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Perinatal and Infant Health Among Rural and Urban American Indians/Alaska Natives

by

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ABSTRACT

Context: A complete national picture of rural and urban American Indian/Alaska Native (AI/AN) maternal and infant health is unavailable, since the Indian Health Service tracks health indicators only in those geographic areas where it has service obligations.

Objective: To examine and compare maternal risk factors, prenatal care use, and birth outcomes of AI/AN populations living in rural and urban areas using a national linked birth-death database.

Design: Cross-sectional study.

Patients: All singleton AI/AN births between January 1, 1989, and December 31, 1991, to residents of the U.S. Comparisons on some measures were made to the 1990 singleton white, African-American, and overall non-AI/AN populations.

Main Outcome Measures: Percentage of women who received an inadequate pattern of prenatal care; percentage of low-birthweight births (< 2500 grams); neonatal, postneonatal, and overall infant mortality rates; and cause of death.

Results: Rural mothers of AI/AN births were significantly more likely to have received an inadequate pattern of prenatal care than urban mothers of AI/AN births (18.1% versus 14.4%, $p \leq 0.001$). Both groups had over twice the rate of receipt of an inadequate pattern of prenatal care compared to whites (6.8%). The low birthweight and neonatal death rates were significantly higher for urban compared to rural AI/AN births. AI/AN postneonatal death rates (rural 6.7/1000; urban 5.4/1000) were over twice that of whites (2.6/1000). Postneonatal death rates from SIDS, infectious diseases, and unintentional injuries were most consistently higher in AI/ANs compared to the rest of the U.S. population. There were large differences in outcome measures both between and within the Indian Health Service's administrative Areas.

Conclusions: There are high rates of receipt of an inadequate pattern of prenatal care and infant death, especially postneonatal death, among American Indians/Alaska Natives nationally. Many of these postneonatal deaths are from preventable causes, suggesting that there are untapped opportunities for improvement through better access to health services and health education and prevention programs. The substantial variation in outcomes among Indian Health Service Areas suggests that programs must be developed at both a national and local level to monitor outcome measures and to devise the most appropriate strategies to address the unmet needs of rural and urban AI/ANs.

INTRODUCTION

Though American Indians (AIs) and Alaska Natives (ANs) are known to have decreased life expectancy and disproportionately high rates of morbidity associated with a broad range of health problems, considerable gains have been realized during the 43 years since the Indian Health Service (IHS) was established as the lead health agency commissioned to improve AI/AN health status (IHS, 1996b; Rhoades et al., 1987). Some of the greatest gains have been made in the area of infant and child health. Since 1955, when the IHS was created, reported infant mortality rates among AI/ANs in IHS Areas have dropped 86 percent (from 62.7 per 1000 live births in 1955 to 8.8 per 1000 live births in 1992), and the gap between AI/ANs and all U.S. residents has narrowed considerably. The IHS reports that the neonatal mortality rate in IHS Areas in 1991-93 was 4.0 per 1000 live births, compared to a rate of 5.4 per 1000 live births in the rest of the U.S. (IHS, 1996b; Waxman, 1999). Postneonatal mortality rates among AI/ANs (4.9 per 1000 live births) continue to lag behind those of the rest of the U.S. population, but are approaching the overall U.S. rate (3.1 per 1000 live births).

Despite these encouraging trends, little is known about how different segments of the entire AI/AN population have fared. The IHS tracks health indicators only in those geographic areas where it has service obligations. Most of these areas are rural counties with Tribal lands and have either IHS-administered or Tribally run health programs. The IHS does not support services in many metropolitan areas of the U.S., despite the fact that an ever increasing proportion of the AI/AN population resides in these areas. In recognition of the increasing urban demographic shift, the U.S. Congress established an urban AI/AN health program under Title V of the 1976 Indian Health Improvement Act. This act led to the establishment of urban health programs in large urban areas outside IHS service boundaries where substantial AI/AN populations were present. However, this program accounts for only 1.6 percent of the current IHS budget and generally does not provide the full spectrum of services available in traditional reservation-based IHS and Tribal programs. The IHS does provide full levels of service in large facilities in some urban areas such as Anchorage and Phoenix, as well as limited services in smaller facilities in other metropolitan areas within the IHS service boundaries.

The health status and trends in the urban AI/AN population are far less clear. IHS statistical reports do not stratify health status reports by rural/urban location of residence and AI/ANs not living in defined service areas are not included in aggregate statistical reports. While several studies have used selected data to examine the maternal or infant health status of urban AI/ANs and differences between rural and urban AI/AN maternal and infant health status, none have examined national urban maternal and infant health status using population-based

data (Grossman et al., 1994; Sugarman et al., 1994). A full picture of rural and urban AI/AN maternal and infant health, both inside and outside the IHS system, is needed to assess progress toward national health objectives.

The objective of this study is to compare differences between AI/AN populations living in rural and urban counties of the U.S., both inside and outside of IHS Areas, with respect to maternal risk factors, prenatal care use, and birth outcomes using linked birth-death data.

METHODS

Study Population

This study is based on the 1989-91 National Linked Birth-Death Database, which were the most recent data available from the National Center for Health Statistics (NCHS) at the time of the study analyses. This database contains selected information compiled from birth certificates for all 50 states and the District of Columbia on all live births between January 1, 1989, and December 31, 1991. We obtained county identifiers for each birth in the database, allowing classification of counties as rural or urban and within or outside of IHS Areas. Death certificate data were linked to these births if the infant died within a year of birth. Only singleton AI/AN births to women who were residents of the U.S. were included in the study population. AI/AN births were identified as those for which the mother or father was reported as an American Indian or Alaska Native on the birth certificate. This differs from the NCHS's practice since 1989 of tabulating births primarily by the race of the mother (U.S. Department of Health and Human Services, 1995b). We included births with AI/AN fathers designated as AI/AN regardless of the parents' racial identity because non-AI/AN women giving birth to AI/AN children are eligible for IHS services. Births of other racial groups were identified by the race of the mother only, after excluding those with AI/AN fathers.

Definition of Study Variables

Births were classified as either rural or urban based on the county of residence of the mother on the birth certificate. All counties were assigned Urban Influence Codes as defined by the U.S. Department of Agriculture's Economic Research Service (revised December 1996). These codes are based in part on the 1993 federal Office of Management and Budget's (OMB's) metropolitan and non-metropolitan county definitions. Births in counties designated with Urban Influence Codes 1 (central and fringe counties of metropolitan areas of one million population or more) and 2 (counties in metropolitan areas of fewer than one million population)

were designated as metropolitan (referred to as urban in this paper); Urban Influence Codes 3 through 9 (all nonmetropolitan counties) were classified as rural.

Selected maternal characteristics were categorized to describe the AI/AN births in our study: age (< 18, 18-34, > 34), educational attainment (no high school degree, high school only, some college), marital status (married, other), parity (0, 1-4, 5 or more previous live births), cigarette use (none, < 11 cigarettes per day, 11+ cigarettes per day), alcohol use (none, 1-4 drinks per week, 5 or more drinks per week), history of prior premature labor, preexisting medical risk factors (one or more of the following: maternal cardiac disease, chronic hypertension, and gestational or established diabetes), and complications of labor (one or more of the following: eclampsia, anemia, oligohydramnios, incompetent cervix, uterine bleeding, abruptio placenta, and placenta previa).

During analysis, a high degree of correlation was found between the race of the AI/AN parent and marital status. The majority of AI/AN mothers were unmarried, while the majority of AI/AN fathers were married. There was a rural/urban difference in the distribution of these births, with a much higher proportion of births with an AI/AN father only in urban areas. For this reason, we created an interaction variable between parental race and marital status for use in analysis.

Prenatal care use was defined using a modified Kessner Index (U.S. Department of Health and Human Services, 1995a). This index is based on the month prenatal care began and the number of prenatal visits adjusted for gestational age at birth. The modified Kessner Index does not reflect the quality of the content of prenatal care, but rather the pattern of prenatal care received. In this study, we examined the percentage of births with an inadequate pattern of prenatal care as defined by the modified Kessner Index. Women classified as having received an inadequate pattern of prenatal care were primarily those who initiated care in the third trimester, regardless of the number of prenatal visits they received.

