

tion since all maternal conditions were identified from medical discharge diagnoses. Another limitation was the inability to assess the effect of medical interventions on each maternal condition. In addition, we were unable to account for conditions that occurred early in the pregnancy but resolved, since the maternal conditions were based on hospital maternal discharge diagnosis at the time of birth. Furthermore, we could not detect the effect of maternal medical conditions at different gestational ages, since gestational age was not consistently and accurately measured. Despite these limitations inherent in linked record data sets, previous studies with similar study designs have provided important findings regarding the effects of maternal smoking on infant mortality and preterm delivery.^{6,7}

We conclude that treatable maternal antepartum medical complications contribute significantly to the risk of very-low-birthweight delivery among Black and White mothers but vary in estimated effects by race. Future research in maternal and child health is warranted to assess the impact of treating maternal conditions associated with very-low-birthweight delivery. □

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References

1. Kempe A, Wise PH, Barkan SE, et al. Clinical determinants of the racial disparity in very low birth weight. *N Engl J Med.* 1992;327:969-973.

2. Carucci PM. *Reliability of Statistical and Medical Information Reported on Birth and Death Certificates.* Albany, NY: New York State Department of Health; 1979. New York Department of Health monograph 15.
3. Van Metre PR. *An Accuracy Assessment of the Medical Supplement to the Utah Live Birth Certificate.* Salt Lake City, Utah: University of Utah; 1977. Thesis.
4. Villar J, Belizan JM. The relative contribution of prematurity and fetal growth retardation to low birth weight in developing and developed societies. *Am J Obstet Gynecol.* 1982;143:793-798.
5. Kessner DM, Singer J, Kalk CE, Schlessinger ER. *Infant Death: An Analysis by Maternal Risk and Health Care.* Washington, DC: Institute of Medicine, National Academy of Sciences; 1973.
6. Kleinman JC, Pierre MB, Madans JH, Land GH, Schramm WF. The effects of maternal smoking on fetal and infant mortality. *Am J Epidemiol.* 1988;127:274-282.
7. Schramm W. Smoking and pregnancy outcome. *Mo Med.* 1980;77:618-626.

Infant Mortality and Related Risk Factors among Asian Americans

Hallie W. Morrow, MD, MPH, Gilberto F. Chávez, MD, MPH, Peggy P. Giannoni, MA, and Rugmini S. Shah, MD

ABSTRACT

To examine differences in perinatal health among nine Asian ethnic subgroups, a descriptive epidemiological study was conducted using linked birth/infant death certificates for 1982 to 1987. When compared with Whites, Asians had a lower proportion of young mothers, unmarried mothers, and women who received first trimester prenatal care; a higher proportion of foreign-born mothers; and a different birthweight distribution. A great deal of heterogeneity was found in risk factors and infant mortality rates among the various Asian ethnic subgroups. Paradoxically, although Asian ethnic subgroups had a higher perinatal risk profile, they had more favorable birth outcomes than did Whites. (*Am J Public Health.* 1994;84:1497-1500)

Introduction

The Asian population in the United States has grown significantly in recent years.^{1,2} The large majority of Asian-American births occur in only a few states, and more than 40% of them occur in California alone. Yet we know very little about the specific perinatal health status and risk factors of the different Asian ethnic subgroups, particularly the growing Southeast Asian populations.

In the United States, Asians overall have a slightly lower infant mortality rate than do Whites (i.e., the non-Hispanic White population).³ However, Asians do not appear to be a homogeneous group in this regard. During 1983 and 1984, reported infant mortality rates varied considerably among some of the Asian ethnic subgroups studied in California and nationwide.³ Overall, Japanese had the lowest infant mortality rates, followed by Chinese and Filipinos.^{4,5} Specific information on infant mortality rates for other Asian ethnic groups is lacking.

Our study examines the prevalence of selected risk factors, the birthweight distribution, and the infant mortality

experience among nine Asian ethnic subgroups in California between 1982 and 1987.

Methods

Data for this study were obtained from the California Birth Cohort file, a computerized record of linked birth/infant death certificates. Further information on this file has been published elsewhere.⁶⁻⁸ Included in the analysis were all infants delivered alive from 1982 through 1987 whose mothers were identified as belonging to any of nine Asian ethnic subgroups (Cambodian, Chinese,

The authors are with the Maternal and Child Health Branch, Primary Care and Family Health, California Department of Health Services, in Sacramento. Gilberto F. Chávez is also with the Division of Reproductive Health, National Center for Health Promotion and Chronic Disease Prevention, Centers for Disease Control and Prevention, Atlanta, Ga.

