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**Poor Birth Outcome in the
Rural United States:
1985-1987 to 1995-1997**

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by

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ABOUT THE CENTER

The WWAMI Rural Health Research Center (RHRC) is one of eight centers supported by the Federal Office of Rural Health Policy (FORHP), a component of the Health Resources and Services Administration (HRSA) of the Public Health Service. The major focus of the WWAMI RHRC is to perform policy-oriented research on issues related to rural health care and the rural health professional workforce. Specific interests of the Center include the training and supply of rural health care providers and the content and outcomes of the care they provide; the availability and quality of care for rural women and children, including obstetric and perinatal care; and access to high-quality care for vulnerable and minority rural populations.

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Poor Birth Outcome in the Rural United States: 1985-1987 to 1995-1997

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ABSTRACT

BACKGROUND

This national study examines rural/urban differences in poor birth outcome and inadequate prenatal care between 1985 and 1997. Outcomes among residents of more remote rural areas and among residents of rural persistent poverty counties are also explored.

METHODS

Data from the national Linked Birth-Death Data Set (LBDDS) were used in this study. Rates of low birthweight, neonatal mortality, postneonatal mortality (referred to collectively as “poor outcomes”), and inadequate prenatal care were evaluated and compared across the study period (1985-1997) and across three geographic classifications: rural vs. urban, remote vs. less remote rural counties, and rural persistent poverty vs. rural nonpersistent poverty counties. Logistic regression was used to assess the independent risk of poor outcome or inadequate care associated with residence in each geographic category.

RESULTS

Regression results suggested that rural risk increased across the study period for low birthweight, infant mortality, and inadequate care. Residents of rural persistent poverty counties experienced higher risk of low birthweight and postneonatal mortality than residents of rural nonpoverty counties.

CONCLUSIONS

While progress was made in closing rural/urban gaps in risk of poor outcome and inadequate prenatal care, rural residence and residence in a persistent poverty county remained independent risk factors for inadequate care and some adverse birth outcomes, especially postneonatal mortality. Attentive maintenance of regionalized systems of perinatal care will be required to close the remaining gaps in the risk of poor birth outcome among rural residents.

INTRODUCTION

During the 1960s, the health status and life expectancy of rural residents of the United States were similar to those experienced by urban residents (Clifford & Brannon, 1985). One important and troubling exception was a substantial rural/urban gap in infant mortality, with rural residents experiencing higher rates of infant mortality. For example, in 1960, overall infant mortality in the metropolitan counties of the United States was 24.9 per thousand live births. In nonmetropolitan counties the rate was 28.0 per thousand live births. By 1970, the urban and rural rates were 19.0 and 21.2, respectively. By 1980, overall crude rates of rural and urban infant mortality were approximately equal (12.6 per thousand births) (Sherman, 1992), but rates of rural birthweight adjusted neonatal mortality (death in the first 28 days of life) and overall postneonatal mortality (death between the 29th and 365th day of life), continued to be higher than urban rates (Sherman, 1992). Rural infants did not appear to be benefiting equally from the overall improvements in mortality risk taking place in the larger population.

The movement to regionalize perinatal care (care delivered between the 28th week of gestation and the 4th week after birth) for high-risk women and infants effectively closed the rural/urban differential in neonatal mortality during the 1980s. Regionalization strategies included implementing infant mortality review at small hospitals, enhancing neonatal resuscitation skills at the local level, and building relationships between rural hospitals and the tertiary centers that helped facilitate timely transfer of high-risk women and infants (Gortmaker et al., 1985, 1987; Hein & Lathrop, 1986). It became clear that, in the context of a regionalized system of perinatal care, obstetrics could be practiced in rural settings with risks comparable to those experienced in urban settings (Larson et al., 1992, 1997; Mayfield et al., 1990; Rosenblatt et al., 1985, 1988). It also became clear that small hospitals, in addition to providing local care for low risk women and infants, played a crucial role in assuring access to timely and appropriate care for

high-risk women and infants, even if that care was not provided locally (Nesbitt et al., 1990, 1997).

