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Twins Born in Pattani Hospital: 1996-2005

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Abstract:

This study aimed to measure the prevalence of twins among all conceptions and to identify demographic factors for twinning in Pattani province of southern Thailand. The sex distribution of the twins was also investigated. Data on demographics and reproductive history of the mother were obtained from Pattani Provincial Hospital. From 1 October 1996 to 30 September 2005, 22,906 infants including 221 twin pairs were delivered to 19,126 mothers on 22,685 occasions. Triplets (4 occasions) and referral mothers (3,433 occasions) were excluded from this study. The prevalence of twins was 9.7 per 1000. Based on the fact that 186 of these pairs were of the same sex, the estimated proportion of identical twins was found to be 0.68 (95% CI: 0.59, 0.78). After preliminary analysis of demographic factors, logistic regression was used to model prevalence. The only statistically significant determinants of twinning found were the mother's age and religion. No associations were found between the sex distribution of the twins and any demographic factors. A more extensive study would need to be done to examine possible associations between prevalence of same-sex twins and ethnic factors in the region.

Key words: Twins, identical twins, same-sex twins, Pattani Hospital

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บทคัดย่อ:

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษาอุบัติการณ์การเกิดแฝดสอง และเพื่อศึกษาความสัมพันธ์ระหว่างปัจจัยภูมิหลังของมารดากับการเกิดแฝดสองและประเภทของเพศแฝดสอง โดยทำการศึกษาเก็บข้อมูลมารดาและทารกในโรงพยาบาลปัตตานีย้อนหลังเป็นระยะเวลา 9 ปี ตั้งแต่วันที่ 1 ตุลาคม 2539 ถึง 30 กันยายน 2548 จากจำนวนเด็กคลอดทั้งหมด 22,906 ราย พบว่ามีการคลอดทารกแฝดสองจำนวน 221 คู่ จากมารดาที่มาคลอดจำนวน 19,126 ราย โดยจำนวนครั้งของการมาคลอด คือ 22,685 ครั้ง การคลอดทารกแฝดสาม (จำนวน 4 ครั้ง) และการคลอดในโรงพยาบาลปัตตานีจากการส่งตัวมารดาจากโรงพยาบาลอื่น ๆ (จำนวน3,433 ครั้ง) ถูกตัดออกจากการศึกษาในครั้งนี้ ผลการศึกษาพบว่า อุบัติการณ์การคลอดทารกแฝดสองเป็น 9.7 ต่อการคลอด 1000 ราย สัดส่วนของการเกิดแฝดสองไข่ใบเดียวกันเป็น 0.68 (95%CI: 0.59, 0.78) และจากการศึกษาความสัมพันธ์ระหว่างปัจจัยภูมิหลังกับการเกิดแฝดสองและเพศของทารกแฝด พบว่า อายุ และศาสนาของมารดามีความสัมพันธ์ต่อการเกิดของแฝดสอง และไม่พบความสัมพันธ์ระหว่างปัจจัยภูมิหลังของมารดากับประเภทของเพศทารกแฝดสอง ในการศึกษาครั้งถัดไปควรพิจารณาความสัมพันธ์ที่เป็นไปได้ระหว่างการเกิดแฝดเพศเหมือนกับปัจจัยทางด้านเชื้อชาติในพื้นที่

คำสำคัญ : แฝดสอง, แฝดไข่ใบเดียวกัน, เพศเหมือน, โรงพยาบาล ปัตตานี

Introduction

Twins are of two kinds, depending on whether they are conceived from two separate eggs (*fraternal* twins) or from a single egg that has subsequently split into two (*identical* twins). Fraternal twins, like normal siblings, can be of the same or opposite sex, but identical twins must have the same sex.

Various studies have investigated the prevalence of identical twins in populations. It has been claimed that this prevalence is constant, even though the prevalence of fraternal twins may vary substantially. The prevalence of twins among humans is approximately 1% but varies substantially by geographical location and the trend appears to be increasing, possibly due to assisted reproduction[1]. Pison[2] claimed that among all births the prevalence of fraternal twins varies from 3 per 1000 in Asia and Oceania to 8 per 1000 in America and

Europe and 16 per 1000 in Africa, whereas the prevalence of identical twins is constant at 3.5-4 per 1000. Disputing an earlier claim by Arey[3] that "statistically about one fourth of all twins are identifiable as of the single egg type", Strandskov and Edelen[4] found that close to one third of 680,000 twins born in the United States from 1922 to 1936 were identical, and that this proportion was the same in both African-Americans and others.