Low birthweight was defined as under 2500 grams. We identified all infant deaths (within one year of birth), and subdivided these into neonatal deaths (within 28 days of birth) and postneonatal deaths (over 28 days to a year). Death rates are presented per 1000 live births.

Cause of death is presented for the neonatal and postneonatal periods separately using ICD-9-based categories defined by the National Center for Health Statistics (U.S. Department of Health and Human Services, 1995c), with one modification. In this modification, a number of infectious diseases were aggregated into a single cause of death entitled "all infectious diseases." Because of the infrequency of many causes of death, only those in which one of the AI/AN groups

had a rate greater than or equal to 0.01 per 1000 births were included. All others were assigned to the single category "all other causes."

The IHS defines each U.S. county as either inside or outside its geographic, administrative Area system. In addition to presenting national data, births were stratified into those from IHS Area counties and non-IHS Area counties to examine the variation between and within the 12 administrative Areas (Figure 1).

Analyses

Maternal characteristics, receipt of an inadequate pattern of prenatal care, low-birthweight rates, infant death rates, and cause of death were compared between rural and urban AI/ANs nationally. Unadjusted and adjusted odds ratios were calculated to compare differences in rural and urban use of prenatal care, low-birthweight, and infant death rates. Adjusted ratios were estimated through multiple logistic and linear regression analyses, controlling for maternal characteristics.

Receipt of an inadequate pattern of prenatal care, low-birthweight, and infant death rates for whites and African-Americans are also presented for comparison. Causes of death in rural and urban areas were compared using rate ratios. Non-AI/AN rates of causes of death were presented as well, and rate ratios comparing AI/AN to non-AI/AN causes of death within rural and urban areas were calculated.

Receipt of an inadequate pattern of prenatal care, low-birthweight, and neonatal and postneonatal death rates were calculated for rural and urban AI/ANs separately within each of the 12 IHS Areas and for all non-IHS Areas combined. Adjusted odds ratios comparing rural to urban rates are presented for each of these areas separately.

It is important to note that this study's AI/ANs comprise the entire population of identifiable births and associated first-year deaths for the nation for three years. Nevertheless, tests of statistical significance were performed because of situations with few cases and because of possible reporting and assignment errors. Estimates have relatively small confidence intervals when they are for all rural AI/AN or all urban AI/AN women. For instance, the 95 percent confidence interval around the 18.1 percent estimate of rural AI/AN women who received an inadequate pattern of prenatal care is 17.8 to 18.4 (n=73,081) and the comparable figures for urban AI/AN women are 14.4, 14.1, and 14.7 (n=68,198). Even in analyses of the IHS Areas the confidence intervals are generally quite narrow. For example, the 95 percent confidence interval around the 25.6 percent estimate of rural Aberdeen AI/AN women who received an inadequate pattern of prenatal care is 24.5 to 26.6 (n=6,733) and the comparable figures for rural Nashville AI/AN women are 9.9, 8.5, and 11.4 (n= 1,695, one of the IHS Areas with the lowest number of

births). However, the analysis of the causes of death are often based on few events and low estimates should be viewed with caution (Table 3). The statistical significance of rates, odds ratios and rate ratios were calculated through the use of standard two-tailed tests at the .05 level of significance or lower.

RESULTS

There were 148,482 American Indian or Alaska Native singleton births using our study definition (mother or father defined as American Indian or Alaska Native on the birth certificate) between January 1, 1989, and December 31, 1991. Of these births, 75,752 (51%) were to mothers living in rural counties and 72,730 (49%) were to mothers living in urban counties. For both rural and urban areas, the greatest proportion of births had an AI/AN mother only (Table 1). Of the remaining AI/AN births, those in rural areas were significantly more likely to have both an AI/AN mother and father, while those in urban areas were significantly more likely to have an AI/AN father only.

The vast majority of AI/AN births in both rural and urban groups were to women between 18 and 34 years old (Table 1). Approximately half of the births were to unmarried women. Urban mothers were more likely to be unmarried, to be having their first child, and to be smokers than rural mothers. Rural mothers were more likely to have preexisting medical risk factors, complications of labor, and to have a prior premature birth.

Rural mothers of AI/AN births (18.1%) were significantly more likely to have received an inadequate pattern of prenatal care than urban mothers of AI/AN births (14.4%), although the difference between these two groups decreased when adjusted for maternal risk characteristics (Table 2). The low-birthweight rate for urban AI/AN births (5.7%) was significantly higher than for rural AI/AN births (5.2%), however. Overall infant death rates were slightly higher for rural AI/AN births compared to urban births (not statistically significant), primarily due to the much higher postneonatal death rate of rural AI/AN births (6.7/1000) compared to urban AI/AN births (5.4/1000). However, when adjusted for birth characteristics, this difference is not quite significant at the 0.05 level. The adjusted neonatal death rate mirrored the low-birthweight rate, and was significantly higher for urban AI/AN births than rural AI/AN births.

More striking are the national comparisons between AI/ANs and other racial groups. The rates of receipt of an inadequate pattern of prenatal care (rural 18.1%; urban 14.4%) were comparable to those of African Americans (16.4%), and nearly three times the rates of whites during the same time period (6.8%). In contrast, low-birthweight rates (rural 5.2%; urban 5.7%), while higher than whites (4.7%), were

less than half those of African Americans (12.0%). Postneonatal death rates (rural 6.7/1000; urban 5.4/1000) were over twice those of whites (2.6/1000) and comparable to those of African Americans (5.8/1000). Neonatal death rates mirrored the low-birthweight rates, with the AI/AN rates somewhat higher than rates for whites, but much lower than rates for African Americans.

There were no statistically significant rural/urban differences in cause of death among AI/ANs in the neonatal period (Table 3). Congenital anomalies, respiratory conditions, including respiratory distress syndrome, and short gestation or low birthweight, were the most common causes in both the rural and urban groups, and for the non-AI/AN population. Compared to non-AI/ANs, urban AI/ANs were significantly less likely to die from short gestation or low birthweight in the neonatal period (rate ratio 0.74). Urban AI/AN infants were significantly more likely to die in the neonatal period from complications of the umbilical cord, membranes, or placenta (rate ratio 1.48), perinatal infections (rate ratio 2.08), and infectious diseases (rate ratio 2.06) than urban non-AI/AN infants. Rural AI/AN infants were more likely to die in the neonatal period from infectious diseases and unintentional injuries than rural non-AI/AN infants.

The causes of death shift in the postneonatal period, with the most common causes for both AI/AN and non-AI/AN deaths being SIDS, infectious diseases, congenital anomalies, and unintentional injuries (Table 3). Compared to urban AI/ANs, rural AI/AN postneonatal deaths were significantly more likely to be caused by infectious diseases (rate ratio 1.89) and unintentional injuries (rate ratio 1.82). Much more dramatic differences were seen between AI/AN and non-AI/AN postneonatal death rates in both rural and urban areas. The postneonatal death rate for SIDS and unintentional injuries in rural and urban AI/ANs was over twice that of non-AI/ANs. Postneonatal deaths from infectious diseases were also significantly higher for both rural and urban AI/ANs than non-AI/ANs (rate ratios 2.76 and 1.57 respectively). Rural AI/ANs had higher postneonatal death rates for congenital anomalies than rural non-AI/ANs, while urban AI/ANs had higher postneonatal death rates for homicide and respiratory distress syndrome than urban non-AI/ANs.

Tables 4, 5, and 6 and Figures 2, 3, 4, and 5 compare the rates of receipt of an inadequate pattern of prenatal care, low birthweight, neonatal death, and postneonatal death among the 12 IHS Area and the non-IHS Area residents. A sizable proportion of both urban (48.7%) and rural (15.3%) AI/AN births were to women living outside the boundaries of IHS Areas. In general, these figures demonstrate as much or more variation between IHS Areas than between rural and urban AI/ANs within Areas. For example, 25.6 percent of Aberdeen's rural births had received an inadequate pattern of prenatal care in contrast to 10.7 percent of Alaska's rural births, more than a two-fold difference. With a few exceptions, the comparisons between rural and urban AI/AN low-birthweight, neonatal death, and

postneonatal death rates for most IHS Areas and the non-IHS Area were comparable to the findings in the national data. Rural low-birthweight (adjusted odds ratios range from 0.59 to 1.12, Table 5) and neonatal death rates (adjusted odds ratios range from 0.43 to 1.99, Table 6) tended to be lower and postneonatal death rates (adjusted odds ratios range from 0.80 to 3.10, Table 6) about the same or higher than urban rates. Comparisons between rural and urban AI/AN rates of receipt of an inadequate pattern of prenatal care within areas were more variable, however, with similar numbers of areas showing significantly higher and lower rates for rural compared to urban populations (adjusted odds ratios range from 0.54 to 1.66, Table 4).