By 1985-1987, the rural/urban gaps in neonatal mortality and risk of low birthweight were quite small, both nationally and in most states (Larson et al., 1997). However, rural residents continued to experience higher rates of postneonatal mortality and inadequate prenatal care (Larson et al., 1997). Some studies also indicated that risks associated with rural residence varied by race and ethnicity (Druschel & Hale, 1987; Hale & Druschel, 1989). Another concern was that residents of particular types of rural areas—such as more remote or poorer ones—might experience higher levels of risk than residents of urban areas or more advantaged rural areas, especially with respect to birthweight specific mortality (Baker & Kotelchuck, 1989; Larson, 1995; Rosenblatt et al., 1985).

Infant mortality and low birthweight are particularly sensitive sentinel health outcomes; the rates of poor outcome appear to respond quickly to changes in a population's exposure to social and biological risk (Wise, 1990). The narrowing (and in some cases, the closing) of the rural/urban gap in risk of poor outcome demonstrates the sensitivity of these outcomes to technological and organizational interventions even when underlying social risks do not change substantially. However, poor outcome rates that decrease quickly in response to organizational and technological innovation may increase quickly in response to minor degradation of systems that promote access to care. Little is known at the national level about the extent to which decreases in rural rates of adverse outcome were preserved and expanded over time.

The association between rural residence and the risk of poor birth outcome has fluctuated considerably over the past 200 years. In the early 19th century, rural populations experienced substantially better maternal and infant outcomes than their urban counterparts (Clifford & Brannon, 1985; Meckel, 1990). As noted above, this situation was reversed by the 1960s (though in the overall context of drastically reduced rates of maternal and infant mortality). The goal of this study was to ascertain whether the nature of rural residence as a risk factor for adverse birth outcome and inadequate prenatal care changed substantially between 1985-1987 and 1995-1997. The study addresses the question of what happened in the decade following a period of great success in decreasing rural/urban outcome differentials; did the gaps continue to narrow? Or did rural residence re-emerge as an independent risk factor for poor outcome and inadequate prenatal care?

National birth and infant death certificate data were used to examine rural/urban differentials at the national level in rates of low birthweight, infant mortality and adequacy of prenatal care over the period

from 1985-1987 to 1995-1997. In addition, outcomes in more remote rural areas were compared with less remote rural areas, and outcomes in rural persistent poverty counties were compared with other rural counties. A series of logistic regression analyses are presented that assess the risk of poor outcome over the study period after controlling for several biological and social risk factors.

METHODS

DATA SOURCE

The main data source for this study was the National Linked Birth Death Data Set (LBDDS) files for the study years. The LBDDS is compiled and maintained by the National Center for Health Statistics (NCHS). The LBDDS contains birth certificate data on over 99% of all births occurring in the United States and linked death certificate data in cases where the infants died before reaching the age of one year. In the public versions of the LBDDS, the county of maternal residence and county of birth occurrence are suppressed in counties with fewer than 250,000 residents to ensure data confidentiality. The NCHS provided the WWAMI Rural Health Research Center with a version of the LBDDS files with restored geographic identifiers on all records with the understanding that we would only publish analysis results in aggregate form. Annual LBDDS files for the years 1985, 1986, 1987, 1989, 1990, 1991, 1995, 1996 and 1997 were collapsed into three files, 1985-1987, 1989-1991, and 1995-1997. The annual files were collapsed into three-year files to ensure stable estimates of poor outcomes in rural areas where low populations and the infrequent occurrence of some adverse outcomes can make estimates based on annual data suspect.

