
Temporal Trends in Maternal Characteristics and Pregnancy Outcomes: Their Relevance to the Provision of Health Services. Hawaii, 1979-1994

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This paper examines changes in maternal sociodemographic characteristics and pregnancy outcomes in Hawaii during the period 1979-1994. The more striking changes were increases of 129% in the proportion of births to women > 35 years old and of 67% in the proportion of births to unmarried mothers. The percentage of low birth weight and small-for-gestational age infants decreased while the proportion of premature births increased. Identified changes were not limited to selected population groups, but were found in various degrees in all ethnic groups. These findings are relevant to all health practitioners and will assist in the provision of appropriate care and counseling to individual women.

Introduction

One of the major functions of Maternal and Child Health (MCH) is the monitoring of maternal and infant health status and its determinants to guide policy development and to ensure that public health programs and health care services are appropriately targeting and meeting the needs of at-risk groups.¹ This effort is guided by the comparison of local health assessment information to established health status objectives for the nation² and the state.³ An appreciable proportion of health objectives specific to the MCH population can be assessed annually through the use of state vital records data. This readily available source of information also allows for the examination of long-term trends in maternal risk characteristics and pregnancy outcomes.

With the end of the millenium rapidly approaching, this is a logical time for state MCH leaders and health services providers to reassess their current approaches to prevent or ameliorate adverse pregnancy outcomes and their associated precursors. Vital records data on maternal risk factors and pregnancy outcomes can support these assessments and be used to engage health services providers and policy makers in discussions of strategic policy initiatives to improve pregnancy outcomes in the next century.

The purpose of this study is to examine trends in maternal sociodemographic risk characteristics and pregnancy outcome indicators to determine if marked population-wide temporal changes have occurred in the state of Hawaii, and whether any change has appeared in the relationship between risk characteristics and birth outcome indicators.

Methods

Hawaii birth certificates for the period 1979-1994 were used in this study. Single live births to resident women (N=283,272) were included and analyzed by major maternal ethnic groups. Ethnicity was self-reported.

Selected sociodemographic characteristics were: maternal age; parity; education; marital status; nativity status; and military status of parents.

Maternal age was separately combined with maternal education and parity to create age-adjusted risk indicators of educational attainment and parity. Maternal educational attainment was defined as high (13 or more years of completed education), average (12 years of completed education), and low (less than 12 years of completed education) for adults, 18 years of age and older. As most adolescents (less than 18 years of age) would be classified by this scheme as having low educational attainment solely by virtue of their age, a separate coding strategy was used to define educational attainment for this group. Adolescents with two or more years above their grade level for age were classified as having high educational attainment while those with two or more years below expected grade level for age were defined as having low educational attainment. This coding scheme facilitates the examination of the impact of low educational attainment without the influence of young maternal age.⁴

Parity was determined by the number of previous live births reported on the birth certificate. High parity-for-age was defined as one or more previous births for adolescents, 3 or more previous births for women 18-21 years of age, 4 or more previous births for

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Maternal Ethnicity	Maternal Characteristics							
	Age		Educ. Attainment				Parity	
	< 18 yrs. % (%change)	≥ 35 yrs % (%change)	Low % (%change)	High % (%change)	Primiparity % (%change)	High-par-age % (%change)		
Caucasian N 10,030	1.1 (-47.6)*	14.6 (+180.8)*	5.2 (-41.6)*	52.4 (+17.5)	47.2 (-0.6)	1.2 (-14.3)		
Hawaiian/PH N 9,092	8.1 (+15.7)*	6.8 (+78.9)*	13.4 (-21.6)*	24.7 (+16.0)	37.5 (-1.0)	3.8 (-32.1)*		
Filipino N 7,170	3.7 (+15.6)*	12.0 (+60.0)*	10.0 (-50.5)*	45.6 (+18.7)*	43.5 (+11.5)*	1.5 (-42.3)*		
Japanese N 4,532	1.1 (-21.4)	25.1 (+221.9)*	1.6 (-42.8)	69.7 (+3.6)	47.9 (0)	0.6 (+20.0)		
Other Asian/PI N 2,868	1.3 (+8.3)	20.2 (+134.8)*	10.6 (-40.8)*	48.6 (-1.4)	49.0 (+7.4)*	0.9 (-35.7)		
Samoan N 1,049	4.6 (+48.3)*	7.3 (+43.1)*	13.0 (-44.7)*	22.4 (+7.7)	34.3 (+12.1)	7.5 (-27.2)*		
Black N 1,189	2.4 (20.0)	5.9 (+195.0)*	4.1 (-53.4)*	49.3 (+50.3)*	45.4 (+6.6)	1.3 (-27.8)		
Total ¹ N 37,299	3.6 (+9.1)*	13.3 (+129.3)*	8.7 (-34.6)*	44.5 (+10.0)	43.6 (+1.6)	2.1 (-22.2)*		