DISCUSSION

This study confirms the findings of other work documenting the high rates of receipt of an inadequate pattern of prenatal care and of infant death, especially postneonatal death, among American Indians/Alaska Natives (Buck et al., 1992; Grossman et al., 1994; Indian Health Service, 1996b). It also elucidates several significant differences between AI/ANs living in rural and urban areas.

Both rural and urban AI/ANs have rates of receipt of an inadequate pattern of prenatal care that are two to three times that of whites and about the same as African-Americans. Within the AI/AN population, rural AI/ANs have higher rates of receipt of an inadequate pattern of prenatal care than urban AI/ANs, despite the fact that a greater proportion of rural AI/ANs live within IHS Areas, where health care services are funded by the IHS. This may reflect barriers to optimal care, such as greater distances from health services and limited transportation systems in rural areas, or other factors (e.g., poverty) that interfere with women's receipt of prenatal care. While national figures demonstrate a less adequate pattern of prenatal care receipt for rural AI/ANs, there was substantial variation between IHS Areas, with several areas showing a less adequate pattern of prenatal care receipt for urban AI/ANs. Clearly, solutions to improve prenatal care use must be tailored to address the barriers specific to a geographic area as well as the local AI/AN population.

Low-birthweight rates for both rural and urban AI/ANs were higher than those of whites, although less dramatically different than the inadequate pattern of prenatal care rates. Unlike the direction of the findings for prenatal care use, urban AI/ANs were more likely than rural AI/ANs to have low-birthweight infants. These findings suggest that factors other than prenatal care receipt play more important roles in the determination of birthweight. In addition, if there were sociodemographic or risk differences between urban and rural AI/AN births that were not available as control factors, this could help explain these differences.

The neonatal death rates of rural and urban AI/ANs mirrored the low-birthweight rates, with urban AI/ANs demonstrating a higher neonatal death rate compared to rural AI/ANs. The most frequent causes of the AI/AN neonatal deaths are all associated with low-birthweight births, confirming this correlation between the rural/urban pattern of low-birthweight and neonatal death rates.

The most concerning finding of this study is the confirmation of very high postneonatal death rates for both rural and urban AI/ANs, more than twice that of whites. While reports of high AI/AN postneonatal death rates are not new (Nakamura et al., 1991; Vanlandingham et al., 1988; Vanlandingham & Hogue, 1995), results from this study have also demonstrated a significantly higher postneonatal death rate among rural compared to urban AI/ANs, especially for infectious diseases and unintentional injuries. Within rural areas, AI/ANs have substantially higher postneonatal rates of death than the overall U.S. population from a number of preventable causes—SIDS, infectious diseases, and unintentional injuries. Within urban areas, SIDS, infectious diseases, unintentional injuries, and homicide are all higher in AI/ANs than the overall population. These higher death rates from preventable causes suggest that there are opportunities to improve the postneonatal death rates of rural and urban AI/ANs through improved access to health services and health education and prevention programs. The large variations in postneonatal death rates between rural and urban AI/ANs in different IHS Areas also suggest that the rates may be malleable.

While there have been dramatic improvements in AI/AN maternal and child health over the last few decades, the findings of this study demonstrate that there are still significant unmet health care needs for both rural and urban AI/ANs. It may be surprising that several of the health status measures examined in this study were worse in rural areas, since the IHS has greater health service coverage in rural areas than in urban areas. However, greater distances from services and a higher degree of poverty in rural areas (Grossman et al., 1994) may make it more difficult for rural AI/ANs to take advantage of available health and preventive services. At the same time, urban AI/ANs may have better access to health services through private insurance or other programs. In addition, increases in the IHS budget have not kept up with inflation in medical costs, so that the level of service relative to need for AI/ANs in some rural areas covered by the IHS may actually have decreased over time.

This study provides important information about the urban segment of the AI/AN population, a group that is more difficult to study given its dispersion and the misclassification of AI/ANs in health databases and reports. While urban AI/ANs appear to have improved access to prenatal services and lower postneonatal deaths than their rural counterparts, their rates of receipt of an inadequate pattern of prenatal care, low birthweight, and neonatal and postneonatal death are still much higher than urban whites, confirming their need for improved services.

The IHS has a small urban AI/AN program that funds 36 programs in cities nationally, some of which provide direct medical services, while others provide outreach and referral services. Further research is needed to characterize the extent to which urban AI/ANs have access to health services through these IHS-funded urban AI/AN programs, Tribal health programs, private insurance, or other programs.

This study's limitations are those common to studies using secondary databases. Birth certificates in particular suffer from both missing data, as evidenced by the high rates of missing data in our database for cigarette use, alcohol use, and maternal and obstetric risk characteristics, as well as underreporting of pregnancy complications (Buescher et al., 1993; Parrish et al., 1993; Piper et al., 1993; Woolbright & Harshbarger, 1995). Prenatal visits are also underreported on the birth certificates (Dobie et al., 1998). Because birth certificates are generally completed in hospitals, differences in accuracy or completion rates by rural and urban hospitals could affect our study results. In addition, the results from this analysis of nearly decade-old data may not be representative of the current situation, although they do establish a baseline from which to measure change and are certainly useful in framing many questions. More recent regional data from the Pacific Northwest suggest there have been substantial improvements in AI/AN infant mortality rates during the mid-1990s, particularly with regard to deaths caused by SIDS ("Decrease in Infant Mortality...," 1999). However, it is not known whether these improvements are generalizable to AI/ANs in the remainder of the nation or whether the gains are equally distributed among urban and rural AI/ANs. Clearly it is important to replicate this study with national linked birth-death data that have recently become available both to update these findings and to examine changes over the last decade.

Prior studies, including the most recently published IHS figures on infant mortality (Indian Health Service, 1996a; Indian Health Service, 1996b) have suffered from the well-documented problem of misclassification of race on the death certificate, which results in an underestimate of AI/AN infant death rates (Epstein et al., 1997; Frost & Shy, 1980; Hahn et al., 1992; Querec, 1994; Support Services International, 1996). This study used linked birth-death records to identify AI/AN deaths, which minimizes this misclassification problem, and has allowed us to provide more accurate national and IHS Area-based infant mortality rate figures that are higher than those previously reported.

In summary, this study has found high rates of receipt of an inadequate pattern of prenatal care and of postneonatal infant death for both rural and urban AI/ANs when compared to whites. In addition, the results document substantial variation across IHS Areas in maternal and child health measures. The patterns are complex and pose more questions than they seem to answer. Programs must be developed locally both to review outcome measures such as these and to devise the most appropriate strategies to address the unmet needs of rural and urban AI/ANs.

To this end, we have performed several additional analyses at the Metropolitan Statistical Area level to examine some of these same measures within the urban areas with the largest AI/AN populations and at the county level to examine these measures within smaller rural geographic units (unpublished data). Development of data systems that can provide information at even more local levels is crucial so that Tribes that have assumed responsibility for their members' health care needs, the IHS, and others involved in providing AI/AN health services can plan the most effective health and social service programs.

