Perinatal Outcomes for Asian, Native Hawaiian, and Other Pacific Islander Mothers of Single and Multiple Race/Ethnicity: California and Hawaii, 2003–2005

Ashley H. Schempf, PhD, Pauline Mendola, PhD, Brady E. Hamilton, PhD, Donald K. Hayes, MD, MPH, and Diane M. Makuc, DrPH

Objectives. We examined characteristics and birth outcomes of Asian/Pacific Islander (API) mothers to determine whether differences in outcomes existed between mothers of single race/ethnicity and multiple race/ethnicity.

Methods. We used data from California and Hawaii birth certificates from 2003 through 2005 to describe variation in birth outcomes for API subgroups by self-reported maternal race/ethnicity (single versus multiple race or API subgroup), and we also compared these outcomes to those of non-Hispanic White women.

Results. Low birthweight (LBW) and preterm birth (PTB) varied more among API subgroups than between mothers of single versus multiple race/ethnicity. After adjustment for sociodemographic and behavioral risk factors, API mothers of multiple race/ethnicity had outcomes similar to mothers of single race/ethnicity, with exceptions for multiple-race/ethnicity Chinese (higher PTB), Filipino (lower LBW and PTB), and Thai (higher LBW) subgroups. Compared with single-race non-Hispanic Whites, adverse outcomes were elevated for most API subgroups: only single-race/ethnicity Korean mothers had lower rates of both LBW (3.4%) and PTB (5.6%); single-race/ethnicity Cambodian, Laotian, and Marshallese mothers had the highest rates of both LBW (8.8%, 9.2%, and 8.4%, respectively) and PTB (14.0%, 13.7%, and 18.8%, respectively).

Conclusions. Strategies to improve birth outcomes for API mothers should consider variations in risk by API subgroup and multiple race/ethnicity. (*Am J Public Health.* 2010;100:877–887. doi:10.2105/AJPH.2009.177345)

Many health outcomes, including those at birth, show striking differences according to race/ethnicity, but relatively little attention has been focused on the perinatal outcomes of Asian, Native Hawaiian, and other Pacific Islander mothers, compared with the vast literature on Black–White perinatal disparities. Since the 1980s, US Asian/Pacific Islander (API) mothers have had rates of low birthweight (LBW) deliveries (defined as birthweight of less than 2500 g) that are higher than all other major race/ethnicity groups except for Blacks.[1] However, substantial variation exists within the API population, with LBW rates ranging from 5.5% among the Chinese to 8.6% among Filipinos in 2002.[2] Other studies have documented elevated rates of LBW or preterm birth (PTB; defined as birth at less than 37 weeks' gestation) among births to Cambodian, Filipino, Hmong, Japanese, and Laotian mothers, as well as elevated infant mortality rates among Native Hawaiians.[3–14] Differences according to nativity status have also been reported, with foreign-born Asian mothers generally having better outcomes than do their US-born counterparts.[11,15–19]

The US Census Bureau began collecting data on multiple-race/ethnicity group identification in 2000. Although approximately 2% of the US population who reported being of multiple races, 54% of those who reported Native Hawaiian or other Pacific Islander (NHOPI) race and 14% of those who reported Asian race did so in combination with another race.[20] An analysis of data from the 5 states (California, Hawaii, Pennsylvania, Utah, and Washington) that had begun reporting parental multiple race/ethnicity on birth certificates as of January 1, 2003, found that birth outcomes for API mothers differed by multiple-race status. LBW rates were significantly lower among infants born to single-race Asian and NHOPI mothers, and PTB rates were significantly lower among single-race Asian mothers than among mothers who reported Asian or NHOPI race in combination with 1 or more of 5 race groups (White, Black, American Indian/Alaska Native, Asian, or NHOPI).[21]

In the current study, we described the rates of LBW and PTB among API subgroups for mothers of single versus multiple race/ethnicity. We also examined these outcomes by specific maternal race/ethnicity combinations (where there were sufficient numbers for analysis), and we made comparisons before and after adjusting for sociodemographic and behavioral risk factors. The examination of differences by single and multiple race/ethnicity can inform future analytic treatment of multiple-race/ethnicity data (e.g., assessing the relative importance of considering multiple race/ethnicity across different API subgroups) and may provide new insight into the strength of race/ethnicity-linked risks.

METHODS

Birth certificate data from the 2003 through 2005 period linked birth and infant death data sets of the National Center for Health Statistics were used to characterize births to API mothers in California and Hawaii as well as births to a comparison group of single-race non-Hispanic White (hereafter, White) women in these states. We used the linked data to ensure that these analyses would be comparable to an anticipated analysis of infant mortality among API mothers. The number of births in

the linked file is nearly the same as the natality file for a given period but may contain some additional records that were filed after the close of the natality file.[22] Births to residents of California and Hawaii were selected for analysis because they reported multiple-race data as of January 1, 2003, and they used the same birth certificate format, allowing inclusion of maternal education and prenatal care in the analysis.[21]

Maternal race/ethnicity data are based on coded and edited data from open-ended self-reported literal responses on birth certificates; the order of responses for mothers who reported more than 1 race/ethnicity was not coded. We evaluated the number of births to mothers who reported belonging to 1 or more API subgroups. Our analysis included data on the following 17 subgroups, each of which had at least 300 births: Asian Indian, Cambodian, Chinese, Filipino, Hmong, Indonesian, Japanese, Korean, Laotian, Pakistani, Thai, Vietnamese, Native Hawaiian, Guamanian, Marshallese, Samoan, and Tongan. In addition, there were sufficient numbers to examine 22 specific race/ethnicity combinations among these subgroups (e.g., Chinese–Filipino, Native Hawaiian–Japanese–White). The ordering of races/ethnicities in these 22 specific combinations is alphabetical and thus does not necessarily correspond to the order listed on the birth certificate. Mothers are referred to as being of multiple race/ethnicity if they reported more than 1 race or API subgroup.

We analyzed 2 birth outcomes, LBW and PTB, using the standard cutpoints of less than 2500 grams for LBW and less than 37 weeks' completed gestation for PTB. Cases of missing birthweight or birthweight of less than 500 grams were excluded from the analysis (less than 0.1%). Gestational age is estimated from date of last menstrual period in California and both last menstrual period and clinical estimate in Hawaii. About 5% of births were missing gestational age and are excluded from the PTB analysis. Most of the missing data came from California, which has no clinical estimate information on the birth certificate.

All data are derived from birth certificates. Sociodemographic and behavioral covariates available on the birth certificate and included in multivariate models are mother's nativity, age, parity, education, marital status, prenatal care, and smoking during pregnancy (Hawaii only). Mother's nativity was categorized as foreign or US born. Maternal age was grouped into 3 categories: less than 20 years, 20–34 years, and 35 years or older. Parity was divided into 3 levels: first birth, 1 or 2 prior births, and 3 or more prior births. Maternal education was categorized as less than high school (less than 12 years), high school (12 years), some college (13 to 15 years), and college graduate (16 or more years). Marital status is a dichotomous variable (married or unmarried), and early prenatal care was defined as first-trimester entry.

