
Secular Trends in New York City Hospital Discharge Diagnoses of Congenital Syphilis and Cocaine Dependence, 1982-88

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Synopsis.....

The ecologic relationship between the incidence of reactive serologic tests for syphilis among 2,229 newborns and diagnoses that included cocaine dependence among 17,219 hospitalized women ages 15-44 in New York City was investigated. Citywide, race-specific and zip code-specific annual rates were computed. The residential zip codes were

grouped into quartiles by cumulative level of diagnoses that included cocaine dependence, and citywide and race-specific annual rates of congenital syphilis were computed in each quartile.

From 1982 to 1988, the citywide rate of congenital syphilis for all races increased from 1.2 to 5.8 per 1,000 live births, while rates of cocaine dependence discharges increased from 23.3 to 423.3 per 100,000 women of all races during the same period.

For African American infants, citywide rates of congenital syphilis increased from 1.8 to 10.6 per 1,000 live births. In quartile-specific analyses of African American women and newborns, rates of congenital syphilis increased from 1.9 to 14.6 in the highest cocaine-exposure quartile; from 2.1 to 12.4 in the third; from 1.5 to 7.6 in the second; and, from 1.6 to 2.8 in the lowest cocaine-exposure quartile.

This study provides support for the hypothesis that cocaine dependence in women may be associated with congenital syphilis infection.

SINCE THE MID-1980s, the incidence of reported cases of congenital syphilis has increased dramatically in urban areas (1). In 1985, cities in Texas, Florida, California, and New York accounted for 80 percent of all reported cases of this infection (2). Incidence trends of congenital syphilis have generally paralleled the incidence of primary and secondary stage syphilis in women (2). In New York City between 1981 and 1989, however, cases of primary and secondary syphilis in women increased four-fold, while cases of congenital syphilis in newborn infants increased 30-fold, according to the New York City Department of Health (NYCDOH). Thus, the ratio of reported cases in adult women to infants has changed. In 1981, for every 100 cases of primary and secondary syphilis in women there were 8.4 cases of congenital disease in infants; by 1989, the ratio was 100 to 60.8. Congenital syphilis is now considered epidemic in New York City (3).

In some studies, maternal cocaine use has been

associated with congenital syphilis by using maternal self-report of cocaine use during pregnancy (4-7) or the results of urine toxicology screens (7,8). The scope of the cocaine problem among women of childbearing age in New York City in relation to congenital syphilis has been difficult to ascertain. Legal implications of maternal drug use, including investigation of parental fitness by the child protective service agency, and possible removal of the infant from the mother's custody (9), seriously have impeded complete reporting by mothers or health care workers. Further, estimates of the prevalence of cocaine use as derived from either maternal or infant urine toxicology screens are usually biased, because they are performed on a highly selected sample, and they detect only recent cocaine use (10).

Our study was undertaken to investigate the ecologic relationship between the incidence of reactive serologic tests for syphilis in newborns and the frequency of cocaine-dependence diagnoses among

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women of childbearing age discharged from a hospital in New York City.

Methods

Every acute care hospital in the State of New York is required to submit a discharge data abstract for every patient to the New York Statewide Planning and Research Cooperative System (SPARCS). This abstract includes the patient's age, race-ethnicity, sex, zip code of residence, and up to five diagnoses at the time of discharge. Although partial SPARCS data were available for earlier years, 1982 is generally considered the first year in which data were complete (11).

In our study, cases of congenital syphilis, based on the SPARCS data, were defined as

1. a discharge diagnosis of syphilis, International Classification of Diseases, 9th edition (ICD-9-CM) codes 090.0-097.9, (congenital, early cardiovascular, neurosyphilis, late or unspecified syphilis) for any patient discharged from a hospital in New York State between 1982 and 1988;
2. newborn (age, 0); and,
3. residence in the New York City Boroughs of the Bronx, Brooklyn, Manhattan, or Queens.