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Table 1: Sociodemographic and Risk Characteristics of Singleton Rural and Urban American Indian and Alaska Native Births, 1989-91

Characteristics	Rural	Urban	Total
Race of parents (%):			
Both parents AI/AN	41.3***	17.6	29.7
AI/AN mother only	44.2***	51.8	47.9
AI/AN father only	14.5***	30.7	22.4
Age (%):			
< 18	7.3***	6.8	7.1
18-34	85.9***	86.5	86.2
35+	6.8	6.6	6.7
Mother's education (%):[1]			
< 12 years high school	35.7***	32.5	34.2
12 years	44.2***	41.1	42.7
Some college	20.2***	26.4	23.1
Marital status (% married)	49.0***	56.3	52.6
Parity (%):[1]			
0	30.9***	37.3	34.0
1-4	63.3***	59.5	61.4
5+	5.8***	3.2	4.5
Smoking (%):[1]			
Nonsmoker	79.5***	76.3	78.1
< 11 cigarettes/day	14.6***	15.4	15.0
11+ cigarettes/day	5.9***	8.3	6.9
Drinking (%):[1]			
Nondrinker	95.8	95.7	95.8
1-4 drinks/week	3.3	3.4	3.3
5+ drinks/week	0.9	0.9	0.9
% with preexisting medical risks[1,2]	5.1***	3.9	4.5
% with complications of labor[1,3]	13.2***	9.9	11.6
% with prior premature delivery[1]	2.3***	1.8	2.1
Number of births	75,752	72,730	148,482

[1] Excludes missing data. Percentage of cases with missing data: education 7.2%; preexisting medical risk 10.5%; prior premature delivery 13.5%; smoking 27.1%, drinking 27.2%; complications of labor 13.6%, parity 0.3%; age, race, and marital status had no missing data.

[2] Maternal cardiac disease, chronic hypertension, diabetes.

[3] Complications include pregnancy-induced complications, eclampsia, anemia, oligohydramnios, incompetent cervix, uterine bleeding, abruptio placenta, placenta previa.

Significance of differences between rural and urban (two-tailed, 95% confidence level):
*** $p \leq 0.001$ ** $p \leq 0.01$ * $p \leq 0.05$

Table 2: Prenatal Care Receipt and Birth Outcomes of Singleton Rural and Urban American Indians/Alaska Natives and Other Races, 1989-91

	American Indians/Alaska Natives					
	Rural	Urban	Rural to Urban Odds Ratio	Rural to Urban Adjusted Odds Ratio[1]	Whites	African Americans
Prenatal care:						
% who received an inadequate pattern of prenatal care	18.1	14.4	1.31***	1.06***	6.8	16.4
Low birthweight:						
% low birthweight (< 2,500 grams)	5.2	5.7	0.90***	0.89***	4.7	12.0
Mortality (rate/1,000):						
Neonatal (0-28 days)	5.0	5.5	0.91	0.83*	4.0	9.8
Postneonatal (29 days-1 year)	6.7	5.4	1.23**	1.13	2.6	5.8
Infant death (first year total)	11.7	11.0	1.07	0.98	6.7	15.6
Number of births[2]	75,752	72,730	NA	NA	9,469,966	1,983,611

[1] Odds ratio from multiple logistic regression adjusted for race/marital status, age, education, complications of pregnancy and birth, prior premature birth, smoking, drinking.

[2] When calculating receipt of an inadequate pattern of prenatal care percentages, the births with missing values for this variable were excluded (rural AI/AN N = 73,081, urban AI/AN N = 68,198, white N = 9,112,958, African-American N = 1,859,810).

Significance of odds ratios from one (i.e., no difference) (two-tailed, 95% significance level): *** $p \leq 0.001$ ** $p \leq 0.01$ * $p \leq 0.05$

Table 3: Cause of Death for Singleton Rural and Urban American Indians/Alaska Natives and Non-Indian Population

Cause of Death (%)	American Indians/Alaska Natives 1989-91			U.S. Population (non-AI/AN) 1990		AI/AN to non-AI/AN Rate Ratio	
	Deaths/1,000		Rural to Urban Rate Ratio	Deaths/1,000		Rural	Urban
	Rural	Urban		Rural	Urban		
Neonatal Death:							
Congenital anomalies	1.62	1.42	1.15	1.49	1.31	1.09	1.08
Other respiratory conditions	0.50	0.55	0.91	0.42	0.46	1.21	1.19
Short gestation, low birthweight	0.45	0.69	0.65	0.62	0.93	0.72	0.74*
Respiratory distress syndrome	0.42	0.56	0.75	0.47	0.49	0.89	1.14
Complications of the cord, membrane, placenta	0.24	0.29	0.82	0.21	0.20	1.15	1.48*
Hypoxia, asphyxia	0.24	0.16	1.44	0.16	0.14	1.52	1.17
Complications of pregnancy	0.22	0.22	1.02	0.18	0.18	1.25	1.25
Infections perinatal period	0.21	0.37	0.57	0.18	0.18	1.16	2.08***
Sudden infant death syndrome	0.16	0.15	1.05	0.10	0.08	1.63	1.87
All infectious diseases	0.15	0.12	1.17	0.07	0.06	2.10*	2.06*
Unintentional injuries	0.07	0.04	1.60	0.02	0.02	3.34*	2.57
Maternal conditions	0.03	0.11	0.24	0.04	0.04	0.60	2.67
Homicide	0.00	0.01	0.00	0.02	0.01	0.00	1.62
All other causes	0.71	0.82	0.86	0.70	0.89	1.02	0.92
All causes	5.02	5.53	0.91	4.67	4.99	1.07	1.11*

Cause of Death (%)	American Indians/Alaska Natives 1989-91 Deaths/1,000 Rural	Urban	Rural to Urban Rate Ratio	U.S. Population (non-AI/AN) 1990 Deaths/1,000 Rural	Urban	AI/AN to non-AI/AN Rate Ratio Rural	Urban
Postneonatal Death:							
Sudden infant death syndrome (SIDS)	2.73	2.65	1.03	1.34	1.10	2.05***	2.42***
All infectious diseases	0.94	0.49	1.89**	0.34	0.31	2.76***	1.57**
Congenital anomalies	0.82	0.58	1.42	0.55	0.49	1.49**	1.17
Unintentional injuries	0.70	0.38	1.82**	0.30	0.18	2.35***	2.13***
Homicide	0.12	0.18	0.66	0.06	0.07	1.83	2.44**
Respiratory distress syndrome	0.07	0.10	0.69	0.04	0.04	1.73	2.46*
Other respiratory conditions	0.05	0.07	0.77	0.10	0.10	0.55	0.66
Maternal conditions	0.03	0.03	0.96	0.00	0.01	18.73*	4.32
Hypoxia, asphyxia	0.00	0.04	0.00	0.01	0.01	0.00	2.90
Infections perinatal period	0.00	0.03	0.00	0.00	0.01	0.00	2.75
Complications of pregnancy	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Short gestation, low birthweight	0.00	0.01	0.00	0.01	0.01	0.00	1.42
All other causes	1.24	0.85	1.46*	0.69	0.65	1.81***	1.31*
All causes	6.69	5.43	1.23	3.43	2.99	1.95***	1.81***
Number of births	75,752	72,730	NA	709,479	3,302,560	NA	NA
Number of neonatal deaths	380	402	NA	3,315	16,465	NA	NA
Number of postneonatal deaths	507	395	NA	2,437	9,892	NA	NA

Significance of rate ratios from one (i.e., no difference) (two-tailed, 95% significance level): *** $p \leq 0.001$ ** $p \leq 0.01$ * $p \leq 0.05$

Table 4: Prenatal Care Received by American Indians/Alaska Natives by Rural/Urban Residence and IHS Area

IHS Areas (example states)	Number of Births		% Who Received an Inadequate Pattern of Prenatal Care[1]		Adjusted Rural to Urban Odds Ratio[2]
	Rural	Urban	Rural	Urban	
Aberdeen (ND, SD)	6,858	1,475	25.6	20.3	1.17*
Navajo (AZ, NM, CO)	19,552	NA	23.9	NA	NA
Phoenix (AZ, NV)	2,380	6,547	21.4	22.3	1.01
Albuquerque (NM, TX)	2,151	2,921	20.0	21.9	0.85*
Billings (MT, WY)	4,209	385	18.9	27.1	0.54***
Bemidji (MN, WI, MI)	4,189	1,053	17.1	10.5	1.66***
Oklahoma (OK, KS, TX)	10,125	7,489	16.5	14.5	1.04
California (CA)	2,181	5,832	16.4	12.5	1.19*
Portland (WA, OR, ID)	3,611	6,225	14.4	16.2	0.74***
Alaska (AK)	7,164	1,832	10.7	7.5	1.36**
Nashville (NY, TN, FL)	1,767	1,949	9.9	10.3	0.65**
Tucson (AZ)	2	1,623	—[3]	15.0	—[3]
All non-IHS counties (MO, IL, GA)	11,563	35,399	11.7	12.7	0.82***
Total	75,752	72,730	18.1	14.4	1.10***

[1] Percentages exclude missing data (rural N = 73,081, urban N = 68,198).