These characteristics were examined according to maternal API subgroup and multiple-race/ethnicity status. Comparisons were drawn between (1) single-race/ethnicity API subgroups (e.g., Chinese only) and their multiple-race/ethnicity counterparts (e.g., Chinese in combination with other races/ethnicities), and (2) all API subgroups (both single and multiple race/ethnicity) compared with a single-race White reference group. It is important to note that "in combination" groups are not mutually exclusive, and women are included in all applicable groups. Logistic regression models served to estimate the odds ratios (ORs) of LBW and PTB for the aforementioned comparisons both before and after adjustment for the maternal sociodemographic and behavioral characteristics previously described. Because tobacco use is not collected on the California birth certificate, a dummy variable indicating California residence was included along with a smoking variable for Hawaii mothers in multivariable models.

RESULTS

The proportion of API mothers reporting multiple races/ethnicities varied greatly by API subgroup, from 0.6% among those reporting Hmong to 90.8% among those reporting Native Hawaiian (Table 1). In part because of California's larger population, the majority of API subgroup mothers lived in that state. However, almost half of mothers reporting Japanese ancestry lived in Hawaii, as did the majority of Native Hawaiian and Marshallese mothers.

Maternal Characteristics

Comparisons of single- versus multiple-race/ethnicity API mothers. Not surprisingly, foreign-born status was more common among API mothers of single race/ethnicity than among those of multiple race/ethnicity, with the exception of Native Hawaiians, who were rarely foreign-born (Table 2). In general, where differences were observed between single- and multiple-race/ethnicity mothers of the same API subgroup, the multiple-race/ethnicity category tended to be of higher risk (e.g., higher proportion adolescent, lower proportion married, etc.). For most API subgroups, multiple-race/ethnicity mothers were more likely to be of young maternal age (less than 20 years) and less likely to be of older maternal age (35 years or older) than were their single-race/ethnicity counterparts. Multiple-race/ethnicity API mothers also were more likely to be unmarried than were their single-race/ethnicity API counterparts, with the exception of Cambodians and Guamanians, for whom no marital differences were noted.

A mixed pattern of differences by multiple-race/ethnicity status was observed for maternal education. For certain API subgroups, including Asian Indian, Chinese, Filipino, Japanese, Korean, and Thai, single-race/ethnicity mothers were more likely to be college-educated than were their multiple-race/ethnicity counterparts. However, Cambodian, Vietnamese, and Samoan multiple-race/ethnicity women were more educated than were their single-race/ethnicity counterparts (i.e., less likely to have less than a high school education or more likely to have a college education). There were no educational differences by multiple-race/ethnicity status for Native Hawaiian and Guamanian women.

Differences in first-trimester prenatal-care entry by maternal multiple-race/ethnicity status were noted for 6 Asian subgroups, Native Hawaiians, and Samoans. For all Asian subgroups, early prenatal care was more prevalent among single-race/ethnicity mothers (Asian Indian, Chinese, Filipino, Japanese, Korean, and Thai) than it was for multiple-race/ethnicity mothers, whereas for Native Hawaiians and Samoans, multiple-race/ethnicity mothers had higher rates of early entry into prenatal care than did their single-race/ethnicity counterparts. Smoking data, only available for Hawaii, suggested that multiple-race/ethnicity API mothers smoke more than do their single-race/ethnicity counterparts, with the exception of

TABLE 1—Asian/Pacific Islander Mothers by Number of Reported Races/Ethnicities: California and Hawaii, 2003–2005

Racial/Ethnic Group	Total No. of Mothers	No. of Races/Ethnicities Reported					CA Resident, %	HI Resident, %
		1, %	2, %	3, %	4, %	≥5, %		
Asian								
Asian Indian	24 969	97.8	1.9	0.2	0.0	0.0	99.5	0.5
Cambodian	4 514	92.8	6.4	0.8	0.0	0.0	99.5	0.5
Chinese	50 420	75.6	9.5	8.2	5.1	1.6	79.6	20.4
Filipino	65 701	78.9	12.3	5.0	2.8	1.0	76.1	23.9
Hmong	5 589	99.3	0.6	0.0	0.0	0.0	100.0	0.0
Indonesian	1 203	77.9	20.3	1.5	0.2	0.2	95.5	4.5
Japanese	20 182	57.8	23.5	9.8	6.3	2.7	51.9	48.1
Korean	17 470	88.7	7.1	2.1	1.4	0.8	90.0	10.0
Laotian	2 566	90.3	8.4	1.1	0.2	0.0	94.1	5.9
Pakistani	1 846	93.9	5.9	0.2	0.0	0.0	99.6	0.4
Thai	1 850	70.9	24.8	3.8	0.4	0.2	88.2	11.8
Vietnamese	27 562	95.3	4.5	0.2	0.0	0.0	98.0	2.0
Pacific Islander								
Native Hawaiian	16 805	9.2	33.6	34.7	17.5	5.0	13.4	86.6
Guamanian	1 406	57.2	32.4	7.0	1.9	1.5	81.2	18.9
Marshallese	938	91.3	5.5	1.5	1.2	0.5	6.3	93.7
Samoan	4 820	69.1	18.0	7.1	3.9	1.9	53.8	46.2
Tongan	1 594	83.7	11.1	2.8	1.9	0.6	70.6	29.4

Native Hawaiians and Samoans, who had high rates for both single- and multiple-race/ethnicity groups.

API subgroups compared with single-race White mothers. Most comparisons were significantly different for API subgroups of either single- or multiple-race/ethnicity compared with White mothers. Compared to Whites, adolescent mothers were less common among single-race/ethnicity Asian Indian, Chinese, Filipino, Indonesian, Japanese, Korean, Pakistani, Thai, and Vietnamese mothers; among nearly all other groups, teenaged mothers were more common than they were among Whites. In comparison with Whites, maternal age of 35 years or older was more common for single-race/ethnicity Chinese and Japanese mothers and less common for most other groups. The proportion of mothers with a college education was higher for 6 single-race/ethnicity Asian subgroups than it was for Whites, and the same proportion was lower for 6 single-race/ethnicity Asian subgroups and for all single-race/ethnicity Pacific Islander mothers than it was for Whites. Multiple-race/ethnicity API mothers generally had lower proportions of mothers with a college education compared with Whites, although Asian Indians and Vietnamese mothers were exceptions. Compared with White mothers, early entry into prenatal care was somewhat higher for single-race/ethnicity Asian Indian, Chinese, Japanese, and Korean mothers, and it was generally lower for all other API subgroups, particularly Hmong, Marshallese, and Tongan mothers.