There were some changes that occurred to the LBDDS data across the study period. Data on maternal risk factors, complications of pregnancy and complications of labor and delivery does not appear in the LBDDS until the 1989 file. The maternal risk factor data from the later part of the period is not presented here since it was not possible to track it across the entire study period. Another important change in data collection that occurred during the study period was in the collection of data on maternal education. In the 1985-1987 period, three states (California, Texas, and Washington) did not collect maternal education data, creating a missing data proportion of about 10% in the national population. By 1995-1997, all states were collecting maternal education information and the overall missing data rate was about 1.5%. A third change during the study period was enhanced collection of data on Hispanic ethnic status. In the 1985-1987 period only 23 states reported Hispanic

ethnic status information, creating an overall missing data rate of about 39.7%. By 1995-1997, all states were reporting the Hispanic ethnic status and the missing data rate was about 1.5%.

STUDY POPULATION AND EXCLUSIONS

Births to nonresidents of the United States (but which occurred in the United States) were excluded from the analyses and the study population was also restricted to singletons; all multiple births were excluded. A handful of cases were also excluded due to missing county of residence data (less than 200 records in each study period). The exclusion criteria resulted in the exclusion of about 2% of records. About 95% of the exclusions were due to multiple births. The final study populations were 11,081,840 for 1985-1987, 12,022,656 for 1989-1991, and 11,352,574 for 1995-1997.

RURAL/URBAN DEFINITIONS

County was the basic geographic unit of analysis used in this study. As noted above, the LBDDS data used in this study included information on the county of maternal residence and the county of birth occurrence. For a dichotomous definition of urban and rural, the metropolitan/nonmetropolitan classification developed by the U.S. Office of Management and Budget (OMB) was used. (About 20.5% of the U.S. population lived in nonmetropolitan counties in 1990.) Because there is often substantial intra-rural variation in rates of adverse outcome and access to care, the county-based Urban Influence Codes (UIC) developed by the U.S. Department of Agriculture (USDA) were used to further classify nonmetropolitan counties. A collapsed version of the codes grouped nonmetropolitan counties into those adjacent to metropolitan counties and those nonadjacent to metropolitan counties (all metropolitan counties were grouped into a single “urban” category). This was done in order to assess whether outcomes in areas relatively isolated from the tertiary health services usually found in metropolitan counties were worse than those in closer proximity to those services. Counties physically adjacent to a metropolitan county where at least 2% of the population commutes to the metropolitan county are classified as “Adjacent rural” (UIC codes 3, 4, 5, and 6). All other nonmetropolitan counties were classified as “Nonadjacent rural” (UIC codes 7, 8 and 9). Differences in adverse outcome rates were also examined in rural “persistent poverty” counties (as identified by the USDA Economic Research Service [ERS, 1995]) compared to rates of adverse outcome in other rural counties.

OUTCOMES STUDIED

To assess change in rural/urban differentials in poor outcome and inadequate care, we examined birthweight outcomes, mortality and adequacy of prenatal care. Specifically, rural/urban differences in rates of low birthweight (birthweight < 2,500 grams) neonatal mortality (death before the 28th day of life) and

postneonatal mortality (death occurring between age 28 days and 1 year) were compared across the three time periods. Differentials in adequacy of prenatal care were examined using two measures, late initiation of care (initiation of care in the seventh month or later or no care) and inadequate care as defined by the Kotelchuck Index of Inadequate Prenatal Care (Kotelchuck, 1994).

ANALYSIS

In the first stage of the analysis, unadjusted rates of poor outcome and inadequate prenatal care were calculated and compared across the three geographic categories described above—rural/urban, rural-adjacent/rural nonadjacent, and rural persistent poverty/rural nonpersistent poverty. Because differences in rural versus urban demography and levels of biological risk may vary systematically across these geographic dimensions, we used logistic regression to adjust for those differences in the second stage of the analysis. The goal of the regression analysis was to assess the independent association between rural residence and risk of adverse birth outcome and inadequate prenatal care. The regression analyses adjusted for demographic and medical risk factors that were known in all three study periods. These include maternal age, parity, race, marital status, maternal education, and (in the case of low birthweight and mortality outcomes) adequacy of prenatal care.