[2] Multiple logistic regression adjusted for race/marital status, age, parity, education, complications of pregnancy, preexisting conditions, prior premature birth.

[3] Inadequate number of births to calculate.

Significance of rate ratios from one (i.e., no difference) (two-tailed, 95% significance level): *** $p \leq 0.001$ ** $p \leq 0.01$ * $p \leq 0.05$

Table 5: Low-birthweight Rates of American Indians/Alaska Natives by Rural/Urban Residence and IHS Area

IHS Area	% Low Birthweight (< 2500 grams)		
	Rural	Urban	Adjusted Rural to Urban Odds Ratio[1]
Tucson	—[2]	4.8	—[2]
Albuquerque	5.8	5.2	1.12
Navajo	5.6	NA	NA
Phoenix	5.2	5.1	1.07
Billings	5.0	4.7	1.02
Aberdeen	5.0	6.0	0.76*
Nashville	4.8	6.0	0.59**
Oklahoma	4.6	5.0	0.96
Portland	4.6	5.2	0.93
California	4.6	5.6	0.76*
Bemidji	4.5	4.4	0.99
Alaska	4.3	5.4	0.84
All non-IHS counties	6.1	6.3	0.99
Total	5.2	5.7	0.89***
Number of births	75,752	72,730	NA

[1] Multiple logistic regression adjusted for race/marital status, age, parity, education, complications of pregnancy, preexisting conditions, prior premature birth, smoking, drinking.

[2] Inadequate number of births to calculate.

Significance of rate ratios from one (i.e., no difference) (two-tailed, 95% significance level):

*** $p \leq 0.001$ ** $p \leq 0.01$ * $p \leq 0.05$

Table 6: Neonatal and Postneonatal Death Rates of American Indians/Alaska Natives by Rural/Urban Residence and IHS Area

IHS Area	Number of Deaths		Death Rate per 1,000		
	Rural	Urban	Rural	Urban	Adjusted Rural to Urban Odds Ratio[1]
Neonatal:					
Tucson	0	7	—[2]	4.3	—[2]
Navajo	96	NA	4.9	NA	NA
Aberdeen	53	5	7.7	3.4	1.99
Phoenix	18	39	7.6	6.0	1.47
Portland	22	44	6.1	7.1	0.96
Albuquerque	5	8	2.3	2.7	0.86
Nashville	15	17	8.5	8.7	0.75
California	10	29	4.6	5.0	0.70
Billings	30	3	7.1	7.8	0.70
Oklahoma	28	30	2.8	4.0	0.69
Alaska	38	14	5.3	7.6	0.53
Bemidji	12	7	2.9	6.6	0.43
All non-IHS counties	53	199	4.6	5.6	0.81
Total neonatal deaths	380	402	5.0	5.5	0.83*
Number of births	75,752	72,730	NA	NA	NA

IHS Area	Number of Deaths		Death Rate per 1,000		
	Rural	Urban	Rural	Urban	Adjusted Rural to Urban Odds Ratio[1]
Postneonatal:					
Tucson	0	15	—[2]	9.2	—[2]
Navajo	104	NA	5.3	NA	NA
Nashville	18	9	10.2	4.6	3.10*
Albuquerque	16	11	7.4	3.8	1.98
Bemidji	40	5	9.5	4.7	1.69
Billings	37	2	8.8	5.2	1.51
Oklahoma	47	26	4.6	3.5	1.20
Alaska	66	17	9.2	9.3	1.07
Aberdeen	71	15	10.4	10.2	1.01
California	13	27	6.0	4.6	0.98
Portland	26	55	7.2	8.8	0.93
Phoenix	9	36	3.8	5.5	0.80
All non-IHS counties	60	177	5.2	5.0	0.98
Total deaths	507	395	6.7	5.4	1.13
Number of births	75,752	72,730	NA	NA	NA

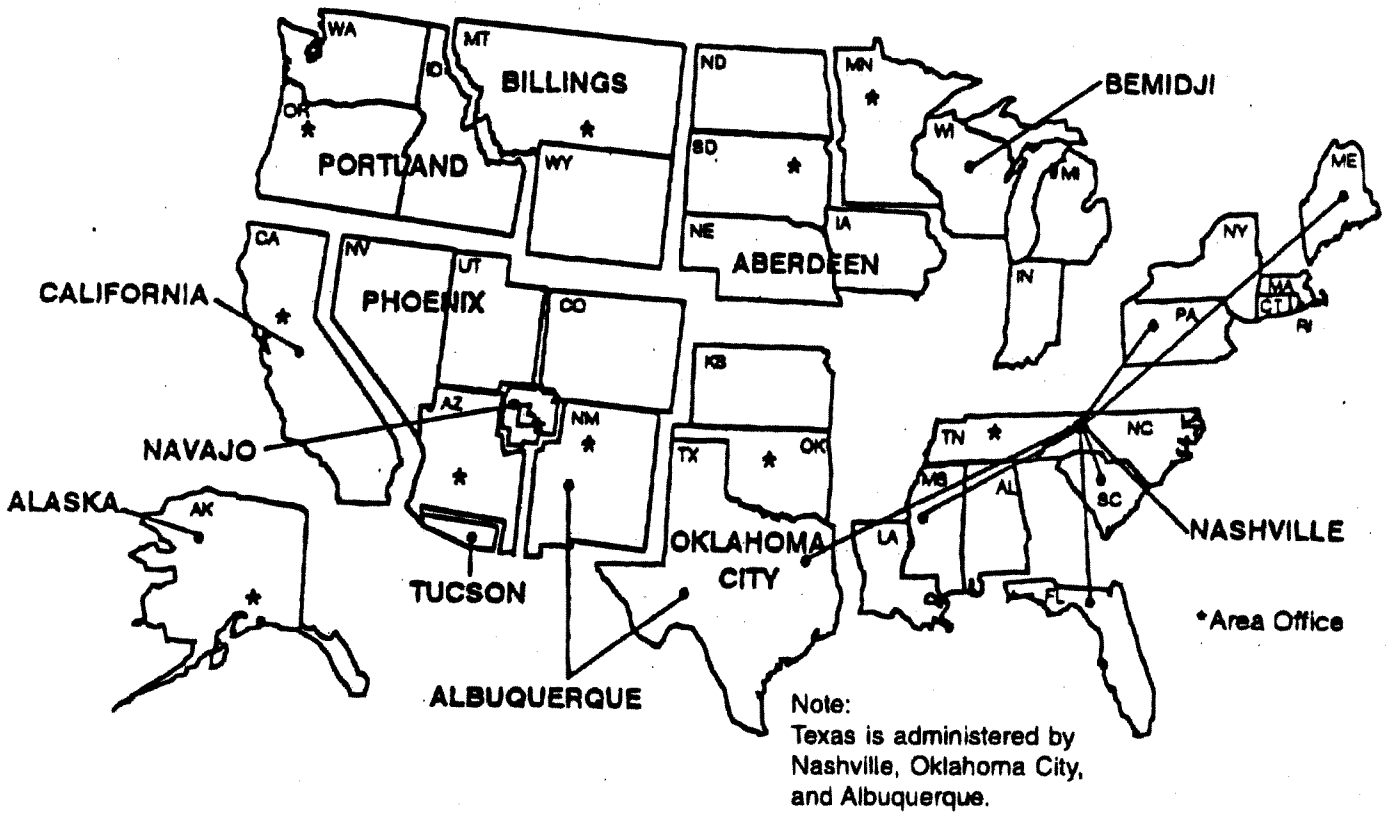
[1] Multiple logistic regression adjusted for race/marital status, age, parity, education, complications of pregnancy, preexisting conditions, prior premature birth, smoking, drinking.

[2] Inadequate number of births to calculate.