Perinatal Outcomes

Comparisons of multiple- versus single-race/ethnicity APIs. Chinese multiple-race/ethnicity mothers had higher proportions of both LBW and PTB than did their single-race/ethnicity counterparts. Filipino, Japanese, and Korean multiple-race/ethnicity mothers had higher PTB rates than did their single-race/ethnicity counterparts, and Thai and Samoan multiple-race/ethnicity mothers had a higher proportion of LBW than did their single-race/ethnicity counterparts (Table 2). Adjustment for sociodemographic and behavioral factors explained the excess odds of adverse outcomes for multiple- versus single-race/ethnicity Japanese, Korean, and Samoan mothers, but differences remained for Chinese, Filipino, and Thai women after adjustment (Table 3). After adjustment, only Chinese–Filipino and Chinese–Native Hawaiian women had higher odds of both LBW and PTB compared with Chinese-only mothers. Filipino was the only subgroup for which some multiple-race/ethnicity combinations conferred reduced odds of LBW or PTB, both before and after adjustment. The combinations of Filipino–White, Filipino–Native Hawaiian–White, and Chinese–Filipino–Native Hawaiian–White had significantly reduced adjusted odds of both LBW and PTB compared with single-race/ethnicity Filipino women. Although the total "in combination" category was not different from single-race/ethnicity Native Hawaiians before or after adjustment, there were greater odds of LBW for certain combinations that remained after adjustment.

API subgroups compared with single-race White mothers. The majority of single- and multiple-race/ethnicity API mothers had higher rates of adverse birth outcomes than White mothers, with the exception of single-race/ethnicity Korean women, who had lower rates of both LBW and PTB. Single-race/ethnicity Cambodian, Laotian, and Marshallese mothers had the highest rates of both LBW and PTB (Table 2). Many adjusted odds ratios (AORs) for LBW and PTB were elevated for API subgroups relative to single-race White mothers (Table 4). The highest unadjusted ORs—for single-race/ethnicity Cambodian, Laotian, and Marshallese mothers and multiple-race/ethnicity Thai women—were reduced after adjustment but remained significantly elevated. Several single-race/ethnicity groups (Indonesian, Korean, Thai, Native Hawaiian, Guamanian, Samoan, and Tongan) had adjusted odds of LBW that were not significantly different from single-race White women, but only Chinese and Korean mothers had equivalent or lower adjusted odds of PTB compared with White mothers. Thus, of single-race/ethnicity mothers, only Koreans had equivalent or lower adjusted odds of both LBW and PTB relative to Whites.

There were several multiple-race/ethnicity combinations with adjusted odds of both LBW and PTB that were not significantly different

TABLE 2—Characteristics of Asian/Pacific Islander Mothers by Multiple-Race/Ethnicity Status: California and Hawaii, 2003–2005

	CA Resident, No.	HI Resident, No.	Foreign Born, %	Maternal Age <20 y, %	Maternal Age ≥35 y, %	Maternal Education <High School, %	Maternal Education ≥College, %	Unmarried, %	Early Prenatal Care, %	Tobacco Use,[a]	LBW, %	PTB,[b] %
Single-race non-Hispanic White	455 369	9320	11.3	4.8	23.3	6.6	43.1	20.5	90.4	3.6	4.1	7.5
Asian												
Asian Indian												
Asian Indian only	24 356	68	95.8[c,d]	0.4[c,d]	11.6[c,d]	3.3[d]	67.8[c,d]	2.2[c,d]	92.4[c,d]	NA[e]	7.1[d]	7.1[d]
Asian Indian in combination[f]	497	48	57.7[d]	5.9	19.8	4.7	51.5[d]	16.9[d]	89.1	NA[e]	7.3[d]	9.3
Cambodian												
Cambodian only	4 169	20	80.6[c,d]	13.3[d]	12.9[c,d]	29.0[c,d]	12.8[c,d]	47.1[d]	78.2[d]	NA[e]	8.8[d]	14.0[d]
Cambodian in combination[f]	321	4	66.2[d]	14.2[d]	5.5[d]	19.8[d]	20.4[d]	46.5[d]	81.5[d]	NA[e]	7.7[d]	12.5[d]
Chinese												
Chinese only	36 874	1242	87.9[c,d]	0.5[c,d]	33.5[c,d]	6.2[c,d]	66.2[c,d]	6.3[c,d]	93.0[c,d]	0.2[c,d]	4.5[c,d]	6.5[c,d]
Chinese in combination[f]	3258	9046	15.8[d]	10.9[d]	15.3[d]	9.7[d]	28.1[d]	41.8[d]	83.0[d]	10.0[d]	6.4[d]	11.0[d]
Filipino												
Filipino only	44 043	7797	77.4[c,d]	3.8[c,d]	23.6[c]	4.6[c,d]	41.8[c,d]	21.4[c,d]	87.2[c,d]	2.4[c,d]	7.6[d]	11.2[c,d]
Filipino in combination[f]	5 927	7934	11.7	14.6[d]	10.0[d]	12.1[d]	17.5[d]	49.1[d]	82.1[d]	10.8[d]	7.1[d]	11.8[d]
Hmong												
Hmong only	5 551	1	66.8[d]	21.0[d]	9.1[d]	29.6[d]	10.1[d]	31.1[d]	62.0[d]	NA[e]	5.4[d]	10.8[d]
Hmong in combination[f]	37	0	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]
Indonesian												
Indonesian only	912	25	93.0[d]	1.0[d]	23.7	2.9[d]	51.3[d]	7.8[d]	89.5	NA[e]	4.4	9.6[d]
Indonesian in combination[f]	237	29	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]
Japanese												
Japanese only	7 614	4046	52.8[c,d]	0.9[c,d]	39.9[c,d]	1.0[c,d]	59.8[c,d]	7.9[c,d]	93.0[c,d]	3.2[c]	6.1[d]	7.9[c]
Japanese in combination[f]	2 868	5654	7.5[d]	10.1[d]	19.0[d]	7.6[d]	33.5[d]	38.1[d]	85.0[d]	8.8[d]	6.4[d]	10.4[d]
Korean												
Korean only	14 756	732	93.5[c,d]	0.4[c,d]	23.0[c]	0.7[c,d]	71.2[c,d]	3.9[c,d]	93.2[c,d]	4.2[c]	3.4[d]	5.6[c,d]
Korean in combination[f]	969	1013	22.1[d]	8.7[d]	16.9[d]	6.4	34.6[d]	34.4[d]	85.2[d]	7.8[d]	4.2	8.7[d]
Laotian												
Laotian only	2 210	108	76.2[d]	12.7[d]	9.2[d]	24.3[d]	12.6[d]	49.7[d]	75.8[d]	NA[e]	9.2[d]	13.7[d]
Laotian in combination[f]	205	43	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]
Pakistani												
Pakistani only	1 726	8	92.1[d]	3.0[d]	12.9[d]	16.1[d]	37.9[d]	2.2[d]	85.0[d]	NA[e]	7.6[d]	9.1[d]
Pakistani in combination[f]	112	0	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]
Thai												
Thai only	1 200	112	88.6[c,d]	2.7[c,d]	23.2[c]	9.1[d]	48.5[c,d]	21.5[c]	87.3[c,d]	NA[e]	4.8[c]	9.4[d]
Thai in combination[f]	431	107	46.4[d]	7.6[d]	8.9[d]	10.3[d]	28.7[d]	38.7[d]	82.4[d]	NA[e]	8.4[d]	11.8[d]

