Vulnerable Populations

America's Health Centers: Reducing Racial and Ethnic Disparities in Perinatal Care and Birth Outcomes

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Objective. To examine whether community health centers (CHCs) reduce racial/ethnic disparities in perinatal care and birth outcomes, and to identify CHC characteristics associated with better outcomes.

Background. Despite great national wealth, the U.S. continues to rank poorly relative to other industrialized nations on infant mortality and other birth outcomes, and with wide inequities by race/ethnicity. Disparities in primary care (including perinatal care) may contribute to disparities in birth outcomes, which may be addressed by CHCs that provide safety-net medical services to vulnerable populations.

Methods. Data are from annual Uniform Data System reports submitted to the Bureau of Primary Health Care over six years (1996–2001) by about 700 CHCs each year.

Results. Across all years, about 60% of CHC mothers received first-trimester prenatal care and more than 70% received postpartum and newborn care. In 2001, Asian mothers were the most likely to receive both postpartum and newborn care (81.7% and 80.3%), followed by Hispanics (75.0% and 76.3%), blacks (70.8% and 69.9%), and whites (70.7% and 66.7%). In 2001, blacks had higher rates of low birth weight (LBW) babies (10.4%), but the disparity in rates for blacks and whites was smaller in CHCs (3.3 percentage points) compared to national disparities for low-socioeconomic status mothers (5.8 percentage points) and the total population (6.2 percentage points). In CHCs, greater perinatal care capacity was associated with higher rates of first-trimester prenatal care, which was associated with a lower LBW rate.

Conclusion. Racial/ethnic disparities in certain prenatal services and birth outcomes may be lower in CHCs compared to the general population, despite serving higher-risk groups. Within CHCs, increasing first-trimester prenatal care use through perinatal care capacity may lead to further improvement in birth outcomes for the underserved.

Key Words. Perinatal care, birth outcomes, health disparities, health centers

In the United States, substantial racial/ethnic disparities exist in birth outcomes. As of 2002, the infant mortality rate for blacks (13.5 per 1,000 live births) was more than 2.5 times that of whites (5.7 per 1,000), Hispanics (5.4 per 1,000), and Asians (4.7 per 1,000) (Arias et al. 2003). Black infants were about twice as likely to be delivered low birth weight (LBW) (13.3%) as whites

(6.9%) and Hispanics (6.5%); and black infants (17.5%) were more likely to be delivered preterm than either Hispanics (11.6%) or whites (11.0%). Both LBW and preterm birth have been associated with increased risks of infant mortality, and developmental disabilities such as mental retardation and cerebral palsy (Avchen, Scott, and Mason 2001; Copper et al. 1993; Escobar, Littenberg, and Petitti 1991; Hack, Klein, and Taylor 1995; Holzman et al. 2001; Horbar et al. 2002; Thompson et al. 2003).

Substantial racial/ethnic disparities also persist in the receipt of prenatal care that has been associated with better birth outcomes (Alexander and Korenbrot 1995; Goldenberg and Rouse 1998; Ickovics et al. 2003; Kogan et al. 1994; McCormick and Siegel 2001). In 2002, blacks (75%) and Hispanics (77%) were less likely than whites (89%) and Asian/Pacific Islanders (85%) to receive prenatal care in the first trimester (Martin et al. 2003). Similarly, receipt of *adequate* prenatal care (defined by the Revised-Graduated Index of Prenatal Care Utilization) was reported by 57% of whites and 51% of blacks (Alexander, Kogan, and Nabukera 2002). Despite these differences, other studies have challenged the effectiveness of prenatal care in reducing disparities in birth outcomes due to the strength of other, more difficult to address, factors such as social class and hereditary risks (Alexander and Kotelchuck 2001; Barfield et al. 1996; Fiscella 1995; Hughes and Simpson 1995; Goldenberg et al. 1996; Lu and Halfon 2003; Lu et al. 2003; Murray and Bernfield 1988).

Birth outcomes—and infant mortality in particular—are considered barometers for the public's health. Despite great national wealth, the U.S. continues to rank poorly relative to other industrialized nations on basic health indicators, and with wide inequities by race/ethnicity and socioeconomic status (SES). The U.S. currently ranks 25th among Organization for Economic Cooperation and Development (OECD) countries in national infant mortality

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rates (*Health at a Glance* 2003). Such a poor ranking in the U.S. is incongruous with its national healthcare expenditures, which are the highest among developed countries (i.e., totaling more than 14% of the U.S. Gross Domestic Product) (*Health at a Glance* 2003). Fundamental improvement of the nation's health and international ranking on health indicators cannot be accomplished without reducing or eliminating disparities in the health of racial/ethnic minorities.

Since their inception in the 1960s, America's community health centers (CHCs) have served as a primary care safety net for underserved populations in both inner-city and rural areas (Freeman, Kiecolt, and Allen 1982; Gardner 1993; Lefkowitz and Todd 1999; Regan et al. 2003). The central mission of CHCs is to increase access to community-based primary care services and improve the health status of vulnerable populations. To receive funding, CHCs must meet federal requirements for community need and potential impact, health services, management, and finance and governance. CHCs are operated by the Bureau of Primary Health Care (BPHC), which is part of the Health Resources and Services Administration in the Department of Health and Human Services.