RESULTS

DEMOGRAPHY OF THE STUDY POPULATION

Births to rural residents accounted for 19% to 20% of the approximately 4,000,000 births per year during the 12-year period covered by the study. There were several important differences in demographic and social risk factors in the rural and urban maternal populations that were observed in the three study periods. As shown in Table 1, the proportion of births occurring among women under age 18 was consistently higher in the rural population than in the urban one (5.5% compared to 4.6% in 1985-1987 and 6.3% compared to 4.9% a decade later). Women over 34 years of age were a substantially larger part of the urban maternal population than the rural one (7.3% in 1985-1987 compared to the rural proportion, 5.4%). Similarly, nulliparous status was slightly more common among urban residents than rural ones across all three time periods, though the gap did narrow between 1985-1987 and 1995-1997.

There were also substantial differences in the racial and ethnic structure of rural and urban populations. Whites and American Indians/Alaska Natives made up larger proportions of the rural population than the urban one. African Americans, Asians and mothers of

Table 1: Demography and Risk Characteristics of Rural and Urban Births, 1985-1987 to 1995-1997 — Singletons Only

	1985-1987			1989-1991			1995-1997		
	Rural	Urban	All	Rural	Urban	All	Rural	Urban	All
Number of births	2,280,237	8,801,603	11,081,840	2,185,157	9,837,499	12,022,656	2,057,822	9,294,752	11,352,574
Mother's age									
% < 18	5.5	4.6	4.8	5.7	4.6	4.8	6.3	4.9	5.1
% 18-34	89.0	88.1	88.3	87.7	86.1	86.4	85.4	82.3	82.9
% ≥ 35	5.4	7.3	6.9	6.5	9.3	8.8	8.3	12.8	12.0
Parity									
% 0	39.7	42.6	42.0	39.7	41.4	41.1	41.4	41.8	41.7
% 1-4	56.2	53.8	54.3	56.1	54.2	54.6	54.7	54.1	54.2
% ≥ 5	4.1	3.6	3.7	4.2	4.0	4.1	4.0	4.1	4.1
Race									
% white	85.2	79.1	80.4	84.0	77.9	79.0	85.0	78.1	79.4
% African American	11.1	16.9	15.7	11.9	17.5	16.5	10.8	16.4	15.4
% Native American	2.7	0.5	0.9	3.0	0.5	1.0	2.8	0.6	1.0
% other race	1.1	3.7	3.6	1.1	4.0	3.5	1.4	4.9	4.2
Hispanic									
% Hispanic*	8.1	19.0	17.2	6.0	16.6	14.3	8.2	20.6	18.3
% missing Hispanic status information	51.2	36.8	39.7	4.1	2.7	2.9	1.2	1.5	1.5
% mother < 12 years education†	17.5	14.8	15.4	18.8	18.7	18.7	17.0	17.5	17.4
% missing education information	10.1	27.5	23.9	4.8	6.8	6.4	0.8	1.6	1.5
% married	79.8	75.9	76.7	74.2	71.2	71.7	67.9	67.4	67.5

* Of those for whom Hispanic status is known.

† Of those for whom educational attainment is known and who are over 18 years old.

Table 2: Birth Outcomes and Prenatal Care — Rural and Urban Births, 1985-1987 to 1995-1997 — Singletons Only

	1985-1987			1989-1991			1995-1997		
	Rural	Urban	All	Rural	Urban	All	Rural	Urban	All
Number of births	2,280,237	8,801,603	11,081,840	2,185,157	9,837,499	12,022,656	2,057,822	9,294,752	11,347,397
Outcomes									
% low birthweight	5.6	5.9	5.8	5.7	6.0	6.0	6.1	6.1	6.1
Neonatal mortality rate	5.5	5.8	5.7	4.8	5.0	5.0	4.2	4.0	4.1
Postneonatal mortality rate	3.7	3.4	3.5	3.6	3.1	3.2	2.7	2.3	2.4
Prenatal care (PNC)									
% 3 rd trimester PNC or no PNC	5.7	6.0	6.0	5.7	6.2	6.1	4.1	4.1	4.1
% inadequate PNC by Kotelchuck index	18.4	19.9	19.5	17.8	17.8	17.8	13.3	12.7	12.8

Hispanic origin (regardless of race) were more likely to be urban residents. Rural women were also somewhat more likely to be married than their urban counterparts, though the rural/urban difference narrowed substantially between 1985-1987 and 1995-1997.

