

# An Approach to Studying Social Disparities in Health and Health Care

Paula A. Braveman, MD, MPH, Susan A. Egerter, PhD, Catherine Cubbin, PhD, and Kristen S. Marchi, MPH

With this article, we propose an approach to studying and monitoring social disparities in health and health care, using prenatal care as an example. We use the term “social disparities in health” broadly here to refer to differences in health—or likely determinants of health—that are systematically<sup>1,2</sup> associated with different levels of underlying social advantage or position in a social hierarchy.<sup>3</sup> Social advantage or position is reflected by economic resources, occupation, education, racial/ethnic group, gender, sexual orientation, and other characteristics associated with greater resources, influence, prestige, and social inclusion.<sup>3–7</sup>

Social disparities in health place people already disadvantaged by belonging to particular social groups at further disadvantage with respect to their health<sup>3,8,9</sup>; good health in turn is essential to escape from social disadvantage.<sup>9–11</sup> Efforts to reduce social disparities in health and equalize opportunities for optimal health reflect social and ethical values,<sup>8,12</sup> including solidarity or compassion<sup>8,13</sup> and distributive justice,<sup>13</sup> and are consonant with human rights principles.<sup>3,13,14</sup> The goals of *Healthy People 2010* include eliminating social disparities in health and health care.<sup>15</sup>

Social disparities in health, including gaps in maternal and child health and health care, are large and persistent in the United States.<sup>16–39</sup> There is widespread recognition that closing these gaps will require more effective strategies, including monitoring and research to guide and evaluate policies.<sup>5,40–48</sup> However, apart from racial/ethnic breakdowns of vital statistics, routine monitoring of social disparities in health in the United States has generally been limited.<sup>40,41,49–51</sup> This article was based on work supported by the Centers for Disease Control and Prevention and the Kaiser Family Foundation that examined socioeconomic and racial/ethnic disparities in 3 maternal and infant health indicators—unintended pregnancy, breastfeeding, and delayed or no prenatal care—in California during 1994–1995 and

**Objective.** We explored methods and potential applications of a systematic approach to studying and monitoring social disparities in health and health care.

**Methods.** Using delayed or no prenatal care as an example indicator, we (1) categorized women into groups with different levels of underlying social advantage; (2) described and graphically displayed rates of the indicator and relative group size for each social group; (3) identified and measured disparities, calculating relative risks and rate differences to compare each group with its a priori most-advantaged counterpart; (4) examined changes in rates and disparities over time; and (5) conducted multivariate analyses for the overall sample and “at-risk” groups to identify particular factors warranting attention.

**Results.** We identified at-risk groups and relevant factors and suggest ways to direct efforts for reducing prenatal care disparities.

**Conclusions.** This systematic approach should be useful for studying and monitoring disparities in other indicators of health and health care. (*Am J Public Health*. 2004;94:2139–2148)

1999–2001. A separate report<sup>52</sup> on that work, aimed at a wide nontechnical audience, highlights issues that policies should address. The focus of our article is primarily methodological, aiming to illustrate a systematic approach for studying and monitoring disparities that can be adapted for other indicators and populations. Space constraints limit us here to using 1 indicator—delayed or no prenatal care—as an example. Although the ideal content and number of prenatal visits are unknown,<sup>53,54</sup> few would contest the importance of at least 1 first-trimester visit for timely assessment and health promotion.<sup>55–57</sup> Healthy People 2010 objectives<sup>15</sup> include first-trimester care for at least 90% of childbearing women.

## METHODS

### Data Sources

We used cross-sectional data from 2 California statewide representative postpartum surveys, with approval from the University of California, San Francisco committee on human research and the California Health and Human Services Agency committee for the protection of human subjects. The 1999–2001 data (n=10 519) were obtained from the Maternal and Infant Health Assessment (MIHA). A col-

laborative effort of the California Department of Health Services Maternal and Child Health Branch and University of California, San Francisco, modeled on the Centers for Disease Control and Prevention’s Pregnancy Risk Assessment Monitoring System,<sup>58</sup> MIHA is an annual population-based mail survey (with telephone follow-up of nonresponders) of mothers a few months after they give birth to live-born infants in California. Data for 1994 and 1995 were obtained from the Access to Maternity Care (ATM) survey, in which 10 132 mothers of live-born infants were interviewed during their postpartum stays in 19 randomly selected California hospitals. The ATM survey was conducted with support from the Agency for Health Care Policy Research, the California Department of Health Services, and the Robert Wood Johnson Foundation. Both surveys were linked with birth certificates and with census data from 2000 (MIHA) or 1990 (ATM). Residential addresses from birth certificates were geocoded to the census tract level (approximately 4000–8000 people per tract) using MapMarker Plus software<sup>59</sup> for MIHA and services from Geographic Data Technology, Inc. (Lebanon, NH), for ATM. Both procedures use several reliable and regularly updated sources of address files (e.g., US Postal