Denominator data for the number of live born infants by zip code of residence and by race-ethnicity were also determined from SPARCS. Prior to 1986, however, SPARCS coded race-ethnicity of patients into one of seven categories: Asian or Pacific Islander, African-American, Hispanic, American Indian or Alaskan Native, other, white, and unknown/error. In 1986, SPARCS changed the coding for persons of Hispanic race-ethnicity from the Hispanic category to "other." Because the "other" race category was seldom used for the years 1982-85, we combined the "other" and "Hispanic" race categories for all years to estimate the number of Hispanic infants from

SPARCS. The coding scheme for infants of African American or white race-ethnicity was not changed during the study period.

Cases of cocaine dependence in women of childbearing age were defined as

1. a discharge diagnosis of cocaine dependence from a hospital in New York State between 1982 and 1988, ICD-9-CM code 304.2, specific for "cocaine dependence; coca leaves and derivatives;"
2. age between 15 and 44; and,
3. residence in the Bronx, Brooklyn, Manhattan, or Queens.

For race-specific analyses, we combined the "other" and "Hispanic" race categories for all years to estimate the number of Hispanic women with cocaine-dependence discharges from SPARCS. The number of women of African American or white race-ethnicity was estimated as coded by SPARCS over the entire study period.

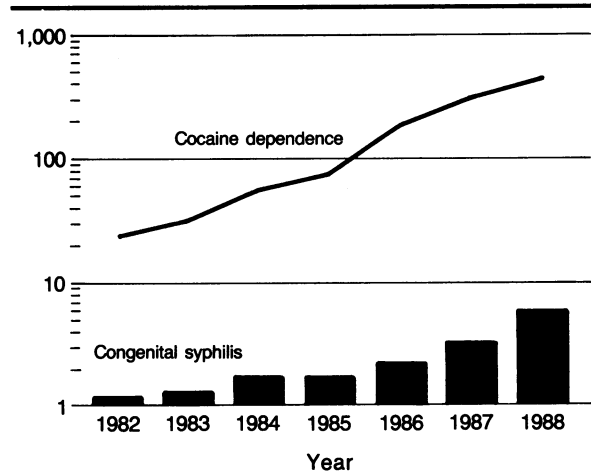
Denominator data for each zip code area were provided by the 1980 U.S. Census, specific for sex and age. For African American and white race-specific analyses, we multiplied the overall proportion of the zip code area identified as belonging to a particular racial group by the sex- and age-specific totals (12). For example, if the census reported 30 percent of the residents of a zip code area as African American, 30 percent was multiplied by the total number of women ages 15-44 to derive an estimate of the number of African American women in that age category. Similarly, we used the overall proportion of Hispanics in a zip code area to compute the sex- and age-specific estimates of Hispanic women ages 15-44. In the census, Hispanic persons may have identified themselves additionally by color as "white," "black," or "other."

Temporal trends in congenital syphilis diagnoses per 1,000 live births and hospital discharges for cocaine-dependence per 100,000 females of childbearing age were analyzed overall and by race. Bartholomew's test for increasing proportions was used to test for trend (13).

Analyses using residential zip codes were performed in order to examine differences in rates of congenital syphilis by mean level of cocaine discharges. To categorize the distribution of cocaine use, each zip code was assigned a rank by the following method:

First, an annual rate of cocaine dependence was computed for each zip code area by dividing the

Rates of congenital syphilis per 1,000 live births and cocaine dependence per 100,000 women, New York City, 1982–88



1985. In 1986, the rate was 2.2, increasing to 3.2 in 1987 and to 5.8 in 1988.

Secular trends in cocaine-dependence discharges. The rate of cocaine-dependence discharges (per 100,000 women) increased 18-fold over the study period, from 23.3 in 1982 to 423.3 in 1988 ($P < .01$) (chart). The rate of increase for cocaine-dependence discharges was not equally distributed over all years. In 1982, the rate was 23.3, increasing to 30.9 in 1983, to 54.9 in 1984, and to 71.3 in 1985. In 1986, the rate increased sharply to 180.2, to 302.2 in 1987 and to 423.3 in 1988.