Significance of rate ratios from one (i.e., no difference) (two-tailed, 95% significance level): *** $p \leq 0.001$ ** $p \leq 0.01$ * $p \leq 0.05$

FIGURE 1:

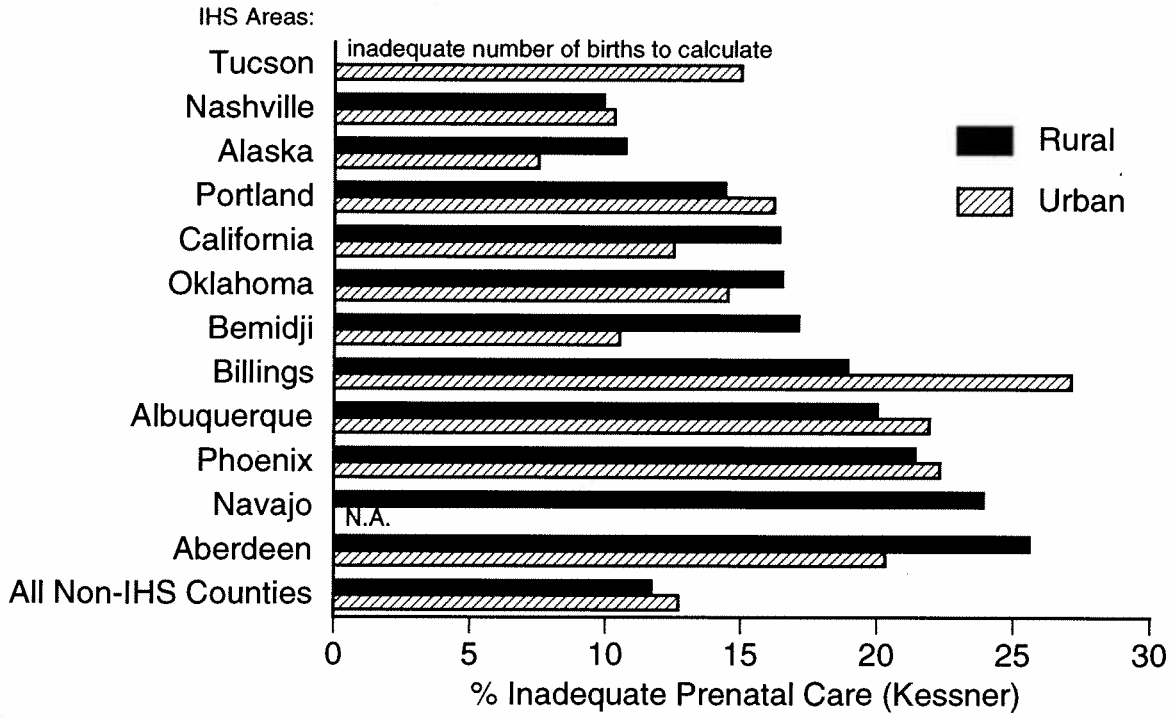
Indian Health Service Area Offices[1]



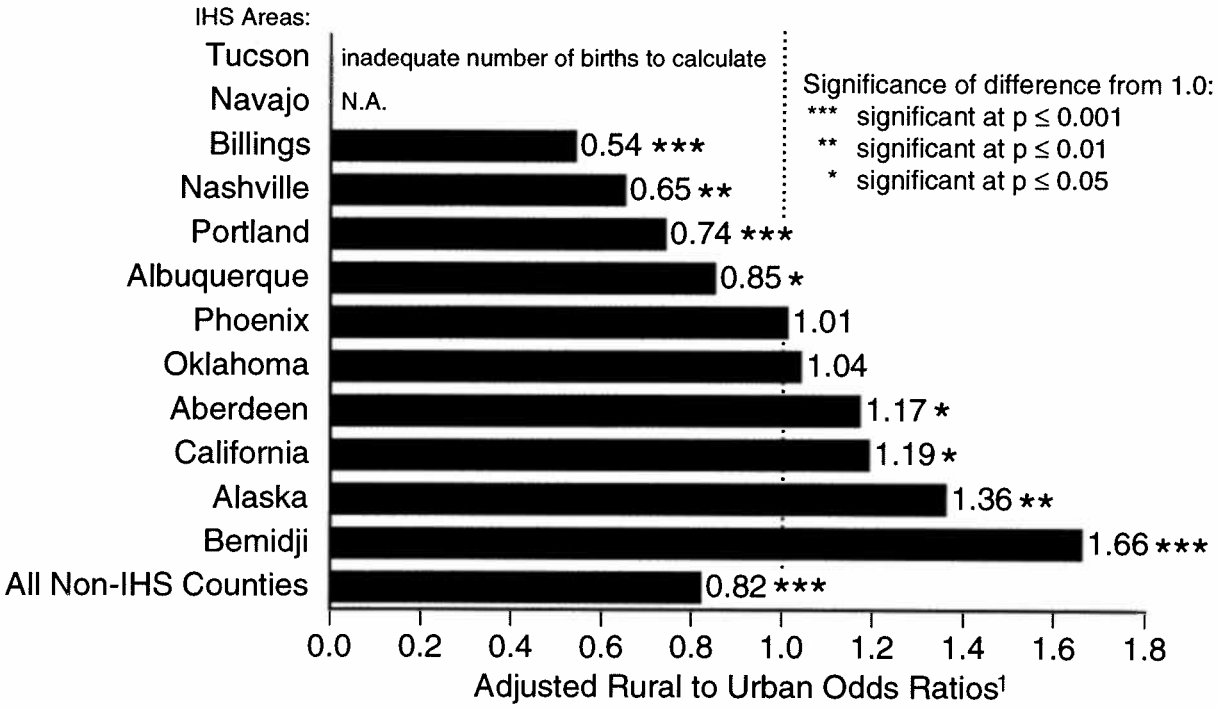
1. Figure 1 is Chart 1.1 from Regional Differences in Indian Health 1996; U.S. Department of Health and Human Services, Indian Health Service, Office of Planning, Evaluation, and Legislation, Division of Program Statistics.

FIGURE 2:

Prenatal Care Received by American Indians/Alaska Natives by Rural/Urban Residence and IHS Area



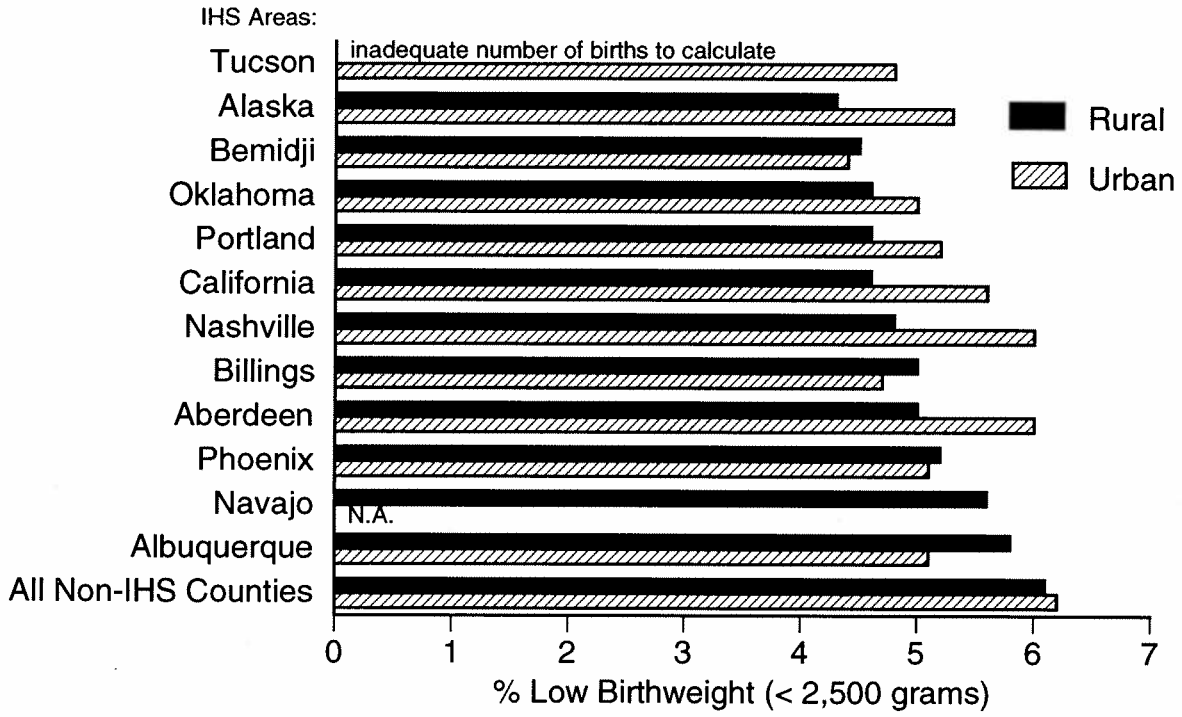
Adjusted Rural to Urban Odds Ratios for Prenatal Care Received by American Indians by IHS Area