Service, Census TIGER files),<sup>60</sup> and geocoding was successful for 97.4% of addresses in MIHA and 83.8% (87.3% after excluding 1 hospital without linked birth certificates) in ATM. Both statistically weighted samples were similar to the statewide maternity populations during corresponding time periods. MIHA and ATM response rates were 71% and 86%, respectively. Methods for both surveys have been described elsewhere.<sup>29,61,62</sup>

## Variables

The indicator of health and health care used as an example was delayed or no care, which was defined as either beginning prenatal care after the first trimester or receiving no prenatal care during the index pregnancy. Social groups were defined according to (1) 3 socioeconomic variables (i.e., family income, maternal education, and neighborhood poverty), chosen a priori to categorize the sample into groups reflecting different dimensions of socioeconomic status or position plausibly related to delayed or no care<sup>28,56,61,63–65</sup>, and (2) race/ethnicity.

**Family income.** Family income was defined as the self-reported family income during pregnancy in 100% increments of the federal poverty level for the relevant year (e.g., \$17 650 for a family of 4 in 2001). Income of the nuclear family (the woman, her partner, and dependent children) was used instead of household income to conform with eligibility criteria for Medi-Cal and other programs that could influence prenatal care use.

**Maternal education.** Maternal education was defined as the respondent's self-reported highest completed educational level (i.e., did not complete high school, high-school graduate, some college, college graduate).

**Neighborhood poverty.** The definition of neighborhood poverty was based on women's residences at the index birth, defining a "poor" neighborhood as a census tract with at least 20% of persons below the federal poverty level<sup>66</sup> in 1990 (ATM) or 2000 (MIHA). We used census tracts rather than smaller block groups because tracts generally geocode at a higher rate and are simpler to use; previous studies have found similar results using tracts or block groups to define neighborhoods.<sup>67–69</sup> Although multiple characteristics of neighborhoods ideally should be examined,<sup>28,70–72</sup> for brevity we examined only poverty concentra-

tion, which has been widely used<sup>68,73–78</sup> and is easily understood by policymakers. Sample size constraints (e.g., few women in the highest income or education categories lived in "poor" neighborhoods) limited us to 2 poverty concentration categories; the 20% cutoff reflects the US Census Bureau definition of "poverty area"<sup>79</sup> and is supported by previous studies.<sup>73–76</sup>

**Race/ethnicity.** Self-reported racial/ethnic identification was categorized as African American, Asian/Pacific Islander, European American (including women from the Middle East), immigrant Latina, US-born Latina, or Native American/Alaska Native. Small numbers precluded separate multivariate analyses for Native Americans and categorizing non-Latina women by nativity.

Other covariates in 1999–2001 MIHA data were chosen on the basis of the literature<sup>56,63,65,80,81</sup> as being plausibly associated with delayed or no care, either as confounders or as mediators on pathways between social factors and prenatal care: paternal education, maternal first-trimester insurance coverage,<sup>81</sup> age, parity, marital status at the time of birth, primary language spoken at home, having a regular source of health care before pregnancy, whether the respondent felt her receipt of prenatal care was "very important" to others close to her, unintended pregnancy, initial unhappiness about the pregnancy, the respondent's general "sense of control" over her life ("mastery"),<sup>82</sup> and both smoking and drinking during pregnancy (as markers of general knowledge, attitudes, or beliefs that could influence use of care).

## Statistical Analyses

**Describing social disparities in prenatal care.** After categorizing women in each time period into social groups defined by family income, education, neighborhood poverty, and race/ethnicity, we estimated rates of delayed or no care in each group and calculated rate differences and relative risks for each group compared with the a priori most-advantaged corresponding group (Table 1). For example, each of the 4 lower income groups was compared with the highest income group. Because both risk levels and relative size of groups are relevant, we further examined disparities by income and education in 2 ways: (1) using bar graphs, with bar width reflecting the proportion of the popu-

lation in each group (suggested to us by work published by Wagstaff et al.<sup>83</sup>; this approach was used by Krieger and colleagues in 2002<sup>68</sup>); and (2) estimating 2 "summary (composite) measures"—the population-attributable risk and the relative index of inequality<sup>83–85</sup> (defined in Table 1 footnotes). Comparing 1994–1995 and 1999–2001, we examined changes between the 2 periods in the group-specific rates of delayed or no care, the sizes of the disparities, and the socioeconomic distributions.

**Identifying issues that warrant attention in efforts to reduce disparities.** Using logistic regression to estimate the odds ratio for delayed or no care in each disadvantaged social group relative to its counterpart a priori most-advantaged group, we assessed the potential contributions of different variables to the observed disparities by comparing the unadjusted and adjusted odds ratios from a series of models. We considered the variables used to define the social groups of a priori interest—income, maternal education, neighborhood poverty, and racial/ethnic group—together in the initial model. We next added other covariates in sequential models and in a final model including all variables, observing the effects on the odds ratios for each social variable. For simplicity, and because the results generally had similar implications, we report only the findings from the (1) unadjusted models, (2) initial multivariate model including the 4 social variables, and (3) full model; sequential models are not displayed.