In race-specific analyses, the rate for African American women increased the most sharply, 21-fold, from 46.9 in 1982 to 996.3 in 1988. The rate for Hispanic women increased 16-fold, from 26.2 to 425.8, and for white women 11-fold, from 8.1 to 88.5 during the same period.

Congenital syphilis births by quartile. When area of residence, as defined by zip code, was assigned a quartile rank, the rate of congenital syphilis births was seen to increase in all quartiles over time (table 1). Quartile 4, the highest cocaine-exposure area, accounted for 35.0 percent (309,763 of 886,230) of all live births, but 56.5 percent (1,237 of 2,189) of all live births with congenital syphilis [odds ratio (OR) 2.4, 95 percent CI 2.2, 2.6]. In this quartile, the rate of affected live births (per 1,000 live births) increased from 1.9 in 1982 to 10.0 in 1988. During this same period, in quartile 3, (N=262,669 live births) the rate of congenital syphilis increased from 1.4 to 5.6; in quartile 2, (N=173,254 live births) from 0.6 to 1.7; and, in quartile 1, (N=140,544 live births) from 0.3 to 1.1.

number of hospitalized women, ages 15–44, with cocaine dependence as a diagnosis by the total number of women, ages 15–44, who lived in the zip code area according to the 1980 U.S. Census. Second, for every zip code area, the seven annual rates were summed, so that each zip code had one cumulative rate of cocaine use. Third, the cumulative rates were ranked and divided into quartiles. Zip codes designated as “quartile four” represented the upper quartile, or 75th percentile and above, of cocaine exposure. Zip codes in quartile one represented the lowest 25th percentile of cocaine exposure. After assignment of each zip code to a quartile for cocaine use, annual incidence rates of congenital syphilis were calculated, summing cases of congenital syphilis divided by the total number of live births in each quartile. These analyses were performed overall and by race-ethnicity.

Zip codes that did not correspond to residential geographic areas (N=32) were eliminated from the zip code-specific analyses (12). Citywide analyses used data from 154 zip code areas for each of the 7 years under consideration.

Results

Characteristics of infants. Analyses of infants with congenital syphilis by year of birth revealed that the percentage of infected African American infants increased from 49.7 percent (76 of 153) in 1982 to 63.6 percent (506 of 795) in 1988. Hispanic infants with congenital syphilis decreased from 41.8 percent (64 of 153) in 1982 to 30.8 percent (245 of 795) in 1988; affected white infants remained proportionally stable, 5.9 percent (9 of 153) in 1982 and 5.2 percent (41 of 795) in 1988. Overall, 91.5 percent of affected infants were African American or Hispanic, excluding 18 infants of “unknown” race.

The majority of infants had either Medicaid insurance (66.4 percent) or no insurance coverage (20.8 percent). Only 9.8 percent had private insurance coverage for this hospitalization.

Secular trends in congenital syphilis births. There was an overall trend toward an increased rate of live born infants with congenital syphilis (per 1,000 live births) over time, increasing almost 5-fold from 1.2 in 1982 to 5.8 in 1988 ($P < .01$) (see chart). The rate of increase for births with a diagnosis of congenital syphilis was not equally distributed over all years. In 1982, the rate was 1.2, increasing slightly to 1.3 in 1983, and it was 1.7 in both 1984 and

Table 1. Rate of congenital syphilis per 1,000 live births by quartile of cocaine exposure, New York City, 1982–88

Year	Quartile 1	Quartile 2	Quartile 3	Quartile 4
1982	0.25	0.59	1.36	1.85
1983	0.45	0.57	1.57	1.97
1984	0.58	0.61	1.92	2.59
1985	0.78	0.75	1.96	2.48
1986	0.55	1.38	2.27	3.12
1987	0.63	1.60	3.23	5.07
1988	1.11	1.72	5.59	9.98