CHCs provide comprehensive, coordinated, and integrated health care including primary and preventive health services. They also provide enabling services such as case management, transportation, health education, translation, and child care within a single institutional setting for persons residing in their service areas. These services facilitate primary care access for vulnerable populations—predominantly racial/ethnic minorities, low-income families, and uninsured or Medicaid-enrolled individuals (Forrest and Whelan 2000). In 2001, nationally, 748 CHCs delivered care at about 3,300 sites to over 10 million of the nation's estimated 50 million underserved persons (Bureau of Primary Health Care 2003).

Recognizing the importance of primary care and the potential of CHCs to improve national levels of health, the Bush administration has embarked on an initiative to serve an additional 6.1 million underserved persons by providing 1,200 communities with new access points and significantly expanding existing facilities. By targeting the most at-risk groups, there is the potential to produce large improvements in national health that may be reflected in improved national rankings on health status indicators.

Health centers have been previously credited with improving access to and quality of care for vulnerable populations (Dievler and Giovannini 1998; Frick and Regan 2001; Politzer et al. 2001; Shi et al. 2001). Given continuing racial/ethnic differences in birth outcomes and prenatal care utilization, the purpose of this study is to examine whether CHCs contribute to reducing

these disparities. This study examines birth outcomes (i.e., birth weight) and receipt of perinatal services (i.e., prenatal, postpartum, and newborn care) across racial/ethnic groups receiving care in CHCs. Where possible, disparity rates are compared to nationally reported population rates. This study also identifies factors associated with perinatal care and achieving positive birth outcomes, such that these can be promoted by policy makers and CHC administrators to enhance outcomes for the nation's most vulnerable populations.

METHODS

Data Sources

Data for this study came from the Uniform Data System (UDS) maintained by the Bureau of Primary Health Care (BPHC). Initiated in 1996, the UDS is an integrated reporting system, completed by all health center grantees, that provides uniformly defined data and yields consistent information on health center, patient panel, and clinical characteristics (Bureau of Primary Health Care 1996; 1997; 1998; 1999; 2000; 2001). For this project, we used 1996–2001 data. About 700 CHCs annually were included in the analysis (686 CHCs in 1996, 671 in 1997, 694 in 1998, 690 in 1999, 730 in 2000, and 748 in 2001). The number of CHCs reporting in the UDS has generally increased over time in response to changes in funding levels.

Measures

Perinatal Care. Perinatal care refers to the primary care provided to a pregnant woman prior to birth, and to both the woman and her infant within eight weeks after birth. The UDS collects CHC-level information on the number of pregnant women at each CHC receiving: (1) first trimester *prenatal care*, (2) any *newborn care* within four weeks of birth, and (3) any *postpartum care* within eight weeks of birth. Early prenatal care allows providers to identify medical problems, lifestyle factors, and environmental factors that put the mother or baby at risk. Identifying these factors early allows time for intervention, education, and monitoring to improve birth outcomes. Receiving prenatal care may help encourage mothers to seek postpartum and newborn care. These visits are opportunities to educate new mothers (e.g., about breastfeeding), screen for depression, monitor infant health, and help teenage mothers prevent future unintentional pregnancies (American College for Obstetrics and Gynecology 2002).

Birth Outcomes. The UDS collects CHC-level information on the number of live births among women receiving care in CHCs that were either LBW or very low birth weight (VLBW). LBW infants weigh between 1,500 and 2,500 grams at birth, and VLBW infants weigh less than 1,500 grams. The VLBW and LBW rates can be added together to reflect how national rates of LBW are reported (i.e., < 2,500 grams). While other birth outcome measures exist, birth weight is most likely to benefit from the greater access to primary and prenatal care that CHCs provide (Alexander and Korenbrot 1995; Goldenberg and Rouse 1998; Ickovics et al. 2003; Kogan et al. 1994; McCormick and Siegel 2001). Other measures frequently used include preterm births and infant mortality, but were not reported in the UDS. Teen pregnancy is included, but it is used as a predictor of birth outcomes rather than as an outcome itself.

CHC Characteristics. The UDS collects center-level data on the following six CHC characteristics. CHCs reported the number of users with the following client self-reported racial/ethnic backgrounds: non-Hispanic White, non-Hispanic Black, Hispanic, Asian and Pacific Islander (API), and American Indian/Alaska Native (AI/AN). CHCs also reported the number of total patients with incomes at or below the federal poverty level (FPL), determined by CHCs through family size and income criteria. Center location was rural or urban, and reported by region (South, Northeast, Midwest, or West).

CHCs also reported information specific to perinatal service capacity, including the total number of prenatal care users (reflecting CHC size), and the total prenatal care users per full-time equivalent (FTE) Obstetrician/Gynecologist (OB/GYN). While data on other provider types was available in the UDS, most perinatal services were delivered by OB/GYN providers in CHCs, and thus they most directly reflect perinatal service capacity. These six independent measures were identified in the literature as potentially associated with perinatal care and birth outcomes (Collins and Hawkes 1997; Hogan and Ferre 2001; Rowley 1995).