In a study of birth weight among 12,392 pairs of twins born in Japan in 1974, Asaka et al[5] obtained a 95% confidence interval (0.66, 0.69) for the proportion of identical twins among all twins. This finding confirms, at least for the Japanese, an earlier hypothesis by Bulmer[6] stating that the prevalence of identical twins among twins in Caucasian populations is one-third whereas the prevalence among Asian populations is two-thirds. In a study of the health status of twin babies born from May 1993 to April 1994 in a Kerala hospital, Jaya et al[7] found the proportion of same-sex pairs to be 79.6%, giving an estimated prevalence of 60% for identical twins among all twins.

But there is more recent evidence suggesting that the prevalence of identical twins is not constant in Asia. Based on the gender distribution of 11,870 twin pairs born in Singapore between 1 January 1986 and 31 December 2001, Chia et al[8] estimated the proportion of identical twins among twins to be 0.55 for those born to Malay mothers, 0.63 for those born to Malay fathers, 0.65 and 0.66 for those born to Chinese mothers and fathers respectively, and 0.87 and 0.99 for those born to Indian fathers and mothers respectively. Note that these estimates for Indians in Singapore appear to be inconsistent with that obtained from the study by Jaya et al[7] which suggests that there could be regional differences among Indians.

In Thailand, at least two studies have reported on the gender composition of twins among hospital births. Based on 276 twin pairs born in Rayong Hospital between 1 October 1987 and 30 September 1991, Sangpethsong[9] found only 22 to be of opposite sex, from which statistical theory gives the estimated prevalence of identical twins to be 0.84 with a 95% confidence interval (0.75, 0.90). A similar study by Lertkungwarnkai and Ramkiattisak[10] of 67 twins born in Lerdsin Hospital from 1989 to 1993 found 9 opposite sex twins, giving an estimated prevalence of identical twins of 0.73 with a 95% confidence interval (0.45, 0.88). As a matter of scientific interest it would be useful to know the prevalence of identical twins in Thailand, both among all twins and among all births, and whether it is constant or subject to regional variation among the different ethnic groups in the kingdom. This study aimed to measure the prevalence of twins among all conceptions, to identify the demographic for twinning and to identify the factors associated with the sex distribution of twins in Pattani hospital.

Materials and methods

Data Source

Since 1996 Pattani Provincial Hospital has collected extensive records of all neonatal deliveries, including demographics and reproductive history of the mother (identified by hospital number) and perinatal characteristics including multiple birth information.[11]

Variables

We focus herein on the two outcome variables mainly considered in the literature, namely (a) the prevalence of twins among births and (b) the sex distribution of twins (given that the hospital records contain no information as to whether a twin pair is identical or fraternal).

The ethnicity of residents of Pattani province is mostly Jawi Malay[12] but also includes Chinese and Thai and persons of mixed ethnicity. Since ethnicity is not recorded in the hospital records (and residents of mixed ethnic heritage are difficult to classify), the mother's sub-district of residence provides the most useful surrogate for ethnicity. Other demographic determinants include the mother's age, parity, education, occupation, and religion (Islamic or other).

Study Design

The study sample comprised all occasions of a delivery (single or multiple birth) at Pattani hospital during the nine-year period. Mothers delivered triplets (4 occasions) and referral mothers from another hospital to Pattani hospital (3,433 occasions) were excluded, because such referral is an intervening variable associated with the twin outcome. This sample included 221 mothers who delivered twins (cases) and 22,464 who delivered singletons on separate occasions (controls). Figure 1 shows a path diagram for the variables of interest.

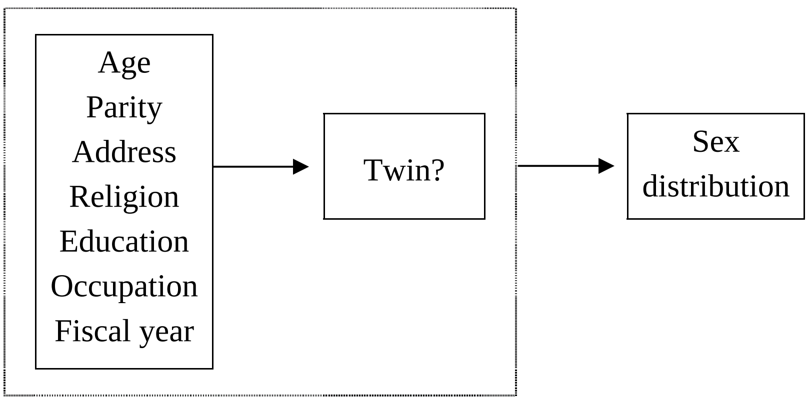

Figure 1: Path diagram showing variables in the study

Age was defined as the age of the mother at delivery at Pattani hospital during the period, classified by 5-year group (less than 20, 20-24, 25-29, 30-34, 35+), and parity was similarly defined into three groups (0, 1 and 2+). Address was classified into 15 regions comprising aggregates of neighbouring sub-districts of Pattani City or other districts of Pattani province or other provinces as follows: 1: Bana, 2: City East, 3: City South, 4: City Centre, 5: Sabarang, 6: Anuru, 7: Rusamilae, 8: Yaring, 9: Nong Chik, 10: Khok Pho and Mae Lan, 11: Pattani East, 12: Yarang, 13: Pattani South, 14: Songkla, 15: Narathiwat, Yala, not stated. Religion was classified as Islamic or other. Education was classified into four groups as 1: primary or less, 2: secondary, 3: tertiary or other, 4: not stated. Occupation was classified as 1: housewife, 2: gardener or farmer, 3: worker or in business, 4: government officer or other or not stated occupation. The fiscal year was defined as between 1 October in the preceding year and 30 September in the current year.