Requests for reprints should be sent to Gilberto F. Chávez, Maternal and Child Health Branch, California Department of Health Services, 714 P St, Room 300, Sacramento, CA 95814.

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TABLE 1—Percentage Distribution of Maternal Risk Factors, by Race/Ethnicity: California, 1982 to 1987

	Whites (1 371 189)	Asians									
		Total (217 014)	Filipino (65 931)	Chinese (44 629)	Vietnamese (27 377)	Korean (21 195)	Laotian (20 237)	Japanese (18 396)	Cambodian (10 644)	Thai (3 098)	Other Asian (5 507)
Maternal age, y											
<15	0.1	0.1	0.1	0.0	0.1	0.0	0.6	0.0	0.1	0.1	0.1
15-17	2.7	1.4	1.5	0.2	1.1	0.2	5.6	0.8	2.0	1.2	1.4
18-19	6.0	2.8	3.2	0.5	3.5	0.8	8.0	1.7	5.1	2.1	2.5
20-29	61.8	52.1	51.1	45.0	58.9	64.5	56.0	45.5	54.8	37.2	53.5
30-34	21.3	29.8	29.4	39.4	24.7	26.9	17.1	36.5	21.1	37.2	30.1
35-39	7.2	11.5	12.7	13.6	9.7	6.7	8.2	13.7	11.3	19.1	10.9
40+	1.0	2.1	2.2	1.3	2.0	0.9	4.2	1.6	5.5	3.1	1.3
Trimester pre-natal care began											
First	81.8	75.7	78.5	83.1	70.4	79.2	53.5	85.4	54.5	78.9	82.0
Second	13.6	15.9	16.2	10.1	17.3	13.2	28.3	10.1	28.3	15.0	12.0
Third	2.4	3.5	3.1	2.4	4.7	3.4	6.2	1.8	6.8	2.4	2.6
None	0.7	0.9	0.7	0.5	1.4	0.8	1.8	0.6	2.4	0.8	0.9
Unknown	1.5	4.0	1.6	3.9	6.2	3.4	10.2	2.0	8.1	2.8	2.5
Maternal birth-place											
US born	90.5	12.4	11.9	14.7	0.2	1.3	0.9	50.9	0.1	0.5	49.2
Foreign born	9.5	87.5	88.1	85.2	99.8	98.6	99.0	49.1	99.9	99.5	50.1
Marital status											
Married	83.3	92.3	88.9	96.9	91.2	98.3	92.8	92.4	85.0	93.8	90.5
Not married	16.7	7.7	11.1	3.1	8.8	1.7	7.2	7.6	15.0	6.2	9.5

Note. Excludes multiple births, non-California residents, infants under 500 g, and those with unknown maternal age and birthplace. Percentages may not add up to 100.0 because of rounding.

Source. California Department of Health Services, Birth Cohort File, 1982 to 1987.

TABLE 2—Percentage Distribution of Live Births, by Birthweight and Race/Ethnicity: California, 1982 to 1987

Birthweight, g	Whites (1 371 189)	Asians									
		Total (217 014)	Filipino (65 931)	Chinese (44 629)	Vietnamese (27 377)	Korean (21 195)	Laotian (20 237)	Japanese (18 396)	Cambodian (10 644)	Thai (3 098)	Other Asian (5 507)
<1500	0.6	0.6	0.7	0.5	0.5	0.6	0.6	0.5	0.6	0.9	0.7
1500-2499	3.6	4.6	5.5	3.8	4.6	2.9	5.0	4.3	5.6	4.7	4.2
2500-3999	81.4	88.9	87.4	89.6	91.1	87.9	89.7	88.6	90.6	88.2	87.6
4000 +	14.3	5.9	6.3	6.0	3.7	8.5	4.7	6.5	3.2	6.3	7.4
Unknown	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0

Note. Excludes multiple births, non-California residents, and infants under 500 g. Percentages may not add up to 100.0 because of rounding.

Source. California Department of Health Services, Birth Cohort File, 1982 to 1987.

Filipino, Japanese, Korean, Laotian, Thai, Vietnamese, and Other Unspecified Asians). Excluded were infants born to mothers who were not California residents at the time of delivery (0.17%), infants whose birthweights were below 500 g (0.06%), and multiple births (1.57%).