Analysis

First, CHC characteristics (including reported rates of receiving first trimester prenatal care) are presented by each year of UDS data. Second, the rates of perinatal care and birth outcome measures were compared across racial/ethnic groups between 1998 and 2001, and chi-squared tests of association were used to assess the statistical significance of these rates across racial/ethnic groups. Third, the association of CHC characteristics (focusing on race/ethnicity) with perinatal care and birth outcomes was examined through pooled,

cross-sectional, longitudinal regression analyses. Not all CHCs reported all data, so the number of observations in this study varies depending upon the analysis.

For the regression analysis, we used a Mixed Linear Model—a generalization of the standard model used in the Generalized Linear Model (GLM) method—to account for the dependence of repeated measurements within each center (Laird 1982; Rao 1965; Rao 1975; Wolfinger and Chang 1995). This model takes the repeated measurements into consideration with specified variance/covariance structures within each block (in this analysis, a block is a CHC). This model approach has a better mechanism for handling missing values. Due to non-normality of the response variables, the outcome measures were log-transformed for regression models. The coefficients and standard errors were antilog transformed to facilitate interpretation.

These regression analyses were strengthened through the imputation of missing data for the predictor variables. More than 50% of CHCs had some missing data for at least one of the six years. In many cases this was easily addressed. Some variables (e.g., region and urban/rural designation) were fixed across years, and missing data for a given CHC could simply be imported from the same CHC in other years. Other variables were not fixed across years, and missing values were imputed by taking the average value of data within the same CHC from previous available years. For example, if poverty status data were available for a given CHC in only 4 years, these data were averaged and imputed for the missing 2 years of data. Regardless of the imputation of independent factors, only about 2,800 observations were available for perinatal services, only 2,600 for LBW, and only 1,900 for VLBW. We compared the study results before and after imputation, and no results changed direction or magnitude, and none gained or lost significance.

This study also compares birth weight for CHCs compared to the U.S. population by race/ethnicity. Tables 4 and 5 present the number of births for these racial/ethnic groups and for the total population in 2001, the women cared for in CHCs compared to the national population, and a comparison of LBW rates in CHCs versus the national population. Because the total national population is not necessarily an appropriate comparison population for those cared for in CHCs (because CHCs care for a higher-risk population), the rates are also compared to those of lower SES. Low SES was defined based from available national data as births for mothers with less than 12 years of education, the only applicable statistic that was available by race/ethnicity from the National Center for Health Statistics. LBW data were not available by income for racial/ethnic groups, but it was estimated that the majority of

mothers have less than 12 years of education (since 20% of CHC clients are 19 years of age or under, and about 50% of mothers in CHCs are living in poverty, both of which correlate with education). Rough estimations are then made of potential reductions in LBW if disparity rates in CHCs were achieved nationally.

RESULTS

Table 1 displays the CHC patient panel demographics, trimester of entry into prenatal care, and CHC characteristics between 1996 and 2001. The number of CHC prenatal care users increased by about 4% annually from 248,279 in 1996 to 324,299 in 2001 (the percent change over the 6-year time period is approximately 23%). Most of the pregnant women were between the ages of 20 and 44 years. There has been a steady decline in teenage prenatal care users (from 25% in 1996 and 1997, 24% in 1998, 23% in 1999, 22% in 2000, to 21% in 2001). This decreasing trend of teenage prenatal care users is unexplained; and thus suggests the need for a further study using enhanced data in which CHC prenatal care users are reported so that cross-tabulations of the indicators of age, racial/ethnic, and socioeconomic status can be constructed and analyzed.

Among racial/ethnic groups, Hispanics represent the largest proportion of prenatal care users, followed by blacks, whites, American Indians/Alaska Natives, and APIs. Hispanics also showed the largest increase, from 44% of total users in 1996 to 51% in 2001. This may be due to the larger proportion of younger Hispanic health care users than any other racial groups. In 2001, about 61% of pregnant women started prenatal care during the first trimester, 30% the second trimester, and 9% the third trimester. The patterns of trimester of entry into prenatal care by CHC users were relatively constant between 1996 and 2001.

Table 2 compares birth outcomes and post-delivery care experience among CHC users of different racial/ethnic backgrounds. In 2001, blacks experienced the highest rates of LBW (births 1,500–2,499 grams) (8.4%), followed by whites and American Indians/Alaska Natives (6.1% each), APIs (5.6%), and Hispanics (4.5%). Only 3.9 percentage points separate the highest and lowest groups. In 2001, blacks experienced the highest VLBW (2.4%), followed by American Indians/Alaska Natives (1.8%), whites (1.2%), Hispanics (1.1%), and APIs (1.0%). Only 1.4 percentage points separated the highest and lowest groups.

The racial/ethnic groups that have the highest proportion of LBW babies do not necessarily have the highest postpartum and newborn care rates.