Using 1999–2001 data, we identified at-risk social groups warranting particular attention because they did not meet the *Healthy People 2010* objective of 90% with early care and had elevated risks relative to their a priori most-advantaged counterparts. We conducted separate logistic regression analyses, including all covariates listed above, to explore risk factors for delayed or no care in each at-risk group. Because policy implications depend in part on numbers of affected people, we also calculated the prevalence of each covariate within each at-risk group.

All analyses were conducted with SUDAAN software<sup>86</sup> to account for effects of the clustered survey sampling designs<sup>87</sup> and to alleviate difficulties with statistical inference introduced by including both individual and family- and neighborhood-level variables in models.<sup>88,89</sup> Previous studies used a similar

**TABLE 1—Rates, Rate Differences, and Relative Risks of Delayed or No Care, by Income, Education, Race/Ethnicity, and Neighborhood Poverty, and Summary Measures of Socioeconomic Disparities: Postpartum Women Surveyed in California, 1994–1995 and 1999–2001**

	% of Total	% Delayed or No Care	95 % CI	Rate Difference	Relative Risk	95 % CI	PAR% <sup>a</sup>	RII <sup>b</sup>
1994–1995 (n = 10 132) <sup>c</sup>								
% of federal poverty level								
Missing	3.2	25.0	(14.2, 35.8)	21.2	6.6	(2.5, 17.2)*		
0–100	44.9	37.5 <sup>d</sup>	(34.4, 40.6) <sup>d</sup>	33.7 <sup>d</sup>	9.9	(5.6, 17.5)*		
101–200	18.1	17.9	(13.4, 22.4)	14.1	4.7	(2.1, 10.6)*	77.06	-2.03
201–300	11.9	11.8	(9.4, 14.2)	8.0	3.1	(1.6, 5.9)*		
301–400	8.6	8.1	(3.0, 13.2)	4.3	2.1	(0.6, 7.4)		
≥401	13.2	3.8	(1.8, 5.8)		1.0			
	100.0							
Maternal education <sup>e</sup> (completed level)								
< High school	30.0	38.0 <sup>d</sup>	(32.9, 43.1) <sup>d</sup>	31.5 <sup>d</sup>	5.8	(3.8, 8.9)*		
High school graduate/GED	31.3	24.4	(20.5, 28.3)	17.9	3.7	(2.7, 5.2)*		
Some college	23.9	14.6	(10.3, 18.9)	8.1	2.2	(1.2, 4.1)*	72.22	-1.69
College graduate	14.8	6.5	(3.8, 9.2)		1.0			
	100.0							
Neighborhood poverty								
Missing	18.2	22.2	(10.6, 25.9)	2.0	1.2	(0.7, 2.0)		
≥20% poor	22.7	31.6 <sup>d</sup>	(27.9, 35.3) <sup>d</sup>	11.4 <sup>d</sup>	1.6	(1.4, 1.7)*		
<20% poor	59.2	20.2	(17.1, 23.3)		1.0			
	100.0							
Race/ethnicity <sup>f</sup>								
African American	6.8	21.6	(15.7, 27.5)	6.5	1.4	(0.8, 2.6)		
Asian/Pacific Islander	9.9	25.9	(17.5, 34.3)	10.8	1.7	(0.9, 3.2)		
Foreign-born Latina	35.4	31.5	(26.8, 36.2)	16.4	2.1	(1.4, 3.1)*		
US-born Latina	12.5	24.0	(18.5, 29.5)	8.9	1.6	(1.3, 1.9)*		
Native American/Alaska Native	0.4	26.5	(3.6, 49.4)	11.4	1.8	(0.7, 4.4)		
European American	34.9	15.1	(10.0, 20.2)		1.0			
	100.0							
1999–2001 (n=10,519) <sup>g</sup>								
% of federal poverty level								
Missing	9.9	22.3	(19.6, 25.0)	18.9	6.6	(5.0, 8.6)*		
0–100	31.2	27.9 <sup>d</sup>	(26.3, 29.5) <sup>d</sup>	24.5 <sup>d</sup>	8.2	(6.4, 10.5)*		
101–200	20.6	18.3	(16.5, 20.1)	14.9	5.4	(4.2, 7.0)*	75.50	-2.19
201–300	9.9	12.8	(10.6, 15.0)	9.4	3.8	(2.8, 5.0)*		
301–400	7.3	6.0	(4.2, 7.8)	2.6	1.8	(1.2, 2.6)*		
≥401	21.1	3.4	(2.6, 4.2)		1.0			
	100.0							
Maternal education <sup>e</sup> (completed level)								
< High school	22.8	28.4 <sup>d</sup>	(26.4, 30.4) <sup>d</sup>	22.0 <sup>d</sup>	4.4	(3.7, 5.3)*		
High school graduate/GED	23.6	21.9	(20.1, 23.7)	15.5	3.4	(2.8, 4.1)*		
Some college	30.4	12.7	(11.5, 13.9)	6.3	2.0	(1.6, 2.4)*	62.38	-1.70
College graduate	23.1	6.4	(5.2, 7.6)		1.0			
	100.0							
Neighborhood poverty								
Missing	2.8	15.2	(10.7, 19.7)	0.9	1.1	(0.8, 1.4)		
≥20% poor	30.0	23.8 <sup>d</sup>	(22.2, 25.4) <sup>d</sup>	9.5 <sup>d</sup>	1.7	(1.5, 1.8)*		