Continued

TABLE 2—*Continued*

Vietnamese											
Vietnamese only	25 818	439	97.0[c,d]	1.3[c,d]	23.6[c]	13.1[c,d]	36.0[c,d]	12.3[c,d]	89.6[d]	1.4[d]	5.1[d]	8.1[d]
Vietnamese in combination[f]	1 201	104	78.1[d]	4.3	19.7[d]	9.7[d]	43.4	20.7	89.9	NA[e]	4.8	8.3
Pacific Islander												
Native Hawaiian												
Native Hawaiian only	716	832	1.0[d]	10.7[c,d]	12.0[c,d]	13.8[d]	15.1[d]	48.6[c,d]	75.1[c,d]	13.3[d]	5.6[d]	11.1[d]
Native Hawaiian in combination[f]	1 541	13 716	1.3[d]	15.1[d]	10.2[d]	13.5[d]	13.4[d]	54.4[d]	78.3[d]	12.0[d]	6.6[d]	11.9[d]
Guamanian												
Guamanian only	716	88	60.8[c,d]	9.5[c,d]	12.2[d]	14.6[d]	15.3[d]	48.0[d]	76.9[d]	NA[e]	6.0[d]	11.8[d]
Guamanian in combination[f]	425	177	23.3[d]	15.1[d]	9.8[d]	14.1[d]	17.7[d]	49.3[d]	79.1[d]	NA[e]	6.0[d]	11.7[d]
Marshallese												
Marshallese only	58	798	97.1[d]	13.7[d]	4.2[d]	43.5[d]	1.3[d]	72.0[d]	48.4[d]	4.5	8.4[d]	18.8[d]
Marshallese in combination[f]	1	81	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]
Samoan												
Samoan only	2 159	1171	48.3[c,d]	8.7[c,d]	12.7[c,d]	12.2[c,d]	5.3[c,d]	39.1[c,d]	69.7[c,d]	14.4[d]	4.2[c]	12.0[d]
Samoan in combination[f]	434	1056	16.5[d]	16.9[d]	7.1[d]	15.0[d]	10.3[d]	52.2[d]	74.8[d]	12.9[d]	5.5[d]	10.7[d]
Tongan												
Tongan only	1 013	321	65.9[d]	7.4[d]	18.1[d]	14.2[d]	9.8[d]	17.7[d]	62.7[d]	5.0	5.0	10.8[d]
Tongan in combination[f]	113	147	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]

Note. LBW = low birthweight; PTB = preterm birth; NA = not applicable.
[a]Tobacco use is only available on Hawaii birth certificates.
[b]PTB excludes cases of missing data on gestational age, 4.6%.
[c]Different from racial/ethnic group in combination; $P < .05$.
[d]Different from single-race non-Hispanic White; $P < .05$.
[e]Total number of mothers less than 300.
[f]In combination with one or more other race/ethnicity; not mutually exclusive of other "in combination" subgroups.

from those for White women. AORs for LBW greater than 2.0 were observed for single-race/ethnicity Asian Indian and Pakistani mothers, for Chinese–Filipino and Filipino–Japanese mothers, and for PTB for Marshallese single-race/ethnicity mothers.

DISCUSSION

In recognition of the growing multiracial US population, in 1997 the federal Office of Management and Budget issued revised standards for the collection of federal data on race/ethnicity.[23,24] A challenge for the field of public health is to examine and evaluate the variation in health outcomes that exists according to race/ethnicity in an increasingly multiracial society. Although previous studies have evaluated the outcomes of interracial births or of births to parents of different races, few have examined the birth outcomes of multiple-race/ethnicity parents.[21,25] To our knowledge, this is the first study to examine outcomes for specific multiple-race/ethnicity combinations for the API population.

Overall, these results show that multiple-race/ethnicity API women tend to have more sociodemographic and behavioral risk factors than their single-race/ethnicity counterparts, and that these differences are greater for Asian subgroups than for Pacific Islander subgroups. However, for birth outcomes, significant heterogeneity was observed according to racial/ethnic subgroup. For 6 of 11 subgroups (Chinese, Filipino, Japanese, Korean, Thai, and Samoan), multiple-race/ethnicity women (all "in combination") had higher rates of delivering LBW or preterm infants than did their single-race/ethnicity counterparts. After adjustment for maternal characteristics, Chinese multiple-race/ethnicity mothers had higher PTB rates and Thai multiple-race/ethnicity mothers had higher LBW rates than their single-race/ethnicity counterparts, whereas multiple-race/ethnicity Filipinos had reduced LBW and PTB rates compared with single-race/ethnicity Filipinos.

These findings suggest that for Chinese and Thai mothers, multiple race/ethnicity carries additional risk for adverse birth outcomes that cannot be explained by differences in conventional risk factors. However, the birth certificate does not contain a complete or accurate assessment of all risk factors.[26] The relative

TABLE 3—Odds Ratios and Adjusted Odds Ratios of LBW and PTB for Multiple- Versus Single-Race/Ethnicity Asian/Pacific Islander Subgroups: California and Hawaii, 2003–2005