Table 1: Community Health Center Characteristics, 1996–2001

CHC Characteristics[1]	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
# CHCs Reporting (n)	686	671	694	690	730	748
# Users in Reporting CHCs	248,279	253,894	276,038	287,667	306,993	324,299
Panel Characteristics	%	%	%	%	%	%
Race/Ethnicity[2]						
Asian/Pacific Islander	3.1%	3.1%	3.7%	3.8%	4.3%	4.0%
AI/AN	3.0%	3.4%	3.6%	4.1%	3.9%	4.2%
Black	25.0%	24.4%	23.5%	22.6%	21.8%	20.9%
Hispanic (all races)	43.8%	45.5%	45.9%	48.4%	49.8%	51.4%
White	25.1%	23.6%	23.3%	21.2%	20.2%	19.4%
Living in poverty[2]	58.2%	57.2%	57.9%	58.5%	56.7%	57.1%
Maternal age (yrs)						
<15	1.7%	1.4%	1.4%	1.5%	1.0%	1.3%
15–19	23.4%	23.3%	22.6%	21.9%	21.4%	20.0%
20–24	33.8%	34.2%	34.2%	34.8%	35.4%	35.4%
25–44	40.4%	40.3%	41.1%	41.4%	41.9%	43.0%
≥ 45	0.7%	0.8%	0.7%	0.6%	0.4%	0.3%
Prenatal care trimester						
First	61.1%	62.5%	60.9%	59.9%	59.9%	60.7%
Second	29.7%	29.3%	29.1%	30.4%	30.1%	30.6%
Third	9.3%	8.2%	9.9%	9.7%	10.0%	8.7%
CHC Perinatal Capacity	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Prenatal care users/CHC	378 (551)	378 (548)	415 (587)	426 (622)	434 (640)	471 (690)
Prenatal care users/OBGYN[2]	1,342 (3,217)	1,722 (4,671)	2,251 (6,274)	2,941 (14,109)	2,248 (8,548)	2,102 (6,119)
Center Location	%	%	%	%	%	%
Geographic setting						
Rural	53.4%	52.9%	52.6%	52.9%	52.9%	52.2%
Urban	46.6%	47.1%	42.7%	47.1%	47.1%	47.8%
Region						
South	39.2%	39.2%	39.0%	39.2%	37.2%	37.3%
Midwest	16.7%	16.6%	16.5%	16.1%	16.9%	17.1%
West	22.4%	22.0%	22.8%	22.9%	23.7%	23.6%
Northeast	21.7%	22.2%	21.7%	21.9%	22.2%	22.1%

[1]Estimates are for all CHC users per year (e.g., the percentage Hispanic per year is calculated as the total number of Hispanic users across all CHCs divided by the total users in all CHCs). The only exceptions are for the two perinatal capacity measures, which are the means of the reported users/rates across CHCs, and thus standard deviations (SD) are presented.

[2]Estimates for race/ethnicity and poverty status are only available for *all* CHC users, not just prenatal care users.

[3]The number of prenatal care users per full-time equivalent (FTE) Obstetrician/Gynecologist.

Table 2: Birth Outcomes, Postpartum, and Newborn Care for Community Health Center Prenatal Care Users by Race/Ethnicity, 1998–2001

Birth Outcomes[1]	*1998*	*1999*	*2000*	*2001*	*Total (1998–2001)*
Total Live Births/Year (*n*)	125,896	133,908	145,422	150,331	138,889
Very Low Birth Weight[2] (<1,500 grams)	%	%	%	%	% (*SD*)
Asian/Pacific Islander	1.2%	0.7%	1.0%	1.0%	1.0% (0.2)
AI/AN	4.1%	5.0%	1.5%	1.8%	3.1% (1.7)
Black	2.4%	2.3%	2.3%	2.4%	2.3% (0.1)
Hispanic	0.9%	0.9%	1.0%	1.1%	1.0% (0.1)
White	1.2%	1.1%	1.5%	1.2%	1.2% (0.2)
Total	1.9%	2.0%	1.5%	1.5%	1.7% (0.3)
Low Birth Weight[2] (1,501 to 2,500 grams)					
Asian/Pacific Islander	6.2%	5.5%	5.4%	5.6%	5.7% (0.4)
AI/AN	7.0%	7.4%	5.6%	6.1%	6.5% (0.9)
Black	7.6%	8.2%	8.4%	8.4%	8.1% (0.4)
Hispanic	4.2%	4.5%	4.6%	4.5%	4.5% (0.2)
White	5.4%	5.6%	5.9%	6.1%	5.8% (0.3)
Total	6.1%	6.3%	6.0%	6.1%	6.1% (0.1)
Received Postpartum Care (Within 8 weeks of birth)					
Asian/Pacific Islander	81.4%	71.1%	81.5%	81.7%	78.9% (5.2)
AI/AN	79.8%	74.8%	59.3%	56.1%	67.5% (11.6)
Black	67.8%	64.6%	72.6%	70.8%	68.9% (3.5)
Hispanic	74.9%	72.9%	74.6%	75.0%	74.3% (1.0)
White	72.2%	70.7%	72.5%	70.7%	71.5% (1.0)
Total	75.2%	70.8%	72.1%	70.8%	72.8% (1.4)
Received Newborn Care (Within 4 weeks of birth)					
Asian/Pacific Islander	76.7%	95.6%	66.8%	80.3%	79.8% (12.0)
AI/AN	74.9%	67.0%	85.0%	78.7%	76.4% (7.5)
Black	69.5%	77.5%	73.7%	69.9%	72.7% (3.7)
Hispanic	75.1%	73.7%	75.9%	76.3%	75.3% (1.1)
White	71.5%	72.1%	67.9%	66.7%	69.5% (2.6)
Total	73.5%	77.2%	73.9%	74.4%	74.4% (1.8)

Note: Results of all chi-square analyses across race/ethnicity for each outcome were significant at $p < .05$ level.