Continued

TABLE 1—Continued

<20% poor	67.1	14.3	(13.4, 15.2)		1.0	
	100.0					
Race/ethnicity <sup>f</sup>						
African American	6.4	18.8	(16.6, 21.0)	9.5	2.0	(1.7, 2.4)*
Asian/Pacific Islander	10.2	17.8	(15.3, 20.3)	8.5	1.9	(1.6, 2.3)*
Foreign-born Latina	28.6	25.1	(23.3, 26.9)	15.8	2.7	(2.4, 3.1)*
US-born Latina	16.0	19.2	(17.0, 21.4)	9.9	2.1	(1.8, 2.4)*
Native American/Alaska Native	0.6	17.8	(7.0, 28.6)	8.5	1.9	(1.0, 3.5)
European American	38.2	9.3	(8.3, 10.3)		1.0	
	100.0					

Note. CI = confidence interval; GED = general equivalency diploma.

<sup>a</sup>PAR%: Population attributable risk percentage (PAR) is the percentage reduction in delayed or no care in the population overall that would occur if all groups of pregnant women were to experience the rate of the most-advantaged group.

<sup>b</sup>RII: The relative index of inequality (RII) reflects the experiences of the entire population, taking into account the relative size of each socioeconomic group. It involves calculating the mean health status of each socioeconomic group and then ranking the groups by their socioeconomic status. A summary measure (the slope index of inequality) is formed by means of weighted regression analysis. The RII is calculated above by dividing the slope index of inequality (the average decline in the standardized rate of delayed or no care moving from the most-disadvantaged to the most-advantaged socioeconomic group) by the rate of delayed or no care among women overall.

<sup>c</sup>Overall rate of delayed or no care in 1994–1995: 23.5% (95% CI = 20.3, 26.7).

<sup>d</sup>Significantly different ( $P < .05$ ) from the corresponding estimates in the other time period.

<sup>e</sup>Excludes women with unknown education: 0.3% in 1994–1995 and 0.9% in 1999–2001.

<sup>f</sup>Excludes women with unknown or other race/ethnicity: 0.8% in 1994–1995 and 2.4% in 1999–2001.

<sup>g</sup>Overall rate of delayed or no care in 1999–2001: 17.1% (95% CI = 16.3, 17.9).

\*Statistically significant difference compared with most-advantaged group ( $P < .05$ ).

approach.<sup>71,90–94</sup> Explicit multilevel linear modeling techniques were not used here because generally few women were sampled per tract (<5 in 90% of tracts in 1999–2001).<sup>95</sup>

## RESULTS

### Describing Social Disparities in Prenatal Care

Table 1 displays the income, maternal education, neighborhood poverty, and race/ethnicity distributions and corresponding delayed or no care rates during 1994–1995 and 1999–2001. In both periods, an income gradient in delayed or no care rates was suggested: the lower a woman's income, the more likely she was to lack first-trimester care. Figure 1 displays this graphically, along with the proportions of women in each income group. Compared with the highest income group, significantly higher rates (i.e., significant rate differences) and relative risks of delayed or no care were seen in both periods not only for the poorest women but for each income group up to 300% of poverty, and first-trimester care rates in all of these groups were below the 90% *Healthy People 2010* objective. Similarly, even women who had attended but not graduated from college had