The analysis was limited to risk factors for which reliable data were available. Parity, gravidity, and gestational age were not included because the reliability of the information available for meaningful analysis was questionable. Mater-

nal education was not collected in California during the study period. Neonatal (<28 days), postneonatal (28 days to 364 days), and infant (0 to 364 days) mortality rates per 1000 live births were calculated, as were birthweight-specific mortality rates for all groups. Relative risks and 95% confidence intervals⁹ were also calculated using Whites and all Asians as reference standards when comparing outcomes. Epi-Info,¹⁰ SAS,¹¹ and Syntax¹² computer programs were used for the analysis.

Results

Overall, the prevalence of teenage births was lower for Asians than for Whites (4.3% vs 8.8%) (Table 1). Chinese and Koreans had remarkably low percentages of births to teenage mothers (0.7% and 1.0%, respectively), but Laotians had a very high proportion of such births (14.2%). Asians had a higher proportion of births to mothers 35 years of age and older than did Whites (13.6% vs 8.2%). This higher prevalence of older mothers

TABLE 3—Birthweight-Specific Mortality Rates and Relative Risks among Asian Ethnic Subgroups: California, 1982 to 1987

	Birthweight, g				Total	RR (95% CI)
	< 1500	1500–2499	2500–3999	4000+		
Neonatal						
Whites	268.0	21.0	1.5	1.0	4.0	1.00 (Referent)
Asians	251.5	18.2	1.3	1.5	3.9	0.91 (0.85, 0.98)
Filipino	236.1	11.0	1.7	2.6	4.2	0.87 (0.77, 0.98)
Chinese	259.1	22.4	1.0	...	3.2	0.87 (0.74, 1.02)
Vietnamese	310.1	26.0	1.2	...	4.1	1.06 (0.89, 1.27)
Korean	273.4	21.4	1.6	...	4.1	1.01 (0.82, 1.25)
Laotian	235.8	26.7	1.7	...	4.5	1.06 (0.86, 1.29)
Japanese	182.5	15.2	0.8	...	2.7	0.62 (0.47, 0.84)
Cambodian	220.3	15.1	1.0	...	3.1	0.74 (0.53, 1.03)
Thai	481.5	...	...	...	6.5	1.37 (0.94, 2.01)
Other Asian	236.8	34.5	1.0	...	4.2	0.97 (0.65, 1.44)
Postneonatal						
Whites	49.8	12.8	2.7	1.7	3.3	1.00 (Referent)
Asians	47.5	9.6	2.2	1.2	2.8	0.80 (0.73, 0.87)
Filipino	43.1	8.0	2.0	...	2.6	0.72 (0.62, 0.84)
Chinese	59.1	13.6	2.3	1.9	3.0	0.92 (0.78, 1.09)
Vietnamese	38.8	8.7	2.0	...	2.5	0.72 (0.57, 0.92)
Korean	46.9	...	2.0	2.8	2.4	0.75 (0.57, 0.98)
Laotian	89.4	9.9	3.0	...	3.7	1.09 (0.87, 1.37)
Japanese	...	8.8	2.0	...	2.4	0.68 (0.50, 0.93)
Cambodian	...	10.1	1.8	...	2.4	0.67 (0.45, 0.99)
Thai	...	...	2.6	...	2.9	0.82 (0.43, 1.57)
Other Asian	...	21.6	2.1	...	3.3	0.96 (0.61, 1.52)
Infant						
Whites	317.8	33.8	4.2	2.7	7.3	1.00 (Referent)
Asians	299.1	27.9	3.5	2.7	6.6	0.86 (0.82, 0.91)
Filipino	279.3	19.0	3.7	3.6	6.8	0.81 (0.74, 0.89)
Chinese	318.2	36.0	3.3	3.0	6.3	0.90 (0.80, 1.00)
Vietnamese	348.8	34.7	3.2	...	6.6	0.90 (0.78, 1.04)
Korean	320.3	26.4	3.5	3.3	6.5	0.89 (0.75, 1.05)
Laotian	325.2	36.6	4.7	...	8.3	1.06 (0.91, 1.23)
Japanese	204.3	24.0	2.8	...	5.1	0.65 (0.53, 0.80)
Cambodian	237.3	25.2	2.8	...	5.5	0.71 (0.55, 0.91)
Thai	481.5	...	3.7	...	9.4	1.13 (0.81, 1.58)
Other Asian	315.8	56.0	3.1	...	7.4	0.96 (0.72, 1.29)

Note. Excludes multiple births, non-California residents, infants with unknown birthweights, and infants under 500 g. Mortality rates are per 1000 live births; relative risks (RRs) and confidence intervals (CIs) are birthweight adjusted. Rates not presented for cells with fewer than five events.