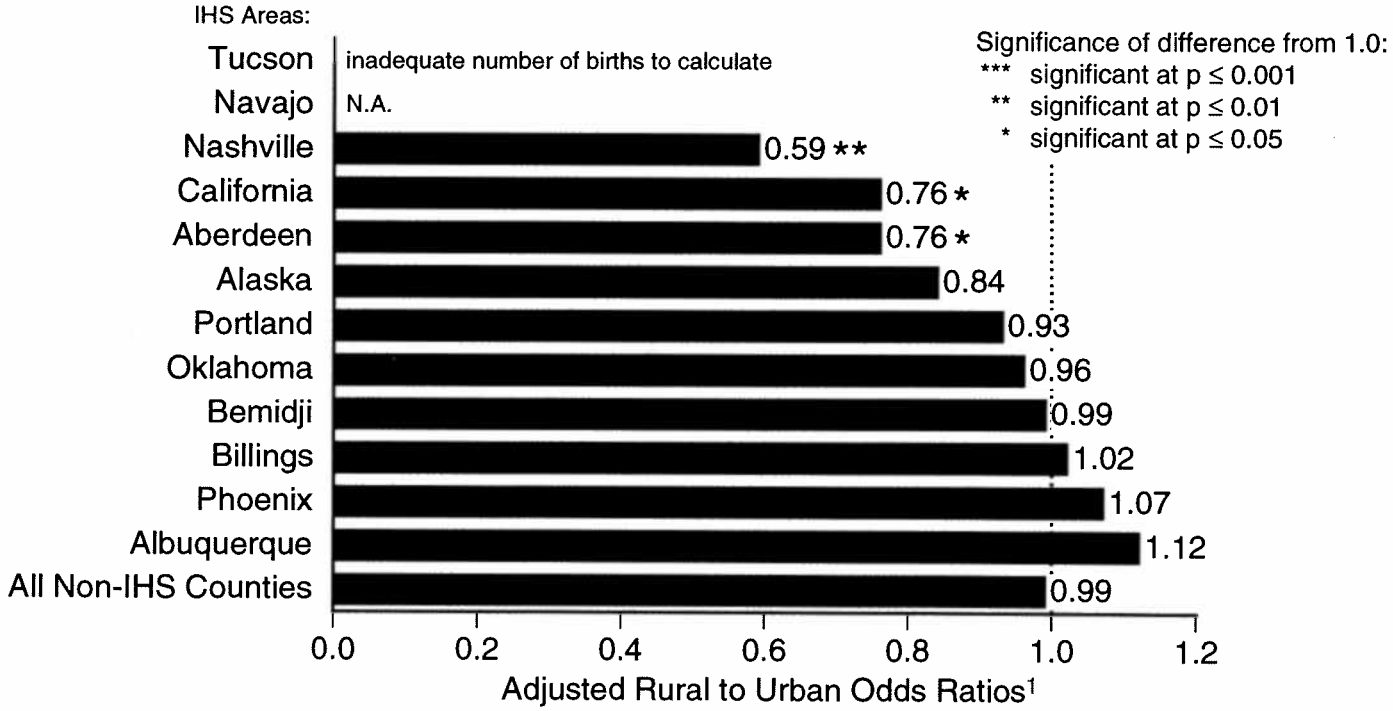
1. Odds ratios from multiple logistic regression adjusted for race/marital status, age, parity, education, complications of pregnancy, preexisting conditions, and prior premature births.

FIGURE 3:

Low Birthweight of American Indians/Alaska Natives by Rural/Urban Residence and IHS Area



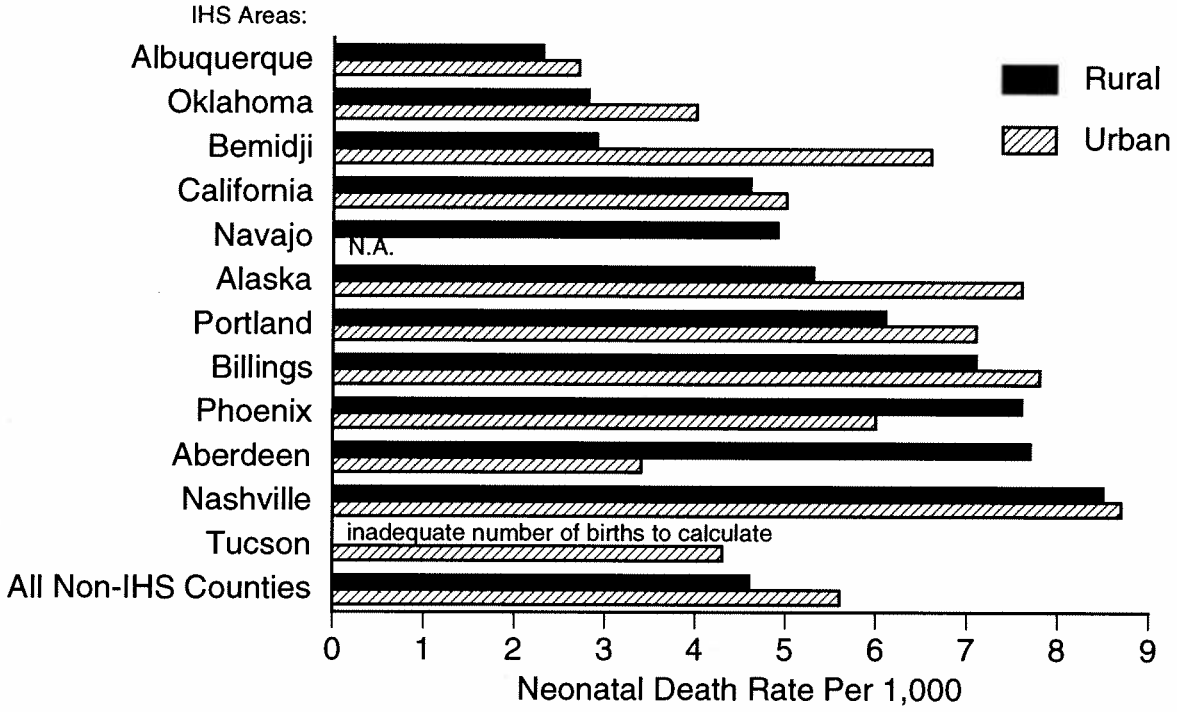
Adjusted Rural to Urban Odds Ratios for Low Birthweight of American Indians by IHS Area