The path diagram includes the variables used when twin status was taken as the outcome, or when the sex distribution of the twins was taken as the outcome. The sex distribution outcome variable was classified as 1: same-sex, 0: opposite-sex.

Statistical Methods

Many studies of twins do not directly measure their status as identical or fraternal. But since identical twins must be of the same sex it is possible to estimate the proportion of identical twins among twins if the proportion of same-sex twins is known. If p_S and p_Z denote the respective proportions of same-sex and identical twins among twins in a population, and 50% of fraternal twins are same-sex (approximately true in any population)[13] it follows that $p_S = p_Z + (1 - p_Z)/2$, and thus $p_Z = 2p_S - 1$ If the sample size (n) is known, a 95% confidence interval can be obtained. Since the standard error of a proportion p based on a sample of size n is $\sqrt{p(1-p)/n}$, and the standard deviation of a linear function $a + bX$ of a random variable X is b times the standard deviation of X, it follows that the standard error of p_Z is $2\sqrt{p_S(1-p_S)/n}$.

In the preliminary analysis the associations between the determinant variables were examined. Since all of these variables are categorical chi-squared statistics and corresponding p-values describe the statistical significance of these associations.

Since both outcome variables are binary, logistic regression is an appropriate method for assessing the effects of the determinants on each outcome.[14] This modeling strategy involved initially including all determinants as factors and subsequently omitting in turn determinants with overall p-values less than 0.05 (based on the reduction in residual deviance using the chi-squared test).

Results

Preliminary Analysis

From 1 October 1996 to 30 September 2005, 19,126 mothers delivered 22,906 babies including 221 twin pairs on 22,685 occasions. The prevalence of twins was thus 9.7 per 1000. Given that 35 opposite-sex twins were recorded, this gives an estimate of 0.68 for the proportion of identical twins, with a 95% confidence interval (0.59, 0.78).

Table 1 shows the distributions of twins and singletons as classified by the demographic factors. Although some of the demographic factors appear to be associated with twin prevalence, they need to be considered jointly to allow for possible confounding. Table 2 shows the chi-squared statistics and their corresponding degrees of freedom for the associations between pairs of determinants. The associations are highly statistically significant in all cases with p-values less than 0.005.

Factor	Category	Percent	
		Twin (221)	Singleton (22,464)
Age of mother	<20	4.1	8.9
	20-24	21.3	24.9
	25-29	29.9	29.2
	30-34	30.3	22.6
	35+	14.5	14.4
Parity	0	29.4	36.9
	1	31.2	31.6
	2+	39.4	31.6
Address	Bana	11.3	14.5
	City East	5.0	4.6
	City South	6.3	5.6
	City Centre	4.5	6.5
	Sabarang	8.1	12.8
	Anakru	5.4	6.1
	Rusamilae	4.5	6.9
	Yaring	13.6	10.3
	Nong Chik	12.2	7.7
	Khok Pho + Maelan	6.8	6.3
	Pattani East	8.6	5.4
	Yarang	3.2	3.6
	Pattani South	4.1	2.1
	Songkla	1.8	2.9
	Narathiwat +Yala + NS	4.5	4.8
Religion	Islam	71.0	57.2
	Other	29.0	42.9
Education	Not stated	13.1	14.9
	Primary	40.7	32.9
	Secondary	21.7	24.6
	Other	24.4	27.6
Occupation	Housewife	46.6	41.7
	Gardener or farmer	2.3	1.6
	Worker/business	22.6	25.1
	Government officer/other	28.5	31.7
Fiscal Year	1997	13.1	11.1
	1998	7.7	10.5
	1999	7.7	10.3
	2000	12.7	10.4
	2001	9.1	11.0
	2002	12.2	11.5
	2003	14.0	11.6
	2004	13.1	11.6
	2005	10.4	12.0

NS = Not stated

Table 1: Distributions of demographic factors for twins and singletons

parity	7551.1 8					
address	336.9 56	338.9 28				
religion	138.0 4	878.3 2	4156.1 14			
education	617.1 12	707.9 6	570.4 42	141.7		
occupation	490.7 12	85.6 6	889.9 42	109.7 3	17703.4 9	
fiscal year	60.5 32	36.6 16	886.8 112	209.7 8	20635.4 24	15393.3 24
	age	parity	address	religion	educ- ation	occup- ation