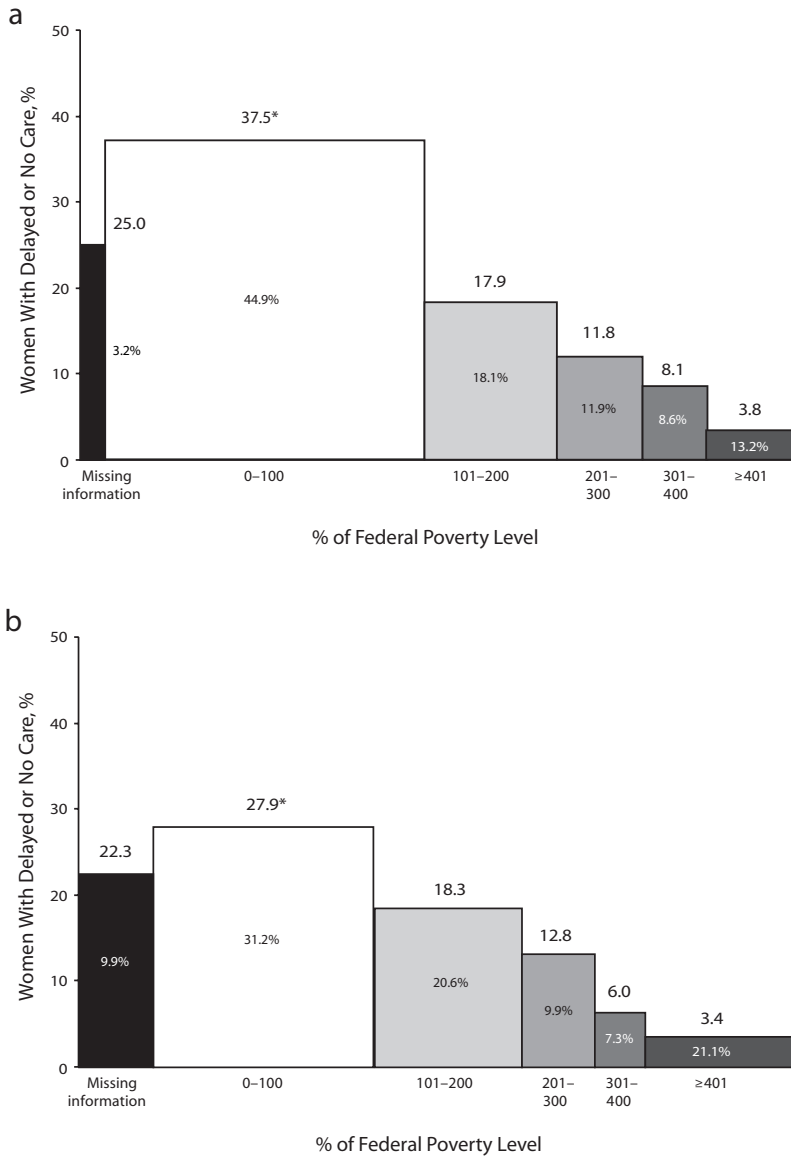
higher rates of delayed or no care than college graduates. At both times, delayed or no care rates were higher for women in poor compared with nonpoor neighborhoods; this difference was observed within most income, education, and racial/ethnic groups (not displayed). During both periods, all other racial/ethnic groups appeared to have higher rates of delayed or no care than European Americans, although these differences were not always statistically significant.

As shown in Table 1 and Figure 1, the percentage of women who were poor declined from 45% in 1994–1995 to 31% in 1999–2001. Comparing the 2 periods, we found declines in delayed or no care rates overall and within the most disadvantaged socioeconomic groups (poor, not high school graduates, residents of poor neighborhoods), with apparent declines in the corresponding rate differences for these groups. Comparing relative risks in the 2 periods, we found no significant reductions in the size of the disparities in care initiation. For example, although a smaller percentage of poor women had delayed or no care in 1999–2001 compared with 1994–1995, the relative gap between the poorest and most affluent groups was not significantly smaller. Comparing summary

measures of socioeconomic disparities for the 2 periods also suggested no significant improvement in income or education disparities.

### Identifying Issues that Warrant Attention in Efforts to Reduce Disparities

Table 2 displays prevalence rates and unadjusted odds ratios of delayed or no care in the entire 1999–2001 sample for each social group variable and covariate, along with multivariate results. Results from the initial model (model 1), including only the 4 variables defining the social groups of a priori concern, show that adjusted odds ratios for all income groups up to 300% of poverty remained significantly elevated and were not significantly lower than the unadjusted estimates; adjusted odds ratios for the education groups without any college remained elevated but were significantly reduced; and differences by neighborhood poverty were no longer significant. Compared with European Americans, other racial/ethnic groups remained at significantly higher risk of delayed or no care, but the odds ratio for each group except Asian/Pacific Islanders was significantly reduced after adjusting for the 3 socioeconomic variables. Full model (model 2) results again showed



Note. Width of bar shows percentage of population in each income group.

\*The proportion for this group in 1999-2001 was significantly different from that in 1994-1995 (at  $\alpha = .05$ ).

**FIGURE 1—Proportions of women with delayed or no prenatal care, by income: postpartum women surveyed in California in (a) 1994-1995 and (b) 1999-2001.**

marked and statistically significant income disparities; however, no other social group except Asian/Pacific Islanders appeared to be at elevated risk.

Separate models were run for the 3 groups of women—those with incomes up to 300% of poverty, lacking college degrees, or living in poor neighborhoods—identified as at-risk

(not displayed). In all 3 groups, significantly higher risks of delayed or no care were seen among women who were multiparous, lacked first-trimester insurance, reported that their prenatal care was not “very important” to others close to them, had unintended pregnancies, were initially unhappy about being pregnant, or were Asian/Pacific Islanders. Ele-

vated risks also were seen (but not in all 3 groups) among women who were young teens, unmarried, or who smoked or drank during pregnancy. Most of these risk factors were experienced by at least 10%—unintended pregnancy by over 40%—of women in each at-risk group.