Source. California Department of Health Services, Birth Cohort File, 1982 to 1987.

was true for all the Asian subgroups except Koreans (7.6%). Additionally, more Asian mothers than White mothers were giving birth after the age of 39. Laotians and Cambodians, the groups with the highest percentage of teenage births, also had the highest percentage of births among women 40 years of age and older.

Compared with Whites, Asians had a lower proportion of women who received prenatal care in the first trimester of pregnancy and a higher proportion of women who received no prenatal care (Table 1). Only about 50% of Laotian and Cambodian women received prenatal care in the first trimester. In addition, these groups had the highest percentages of women who received no prenatal care and whose prenatal care history was unknown.

Asian mothers overall were nine times more likely than Whites to have been born outside the United States (Table 1). In several of the Asian subgroups—Vietnamese, Korean, Laotian, Cambodian, and Thai—essentially all the mothers were women who had immigrated to this country.

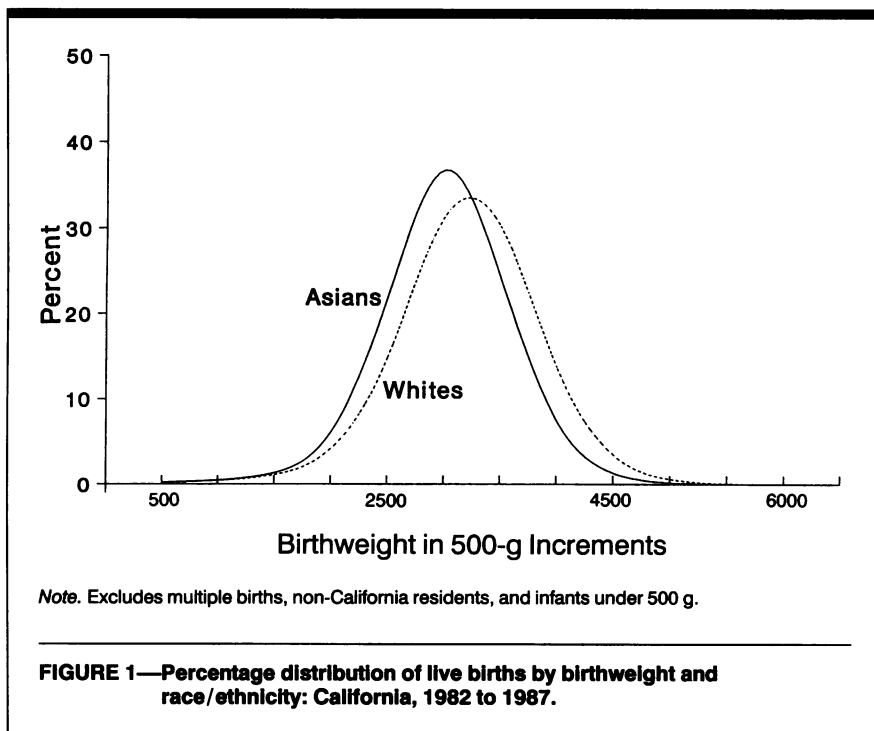
As a group, Asian mothers were less likely to be unmarried than White mothers (7.7% vs 16.7%) (Table 1). Each of the specific Asian subgroups also had a lower prevalence of unmarried mothers than Whites did. Koreans and Chinese had the lowest prevalence of unmarried mothers (1.7% and 3.1%, respectively); Filipinos and Cambodians had the highest prevalence (11.1% and 15.0%, respectively).

There were more low-birthweight infants (< 2500 g) born to Asians than to Whites (5.2% vs 4.2%) (Table 2). This was true for all the Asian subgroups except Chinese, for whom there was no difference, and Koreans, who had fewer low-birthweight infants than Whites did. Examining the differences between all Asians combined and Whites by 500-g increments, we observed that the birthweight distribution for Asians was different than that for Whites and appeared to be shifted toward lower birthweight infants (Figure 1).