BIRTH OUTCOMES AND INADEQUATE PRENATAL CARE

Table 2 shows unadjusted rural and urban rates of adverse birth outcome and inadequate prenatal care across the study period. Low birthweight rates among rural residents increased from 5.6% in 1985-1987 to 6.1% in 1995-1997. The urban rate increased slightly from 5.9% to 6.1% across the study period. Overall neonatal mortality rates dropped from 5.73 per thousand births to 4.05. Rural neonatal mortality rates were lower than urban rates in 1985-1987 and 1989-1991, but were slightly higher in 1995-1997 (4.21 compared to 4.01 for urban infants). Postneonatal mortality continued to be higher among rural populations in all three study periods, though in the context of an overall drop in the rate from 3.48 per thousand births to 2.39. Rural postneonatal mortality dropped from 3.72 in 1985-1987 to 2.70 in 1995-1997 compared to a drop from 3.41 to 2.31 among urban residents.

Rates of inadequate prenatal care decreased substantially across the study period. The proportion of women receiving either no care or third trimester care only dropped from 6.0% in 1985-1987 to 4.1% in 1995-1997. As measured by the Kotelchuck Index of Inadequate Prenatal Care (Kotelchuck, 1994), the overall rate of inadequate care decreased from 19.5% to 12.8%. In 1985-1987, rural rates of inadequate care were slightly lower than urban rates. By 1995-1997, rural rates of inadequate care were slightly higher than among urban residents (13.3% versus 12.7% by the Kotelchuck Index).

Intra-rural differences in rates of poor outcome and inadequate prenatal care in adjacent and nonadjacent

rural counties were compared and results are shown in Table 3. Low birthweight rates and rates of neonatal mortality were quite similar in counties adjacent to metro counties and those in nonadjacent counties across the study period. Residents of nonadjacent counties, however, did experience slightly higher rates of postneonatal mortality across all three time periods: 3.83 in 1985-1987 compared to 3.63 in adjacent counties and 2.80 in 1995-1997 compared to 2.62. Birth outcomes in more remote rural counties (UIC 8 and UIC 9) were also compared to outcomes and care in nonadjacent counties with large towns of (UIC 7) (results not tabled) and no significant differences were found other than slightly higher rates of inadequate prenatal care as measured by the Kotelchuck Index among residents of more remote counties.

The largest intra-rural differences in unadjusted rates of poor birth outcome and inadequate prenatal care were between persistent poverty counties and nonpersistent poverty counties, as can be seen clearly in Table 4. Rates of infant mortality and inadequate care did decrease between 1985-1987 and 1995-1997 in both types of rural counties. However, in persistent poverty rural counties, low birthweight rates and rates of neonatal and postneonatal mortality were about 30% higher in all three time periods. Inadequate prenatal care differences were even more pronounced, with rates of inadequate care at least 50% higher among residents of persistent poverty counties compared to other rural counties.