1. Includes all ethnic groups shown and all other ethnic groups which had too few births.
* Indicates statistical significance at P < 0.05.

women 22-24 years of age, and 5 or more previous births for those 25 years or older. All other multiparous women were categorized as having appropriate parity-for-age.

Selected pregnancy outcomes were: birth weight; gestational age; and birth weight-for-gestational age. Birth weight was categorized as low (< 2,500 g.), very low (< 1,500 g.), and high (≥ 4,250 g.). Gestational age was categorized as preterm (< 37 weeks), very preterm (< 33 weeks), and postterm (≥ 42 weeks). The criteria for defining small-for-gestational age (SGA) and large-for-gestational age (LGA) were based on the 1991 U.S. fetal growth reference curve.⁵

Linear multiple regression analysis was used to test the statistical significance of temporal trends in sociodemographic characteristics and pregnancy outcomes within each maternal ethnic group and in the total population. This statistical method was also used to identify the predictors of mean birth weight at the beginning and at the end of the study period. Logistic regression analysis was used to calculate the odds ratios measuring the independent effects of maternal sociodemographic characteristics on low birth weight, prematurity, and small-for-gestational age at the beginning and at the end of the study period.

Results

Tables 1 and 2 present maternal sociodemographic characteristics in 1993-94 and the percentage change since 1979-80 by ethnic group. At the state level, there was a marked increase of births to women ≥ 35 years old (129%) and to unmarried women (67%), and a small increase of births to foreign-born women (16%) and to teenaged (< 18 yrs) mothers (9%). The proportion of births to mothers with low educational attainment and with high parity-for-age decreased (-35% and -22%, respectively) while births to highly educated women increased, although not statistically significantly.

Marked differences were found between ethnic groups. In 1993-94, Hawaiians had the highest percentage of births to teenagers

(8%), single women (52%), and mothers with low educational attainment (13%). Compared to Hawaiians, Samoan mothers had a similar percentage of births to women with low educational attainment. Samoans also had the highest proportion of high parity-for-age births (7.5%) and nearly a 50% increase in births to teen mothers. Japanese mothers had the highest percentage of older childbearing (25%), and high educational attainment (70%). Childbearing to Japanese women ≥ 35 years old increased more than 200 percent during the study period. Other Asian/Pacific Islanders had

Maternal Ethnicity	Maternal Characteristics					
	Unmarried		Foreign-born ²		Active Milit. Duty	
	%	(%change)	%	(%change)	%	(%change)
Caucasian N 10,030	15.1	(+28.1)*	8.9	(+30.9)*	43.1	(+4.3)*
Hawaiian/PH N 9,092	51.8	(+53.2)*	1.4	(+75.0)*	2.6	(-43.5)*
Filipino N 7,170	27.3	(+88.3)*	61.5	(+4.1)*	8.7	(-46.3)*
Japanese N 4,532	15.1	(+118.8)*	16.7	(+19.3)*	4.1	(+13.9)*
Other Asian/PI N 2,868	14.4	(+118.2)*	72.3	(+14.2)*	7.1	(-44.1)*
Samoan N 1,049	38.7	(+52.4)*	65.2	(-27.4)*	7.3	(-56.3)*
Black N 1,189	19.3	(+69.3)*	7.8	(+2.6)	81.3	(+0.7)
Total ¹ N 37,299	28.0	(+66.7)*	26.5	(+16.2)*	18.3	(-13.7)*

1. Includes all ethnic groups shown and all other ethnic groups which had too few births.
2. Includes U.S. Territories.
* Indicates statistical significance at P < 0.05.