Asians as a group and the Filipino, Japanese, and Cambodian subgroups had significantly lower infant mortality risks than Whites (Table 3). The Thai and Laotian subgroups had slightly, but not statistically significant, elevated risks for infant mortality. Neonatal mortality was significantly lower for Asians as a group and for the Filipino and Japanese subgroups. The risks for postneonatal mortality were significantly lower for Asians as a group and for the Filipino, Vietnamese, Korean, Japanese, and Cambodian subgroups. After adjusting for birthweight, we found that Asians had lower overall neonatal, postneonatal, and infant mortality rates than did Whites.

Discussion

We showed a high degree of variation among the various Asian ethnic groups for maternal risk factors. Additionally, we observed that ethnic-specific differences in birthweight distributions, which have been reported for Chinese and Southeast Asian infants,^{13–15} exist overall among several Asian ethnic subgroups when compared with Whites. We believe that our most remarkable finding was that even with great variability in the frequency of risk factors among the various Asian subgroups, the variability in birth outcomes is relatively small. In addition, despite their higher frequency of risk factors, Asians overall had significantly better birth outcomes than did Whites. Many factors could contribute to this finding, including differences in education, acculturation, nutrition, access to and content of prenatal care, life-style, family structure, social support, and under-reporting. This apparent epidemiological paradox deserves further investigation since much may be learned from those ethnic groups that, despite serious disad-



vantages, are able to have healthier babies.

The high proportion of foreign-born Asian mothers in our study emphasizes the need for developing culturally appropriate multilingual prenatal care and health care services for this growing population. Larger sample sizes are needed to examine the differences in infant mortality risks between US- and foreign-born mothers with respect to acculturation and socioeconomic status.

Our study emphasizes the need for continued analysis of ethnic-specific perinatal health data to assess community needs adequately and to target health education efforts and intervention strategies to the groups at highest risk for suboptimal pregnancy outcomes

and to those with the highest need for services. □

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References

1. National Center for Health Statistics. Advance report of final natality statistics, 1982. *Month Vital Stat Rep.* 1984;33(6 suppl).
2. National Center for Health Statistics. Advance report of final natality statistics,

1988. *Month Vital Stat Rep.* 1990;39(4 suppl).

3. Kleinman JC. Infant mortality among racial/ethnic minority groups, 1983–1984. *MMWR.* 1990;39(SS-3):31–39.
4. Tashiro M, Oreglia A. *Infant Death Rates by Race/Ethnicity, California Birth Cohorts, 1978–1987.* Sacramento, Calif: State of California, Department of Health Services; August 1990. Report Register 90–05002.
5. Oreglia A. *California's Infant Death Rate—1989.* Sacramento, Calif: State of California, Department of Health Services; February 1991. Report Register 91–02000.
6. Oreglia A, Tashiro M. *What Are California's Birth Cohort Files? Questions and Answers.* Sacramento, Calif: State of California, Department of Health Services; November 1986. Report Register 86–10144.
7. Tashiro M. *A Description of the California Birth Cohort Perinatal File.* Sacramento, Calif: State of California, Department of Health Services; February 1984. Report Register 83–11078.
8. Williams RL, Rust FP, Chen PM, Waller S. *1982–1986 Maternal and Child Health Data Base: Descriptive Narrative.* Santa Barbara, Calif: Regents of the University of California; 1990.
9. Greenland S, Robins JM. Estimation of a common effect parameter from sparse follow-up data. *Biometrics.* 1985;41:55–68.
10. Dean AD, Dean JA, Burton JH, Dicker RC. *Epi-Info, Version 5: A Word Processing, Database, and Statistics Program for Epidemiology on Microcomputers.* Atlanta, Ga: Centers for Disease Control; 1990.
11. *SAS User's Guide: Basics, Version 5 Edition.* Cary, NC: SAS Institute Inc; 1985.
12. *Syntax II (Tables and Editor) Documentation—Version V.O.* Berkeley, Calif: University of California; 1977.
13. Yip R, Li Z, Chong WH. Race and birth weight: the Chinese example. *Pediatrics.* 1991;87:688–693.
14. Helsel D, Pettitt DB, Kunstadter P. Pregnancy among the Hmong: birthweight, age, and parity. *Am J Public Health.* 1992;82:1361–1364.
15. Gann P, Nghiem L, Warner S. Pregnancy characteristics and outcomes of Cambodian refugees. *Am J Public Health.* 1989;79:1251–1257.