[1]The denominator for all estimates is the total live births for each racial/ethnic group per year.

[2]VLBW and LBW rates can be added together to reflect how national rates of LBW are presented (<2,500 grams).

SD = Standard Deviation.

For example, blacks have the highest rate of LBW but were about as likely as whites, and slightly less likely than APIs and Hispanics, to receive postpartum and newborn care. In 2001, APIs were most likely to receive timely postpartum care (81.7%), followed by Hispanics (75.0%), blacks (70.8%), whites (70.7%), and American Indians/Alaska Natives (56.1%). In 2001, APIs were the

most likely to receive timely newborn care (80.3%), followed by American Indians/Alaska Natives (78.7%), Hispanics (76.3%), blacks (69.9%), and whites (66.7%). The trends of these indicators were consistent between 1998 and 2001.

All of the study covariates were examined for their bivariate relationships with the study outcome measures, and all statistically significant predictors of perinatal outcomes and perinatal care in bivariate analyses were also found to be statistically significant in the multivariate analyses presented next.

Table 3 shows the relationship between birth outcomes, prenatal care, and CHC characteristics in the multivariate longitudinal models. Controlling for other covariates in the model, LBW rates were significantly predicted by teenage birth and prenatal care. For every 5% increase in the percentage of teenage births in a CHC, the LBW rate increased 1.06%. Similarly, for every 5% increase in first-trimester prenatal care the LBW rate decreased by 1.02%. The proportion of Hispanic users was significantly associated with lower LBW rates (− 1.02% per 5% increase in Hispanic panel) but no other patient panel characteristics, including poverty status, were associated with LBW rates. VLBW rates were significantly predicted by center size (i.e., the total number of CHC users), such that for every increase of 10,000 users, VLBW rates decreased by 15.9%. Surprisingly, less prenatal care capacity (i.e., more prenatal care users per OB/GYNs) was associated with lower rates of LBW and VLBW.

Prenatal care capacity (i.e., the number of prenatal care users to FTE OB/GYNs) was associated with lower rates of first-trimester prenatal care use, as was the number of clients in poverty. The percentage of black users was significantly negatively associated with first-trimester prenatal care use (i.e., a 1% decrease in the rate of prenatal care use for every 5% increase in the proportion of black users in a CHC). CHCs with a higher proportion of first-trimester prenatal care users had higher rates of postpartum care and newborn care use (a 1% increase in both postpartum and newborn care per 5% increase in prenatal care users). Poverty status positively predicted timely postpartum care and newborn care, as did CHCs with a higher ratio of users to OB/GYNs.

Table 4 compares U.S. and CHC live birth and LBW statistics. The table shows that CHCs provide care for an estimated 3.7% of all births in the U.S., but about one-fifth (17.2%) of all low-SES births nationally. While this low-SES rate is estimated without information on education within CHCs, it is comparable to other data showing that CHCs care for about one-fifth of individuals living in federally designated underserved areas (Politzer et al. 2001). CHCs account for a larger proportion of births among minorities, caring for about 9% of Hispanics nationally and 21% of all low-SES blacks. CHCs appear to have comparable rates of LBW compared to the total U.S. population (7.5% vs.

Table 3: Predictors of Birth Outcomes, Postpartum, and Newborn Care Rates in Community Health Centers, 1996–2001[†]