## DISCUSSION

The objective of this article was to demonstrate the methods and potential applications of a systematic approach for studying and monitoring social disparities in health and health care. Using routinely collected population-based information for childbearing women in California during 1994-1995 and 1999-2001 and focusing on prenatal care as an example indicator, we (1) identified and measured disparities in delayed or no prenatal care across social groups defined by family income, maternal education, neighborhood poverty, and race/ethnicity; and (2) identified factors to consider in future efforts to reduce disparities. Results on the example indicator—delayed or no care—are discussed here to illustrate how this approach might provide useful information for other indicators, rather than to provide a comprehensive discussion of how to reduce prenatal care disparities.

Despite significant improvements in early prenatal care rates among childbearing women in California overall and within disadvantaged groups, disparities did not appear significantly smaller in 1999-2001 than in 1994-1995. In both periods, most groups of childbearing women in California had elevated delayed or no care rates, in absolute and relative terms. Only women with incomes above 300% of poverty, college graduates, and European Americans met the *Healthy People 2010* target. Although the proportion of childbearing women in poverty declined, as did rates of poverty in the general population at that time,<sup>96</sup> disparities by income persisted. In earlier work, we found marked improvements and reduced disparities in early prenatal care corresponding with federal and state initiatives during the late 1980s and early 1990s.<sup>65,97</sup> The absence of continued reductions in disparities during the later



**TABLE 2—Odds Ratios for Delayed or No Prenatal Care, by Income, Maternal Education, Race/Ethnicity, and Neighborhood Poverty: Postpartum Women (n = 10 210) Surveyed in California, 1999–2001**

	% of Total	Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)	
			Model 1	Model 2
<b>Primary social variable</b>				
% of federal poverty level				
Missing	10.2	8.28 (6.18, 11.10)	5.98 (4.32, 8.29)	3.42 (2.32, 5.04)
0–100	31.9	10.91 (8.41, 14.14)	6.94 (5.05, 9.54)	2.98 (2.03, 4.39)
101–200	20.4	6.31 (4.80, 8.30)	4.55 (3.31, 6.26)	2.39 (1.64, 3.49)
201–300	9.5	4.02 (2.93, 5.53)	3.33 (2.35, 4.70)	2.62 (1.78, 3.85)
301–400	7.1	1.65 (1.09, 2.52)	1.49 (0.96, 2.30)	1.46 (0.89, 2.37)
≥ 401	20.8	Reference	Reference	Reference
<b>Maternal education (completed level)</b>				
Less than high school	23.8	5.90 (4.80, 7.25)	1.95 (1.49, 2.54)	1.33 (0.96, 1.85)
High school/GED	23.8	4.16 (3.37, 5.13)	1.66 (1.28, 2.14)	1.30 (0.95, 1.78)
Some college	29.6	2.16 (1.74, 2.67)	1.20 (0.93, 1.54)	1.05 (0.78, 1.40)
College graduate	22.8	Reference	Reference	Reference
<b>Neighborhood poverty<sup>a</sup></b>				
≥ 20% poor	30.9	1.90 (1.69, 2.13)	0.99 (0.87, 1.13)	1.01 (0.87, 1.18)
< 20% poor	69.1	Reference	Reference	Reference
<b>Race/ethnicity<sup>b</sup></b>				
African American	6.5	2.25 (1.87, 2.70)	1.25 (1.01, 1.53)	1.26 (1.00, 1.60)
Asian/Pacific Islander	10.3	2.10 (1.69, 2.60)	2.17 (1.74, 2.72)	2.29 (1.70, 3.09)
Foreign-born Latina	29.8	3.26 (2.80, 3.78)	1.38 (1.16, 1.65)	1.20 (0.88, 1.63)
US-born Latina	16.0	2.31 (1.94, 2.76)	1.23 (1.01, 1.49)	1.24 (0.98, 1.57)
European American	37.5	Reference	Reference	Reference
<b>Covariate</b>				
<b>Paternal education (completed level)</b>				
Missing	8.0	6.49 (5.10, 8.26)		1.20 (0.85, 1.71)
Less than high school	23.6	5.52 (4.49, 6.78)		1.15 (0.82, 1.59)
High school/GED	28.5	3.44 (2.80, 4.22)	...	1.13 (0.83, 1.52)
Some college	17.0	1.98 (1.56, 2.52)		1.03 (0.76, 1.41)
College graduate	23.0	Reference		Reference
Unmarried	34.5	2.67 (2.38, 2.99)	...	1.26 (1.06, 1.49)
<b>Maternal age, y</b>				
15–17	3.9	5.17 (3.96, 6.74)		2.45 (1.65, 3.62)
18–19	6.8	2.50 (1.95, 3.20)	...	1.38 (0.97, 1.96)
20–34	73.5	1.47 (1.23, 1.75)		1.12 (0.88, 1.43)
≥ 35	15.7	Reference		Reference
<b>Parity</b>				
≥ 5 births	4.3	2.40 (1.89, 3.05)		1.75 (1.23, 2.48)
2–4 births	55.7	1.14 (1.01, 1.28)	...	1.37 (1.15, 1.63)
First birth	40.1	Reference		Reference
No coverage in first trimester	17.5	6.60 (5.81, 7.50)	...	4.61 (3.93, 5.40)
No usual source of prepregnancy care	30.0	2.05 (1.82, 2.30)	...	1.10 (0.94, 1.28)
Non-English language spoken at home	40.3	2.18 (1.94, 2.43)	...	1.09 (0.86, 1.39)
Prenatal care not “very important” to others	6.8	3.01 (2.52, 3.59)	...	1.92 (1.52, 2.42)