Table 2: Chi-squared statistics and degrees of freedom for associations between determinants

Logistic Regression Models

Table 3 shows the p-values for the determinants in the logistic regression model where the outcome is twin status. After omitting address, parity, fiscal year, occupation and education, which have no independent effects on the prevalence of twins, the only statistically significant determinants of twinning are religion and age group.

parity	0.960					
occupatio	0.478	0.463				
fiscal year	0.287	0.281	0.300			
education	0.190	0.168	0.081	0.161		
address	0.122	0.124	0.121	0.123	0.145	
age group	0.032	0.009	0.014	0.017	0.015	0.011
religion	0.0006	0.0005	0.0005	0.0005	0.0002	<0.001
deviance	2418.9	2419.0	2421.6	2431.1	2436.2	2455.8
r-squared	0.0273	0.0273	0.0263	0.0224	0.0204	0.0125

Table 3: P-values for determinants in logistic regression model for twin status

Table 4 shows the individual regression coefficients and their standard errors in the final reduced model. In order to adjust for confounders, we put all demographic factors into the full model. After removing statistically not significant factors from the model, the coefficients do not change substantially, indicating that confounding is not a serious problem.

Factor		Multivariate model Coefficient	St Error
		-5.751	0.365
religion:	other	0	-
	Islamic	0.600	0.149
age group:	<20	0	-
	20-24	0.589	0.365
	25-29	0.773	0.356
	30-34	1.043	0.356
	35+	0.701	0.379

Table 4: Reduced logistic regression model for twin status

Table 5 shows the p-values for the determinants in a sequence of logistic regression models where the outcome is gender distribution (same sex versus opposite sex). Since all twins born to mothers aged less than 20 were of the same sex, in this analysis age was regrouped as <25, 25-29, 30-34 and 35+ years. At each step the determinant with the largest p-value was omitted from the model. Although address group is statistically significant when all factors are included and remains so after two factors are omitted, its influence diminishes when the model is further reduced. In the end there is no evidence that any of these demographic factors is associated with the gender distribution of the twins.

education	0.908						
age group	0.660	0.711					
parity	0.541	0.590	0.770				
occupatio	0.346	0.275	0.288	0.284			
religion	0.259	0.255	0.356	0.334	0.348		
fiscal year	0.178	0.195	0.245	0.232	0.411	0.469	
address	0.038	0.031	0.034	0.030	0.039	0.049	0.228
deviance	157.3	157.8	159.2	159.7	163.5	164.4	191.7
r-squared	0.157	0.155	0.147	0.144	0.124	0.119	0.078

Table 5: P-values for determinants in stepwise analysis for sex distribution

Discussion

The prevalence of twins in Pattani hospital was higher than in Vajira hospital, and in Lerdsin and Rayong hospitals, which were 6.07, 6.3 and 7.7 per 1000, respectively.[9-10,15] The explanation for this may be due to mothers in the three Southernmost provinces in Thailand still delivering their babies with traditional birth attendants, especially for singleton deliveries. During the year 1999-2005 mothers in Pattani province delivered their babies with traditional birth attendance at rates of 56.0%, 41.0%, 37.9%, 36.4%, 28.6% and 17.1%, respectively[16] whereas there are few such birth attendant workers in other parts of Thailand. As a result, the proportions of women delivering singleton births in hospital tend to be lower than in other areas of Thailand.

Our study found that the maternal age for twins was significantly higher than that for singleton births, which agrees with studies from Brazil, Japan, France, England, Wales, Sweden, Nigeria.[17-21]

Compared to other religions, Muslim mothers have higher twin prevalence which is in concord with a study in India.[22] The difference in the rates of having twins among religious groups may be due to gene flow caused by interethnic mixing and/or environmental factors including altered lifestyles or socioeconomic and demographic changes.[12,23]

In contrast to our study, a study in Nepal found that the twinning rate was higher among women of higher parity, but was not associated with maternal age.[24]

Our result confirmed the suggestion of Bulmer that the prevalence of identical twins in Asian populations is approximately two-thirds.[6] The sex distribution in the southern Thai population found no evidence of any association with the mother's demographic factors.

The major limitations to our study were a) the data sources did not provide the information on whether the twins were monozygotic or dizygotic, and b) there was no information available on assisted reproduction.

Conclusion

The prevalence of twins in Pattani hospital was 9.7 per 1000 with an estimated proportion of identical twins of 0.68 (95%CI: 0.59, 0.78). For the twin status predictive model, twin status was found to be associated with age and religion. For the sex distribution predictive model, no statistically significant associations between sex distribution and determinants were found. A more extensive study would need to be done to examine possible associations between prevalence of same-sex twins and ethnic factors in the region.

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