	VLBW	*LBW*	*1st Trimester Prenatal Care*	*Postpartum Care*	*Newborn Care*
CHCs included in analysis (n)	1,510	1,927	1,957	2,114	2,032
Patient Panel Characteristics					
% Asian/Pacific Islander (per 5%)[1]	− 1.5898 (1.4031)	1.1933 (1.2917)	− 1.0640 (1.1429)	1.0015 (1.1393)	− 1.0813 (1.1771)
% Black (per 5%)	1.0165 (1.0104)	1.0058 (1.0080)	− 1.0082 (1.0042)*	− 1.0055 (1.0040)	− 1.0023 (1.0052)
% Hispanic (per 5%)	− 1.0117 (1.0095)	− 1.0181 (1.0072)*	− 1.0046 (1.0037)	− 1.0044 (1.0036)	− 1.0030 (1.0046)
% White (per 5%)	1.0014 (1.0103)	− 1.0008 (1.0078)	1.0080 (1.0040)*	− 1.0014 (1.0038)	− 1.0014 (1.0049)
% Teenage mothers (per 5%)	1.0216 (1.0159)	1.0612 (1.0116)****	− 1.0094 (1.0056)	1.0038 (1.0056)	1.0083 (1.0071)
% With first trimester prenatal care (per 5%)	− 1.0043 (1.0067)	− 1.0166 (1.0047)***	–	1.0077 (1.0024)**	1.0066 (1.0028)*
# At or below poverty (per 100,000 pop)	− 1.8072 (1.4461)	− 1.0819 (1.3459)	− 1.0375 (0.0000)****	1.1089 (0.0000)****	1.3964 (0.0000)****
CHC Characteristics					
# of prenatal care users (per 10,000 pop)	− 15.849 (1.7783)****	− 1.5849 (1.5849)	1.3804 (1.2882)	− 1.0919 (1.2589)	− 1.0332 (1.3490)
# Prenatal care users per OB/GYN (per 100,000 pop)	− 1.9187 (1.3425)*	− 1.0062 (0.0000)****	− 1.3183 (0.0000)****	1.1426 (0.0000)****	1.1023 (0.0000)****
Rural vs. urban location (urban = ref)	− 1.0174 (1.0846)	− 1.0563 (1.0667)	1.0332 (1.0353)	1.0132 (1.0325)	− 1.0628 (1.0432)
Region (vs. West)					
South	1.0577 (1.0978)	1.0154 (1.0770)	− 1.1823 (1.0404)****	− 1.0183 (1.0371)	− 1.1598 (1.0493)**
Northeast	− 1.3074 (1.1170)*	− 1.1206 (1.0909)	− 1.1664 (1.0479)**	− 1.0097 (1.0436)	− 1.0179 (1.0583)
Midwest	− 1.2610 (1.1153)*	− 1.0840 (1.0890)	− 1.2141 (1.0465)****	− 1.0338 (1.0430)	− 1.0073 (1.0572)

Note: All estimates are made at the CHC level, not at the patient level.

[†]The coefficients and standard errors from MIXED models are antilogarithm-transformed values.

*$p<0.05$; **$p<0.01$; ***$p<0.001$; ****$p<0.0001$.

Table 4: Approximate Proportion of Births in the U.S. Accounted for by CHCs and Reported LBW Rates

	A. Total Number of Births (n)			*B. Births Accounted for by CHCs (%)*		*C. LBW Rate[3] (%)*		
	U.S. (Total)	*U.S. (Low SES)[1]*	*CHC*	*U.S. (Total)*	*U.S. (Low SES)*	*U.S. (Total)*	*U.S. (Low SES)*	*CHC[3]*
Total	4,025,933	873,628	150,331	3.7%	17.2%	7.7%	8.2%	7.5%
Asian	200,279	21,626	5,495	2.7%	25.4%	7.5%	7.5%	6.6%
Black	589,917	146,889	30,235	5.1%	20.6%	13.0%	14.9%	10.7%
Hispanic	851,851	415,703	78,618	9.2%	18.9%	6.5%	6.0%	5.6%
White	2,236,578	504,855	28,498	1.3%	5.6%	6.8%	9.1%	7.4%

Source: Data for the U.S. come from Health, United States, 2003 and the U.S. National Vital Statistics Report. *Births, Final Data 2001*. 2002: 51(2).

Note: The total U.S. and CHC births include women of "other" racial/ethnic groups, but these "other" data are not presented.

[1]U.S. rates in this column are limited to women with less than 12 years of education.

[2]CHC rates are for the total women receiving prenatal care from CHCs with live births. CHCs are assumed to serve low-SES populations.

[3]LBW rates are defined as $< 2{,}500$ grams, which for CHCs required adding VLBW and LBW rates. Year 2000 data from Table 1 are used, consistent with data reported for the U.S.

7.7%). When compared to low-SES mothers, CHCs appear to have lower rates of LBW overall (7.5% vs. 8.2%), for whites (7.4% vs. 9.1%), Hispanics (5.6% vs. 6.0%), and blacks (10.7% vs. 14.9%).

Table 5 shows that the black–white disparity in LBW rates may be smaller in CHCs (3.3 percentage points) than among national rates for low-SES mothers (5.8 percentage points) and for the overall population (6.2 percentage points). Nationally, there are about 36,500 more black LBW infants born than should be if blacks had LBW rates similar to whites (termed *excess* incidence). If CHC rates of black–white disparity are applied to national populations, *excess* incidence of black LBW infants is reduced by about 17,100 annually. If this is compared just within the low-SES population, the reduction in *excess* incidence of black LBW infants is reduced by about 3,700 annually.