REGRESSION RESULTS

Rural vs. Urban: A series of logistic regression analyses were performed to examine the risk of poor birth outcome and inadequate prenatal care among rural residents after adjustment for demographic and social risk factors between rural and urban populations in the three time periods. Control variables used were maternal age, maternal race, parity, marital status, and maternal education. The adjusted odds ratios (ORs) for rural risk and associated 95% confidence

Table 3: Birth Outcomes and Prenatal Care—Rural Births, 1985-1987 to 1995-1997, Adjacent Rural Compared to Nonadjacent Rural Counties, Singletons Only

	1985-1987		1989-1991		1995-1997	
	Adjacent	Nonadjacent	Adjacent	Nonadjacent	Adjacent	Nonadjacent
Number of births	1,235,989	1,044,248	1,197,763	987,484	1,137,778	920,044
Outcomes						
% low birthweight	5.6	5.5	5.8	5.6	6.1	6.1
Neonatal mortality rate	5.6	5.4	4.8	4.7	4.2	4.3
Postneonatal mortality rate	3.6	3.8	3.4	3.7	2.6	2.8
Prenatal care (PNC)						
% 3 rd trimester PNC or no PNC	5.6	5.8	5.7	5.7	4.0	4.1
% inadequate PNC by Kotelchuck index	18.1	18.7	17.6	18.0	12.9	13.8

Table 4: Birth Outcomes and Prenatal Care—Rural Births, 1985-1987 to 1995-1997, Persistent Poverty Counties Compared to Other Rural Counties, Singletons Only

	1985-1987		1989-1991		1995-1997	
	Persistent Poverty Rural County	Other Rural County	Persistent Poverty Rural County	Other Rural County	Persistent Poverty Rural County	Other Rural County
Number of births	457,240	1,822,997	459,497	1,725,660	426,303	1,631,519
Outcomes						
% low birthweight	7.1	5.2	7.4	5.2	7.7	5.7
Neonatal mortality rate	6.5	5.2	5.9	4.5	5.1	4.0
Postneonatal mortality rate	4.5	3.5	4.6	3.3	3.4	2.5
Prenatal care (PNC)						
% 3 rd trimester PNC or no PNC	8.3	5.1	8.0	5.1	5.4	3.7
% inadequate PNC by Kotelchuck index	25.6	16.5	24.2	16.1	17.4	12.3

intervals are presented in Table 5. The results show a pattern of higher risk of poor birth outcome and inadequate prenatal care for rural residents in the later part of the study period. For example, in 1985-1987, the adjusted risk of low birthweight among rural residents was not significantly different from the risk among urban residents (OR = 1.002, CI 0.994, 1.001). By 1995-1997, the adjusted risk of low birthweight among rural residents was fairly large and statistically significant (OR = 1.089, CI 1.082, 1.095). This pattern of increasing rural risk across time is observed in the results for neonatal and postneonatal mortality as well. With postneonatal mortality as the dependent variable, the OR for residence in a rural county was 1.105 (CI 1.077, 1.134) in 1985-1987. It was 1.193 (CI 1.157, 1.232) in 1995-1997. A similar, though slightly less pronounced increase in risk for rural residents compared to urban ones was observed in the cases of late prenatal care and inadequate care as measured by the Kotelchuck Index. It is important to bear in mind that the observed increases in *rural risk* occurred in the context of *falling crude rates* of mortality and inadequate care in both rural and urban populations during the period covered by the study (see Table 2).

Adjacent vs. Nonadjacent Rural Counties: A second series of regressions were performed to examine the risk of poor outcomes and care for residents of adjacent and nonadjacent rural counties (urban residents were excluded from these analyses). In Table 6 the independent variable of interest is residence in a nonadjacent rural county, and the ORs and 95% confidence intervals are shown for the various outcomes. In contrast to the rural/urban results, this series of analyses revealed very small and, for the most part, nonsignificant differences in risk of poor outcome and inadequate care among residents of nonadjacent counties compared to their counterparts in adjacent counties.