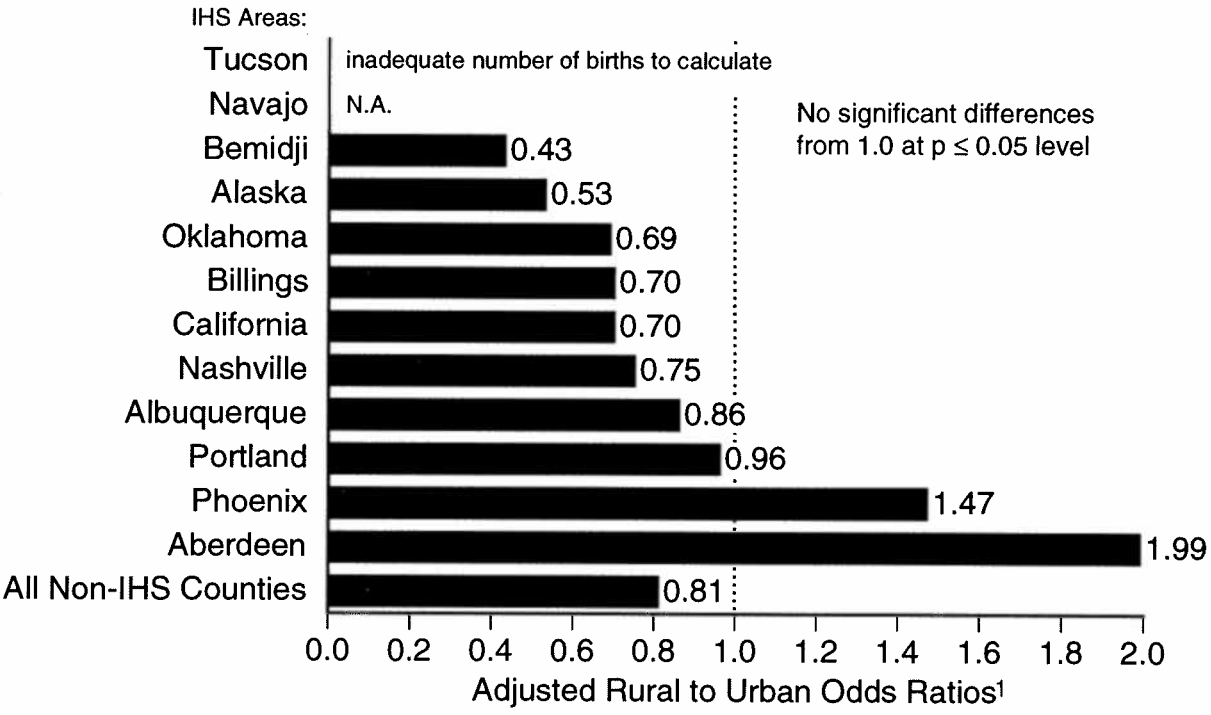
1. Odds ratios from multiple logistic regression adjusted for race/marital status, age, parity, education, complications of pregnancy, preexisting conditions, and prior premature births.

FIGURE 4:

Neonatal Death Rates of American Indians/Alaska Natives by Rural/Urban Residence and IHS Area



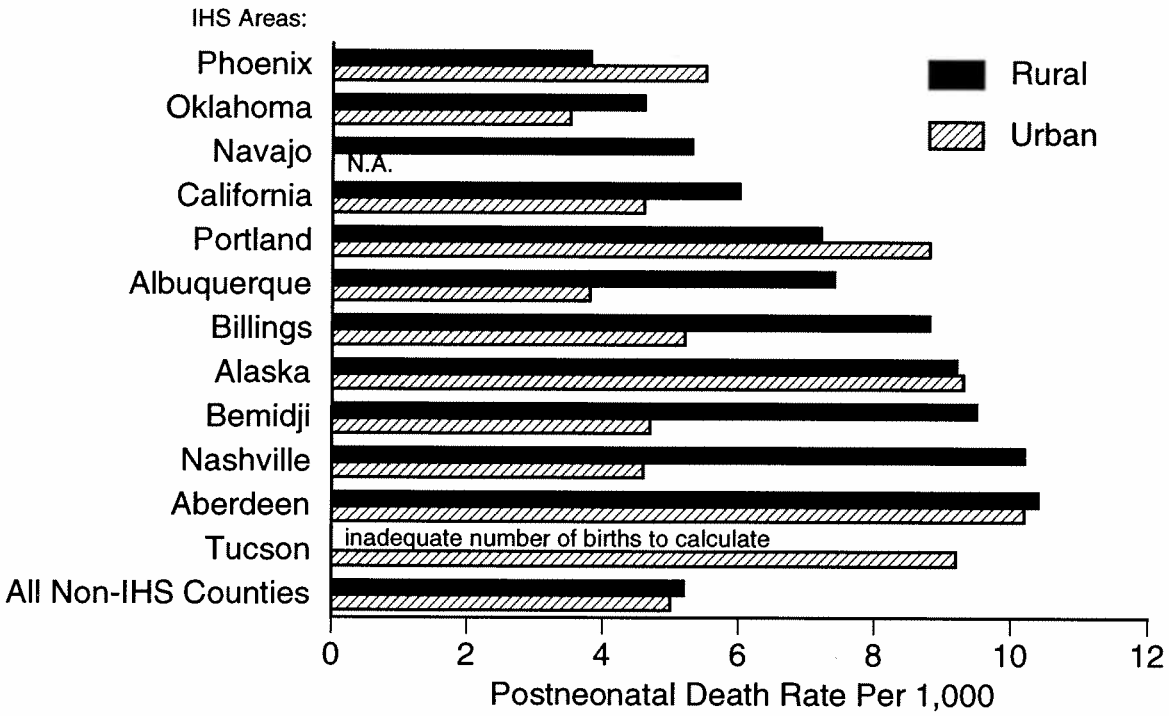
Adjusted Rural to Urban Odds Ratios for Neonatal Death Rates of American Indians by IHS Area



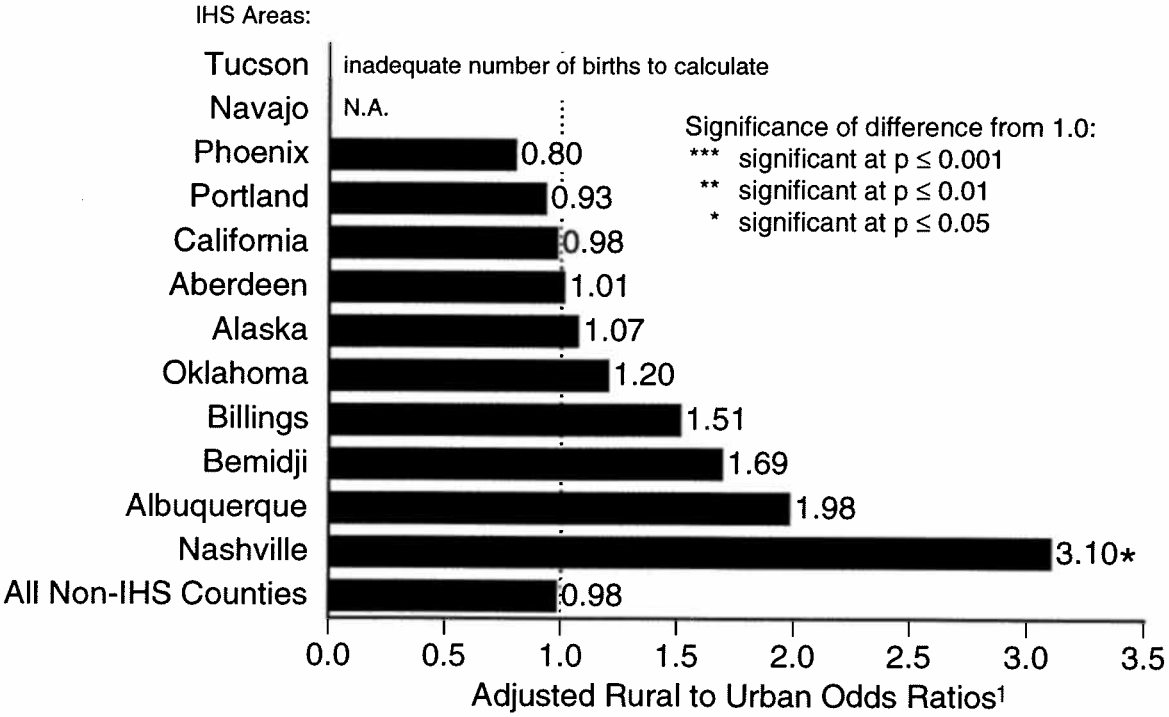
1. Odds ratios from multiple logistic regression adjusted for race/marital status, age, parity, education, complications of pregnancy, preexisting conditions, and prior premature births.

FIGURE 5:

Postneonatal Death Rates of American Indians/Alaska Natives by Rural/Urban Residence and IHS Area



Adjusted Rural to Urban Odds Ratios for Postneonatal Death Rates of American Indians by IHS Area



1. Odds ratios from multiple logistic regression adjusted for race/marital status, age, parity, education, complications of pregnancy, preexisting conditions, prior premature births, smoking, and drinking.

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