DISCUSSION

Many of the nation's *Healthy People 2010* objectives are targeted at underserved populations, who have disproportionately poorer access to care and poorer health (U.S. Department of Health and Human Services 2000). The extent to

Table 5: Estimations of Black–White Disparities in LBW Incidence

Estimation of Black–White Disparities	*Estimate*
A. Black population (*n*)	
U.S. (Total)	589,917
U.S. (Low SES)	146,889
CHC	30,235
B. Difference (%) in Black–White LBW Rate (from Table 4)	
U.S. (Total)	6.2%
U.S. (Low SES)	5.8%
CHC	3.3%
C. *Excess* Black LBW incidence (Row A * Row B)	
U.S. (Total)	36,574
U.S. (Low SES)	8,520
CHC	998
D. *Excess* Black LBW incidence if CHC rate applied (Row A * 3.3%)	
U.S. (Total)	19,467
U.S. (Low SES)	4,847
E. Reduction in *Excess* Black LBW incidence (Row C – Row D)	
U.S. (Total)	17,107
U.S. (Low SES)	3,673

Source: Data for the U.S. come from Health, United States, 2003 and the U.S. National Vital Statistics Report. *Births, Final Data 2001.* 2002: 51(2).

which safety-net providers, such as CHCs, are able to use their limited capacity and resources to facilitate access to high quality care for the underserved, may have a considerable influence on whether these objectives are met. While research has shown that CHCs may contribute to reducing racial/ethnic disparities in access to care and health status among adults (Dievler and Giovannini 1998; Frick and Regan 2001; Politzer et al. 2001; Shi et al. 2001), this is the first study to provide evidence that disparities in some perinatal care and birth outcomes may be lower in CHCs.

Overall, CHCs had LBW rates that were similar to the total U.S. population (7.5% vs. 7.7%) and lower than the national low-SES population rate of 8.2% in 2001. This is impressive given that CHCs largely serve uninsured and low-SES populations who are at greater risk of poor outcomes (Forrest and Whelan 2000; Freeman, Kiecolt, and Allen 1982; Gardner 1993; Lefkowitz and Todd 1999; Regan et al. 2003). This study further found that black–white disparity in LBW rates (inclusive of VLBW) was 3.3 percentage points in CHCs compared to 5.8 percentage points among low-SES mothers nationally and 6.2 percentage points for the total U.S. population. Although disparities in perinatal care by race/ethnicity have been well-documented nationally (Agency for Healthcare Quality Research 2003), Hispanics and APIs were

as or *more* likely to receive postpartum and newborn care than whites in CHCs. Blacks were also as likely as whites to obtain postpartum care and as or *more* likely than whites to obtain newborn care in CHCs. Finally, in multivariate analyses, *no* disparities by race/ethnicity were found in the receipt of postpartum or newborn care.

In addition to blacks, this study found decreases in LBW for Hispanics (5.6% vs. 6.5%) and Asians (6.6% vs. 7.5%) in CHCs compared to the general U.S. population. These decreases were all the more impressive due to the overall higher risk profiles of those attending CHCs (Forrest and Whelan 2000; Freeman, Kiecolt, and Allen 1982; Gardner 1993; Lefkowitz and Todd 1999; Regan et al. 2003), and were still lower than the white LBW rate in both CHCs (8.2%) and in the national low-SES population (9.1%). These better overall birth outcomes for Hispanics versus whites, even among vulnerable groups in CHCs, have been previously attributed to acculturation factors (Callister and Birkhead 2002). In addition, increasing percentages of black patients in CHCs remained significantly associated with a lower rate of first-trimester prenatal care.

While this study does not demonstrate causality between CHCs and reductions in disparities, the lower rates of certain disparities in CHCs may have something to do with how CHCs promote access to primary care. CHCs have made considerable effort to remove economic barriers to care and offer enabling services (e.g., translation services, transportation, and child care) that are traditionally inadequately reimbursed by insurance carriers, and that are particularly critical for vulnerable groups (Freeman, Kiecolt, and Allen 1982; Gardner 1993; Lefkowitz and Todd 1999; Regan et al. 2003). One study of pregnant CHC users, in fact, found that enabling services were associated with more timely receipt of perinatal care (Lewis-Idema 2002). Moreover, CHCs coordinate with national and local initiatives such as the Women, Infants, and Children (WIC) program and Healthy Start, which have been linked with better infant outcomes (Gregory and de Jesus 2003; Kowaleski-Jones and Duncan 2002; Lane et al. 2001; Moss and Carver 1998).

Although the black–white disparity in LBW rate within CHCs appears smaller than the national disparity rate, this remaining difference (3.3 percentage points) still reflects nearly 1,000 *excess* LBW black infants delivered annually in CHCs. If the U.S. replicated this lower disparity rate nationally, the number of *excess* black infants delivered with LBW would be reduced by over 17,100 annually (from about 36,574 to 19,467 black infants). More specifically, if the black and white LBW rates among all low-SES mothers (14.9% and 9.1%) were reduced to the black and white LBW rates within CHC

(10.7% and 7.4%), the number of black and white LBW infants would be reduced by 6,169 and 8,583 annually among low-SES mothers.