Persistent Poverty Rural Counties vs. Nonpoverty Rural Counties: The final set of regression analyses was performed to examine the adjusted risk of poor outcome associated with residence in rural persistent poverty counties compared to nonpoverty rural counties. The adjusted ORs (and 95% confidence intervals) for risk of poor outcome in inadequate care in persistent poverty counties are shown in Table 7. After adjustment, residents of persistent poverty counties were found to be much more likely than residents of nonpoverty rural counties to have low birthweight infants and to have received inadequate prenatal care. In 1985-1987, for example, the adjusted OR for low birthweight outcome among residents of persistent poverty counties was 1.07 (1.06, 1.09). In 1995-1997 it was 1.10 (1.09, 1.12). Rates of inadequate prenatal care by the Kotelchuck Index were also higher in persistent poverty populations, though the differences narrowed between 1985-1987 and 1995-1997. In contrast, adjusted ORs for neonatal and postneonatal mortality showed little difference in risk across time or the two populations.

DISCUSSION

SUMMARY

Nationally, there were substantial drops in overall rates of neonatal and postneonatal mortality in the United States between 1985-1987 and 1995-1997, while the proportion of low birthweight births increased slightly from 5.8% to 6.1%. The proportion of women receiving inadequate prenatal care also decreased substantially during the study period. These trends are seen in both rural and urban populations. The trends for rural residents compared to their urban counterparts, however, were not as favorable. In unadjusted analyses, rural residents were shown to have experienced higher rates of postneonatal mortality and inadequate prenatal

Table 5: Adjusted Odds Ratios and 95% Confidence Intervals for Risk of Poor Birth Outcome and Inadequate Prenatal Care Among Rural Residents of the United States Compared to Urban Residents

	1985-1987	1989-1991	1995-1997
Poor birth outcome			
Low birthweight*	1.002 (0.994,1.010)	1.037 (1.031,1.043)	1.089 (1.082,1.095)
Neonatal mortality*	1.018 (0.996,1.040)	1.042 (1.019,1.068)	1.174 (1.144,1.204)
Postneonatal mortality*	1.105 (1.077,1.134)	1.173 (1.143,1.203)	1.193 (1.157,1.232)
Inadequate prenatal care (PNC)			
3 rd trimester PNC or no PNC*	1.026 (1.021,1.029)	1.038 (1.034,1.042)	1.085 (1.081,1.090)
Inadequate PNC by Kotelchuck index*	1.030 (1.025,1.039)	0.956 (0.950,0.962)	1.035 (1.027,1.043)

* Control variables: maternal race (African American, Native American, other race), maternal age (under 18, over 35), parity (parity = 0, parity > 4), marital status (single), less than 12 years of education (for women over age 18), late prenatal care.

Table 6: Adjusted Odds Ratios and 95% Confidence Intervals for Risk of Poor Birth Outcome and Inadequate Prenatal Care Among Residents of Rural Counties Not Adjacent to Metro Areas Compared to Rural Residents of Counties Adjacent to Metro Areas

	1985-1987	1989-1991	1995-1997
Poor birth outcome			
Low birthweight*	1.005 (0.993,1.017)	0.990 (0.978,1.002)	1.001 (0.989,1.013)
Neonatal mortality*	1.006 (0.967,1.046)	0.999 (0.959,1.041)	1.048 (1.002,1.096)
Postneonatal mortality*	1.027 (0.982,1.075)	1.056 (1.007,1.106)	1.057 (1.001,1.117)
Inadequate prenatal care (PNC)			
3 rd trimester PNC or no PNC*	1.046 (1.034,1.058)	1.001 (0.993,1.009)	0.991 (0.978,1.005)
Inadequate PNC by Kotelchuck index*	1.052 (1.044,1.061)	0.953 (0.942,0.964)	1.057 (1.048,1.065)

* Control variables: maternal race (African American, Native American, other race), maternal age (under 18, over 35), parity (parity = 0, parity > 4), marital status (single), less than 12 years of education (for women over age 18), late prenatal care.