Table 3.—Birth weight, 1993-94, and Percentage Change since 1979-80 by Ethnic Group, Hawaii Single Live Births

Maternal Ethnicity	Mean BW g ± s.d. (%change)	LBW < 2,500g % (%change)	VLBW < 1,500g % (%change)	HBW ≥ 4,250g % (%change)	SGA ² % (%change)
Caucasian N 10,030	3,435 ± 550.2 (+1.3)*	4.2 (-17.6)*	0.6 (-14.3)	5.6 (+12.0)*	7.9 (-27.5)*
Hawaiian/PH N 9,092	3,315 ± 547.2 (+1.3)*	5.6 (-17.6)*	0.7 (-22.2)	3.9 (+14.4)	11.0 (-16.0)*
Filipino N 7,170	3,178 ± 525.1 (+1.5)*	7.8 (-8.2)	0.7 (-12.5)	2.1 (+75.0)*	15.4 (-17.6)*
Japanese N 4,532	3,212 ± 499.4 (+1.0)	6.4 (-7.2)	0.6 (-14.3)	1.6 (+23.1)	13.7 (-16.5)*
Other Asian/PI N 2,868	3,266 ± 481.4 (+0.3)	4.8 (-11.1)	0.3 (-62.5)	1.8 (-14.3)	11.0 (-14.7)*
Samoan N 1,049	3,496 ± 594.0 (-2.1)*	3.8 (+52.0)*	1.1 (+266.7)	9.0 (-1.1)	5.5 (+103.7)*
Black N 1,189	3,187 ± 634.2 (-0.7)	9.8 (+3.1)	2.4 (+60.0)*	2.5 (+257.1)	12.6 (-14.3)*
Total ¹ N 37,299	3,308 ± 549.1 (+0.8)*	5.8 (-9.4)*	0.7 (-12.5)	3.8 (+15.1)*	11.1 (-18.4)*

1. Includes all ethnic groups shown and all other ethnic groups which had too few births.

2. Percentages based on cases not missing gestational age data.

* Indicates statistical significance at P < 0.05.

Table 4.—Gestational Age, 1993-94, and Percentage Change since 1979-80 by Ethnic Group, Hawaii Single Live Births.

Maternal Ethnicity	Mean GA wks ± sd (%change)	PreT (< 37 wks) % (%change)	VPreT (< 33 wks) % (%change)	PostT (≥ 42 wks) % (%change)	Missing GA info % (%change)
Caucasian N 10,030	39.3 ± 2.04 (-1.5)*	7.1 (+22.4)*	0.7 (-30.0)*	8.4 (-54.3)*	7.2 (+140.0)*
Hawaiian/PH N 9,092	39.1 ± 2.36 (-0.5)*	9.9 (0)	1.5 (-21.0)*	10.3 (-33.5)*	11.9 (+271.9)*
Filipino N 7,170	38.8 ± 2.26 (-0.5)*	10.3 (-1.0)	1.5 (-25.0)	8.0 (-23.1)*	11.1 (+382.6)*
Japanese N 4,532	39.0 ± 2.00 (-1.0)*	7.6 (-1.3)	0.9 (-35.7)*	6.8 (-49.2)*	11.6 (+452.4)*
Other Asian/PI N 2,868	39.1 ± 2.07 (-0.8)*	7.5 (-3.8)	0.7 (-50.0)*	8.2 (-41.4)*	14.1 (+314.7)*
Samoan N 1,049	39.0 ± 2.52 (-0.2)	12.5 (-0.8)	2.1 (+40.0)*	11.9 (0)	20.3 (+190.0)*
Black N 1,189	38.6 ± 2.70 (-1.5)*	13.8 (+40.8)*	3.1 (+55.0)*	6.8 (-54.0)*	7.7 (+165.5)*
Total ¹ N 37,299	39.1 ± 2.21 (-1.0)*	8.9 (+7.2)*	1.2 (-20.0)*	8.6 (-43.0)*	10.8 (+260.0)*

1. Includes all ethnic groups shown and all other ethnic groups which had too few births.

2. Indicates statistical significance at P < 0.05.

Note: percentages do not include missing values.

the highest proportion of first births and of foreign-born mothers. Black mothers, followed by Caucasians, were most likely to indicate an active duty military father.