Asian/Pacific Islander Subgroup	LBW		PTB[a]	
	OR (95% CI)	AOR[b] (95% CI)	OR (95% CI)	AOR[b] (95% CI)
Asian Indian				
Asian Indian only (Ref)	1.00	1.00	1.00	1.00
Asian Indian in combination[c]	1.04 (0.75, 1.45)	0.84 (0.59, 1.20)	1.34 (1.00, 1.81)	1.18 (0.85, 1.63)
Cambodian				
Cambodian only (Ref)	1.00	1.00	1.00	1.00
Cambodian in combination[c]	0.87 (0.57, 1.32)	0.83 (0.54, 1.27)	0.87 (0.61, 1.24)	0.92 (0.64, 1.32)
Chinese				
Chinese only (Ref)	1.00	1.00	1.00	1.00
Chinese in combination[c]	1.46 (1.34, 1.59)	1.06 (0.90, 1.23)	1.78* (1.66, 1.91)	1.21* (1.07, 1.38)
Chinese–White	1.01 (0.76, 1.34)	0.83 (0.62, 1.12)	1.22 (0.97, 1.52)	1.05 (0.83, 1.33)
Chinese–Filipino	2.18* (1.73, 2.76)	1.74* (1.34, 2.26)	2.08* (1.69, 2.56)	1.57* (1.25, 1.98)
Chinese–Japanese	1.33 (0.91, 1.92)	1.02 (0.68, 1.51)	1.22 (0.88, 1.69)	0.97 (0.68, 1.37)
Chinese–Vietnamese	1.10 (0.78, 1.54)	1.09 (0.77, 1.53)	1.31* (1.00, 1.72)	1.27 (0.97, 1.67)
Chinese–Native Hawaiian	2.06* (1.62, 2.62)	1.37* (1.01, 1.85)	2.20* (1.80, 2.69)	1.29* (1.00, 1.67)
Chinese–Filipino–White	1.18 (0.73, 1.91)	0.84 (0.51, 1.38)	1.54* (1.07, 2.21)	1.06 (0.72, 1.55)
Chinese–Native Hawaiian–White	1.32* (1.09, 1.60)	0.88 (0.68, 1.15)	1.73* (1.49, 2.00)	1.07 (0.87, 1.33)
Chinese–Filipino–Native Hawaiian	2.02* (1.56, 2.61)	1.31 (0.95, 1.80)	2.40* (1.95, 2.96)	1.41* (1.09, 1.83)
Chinese–Filipino–Native Hawaiian–White	1.18 (0.89, 1.56)	0.75 (0.53, 1.06)	1.94* (1.60, 2.36)	1.17 (0.91, 1.50)
Chinese–Japanese–Native Hawaiian–White	1.79* (1.32, 2.42)	1.20 (0.84, 1.71)	1.96* (1.53, 2.51)	1.24 (0.92, 1.66)
Filipino				
Filipino only (Ref)	1.00	1.00	1.00	1.00
Filipino in combination[c]	0.94 (0.87, 1.01)	0.77* (0.70, 0.84)	1.06* (1.00, 1.13)	0.87* (0.81, 0.94)
Filipino–White	0.76* (0.67, 0.87)	0.70* (0.61, 0.80)	0.90* (0.81, 0.99)	0.81* (0.72, 0.90)
Black–Filipino	1.19 (0.86, 1.63)	1.06 (0.77, 1.47)	1.24 (0.94, 1.62)	1.07 (0.82, 1.41)
Chinese–Filipino	1.24 (0.99, 1.56)	1.08 (0.86, 1.37)	1.14 (0.93, 1.40)	1.03 (0.84, 1.27)
Filipino–Japanese	1.26 (0.92, 1.72)	1.00 (0.72, 1.37)	0.87 (0.64, 1.19)	0.73* (0.53, 0.99)
Filipino–Native Hawaiian	1.23 (0.99, 1.54)	0.93 (0.73, 1.17)	1.29* (1.07, 1.55)	0.93 (0.76, 1.13)
Chinese–Filipino–White	0.67 (0.42, 1.08)	0.54* (0.33, 0.87)	0.85 (0.59, 1.21)	0.71 (0.49, 1.02)
Chinese–Filipino–Native Hawaiian	1.15 (0.89, 1.48)	0.85 (0.65, 1.11)	1.32* (1.07, 1.62)	0.97 (0.78, 1.21)
Filipino–Native Hawaiian–White	0.89 (0.69, 1.14)	0.65* (0.50, 0.84)	1.04 (0.85, 1.26)	0.77* (0.62, 0.94)
Chinese–Filipino–Native Hawaiian–White	0.67* (0.51, 0.89)	0.49* (0.36, 0.65)	1.07 (0.88, 1.29)	0.80* (0.65, 0.98)
Japanese				
Japanese only (Ref)	1.00	1.00	1.00	1.00
Japanese in combination[c]	1.05 (0.93, 1.17)	0.90 (0.78, 1.04)	1.35* (1.22, 1.49)	0.97 (0.86, 1.10)
Japanese–White	0.87 (0.73, 1.05)	0.86 (0.70, 1.04)	1.01 (0.87, 1.19)	0.87 (0.73, 1.03)
Chinese–Japanese	0.95 (0.65, 1.38)	0.88 (0.60, 1.29)	0.99 (0.71, 1.37)	0.81 (0.58, 1.13)
Filipino–Japanese	1.59* (1.15, 2.18)	1.34 (0.96, 1.87)	1.28 (0.94, 1.75)	0.93 (0.68, 1.29)
Japanese–Native Hawaiian	1.20 (0.80, 1.81)	0.95 (0.62, 1.45)	1.74* (1.27, 2.39)	1.12 (0.81, 1.57)
Japanese–Native Hawaiian-White	0.93 (0.66, 1.31)	0.73 (0.51, 1.05)	1.47* (1.14, 1.91)	0.97 (0.73, 1.28)
Chinese–Japanese–Native Hawaiian–White	1.28 (0.94, 1.74)	1.00 (0.72, 1.40)	1.58* (1.23, 2.04)	1.06 (0.80, 1.39)
Korean				
Korean only (Ref)	1.00	1.00	1.00	1.00
Korean in combination[c]	1.26 (0.99, 1.59)	0.91 (0.64, 1.29)	1.60* (1.35, 1.91)	1.02 (0.78, 1.33)
Korean–White	0.82 (0.53, 1.27)	0.72 (0.45, 1.15)	1.05 (0.77, 1.44)	0.84 (0.60, 1.19)