Continued

1990s may reflect a lack of major new initiatives, “welfare reform,” or changes in policies affecting immigrants.<sup>98–103</sup>

The findings presented here suggest that interventions to further reduce prenatal care disparities should be more broadly targeted to reach women with incomes up to 300% of poverty (approximately three quarters of the California maternity population in 1999–2001) and those without college degrees (also approximately three quarters of childbearing women), as well as Asian/Pacific Islanders (10% of childbearing women) who are not generally considered at-risk. Our results confirmed earlier evidence that interventions to promote early prenatal care should focus on first-trimester insurance coverage,<sup>81</sup> family planning,<sup>63</sup> and general population attitudes about prenatal care.<sup>63</sup> Even with these efforts, the findings suggest that social disparities in prenatal care are unlikely to be eliminated without addressing underlying economic inequalities. Significant income disparities persisted after adjusting for education, insurance, and many other factors that may be on pathways from economic disadvantage to delayed or no prenatal care. Notably, racial/ethnic disparities were greatly reduced for most groups when income, education, and neighborhood poverty were considered.

We believe that the general approach presented here and summarized in Table 3 provides a model for monitoring social disparities and informing efforts to reduce them. Particularly relevant for states with Centers for Disease Control and Prevention Pregnancy Risk Assessment Monitoring System surveys, the approach requires routinely collected population-based data—on key social factors, potential risk or protective factors, and indicators of health (including health status, health care, health-related behaviors, and other likely health determinants)—that can be disaggregated to compare groups with different levels of underlying social advantage.<sup>5,41,104–106</sup> Socioeconomic, racial/ethnic, gender, and geographic groups should always be considered when potentially relevant. Another crucial element of the approach is to examine indicators of health separately for each social group, comparing all other social groups with the a priori most-advantaged group. With that group

TABLE 2—Continued

Smoked during pregnancy	10.5	1.84 (1.57, 2.15)	...	1.33 (1.07, 1.64)
Drank during pregnancy	18.7	1.12 (0.97, 1.29)	...	1.50 (1.25, 1.81)
Sense of control (7 = least, 28 = most), mean	23.05	0.90 (0.88, 0.91)	...	0.99 (0.97, 1.01)
Unintended pregnancy	46.7	2.84 (2.52, 3.19)	...	1.52 (1.29, 1.80)
Somewhat/very unhappy about pregnancy	18.7	2.55 (2.25, 2.89)	...	1.36 (1.15, 1.61)

Note. CI = confidence interval; GED = general equivalency diploma.

<sup>a</sup>Women with missing data on neighborhood poverty were excluded.

<sup>b</sup>Native American/Alaska Native, other, or unknown race/ethnicity were excluded because of too few numbers.

TABLE 3—Overview of an Approach to Studying Social Disparities in Health and Health Care

1. Define groups with different levels of social advantage.
  - Categorize the population into socioeconomic and racial/ethnic groups (and other social groups of concern), identifying the a priori most-advantaged group in each category and viewing all other groups as relatively disadvantaged.
  - Use at least 2 different socioeconomic measures (e.g., education and income) and categorize into as many groups as sample sizes permit.
2. Describe the social disparities.
  - Examine the distributions of each social variable for each time period and rates of the health or health care indicator in each social group. Display the information as clearly as possible, in tabular and graphical form (Figure 1), using bar graphs in which (a) the height of each bar corresponds to the rate of the indicator in the social group and (b) the width corresponds to the relative size of the group (the proportion of the population included in the group).
  - Quantify the size of the gaps at each time using relative risks and rate differences, comparing each disadvantaged group with the a priori most-advantaged group. If possible, confirm socioeconomic comparisons using summary measures.
  - Compare differences across time periods in (a) group-specific rates of the health-related indicator, (b) the sizes of the disparities, and (c) the sizes of the social groups.
  - Identify at-risk social groups (a priori disadvantaged groups with elevated rates of adverse outcomes).
3. Identify important issues that should be addressed to reduce disparities.
  - Review previous research and local experience to identify likely risk and protective factors in at-risk groups; whenever possible, consult representatives of those groups.
  - When technical capabilities permit, use multivariate analyses to identify significant risk factors—including the social variables—in the population overall and in the identified at-risk social groups.
  - Calculate the prevalences of significant risk factors overall and in each at-risk group.
4. Disseminate findings to policymakers, advocates, and the public, highlighting how the results might inform further efforts to reduce disparities.

as a reference, disparities can be measured using rate differences and relative risks (and, when feasible, more complex summary measures), and at-risk social groups can be identified. Examining changes over time provides critical information for guiding policy. Although not definitive, a narrowing disparity may indicate that current policies should continue; a widening gap may suggest the need for changes. Policy responses are also informed by changes in the sizes of different socioeconomic groups (particularly in the proportions

who are poor or near-poor, of low educational levels, or living in poor neighborhoods) and in the prevalence of likely risk factors.