Table 2. Rate of congenital syphilis per 1,000 live births by race, New York City, 1982–88

Year	African American	Hispanic	White
1982	1.83	1.63	0.20
1983	2.31	1.30	0.34
1984	2.77	1.98	0.18
1985	2.74	1.87	0.47
1986	3.38	2.56	0.64
1987	5.63	2.81	0.96
1988	10.59	5.64	1.01

Table 3. Rate of congenital syphilis births among African American infants, by quartile of cocaine dependence hospital discharges in African American women, New York City, 1982–88

Year	Quartile 1	Quartile 2	Quartile 3	Quartile 4
1982	1.62	1.50	2.05	1.94
1983	0.42	1.30	2.82	3.54
1984	0.43	2.78	2.65	3.93
1985	2.07	2.80	2.38	3.85
1986	1.53	2.95	3.83	3.70
1987	1.02	4.49	6.16	8.16
1988	2.76	7.63	12.37	14.61

A total of 40 of 2,229 infants with congenital syphilis (1.8 percent) and 13,028 newborns of 899,258 (1.4 percent) did not have a usable zip code designation and were eliminated from zip code-specific analyses.

Race-specific analyses. Analyses of infants by race-ethnicity were striking (table 2). For infants of African American race-ethnicity, the rate of congenital syphilis citywide increased from 1.8 per 1,000 live births in 1982 to 10.6 in 1988. From 1982 to 1986, the rate for African American infants increased from 1.8 to 3.4, an 88.9-percent increase. From 1987 to 1988, the rate increased from 5.7 to 10.6, an 86.0-percent increase in 1 year. The change over time for infants of Hispanic race-ethnicity was less dramatic, at least through 1987.

In 1982, the rate was 1.6 and increased slowly to 2.8 in 1987, and then increased sharply to 5.6 in 1988. For whites, the rate was 0.2 in 1982 and increased steadily to 1.0 in 1988.

Race-specific quartile analyses. When African American newborns were analyzed by quartile of the cumulative cocaine dependence rates in African American women, the biggest increase in rate (per 1,000 live births) occurred in quartile 4, the highest cocaine-dependence areas, where the rate of affected infants increased from 1.9 in 1982 to 14.6 in 1988 (table 3). During the same period in quartile 3, the rate increased from 2.1 to 12.4; in quartile 2, from 1.5 to 7.6 in 1988; and, in quartile 1, from 1.6 to 2.8.

Hispanic infants followed a similar pattern but generally had lower annual rates of congenital syphilis. Infants of white race-ethnicity showed an overall increase over time in each quartile, but yearly rates were unstable because of the small number of affected infants. Congenital syphilis births in white infants represented 145 of 263,105 (0.06 percent) live births, compared with 728 of 285,608 (0.25 percent) live births for Hispanics and 1,277 of 296,259 (0.43 percent) live births for African Americans.

Discussion

From 1982 to 1988, the citywide rate of congenital syphilis increased from 1.2 to 5.8 per 1,000 live births, while rates of cocaine dependence for discharged women of childbearing age increased from 23.3 to 423.3 per 100,000 women. Rates of congenital syphilis increased in all racial-ethnic groups and in all quartiles over time, but the magnitude of the increase was greatest for African American infants. In quartile-specific analyses of African American women and newborns, rates of congenital syphilis increased, suggestive of a dose-response relationship—from 1.9 to 14.6 in the highest cocaine-exposure quartile; from 2.1 to 12.4 in the third; from 1.5 to 7.6 in the second; and, from 1.6 to 2.8 in the lowest cocaine-exposure quartile. This finding was not unexpected, because African American women living in New York City have the highest race-specific rates of infectious syphilis among adult women, according to NYCDOH data. They also may be at higher risk for cocaine use, as evidenced by having the biggest increase in cocaine-dependence discharges during the study period—21-fold—and are less likely than white women to receive any prenatal care (14).