Continued

TABLE 3—*Continued*

Thai				
Thai only (Ref)	1.00	1.00	1.00	1.00
Thai in combination[c]	1.81* (1.22, 2.69)	2.09* (1.31, 3.33)	1.29 (0.93, 1.79)	1.30 (0.89, 1.92)
Vietnamese				
Vietnamese only (Ref)	1.00	1.00	1.00	1.00
Vietnamese in combination[c]	0.93 (0.71, 1.20)	0.87 (0.67, 1.14)	1.03 (0.84, 1.27)	0.98 (0.79, 1.22)
Vietnamese-White	0.93 (0.58, 1.50)	0.85 (0.52, 1.39)	0.98 (0.66, 1.44)	0.89 (0.60, 1.34)
Chinese-Vietnamese	0.95 (0.68, 1.34)	0.93 (0.66, 1.30)	1.04 (0.79, 1.36)	1.03 (0.79, 1.35)
Native Hawaiian				
Native Hawaiian only (Ref)	1.00	1.00	1.00	1.00
Native Hawaiian in combination[c]	1.21 (0.96, 1.52)	1.08 (0.85, 1.37)	1.09 (0.92, 1.29)	1.05 (0.88, 1.25)
Native Hawaiian-White	0.99 (0.76, 1.29)	0.90 (0.68, 1.18)	0.96 (0.79, 1.18)	0.93 (0.76, 1.14)
Chinese-Native Hawaiian	1.63* (1.19, 2.25)	1.47* (1.06, 2.04)	1.22 (0.95, 1.58)	1.16 (0.89, 1.51)
Filipino-Native Hawaiian	1.72* (1.26, 2.34)	1.53* (1.12, 2.10)	1.30* (1.02, 1.66)	1.19 (0.93, 1.53)
Japanese-Native Hawaiian	1.34 (0.85, 2.10)	1.21 (0.76, 1.92)	1.20 (0.85, 1.70)	1.18 (0.83, 1.69)
Chinese-Native Hawaiian-White	1.05 (0.79, 1.39)	0.96 (0.71, 1.29)	0.96 (0.78, 1.19)	0.95 (0.76, 1.19)
Chinese-Filipino-Native Hawaiian	1.60* (1.14, 2.24)	1.41 (1.00, 1.99)	1.33* (1.03, 1.73)	1.25 (0.96, 1.64)
Filipino-Native Hawaiian-White	1.24 (0.89, 1.72)	1.09 (0.78, 1.53)	1.05 (0.81, 1.35)	1.00 (0.77, 1.30)
Japanese-Native Hawaiian-White	1.03 (0.69, 1.54)	0.93 (0.62, 1.41)	1.01 (0.75, 1.36)	1.01 (0.74, 1.36)
Chinese-Filipino-Native Hawaiian-White	0.94 (0.66, 1.33)	0.81 (0.56, 1.17)	1.08 (0.84, 1.39)	1.05 (0.81, 1.36)
Chinese-Japanese-Native Hawaiian-White	1.42 (0.98, 2.05)	1.27 (0.87, 1.87)	1.09 (0.81, 1.46)	1.09 (0.80, 1.48)
Guamanian				
Guamanian only (Ref)	1.00	1.00	1.00	1.00
Guamanian in combination[c]	1.00 (0.64, 1.56)	1.09 (0.65, 1.82)	0.99 (0.71, 1.38)	1.22 (0.83, 1.80)
Samoan				
Samoan only (Ref)	1.00	1.00	1.00	1.00
Samoan in combination[c]	1.34* (1.01, 1.77)	1.20 (0.87, 1.65)	0.88 (0.73, 1.08)	0.91 (0.73, 1.14)
Samoan-White	0.73 (0.41, 1.30)	0.69 (0.38, 1.24)	0.73 (0.51, 1.04)	0.76 (0.53, 1.09)

Note. AOR = adjusted odds ratio; CI = confidence interval; LBW = low birthweight; OR = odds ratio; PTB = preterm birth.
[a]Adjusted for nativity, maternal age, education, marital status, parity, prenatal care, tobacco use, and state of residence.
[b]PTB excludes cases of missing gestational age information, 4.6%.
[c]In combination with one or more other race/ethnicity; not mutually exclusive of other "in combination" subgroups.
*$P < .05$

disadvantage for multiple-race/ethnicity women is likely to be driven by socioeconomic and cultural differences that are not well captured by education and nativity alone. Moreover, information on smoking—a key proximate determinant of adverse outcomes—was not collected during this time period in California. This may be a critical omission, given that another study has reported higher smoking rates among multiple-race/ethnicity Asians.[27] A sensitivity analysis including only births in Hawaii revealed that multiple-race/ethnicity Chinese and Thai women did not have elevated odds of adverse birth outcomes after adjustment for potential confounders, including smoking; however, that sample size was considerably smaller (data not shown). The excess risk of multiple-race/ethnicity Chinese and Thai women may also reflect the particular groups that constitute the multiple-race/ethnicity combinations (e.g., one third of multiple-race/ethnicity Thai women were Cambodian, Laotian, or Black).

Compared to single-race Filipinos, the significantly lower odds of PTB and LBW for multiple-race/ethnicity Filipino women suggests that their birth outcomes are better than would be expected on the basis of their greater sociodemographic and behavioral risks. The reason for this is unclear, but it might reflect the success of programs designed to assist disadvantaged populations or perhaps a unique ethnicity-specific risk factor that is lessened in multiple-race/ethnicity combinations. It is interesting to note that among the biracial combinations including Whites, only Filipino–White women had significantly greater adjusted odds of both PTB and LBW than single-race White women. Again, this may suggest a dominant Filipino-related exposure that increases the risk of adverse birth outcomes. Other studies have also reported unexplained poorer birth outcomes for the Filipino population,[6,7,9,10,12,14] which is inconsistent with the overall Filipino population's favorable sociodemographic characteristics based

TABLE 4—Odds Ratios and Adjusted Odds Ratios of LBW and PTB for Single- and Multiple-Race/Ethnicity Asian/Pacific Islander Subgroups, Compared With Single-Race Non-Hispanic Whites: California and Hawaii, 2003–2005