Table 7: Adjusted Odds Ratios and 95% Confidence Intervals for Risk of Poor Birth Outcome and Inadequate Prenatal Care Among Residents of Persistent Poverty Rural Counties Compared to Other Rural Counties

	1985-1987	1989-1991	1995-1997
Poor birth outcome			
Low birthweight*	1.078 (1.063,1.093)	1.095 (1.080,1.110)	1.104 (1.089,1.119)
Neonatal mortality*	0.980 (0.935,1.027)	1.039 (1.080,1.091)	1.008 (0.954,1.065)
Postneonatal mortality*	0.970 (0.919,1.025)	1.078 (1.018,1.141)	1.086 (1.016,1.161)
Inadequate prenatal care (PNC)			
3 rd trimester PNC or no PNC*	1.087 (1.076,1.101)	1.087 (1.072,1.102)	1.020 (1.002,1.038)
Inadequate PNC by Kotelchuck index*	1.193 (1.181,1.204)	1.145 (1.133,1.156)	1.073 (1.063,1.084)

* Control variables: maternal race (African American, Native American, other race), maternal age (under 18, over 35), parity (parity = 0, parity > 4), marital status (single), less than 12 years of education (for women over age 18), late prenatal care.

care than urban residents, though in the context of decreasing rates of poor outcome and inadequate care. Regression results suggested increasing rural risk increased during the study period for low birthweight, infant mortality and inadequate care.

Two groups of rural residents were compared to each other at the national level: (1) residents of adjacent rural counties vs. residents of nonadjacent rural counties and (2) residents of rural persistent poverty counties vs. residents of nonpersistent

poverty counties. When residents of rural counties adjacent to metropolitan counties were compared to residents of more remote nonadjacent counties, there were few differences or observable trends. In contrast, residents of rural persistent poverty counties experienced substantially higher risk of poor outcome and inadequate care and the risk of poor outcome and inadequate care appeared to increase over the study period (see Table 7).

LIMITATIONS

Birth and death certificate data provides very limited information on clinically significant aspects of both prenatal care and birth outcome. There are no data available from the LBDDS on hospital stay, and maternal medical risk factor data were not available for the 1985-1987 period, thereby limiting our ability to compare adjusted risk across the three time periods covered by the study. Though the outcomes studied are considered to be sentinel health measures, they are both severe and relatively rare. Birth certificate data simply does not support the analysis of less severe, but important outcomes. In addition, prenatal care is examined only in terms of initiation of care and number of visits. Nothing, of course, is known about the quality or content of the care received. The data are comprehensive in the sense that essentially every birth to residents of the United States during the study period is included; the data are quite limited in terms of the data elements available for analysis. These limitations should be borne in mind and dictate some caution in interpretation of the results presented here.

CONCLUSIONS

While rates of infant mortality and inadequate prenatal care decreased substantially in both rural and urban populations between 1985-1987 and 1995-1997, regression results suggest that rural residence in the United States continued to be an independent risk factor for infant death and inadequate prenatal care. Of particular concern are the results suggesting that the risk of poor outcome and inadequate care associated with rural residence actually increased across the study period, even as overall crude rates dropped. In addition, the well-known rural disadvantage in postneonatal mortality persisted through the 1995-1997 period and residents of rural persistent poverty counties continued to bear a much higher burden of poor outcome and inadequate care than their counterparts in nonpoverty rural counties.

POLICY IMPLICATIONS

Overall decreases in rates of poor birth outcome and inadequate prenatal care are encouraging, but this work demonstrates that rural outcomes and care remain an important area of policy concern. Closing the remaining rural/urban gaps, and keeping them closed requires that rural systems of perinatal care continue to receive the attention of policy makers. Attentive

maintenance of the regionalized systems of care for high-risk women and infants that did so much to decrease rural/urban infant mortality differentials in the 1970s and early 1980s will be essential. (Gortmaker et al., 1987; Hein & Lathrop, 1986; Mayfield et al., 1990; Nesbitt et al., 1990, 1997; Rosenblatt et al., 1985). In addition, a better understanding of the reasons for higher rural risk of infant mortality, especially postneonatal mortality, is essential, as is continuing to address the less tractable problems of access to care, inadequate care, and poor outcomes in areas afflicted with persistent poverty.

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