Limitations in examining trends in discharge diagnoses of congenital syphilis in New York City using SPARCS data should be addressed. First, diagnoses were reported to SPARCS based on hospital discharge diagnoses, which may have been influenced by the judgement of physicians who applied disparate diagnostic criteria. Second, physician awareness of the epidemic of congenital syphilis in New York may have affected the frequency of this diagnosis over time if, for example, physicians were prompted to re-test infants who were initially seronegative (15). And finally, the diagnosis of syphilis is complicated, especially for newborns.

We believe that problems in uniformity of criteria for diagnosis would have nondifferentially affected case reporting in SPARCS data. Since 1953, all hospital-born New York infants have been tested for syphilis at birth according to a standard protocol. Sensitive criteria for surveillance cases of congenital syphilis in New York that did not depend on serologic evidence of exposure in the infant were adopted in 1989, 1 year after our study concluded (4). Therefore, trends in our data do not reflect the adoption of more inclusive criteria for case reporting.

Greater physician awareness of the epidemic may have contributed to an increased number of reported cases over time. We believe that it was unlikely, however, that physician awareness alone accounted for the observed 5-fold increase in rates citywide.

Finally, the difficulty in establishing a syphilis diagnosis remained unchanged during the period under study, and this difficulty probably did not differentially affect one group of infants over another. Generally, a discharge diagnosis of congenital syphilis as reported to SPARCS included evidence of reactive syphilis serology.

Advantages to using SPARCS included access to data from close to a complete sample of all live births in New York City. In addition, numerator and denominator data were available from the same source. Finally, the number of cases identified through discharge diagnoses was found to be more complete than the number identified through the NYCDOH. For example, in 1982 SPARCS reported 153, and the NYCDOH 16 cases of congenital syphilis in New York City. SPARCS consistently identified more cases than the NYCDOH, but the proportional disparity diminished over time. In 1988, 804 cases were reported by SPARCS and 357 by the NYCDOH.

Regarding the SPARCS diagnosis of cocaine

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dependence, our study included as subjects all women ages 15–44 who were hospitalized in public or private facilities for any reason if cocaine dependence was included among their discharge diagnoses. Limitations of SPARCS data in examining cocaine dependence in women include the probability that nonwhite women were more likely than white women to be assigned a diagnosis of cocaine dependence. In addition, SPARCS data do not contain unique identifiers, so that the number of cocaine-dependence discharges does not represent individuals, and may, on occasion include more than one discharge for a particular woman.

To control partially for the likely racial inequity in assignment of a cocaine-dependence diagnosis, race-specific analyses of infants were performed after recalculating the quartiles of cocaine exposure for women in each racial-ethnic group. Yearly rates of congenital syphilis were then compared in different quartiles for the members of the same group. Regarding possible multiple admissions, we considered cocaine-dependence discharges only as a relative marker of use among women residing in a particular area. The major strength of using SPARCS data was that there were no penalties associated with disclosure of cocaine use. Because of this, we believed SPARCS to be an acceptable indicator of cocaine use in women of childbearing age.

The most significant problem with our data was common to all ecologic studies. We did not know that the women using cocaine were the same ones giving birth to infants with congenital syphilis. The similar time trends that we described may be non-causally related, or only weakly associated on an individual level, a spurious situation called "an ecologic fallacy." Crack-cocaine smoking has been associated, however, with a history of a sexually transmitted disease in African American teenagers, especially girls, in California (16) and cocaine use

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with syphilis in other studies (3-8,17). Therefore, our study supports other evidence of the cocaine and syphilis association.

We believe that our study helped demonstrate the utility of hospital discharge data in public health research. SPARCS data provided an overview of the magnitude of two urban health problems and a way to examine change over time in specific population subgroups. If used in a timely fashion, hospital discharge data can also serve as an early warning system by identifying groups in greatest need of immediate intervention efforts. Finally, examination of SPARCS data suggests that identification of cases of reportable diseases like congenital syphilis could improve with closer cooperation between local departments of health and data collection agencies.

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