When informing policymakers about social disparities in health, a major challenge is to present information clearly and meaningfully without being simplistic. Descriptive findings can be presented in tables and graphically. Although summary measures (reflecting both the overall distribution of a socioeconomic variable and differences in risk across groups defined by that vari-

able<sup>83–85</sup>) are not widely used in research and may have limited intuitive meaning for policymakers, they can help to confirm conclusions based on simpler measures and to compare socioeconomic (but not racial/ethnic) disparities across states or time. A simpler alternative, illustrated in Figure 1, is to graphically display changes over time in both the observed socioeconomic disparities and the socioeconomic distribution. Policymakers are familiar with the concepts involved in these descriptive analyses, and health departments should have the necessary capabilities. When the requisite technical expertise is available, multivariate modeling can help identify risk factors to consider. Regardless of the analytic techniques used, quantitative results must be interpreted in the context of policies in all sectors that could influence health, informed by the literature and local knowledge. Although beyond the scope of this discussion, for many reasons we recommend that any study of disparities include representatives of relevant social groups to help identify issues and interpret findings.<sup>105,107,108</sup>

Work to describe and understand disparities, including selecting social groups to compare and covariates to examine, must be tailored to each health or health care indicator.<sup>109</sup> Using this approach with other indicators and in other states will require adaptations to accommodate differences in data sources, population sizes and characteristics, and technical capabilities. Several limitations we encountered are also likely to affect other efforts. No study can capture all relevant socioeconomic information, but every study should include at least 1 measure of economic resources. Income is limited as a measure of economic resources; however, at least in the US, data are more widely available on income than on accumulated assets. Education is important in itself but should not be used as a proxy for income.<sup>5,72,110,111</sup> The choice of socioeconomic and racial/ethnic variables will generally be limited in studies like this that rely on existing data. The surveys we used were restricted to women who spoke or read English or Spanish, which could have affected findings on Asian-Pacific Islanders. With data from different surveys and only 2 time periods, we could not formally assess trends over time.

Differences in neighborhood-level poverty results between time periods should be interpreted with particular caution for several reasons, including the following: the neighborhoods of surveyed women may not represent neighborhoods statewide; geocoding completeness and accuracy could differ between surveys (e.g., 16.2% of the earlier sample could not be geocoded); and effects may vary depending on the neighborhood socioeconomic characteristic being studied.<sup>28,70,71</sup> Because our primary goal was to demonstrate an overall approach, we did not explore many other area-level factors (e.g., the geographic distribution of health care facilities or providers) with potential relevance for prenatal care. Other states will also face limitations related to sample size, particularly for less prevalent indicators, requiring longer periods of data collection.

We hope that this work will generate discussion leading to more systematic and comprehensive approaches to studying and monitoring social disparities in health, particularly at the state level. Analyses must be framed and findings interpreted with the explicit goal of informing efforts to reduce disparities, systematically focusing on improvements among the socially disadvantaged.<sup>112</sup> Although health policymakers cannot dictate policies in other sectors, they can call attention to health-related disparities and advocate for action in other sectors. The economic recession and budget crises currently faced by California and other states threaten to severely cut back services that very likely contributed to earlier improvements.<sup>65,97</sup> In this environment, ongoing monitoring and analysis of state-level disparities are critical to inform policies and to ensure that scarce resources are used effectively. Monitoring and research are clearly not sufficient to eliminate disparities in health, but they are crucial.<sup>5,41,105,113,114</sup> ■

### About the Authors

Paula A. Braveman, Susan A. Egerter, Catherine Cubbin, and Kristen S. Marchi are with the Center on Social Disparities in Health and the Department of Family and Community Medicine, University of California, San Francisco. Catherine Cubbin is also with the Stanford Prevention Research Center, Stanford University, Stanford, CA.

Requests for reprints should be sent to Paula A. Braveman, MD, MPH, Center on Social Disparities in Health, Department of Family and Community Medicine, University of California, San Francisco, 500 Parnassus Avenue,

MU 3-E, San Francisco, CA 94143-0900 (email: braveman@fcm.uscf.edu).

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### Contributors

All of the authors were involved in developing the conceptual framework and analytic approach presented in the article. P.A. Braveman contributed to writing the article, supervised all aspects of the project, and was the lead investigator on both postpartum surveys used in this work. S.A. Egerter contributed to writing the article and was involved in the methodological development of both surveys. C. Cubbin analyzed the data and contributed to writing the article. K.S. Marchi analyzed the data, contributed to writing the article, and was the project director for both surveys.

### Human Participant Protection

Approval for the original surveys and for the use of survey data in this work was obtained from the University of California, San Francisco committee on human research and the California Health and Human Services Agency committee for the protection of human subjects.

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