	LBW		PTB[a]	
	OR (95% CI)	AOR[b] (95% CI)	OR (95% CI)	AOR[b] (95% CI)
Non-Hispanic White only (Ref)	1.00	1.00	1.00	1.00
Single race/ethnicity				
Asian Indian only	1.78* (1.69, 1.87)	2.11* (1.97, 2.25)	0.93* (0.89, 0.98)	1.15* (1.08, 1.22)
Cambodian only	2.25* (2.02, 2.51)	1.85* (1.65, 2.07)	2.01* (1.83, 2.20)	1.74* (1.58, 1.92)
Chinese only	1.09* (1.04, 1.15)	1.19* (1.12, 1.26)	0.85* (0.82, 0.89)	0.98 (0.93, 1.03)
Filipino only	1.92* (1.85, 1.99)	1.95* (1.86, 2.04)	1.55* (1.51, 1.60)	1.61* (1.55, 1.67)
Hmong only	1.32* (1.18, 1.49)	1.14* (1.00, 1.29)	1.49* (1.37, 1.64)	1.25* (1.14, 1.37)
Indonesian only	1.07 (0.79, 1.47)	1.16 (0.85, 1.60)	1.30* (1.04, 1.63)	1.46* (1.17, 1.83)
Japanese only	1.53* (1.42, 1.65)	1.52* (1.40, 1.66)	1.06 (0.99, 1.13)	1.12* (1.04, 1.21)
Korean only	0.81* (0.74, 0.89)	0.94 (0.85, 1.03)	0.73* (0.68, 0.79)	0.88* (0.82, 0.95)
Laotian only	2.38* (2.07, 2.75)	1.97* (1.70, 2.28)	1.96* (1.73, 2.22)	1.71* (1.51, 1.95)
Pakistani only	1.93* (1.61, 2.31)	2.15* (1.79, 2.58)	1.22* (1.03, 1.45)	1.34* (1.13, 1.59)
Thai only	1.18 (0.92, 1.52)	1.15 (0.89, 1.48)	1.28* (1.06, 1.55)	1.35* (1.11, 1.64)
Vietnamese only	1.26* (1.19, 1.34)	1.27* (1.18, 1.36)	1.08* (1.03, 1.13)	1.14* (1.08, 1.21)
Native Hawaiian only	1.38* (1.11, 1.71)	1.09 (0.87, 1.37)	1.54* (1.31, 1.81)	1.25* (1.06, 1.48)
Guamanian only	1.49* (1.11, 2.00)	1.30 (0.97, 1.75)	1.64* (1.32, 2.05)	1.45* (1.16, 1.81)
Marshallese only	2.15* (1.69, 2.74)	1.38* (1.06, 1.81)	2.85* (2.39, 3.38)	2.10* (1.74, 2.55)
Samoan only	1.02 (0.86, 1.21)	0.85 (0.71, 1.01)	1.67* (1.50, 1.86)	1.41* (1.26, 1.58)
Tongan only	1.24 (0.97, 1.58)	1.09 (0.85, 1.40)	1.49* (1.25, 1.78)	1.31* (1.09, 1.56)
Multiple race/ethnicity[c]				
Asian Indian in combination	1.85* (1.34, 2.56)	1.88* (1.36, 2.60)	1.26 (0.94, 1.68)	1.34 (0.99, 1.79)
Cambodian in combination	1.95* (1.30, 2.93)	1.64* (1.09, 2.48)	1.75* (1.25, 2.46)	1.62* (1.15, 2.28)
Chinese in combination	1.60* (1.48, 1.72)	1.32* (1.20, 1.45)	1.52* (1.44, 1.61)	1.30* (1.21, 1.41)
Filipino in combination	1.80* (1.69, 1.92)	1.44* (1.33, 1.55)	1.65* (1.57, 1.74)	1.39* (1.30, 1.47)
Japanese in combination	1.60* (1.46, 1.75)	1.32* (1.19, 1.46)	1.42* (1.33, 1.53)	1.22* (1.13, 1.33)
Korean in combination	1.02 (0.82, 1.28)	0.90 (0.72, 1.13)	1.17* (1.00, 1.38)	1.09 (0.92, 1.28)
Thai in combination	2.14* (1.58, 2.90)	1.95* (1.43, 2.65)	1.65* (1.26, 2.16)	1.57* (1.20, 2.06)
Vietnamese in combination	1.17 (0.90, 1.51)	1.15 (0.89, 1.49)	1.11 (0.91, 1.36)	1.16 (0.94, 1.42)
Native Hawaiian in combination	1.66* (1.56, 1.78)	1.24* (1.12, 1.38)	1.67* (1.59, 1.75)	1.35* (1.24, 1.46)
Guamanian in combination	1.49* (1.07, 2.09)	1.24 (0.89, 1.75)	1.62* (1.26, 2.09)	1.42* (1.10, 1.84)
Samoan in combination	1.36* (1.09, 1.71)	1.05 (0.83, 1.33)	1.48* (1.25, 1.75)	1.23* (1.03, 1.47)
Two racial/ethnic combinations				
Chinese–White	1.10 (0.83, 1.46)	1.08 (0.82, 1.43)	1.04 (0.83, 1.29)	1.07 (0.86, 1.33)
Filipino–White	1.47* (1.30, 1.66)	1.29* (1.14, 1.46)	1.39* (1.27, 1.54)	1.27* (1.15, 1.40)
Japanese–White	1.34* (1.13, 1.58)	1.25* (1.06, 1.49)	1.07 (0.93, 1.23)	1.05 (0.91, 1.21)
Korean–White	0.67* (0.44, 1.02)	0.64* (0.42, 0.99)	0.77 (0.57, 1.05)	0.78 (0.57, 1.05)
Vietnamese–White	1.18 (0.73, 1.89)	1.12 (0.70, 1.81)	1.05 (0.72, 1.55)	1.05 (0.71, 1.55)
Native Hawaiian–White	1.36* (1.16, 1.59)	1.01 (0.85, 1.20)	1.48* (1.32, 1.66)	1.18* (1.04, 1.35)
Samoan–White	0.75 (0.43, 1.30)	0.59 (0.34, 1.04)	1.22 (0.87, 1.71)	1.03 (0.73, 1.45)
Black–Filipino	2.28* (1.66, 3.13)	1.88* (1.37, 2.59)	1.92* (1.46, 2.51)	1.67* (1.27, 2.19)
Chinese–Filipino	2.39* (1.90, 3.00)	2.19* (1.73, 2.77)	1.78* (1.45, 2.17)	1.72* (1.40, 2.12)
Chinese–Japanese	1.45* (1.00, 2.09)	1.44 (0.99, 2.09)	1.04 (0.75, 1.44)	1.10 (0.79, 1.52)
Chinese–Vietnamese	1.20 (0.86, 1.68)	1.21 (0.87, 1.70)	1.12 (0.86, 1.46)	1.21 (0.93, 1.59)
Chinese–Native Hawaiian	2.25* (1.78, 2.85)	1.67* (1.30, 2.15)	1.88* (1.54, 2.29)	1.48* (1.20, 1.82)
Filipino–Japanese	2.43* (1.78, 3.31)	2.02* (1.47, 2.79)	1.36 (1.00, 1.84)	1.22 (0.90, 1.67)

Continued

TABLE 4—*Continued*

Filipino–Native Hawaiian	2.37* (1.90, 2.95)	1.68* (1.33, 2.13)	2.00* (1.66, 2.40)	1.52* (1.25, 1.84)
Japanese–Native Hawaiian	1.84* (1.23, 2.74)	1.38 (0.92, 2.08)	1.84* (1.35, 2.51)	1.50* (1.09, 2.06)
Three racial/ethnic combinations				
Chinese–Filipino–White	1.29 (0.80, 2.08)	1.06 (0.66, 1.72)	1.31 (0.92, 1.88)	1.18 (0.82, 1.69)
Chinese–Native Hawaiian–White	1.44* (1.19, 1.73)	1.12 (0.91, 1.37)	1.47* (1.28, 1.70)	1.24* (1.06, 1.44)
Filipino–Native Hawaiian–White	1.70* (1.33, 2.18)	1.22 (0.94, 1.59)	1.61* (1.32, 1.95)	1.27* (1.04, 1.56)
Japanese–Native Hawaiian–White	1.42* (1.02, 1.99)	1.09 (0.77, 1.54)	1.56* (1.21, 2.00)	1.30* (1.00, 1.68)
Chinese–Filipino–Native Hawaiian	2.20* (1.71, 2.84)	1.58* (1.21, 2.07)	2.05* (1.67, 2.52)	1.60* (1.29, 1.99)
Four racial/ethnic combinations				
Chinese–Filipino–Native Hawaiian–White	1.29 (0.98, 1.70)	0.94 (0.70, 1.25)	1.66* (1.37, 2.00)	1.35* (1.10, 1.65)
Chinese–Japanese–Native Hawaiian–White	1.95* (1.45, 2.63)	1.54* (1.13, 2.10)	1.67* (1.31, 2.13)	1.43* (1.11, 1.85)