Tables 3 and 4 show birth outcomes in 1993-94 and percentage changes since 1979-80 by maternal ethnicity. At the state level, mean birth weight increased by 28 grams. There was a 9.4 percent reduction in the proportion of low birth weight (< 2,500 g) and a 15 percent increase in the proportion of high birth weight (≥ 4,250 g) infants. The percentage of infants born at less than 37 weeks gestation increased by 7%, while the proportion of very preterm (< 33 wk) and postterm (≥ 42 wk) births decreased by 20 and 43 percent respectively. The proportion of SGA infants also decreased. A large

increase was found in the proportion of birth certificates missing information on gestational age.

In 1993-94, the major ethnic differences were found among Samoan and Black mothers. While Blacks had the highest proportion of low and very low birth weight and preterm and very preterm deliveries, Samoans had the highest increase in the proportion of low and very low birth weight and the second highest increase in the proportion of very preterm births. Filipinos had the highest proportion of small-for-gestational age births (15.4%), and Samoans had the highest proportion of infants weighing 4,250 grams or more (9.0%).

Linear and logistic regression analyses were performed to identify

the independent effects of sociodemographic characteristics on selected pregnancy outcomes, holding constant maternal ethnicity. To detect any change in such associations over time, these analyses were repeated by four year periods from 1979-82 to 1991-94.

Table 5 presents the regression analyses of factors associated with mean birth weight, low birth weight, and SGA in the most recent period. All the variables included in the model were significantly associated with mean birth weight. The largest negative changes in mean birth weight were associated with primiparity and incomplete birth certificates.

With few exceptions, the same characteristics were associated with higher risk of giving birth to a low birth weight or a SGA infant. Maternal age of 35 years or older, low educational attainment, primiparity, and being single were significantly associated with higher risk of bearing a low birth weight or SGA infant. Military status was associated with low birth weight but not with SGA. Maternal foreign nativity status was found to be protective for low birth weight but not for SGA. Maternal high educational attainment was a protective factor for both outcomes.

With few exceptions, the factors associated with pregnancy outcomes at the beginning of the study period were the same (data not presented here). The most relevant differences were found for a father active in the military and a foreign-born mother: in 1979-82 these factors were not associated with low birth weight and were protective against the birth of a SGA infant.

Discussion

This analysis revealed several noteworthy trends. While there was a decline in high parity-for-age births, there was also a marked increase of births to older women in every ethnic group, especially Japanese mothers. These data are consistent with national trends in women delaying pregnancy.⁶ Notwithstanding the evident ethnic differences in other sociodemographic characteristics, the rise in births to unmarried women was observed for every group and was particularly notable among adult women as the percentage of adolescent mothers is very low. These findings have important implications not only for the targeting of public health support services but also for the awareness of private providers to the changed characteristics of their clientele.⁷

In spite of the increases in births to older and to unmarried women during the past 15 years, the overall mean birth weight has risen and low birth weight and small-for-gestational age percentages have decreased. Reductions in births to mothers with low educational attainment and increases to those with high educational attainment are probably contributing to these declines. The overall proportion of teenaged mothers is low in comparison with national rates⁶ and has increased minimally over the study period. Hawaiians, Samoans, and Filipinos are the ethnic groups that have relatively high percentages of adolescent mothers and should be specifically targeted by teen pregnancy prevention efforts. However, older maternal age not adolescent age was found to be significantly associated with low birth weight and small-for-gestational age in this study.

While low birth weight declined in the state and in all other ethnic groups, it increased significantly among Samoans and was accompanied by a non significant but worrisome increase in the proportion of low birth weight and preterm infants. Black mothers also experienced an increase in very low birth weight, very preterm, and

Table 5.—Regression Analysis of Factors Associated with Pregnancy Outcomes, Hawaii Resident Live Births, 1991-94.