Debate remains regarding the ability of prenatal care to reduce disparities in birth outcomes (Alexander and Kotelchuck 2001; Barfield et al. 1996; Fiscella 1995; Hughes and Simpson 1995; Goldenberg et al. 1996; Lu and Halfon 2003; Lu et al. 2003; Murray and Bernfield 1988), but the findings of this study are consistent with other research linking early prenatal care with better birth outcomes (Alexander and Korenbrot 1995; Goldenberg and Rouse 1998; Ickovics et al. 2003; Kogan et al. 1994; McCormick and Siegel 2001). Since CHCs lag behind the nation in rates of pregnant women receiving first trimester prenatal care (61% for CHCs vs. 83% nationally in 2001, both short of the Healthy People 2010 goal of 90%), greater efforts are needed at identifying, outreaching to, and recruiting pregnant low-income and minority women into early prenatal care. In our study, prenatal care was also associated with more timely postpartum care, but not newborn care, suggesting that additional efforts may be required to improve rates of newborn care in CHCs.

The finding that less perinatal care capacity (i.e., a higher ratio of CHC users to OB/GYNs) was associated with lower rates of first trimester prenatal care is intuitive and is likely explained by the diminished capacity of OB/GYNs with large panels to care for all patients in a timely manner. The relationship of less perinatal care capacity with more postpartum and newborn care is less intuitive. One possible explanation, which deserves further inquiry, is that CHCs where OB/GYN capacity is stretched may, out of necessity, develop systems or mechanisms for assuring that mothers who did not receive timely prenatal care (and thus at higher risk of LBW and VLBW) are at least seen for postpartum care and referred for newborn care. Moreover, the slightly lower rate of postpartum and newborn care for black infants compared to Asians and Hispanics, despite higher rates of LBW, may possibly be attributable to higher rates of neonatal intensive care use expected for those born with LBW and VLBW.

The finding that teenage pregnancy was significantly associated with LBW is consistent with the literature (Baruffi 1997; Kogan et al. 1998), and calls for greater educational and health promotional efforts within CHCs to delay childbearing. That a higher proportion of black CHC users was associated with a higher LBW rate, and that Hispanic CHC users had a higher rate of LBW than Hispanics in the general population, highlights that racial/ethnic disparities are not fully addressed in CHCs and further calls for a continued focus on minority clients. To further reduce disparities, it is important to

address risks associated with SES, environmental risks such as occupational stress and residential safety, and behavioral risks such as smoking and inadequate nutrition (Alexander and Kotelchuck 2001; Barfield et al. 1996; Fiscella 1995; Hughes and Simpson 1995; Goldenberg et al. 1996; Lu and Halfon 2003; Lu et al. 2003; Murray and Bernfield 1988). Maternal stress, for example, is one environmental risk factor linked to higher prevalence of bacterial vaginosis (BV), potentially leading to adverse pregnancy outcomes (Culhane et al. 2002; Eschenbach et al. 1984; Flynn, Helwig, and Meurer 1999; Gravett et al. 1986; Hillier et al. 1995; Paige et al. 1998).

This study has several limitations. First, CHC users may be quite different from low-SES, non-users in certain ways (e.g., "users," by definition, are more apt to seek care) that might contribute to the lower disparities in CHCs compared to the national low-SES population. This selection bias is inherent in studies of users, and future research might consider examining disparities in nonusers, and ways to encourage eligible nonusers to obtain needed CHC services. These eligible non-users may be the most at-risk for poor birth outcomes and, thus, may derive some of the greatest benefits from CHC services.

Second, measures of prenatal care experiences do not encompass the content and quality of care in CHCs, which may influence birth outcomes and later utilization. For example, physician surveys find that less than half of physicians follow the recommended protocol to test and treat their pregnant patients for BV in prenatal care (Eschenbach et al. 1984; Gibbs et al. 1994). Black women are three times more likely to have BV than white woman (Royce et al. 1999), a factor that may account for up to 30% of the racial disparity in preterm delivery and infant mortality (Fiscella 1996). Inconsistencies in prenatal care, including the screening and treatment of BV, may be responsible for a proportion of the disparities in birth outcomes within CHCs.

Third, UDS are aggregate center-level data and not patient-level data. Thus, it is not possible to follow specific patients over the six-year period to determine which patients had repeated visits (or repeated prenatal care services), or to test for significant differences among individual CHC user outcomes and national rates. Single vs. multiple births, maternal smoking, and maternal weight gain were not available in the UDS and may be very influential factors in birth outcomes. Individual-level measures are needed to more conclusively identify factors associated with perinatal outcomes in CHCs.

Fourth, given the longitudinal design of the study, the accuracy and completeness of reported measures may have changed over the six-year study period. There may also be variations among CHCs in their accuracy and completeness

of UDS reporting. For example, despite imputation of independent factors for missing data, and because we did not impute data for the dependent variables, only about 2,800 observations were available for perinatal services, only 2,600 for LBW, and only 1,900 for VLBW. While these missing data may create greater variability or "noise" within the results, there is no reason to suspect systematic biases are directly affecting the validity of the reported results.

In conclusion, this study suggests that racial/ethnic disparities in certain perinatal services and birth outcomes may be lower in CHCs compared to the general population. While CHCs appear to have some overall achievements (LBW rates in CHCs are similar to national rates, despite caring for a higher-risk population), there is substantial room for improvement (e.g., prenatal care rates remain lower in CHCs vs. nationally). Future work should explore how the potentially lower disparities in CHCs might be translated to other health care settings to better meet national health priorities.

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