension	218 (1.1)	25-29	5552 (28.8)
Placenta previa	172 (0.9)	30-34	4025 (20.9)
Breech presentation	719 (3.7)	35 or more	2617 (13.6)
Other low severity	483 (2.5)	Gravid: 0	7232 (37.5)
Cephalopelvic disp.	1244 (6.5)	1	8363 (43.4)
Prem membrane rupture	352 (1.8)	2 or more	3673 (19.1)
Post term labour	443 (2.3)	Islamic	11255 (58.4)
Other medium severity	343 (1.8)	Other religion	8013 (41.6)
Prolong stage 2	319 (1.7)	Education:	
Pre term labour	370 (1.9)	Primary school	5508 (28.6)
Severe PI hypertension	232 (1.2)	Junior high	2674 (13.9)
Fetal distress	161 (0.8)	Senior high	2013 (10.4)
Other high severity	211 (1.1)	Dipl/Bachelor	2365 (12.3)
Dead fetus in utero	123 (0.6)	Other/not stated	6708 (34.8)
Place of Residence:		Occupation:	
Anuru	1176 (6.1)	Housewife	8085 (42.0)
Bana	2976 (15.4)	Govt officer	741 (3.8)
Sabarang	2533 (13.1)	Farmer/gardener	260 (1.3)
City-south	1152 (6.0)	Business	1442 (7.5)
City-centre	1292 (6.7)	Worker	3346 (17.4)
City-east	939 (4.9)	Other/not stated	5394 (28.0)
Narat/Yala/not stated	724 (3.8)	Year: 1997	2272 (11.8)
Nong Chik	1475 (7.7)	1998	2105 (10.9)
KhokPho/Maelan	1143 (5.9)	1999	2022 (10.5)
Pattani-east	943 (4.9)	2000	1978 (10.3)
Yaring	1994 (10.3)	2001	2079 (10.8)
Rusamilae	1315 (6.8)	2002	2210 (11.5)
Yarang	680 (3.5)	2003	2162 (11.2)
Pattani-south	383 (2.0)	2004	2202 (11.4)
Songkla	543 (2.8)	2005	2238 (11.6)

Table 3. High risk complication prevalence and associations with demographic factors

Risk factor	Count (OR)((95% CI)	Risk factor	Count (OR) (95% CI)
Residence:		Religion:	
Anuru	57 (0.48) (0.36-0.66)	Islamic	968 (1.59) (1.42-1.78)
Bana	165 (0.56) (0.45-0.69)	Other religion *	448
Sabarang	147 (0.58) (0.47-0.73)	Education:	
City-south	83 (0.74) (0.56-0.96)	Primary school*	460
City-centre	91 (0.72) (0.73-1.25)	Junior high	194 (0.86) (0.72-1.02)
City-east	86 (0.96) (0.73-1.25)	Senior high	131 (0.76) (0.62-0.93)
Nar/Yala/NS	43 (0.60) (0.43-0.84)	Dipl/Bachelor	114 (0.56) (0.45-0.69)
Nong Chik	121 (0.85) (0.67-1.08)	Other/not stated	517 (0.92) (0.80-1.04)
KhokPho/Maelan	85 (0.76) (0.58-1.00)	Occupation:	
Pattani-east	71 (0.77) (0.58-1.03)	Housewife *	600
Yaring *	190	Govt officer	34 (0.60) (0.42-0.85)
Rusamilae	107 (0.84) (0.66-1.08)	Farmer/gardener	36 (2.00) (1.40-2.88)
Yarang	76 (1.19) (0.90-1.58)	Business	127 (1.20) (0.99-1.47)
Pattani-south	42 (1.17) (0.56-0.96)	Worker	234 (0.94) (0.80-1.10)
Songkla	52 (1.01) (0.73-1.39)	Other/not stated	385 (0.96) (0.84-1.10)
Age group:		Budget year:	
less than 20	145 (1.07) (0.88-1.31)	1997	171 (1.02) (0.81-1.28)
20-24 *	357	1998	144 (0.92) (0.73-1.16)
25-29	347 (0.89) (0.76-1.04)	1999	173 (1.17) (0.93-1.47)
30-34	297 (1.06) (0.91-1.25)	2000	146 (1.00) (0.79-1.26)
35 or more	270 (1.53) (1.30-1.81)	2001 *	154
Gravidity:		2002	173 (1.06) (0.85-1.33)
0 *	596	2003	156 (0.97) (0.77-1.23)
1	475 (0.67) (0.59-0.76)	2004	131 (0.79) (0.62-1.01)
2 or more	345 (1.15) (1.00-1.33)	2005	168 (1.01) (0.81-1.27)

* Referent group for odds ratio (OR) calculation

Table 4. Adjusted odds ratios for high risk complications

Risk factor	cases OR (95% CI)	Risk factor	cases OR (95% CI)
Residence:		Religion:	
Anuru	0.59 (0.44-0.81)	Islamic	1.44 (1.26-1.64)
Bana	0.66 (0.52-0.82)	Other relig *	1
Sabarang	0.69 (0.55-0.87)	Education:	
City-south	0.73 (0.55-0.95)	Primary *	1
City-centre	0.79 (0.61-1.03)	Junior high	0.90 (0.75-1.08)
City-east	0.93 (0.71-1.22)	Senior high	0.75 (0.61-0.92)
Nar/Yala/NS	0.73 (0.52-1.04)	Dipl/Bach	0.54 (0.43-0.69)
Nong Chik	0.94 (0.73-1.19)	Other/NS	1.16 (0.95-1.43)
KP/Maelan	0.93 (0.71-1.23)	Occupation:	
Pattani-east	0.94 (0.70-1.25)	Housewife *	1
Yaring *	1	Govt officer	0.77 (0.52-1.14)
Rusamilae	1.05 (0.81-1.35)	Farmer/G	1.63 (1.12-2.38)
Yarang	1.16 (0.87-1.54)	Business	1.19 (0.97-1.46)
Pattani-south	1.17 (0.82-1.68)	Worker	1.01 (0.86-1.19)
Songkla	1.19 (0.85-1.65)	Other/NS	0.58 (0.41-0.82)
Age group:		Budget year:	
less than 20	0.93 (0.75-1.14)	1997	1.37 (0.93-2.01)
20-24 *	1	1998	1.26 (0.85-1.86)
25-29	1.01 (0.86-1.18)	1999	1.33 (1.03-1.73)
30-34	1.22 (1.02-1.46)	2000	1.01 (0.80-1.29)
35 or more	1.58 (1.29-1.93)	2001 *	1
Gravidity:		2002	1.06 (0.85-1.33)
0 *	1	2003	0.96 (0.76-1.22)
1	0.59 (0.51-0.67)	2004	0.79 (0.62-1.01)
2 or more	0.72 (0.60-0.86)	2005	1.01 (0.80-1.27)

Table 5. Associations between conventional neonatal morbidity outcomes and complication based risk outcome

	conventional neonatal morbidity	Number of case		OR (95% CI)
		High risk	Low risk	
Apgar -1 score	9-10*	856	16579	1
	8	132	708	3.6 (3.0-4.4)
	7	66	206	6.2 (4.7-8.2)
	6	52	115	8.8 (6.5-12.2)
	1-5	133	171	15.1 (11.9-19.1)
	0	177	73	47.0 (35.4-62.2)
Birth Weight	2500*	1013	16632	1
	2000-2499	195	1043	3.1 (2.6-3.6)
	<2000	208	177	19.3 (15.6-23.8)