Maternal Characteristics	Mean BW (g)		LBW (< 2,500 g)		SGA	
	Parameter	S.E. estimate	Odds ratio (95% C.I.)	P value	Odds ratio (95% C.I.)	P value
Intercept	3,491.0	6.18				
Age < 18 yrs	-51.3*	12.70	1.17 (0.99, 1.38)	.06	0.98 (0.85, 1.12)	.75
Age ≥ 35yrs	-27.9*	6.27	1.50 (1.37, 1.65)	< .01	1.16 (1.08, 1.26)	< .01
Low educ attain.	-47.5*	7.90	1.15 (1.03, 1.30)	.02	1.20 (1.10, 1.31)	< .01
High educ. attain	32.2*	4.51	0.84 (0.78, 0.91)	< .01	0.87 (0.82, 0.92)	< .01
Primiparity	-104.2*	4.31	1.45 (1.36, 1.56)	< .01	1.59 (1.51, 1.68)	< .01
High parity-for-age	-47.9*	14.82	1.12 (0.90, 1.40)	.31	1.03 (0.85, 1.25)	.77
Unmarried	-51.1*	5.57	1.18 (1.08, 1.28)	< .01	1.16 (1.09, 1.24)	< .01
Foreign-born	12.0*	5.90	0.90 (0.82, 0.99)	0.3	0.95 (0.88, 1.02)	.13
Active milit. duty	24.3*	6.14	1.18 (1.06, 1.30)	< .01	0.92 (0.85, 1.00)	.05

Reference groups: Age 18 - 34; average educational attainment; average parity-for-age; married; U.S.-born; civilian.

* Indicates statistical significance at P < 0.05.

preterm births. This is a matter of concern, particularly in light of their over-representation in the military population in Hawaii, where financial barriers to access of health care services are presumably not an issue.⁸ Further investigation is needed to ascertain the reasons for this disturbing trend among Samoan and Black women.

Mean gestational age declined coinciding with the reduction of postterm and an increase in preterm births. The decline in mean gestational age may have been influenced by changes in obstetrical practices during this period or may reflect changes in the completeness, accuracy and method of reporting gestational age estimates on birth certificates.

Notwithstanding the decline in the proportion of low birth weight infants, the Hawaii rate is still above the U.S. and Hawaii Year 2000 objective of 5%.²⁻³ This finding may suggest the need for a reappraisal of current approaches to address this important public health problem. The multiethnic population of Hawaii, which encompasses diverse groups with disparate anthropometry, socio-economic and nativity status, nutritional practices and cultural traditions, presents a unique challenge to the development of programs and policies aimed at improving pregnancy outcomes.⁹⁻¹⁵ The association of maternal age ≥ 35 years, single marital status, and primiparity, as well as low educational attainment, with low birth weight indicates that focused MCH programs, albeit culturally appropriate, are not sufficient to combat poor pregnancy outcomes as the various risk factors are distributed in the whole population. All providers of health care need to contribute to the effort by focusing on the changed characteristics of their clientele that may

increase the risk of low birth weight in groups otherwise considered in good health. The findings of this study are relevant to health services providers across the socio-economic span. They pinpoint characteristics of population groups that may require special attention to individual women in every ethnic group.

State level MCH needs assessments are aimed at fostering a closer collaboration and complementarity between public agencies in charge of developing programmatic and policy directions and the health services providers who have the responsibility to implement such activities at the individual client level. The examination of vital record data offers the possibility of establishing such essential collaboration on the basis of population-wide information for mothers and infants. The usefulness of information derived from vital records depends on the completeness and accuracy of the information reported. The proportion of records missing gestational age data increased during the study period from 3% to 11%. Concerted efforts should be made to improve the quality of birth certificates and to explain their relevance to the quality of care provided in the state otherwise Hawaii will fail to realize the maximum benefit from this irreplaceable source of readily available data.

In spite of its great usefulness, information on maternal sociodemographic characteristics, birth weight and gestational age is limited in its ability to adequately guide the direction of programs, policies, and service delivery to improve pregnancy outcomes. Infant mortality data could enhance these investigations;¹⁶ but infant death is sufficiently rare that its annual assessment by ethnic group is hindered by unstable small numbers. Other sources of data, including surveys and focus groups, are needed to compile a more complete picture of the population to understand factors that influence pregnancy outcomes.

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