Note. AOR = adjusted odds ratio; CI = confidence interval; LBW = low birthweight; OR = odds ratio; PTB = preterm birth.
[a]PTB excludes cases of missing gestational age information (4.6%).
[b]Adjusted for nativity, maternal age, education, marital status, parity, prenatal care, tobacco use, and state of residence.
[c]In combination with 1 or more other race/ethnicity; not mutually exclusive of other "in combination" subgroups.
*$P < .05$

on Census data.[28] As with all racial/ethnic variations, this may arise from differences in normative cultural practices and behaviors, environmental exposures, or biological factors.[23] Perhaps because of Filipinos' skin color or immigrant history, reported discrimination is higher for Filipinos than it is for other Asian subgroups,[29] which could lead to stress-responsive afflictions, including adverse birth outcomes.[30]

An overarching finding of this analysis was that there was more variability in outcomes between API subgroups than between single- versus multiple-race/ethnicity groups. Relative to single-race White women, many API subgroups had higher rates of LBW or PTB, both before and after adjustment for differences in maternal characteristics. The particularly high rates of LBW and PTB for single-race/ethnicity Cambodians and Laotians have been described before[8–10,12,16] and cannot be explained by the maternal characteristics available on the birth certificate. The heightened risk of single-race/ethnicity Cambodians and Laotians compared to other groups may correlate with the recentness and circumstances of their immigration, which is due in large part to political instability.[28]

This may be the first study to document the high maternal and infant risks of the Marshallese population. In addition to having the highest PTB rate of all API subgroups, Marshallese women had the highest proportion of births to mothers who were unmarried or had less than a high school education. This group also had the lowest rate of early prenatal care entry (48%). Other data from the US Census Bureau show that the Marshallese have the lowest median family income and highest poverty rates among Pacific Islanders.[31]

Similar to other studies,[6,8,10,11,13,14,18] we found that Asian Indians and Pakistanis have a higher risk of LBW despite their lower sociodemographic risk profile. Although this finding could suggest a natural anthropometric difference in fetal growth and size at birth, higher rates of very LBW (less than 1500 g)—a more pathologic outcome—were also observed among these populations (data not shown). Consistent with other studies showing favorable birth outcomes for Korean mothers,[6,8–14] we found that Koreans were the only API subgroup to have lower rates of LBW and PTB than did Whites. Much of this group's relative advantage may be related to higher socioeconomic status, as single-race/ethnicity Koreans had the highest proportion of births to college-educated mothers and the highest rate of early prenatal care of any API subgroup. However, this contrasts with US census data showing that Koreans have a median family income well below the Asian average.[28] This inconsistency may reflect ways in which the Korean populations in California and Hawaii are different from Koreans in other states.

In addition to adverse birth outcomes, other public health priorities suggested by this study include the high proportion of teen births among the Cambodian, Hmong, Laotian, and Pacific Islander populations, and the low rates of early prenatal care entry for Hmong, Marshallese, and Tongan women. We also examined the proportion of women receiving no prenatal care, which did not exceed 5% for any racial/ethnic subgroup; thus, the concern lies mostly in reducing late prenatal care entry. The relatively high rates of smoking for Native Hawaiian and Samoan mothers have been documented before.[32–34] A public smoking ban recently implemented in Hawaii may help to support other perinatal cessation programs.[34]

Limitations

Several limitations to this study warrant mentioning. Foremost is the absence of some data on the birth certificate that would be relevant to our analysis. For example, some variables that would be of interest in describing API subgroup differences (e.g., income, maternal stress, acculturation, and diet) are not available; others, such as maternal smoking and medical conditions, are known to be underreported on the birth certificate.[26,35] Further analyses with more detailed survey instruments, such as the Centers for Disease Control and Prevention's Pregnancy Risk Assessment and Monitoring System and the California Maternal and Infant Health Assessment, could improve our knowledge of subgroup variation in risk factors (e.g., maternal stress and pregnancy intention) for many of the API subgroups reported on here, particularly if multiple

states or multiple years of data are combined. Further quantitative and qualitative investigation is needed to understand the socioeconomic, environmental, cultural, biological, and behavioral factors that may give rise to the racial/ethnic differences observed herein. For example, a determination of the factors undergirding the excess risk of Filipinos or the lower risk of Koreans could help to guide interventions that equitably reduce adverse perinatal events. Future studies could also examine infant mortality outcomes, consider the role of paternal race/ethnicity, and study the order in which races/ethnicities are reported by mothers.

An additional concern may be the use of LBW as an outcome, given known anthropometric differences between White and API populations. However, sensitivity analyses of very LBW—a more severe, pathologic outcome—similarly showed excess adjusted risk for single-race/ethnicity Indian, Cambodian, Filipino, Laotian, and Pakistani mothers. Further analysis of LBW at term—an indicator of growth restriction—also revealed elevated rates for these and other groups (data not shown). Given some concern regarding the validity of gestational age assessment based on last menstrual period across sociodemographic characteristics, including race/ethnicity,[36–39] LBW is presented because it can be accurately measured for all births and is consistent with previous studies.

Conclusions

Interracial births have increased over the past several decades,[40] and this trend seems likely to continue to add to the multiple-race population, strengthening the impetus for considering and studying multiple-race/ethnicity mothers separately from those of single race/ethnicity. This study extends previous analyses of multiple-race Asians and Pacific Islanders[21,25] by examining API subgroups, and its findings lead us to conclude that for many subgroups, multiple-race/ethnicity status is associated with poorer demographic and behavioral characteristics that generally explain poorer outcomes, compared to single-race/ethnicity counterparts. However, given the observed heterogeneity among the API population, there is reason to avoid reducing or combining API single- and multiple-race/ethnicity groups into 1 analytic group whenever possible. In particular, we found that multiple-race/ethnicity Chinese, Filipino, and Thai women had risks of LBW or PTB that were different from their single-race/ethnicity counterparts and that could not be explained by characteristics available on the birth certificate. Special consideration for the most disadvantaged API subgroups, particularly Cambodian, Laotian, and Marshallese, is warranted both for future research and potential public health interventions. ■

About the Authors

Ashley H. Schempf, Pauline Mendola, Brady E. Hamilton, and Diane M. Makuc are with the National Center for Health Statistics, Hyattsville, MD. Donald K. Hayes is with the Division of Reproductive Health, Centers for Disease Control and Prevention, Atlanta, GA.

Correspondence should be sent to Ashley H. Schempf, Office of Analysis & Epidemiology, National Center for Health Statistics, 3311 Toledo Road, Room 6103, Hyattsville, MD 20782 (e-mail: ASchempf@cdc.gov). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints/Eprints" link.

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Contributors

A. H. Schempf conceptualized the study, performed the analyses, and led the writing of the article. P. Mendola assisted with drafting the article and interpreting the results. B. E. Hamilton assisted with the coding and design of the analysis. D. K. Hayes and D. M. Makuc critically reviewed and revised the article. All authors reviewed and approved the final version of the article.

Human Participant Protection

No protocol approval was necessary because data were obtained from birth certificates without identifying information.

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