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White Infant Mortality in Appalachian States, 1976-1980 and 1996-2000: Changing Patterns and Persistent Disparities

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Abstract

Purpose—Appalachian counties have historically had elevated infant mortality rates. Changes in infant mortality disparities over time in Appalachia are not well-understood. This study explores spatial inequalities in white infant mortality rates over time in the 13 Appalachian states, comparing counties in Appalachia with non-Appalachian counties.

Methods—Data are analyzed for 1,100 counties in 13 Appalachian states that include 420 counties designated as Appalachian by the Appalachian Regional Commission. Area Resource File data for 1976-1980 and 1996-2000 provide county- and city-level infant mortality rates, poverty rates, rural-urban continuum codes, and numbers of physicians per 1,000 residents. Multiple regression analyses evaluate whether Appalachian counties are significantly associated with elevated white infant mortality in each time period, accounting for covariates.

Findings—White infant mortality rates decreased substantially in all sub-regions over the last 2 decades; however, disparities in infant mortality did not diminish in Appalachian counties compared to non-Appalachian counties. After accounting for poverty, rural/urban status, and health care resources, Appalachian counties were significantly associated with comparatively higher infant mortality during the late 1970s but not in the late 1990s. At the more recent time point, higher poverty rates, residence in more rural areas, and lower physician density were associated with greater infant mortality risk.

Conclusion—Appalachian counties continue to experience relatively elevated infant mortality rates. Poverty and rurality remain important dimensions of health service need in Appalachia.

Keywords

Appalachia; disparity; infant mortality; rural

Numerous studies have found that health outcomes in Appalachia are disproportionately poor compared with those in the rest of the nation.^{1,2} For example, researchers have identified higher rates of cancer,³ heart disease,⁴ and premature mortality⁵ in Appalachia. Moreover, researchers have reported regional variations in health outcomes between subdivisions of the Appalachian region.⁵ In general, the mechanisms underlying this regional health disadvantage are not well-understood. Economic conditions are thought to play a prominent role,^{1,6} since the economy of Appalachia has historically been depressed and dependent on a limited mix of industries.⁷ Geographic isolation and lack of public

transportation also are relevant in many parts of Appalachia.^{5,7,8} Health outcomes are known to be influenced by the availability of health care resources,^{9,10} and Appalachia has been characterized by insufficient numbers of health care providers and facilities.^{5,11} Populations in the Appalachian region have also been disproportionately exposed to a range of other adverse health risks including environmental contamination,¹² food insecurity,¹³ substandard housing conditions,¹⁴ and tobacco use and second-hand smoke.¹⁵

Infant Mortality in Appalachia

In this paper we are interested in infant mortality, a sentinel health outcome that has received limited attention in Appalachia. One study found considerable heterogeneity in infant mortality rates among whites within Appalachia over the period 1993-1997.⁵ There were pockets of high white infant mortality in parts of Central and Southern Appalachian counties, and relatively lower rates were found in less rural areas.⁵ An earlier study looking at infant mortality rates for all race/ethnic groups combined also found regional variation, with Southern Appalachian rates exceeding those of Central and Northern Appalachia and with isolated non-metropolitan county rates exceeding those of the metropolitan counties.¹⁶ A more recent study examining white infant and child mortality found that non-Appalachian regions of Appalachian states had lower rates than the Appalachian regions; however, this descriptive analysis did not take covariates such as economic conditions and health care resources into account.¹⁷

Risk Factors Associated With Increased Infant Mortality

Infant mortality rates are known to be elevated in low-income populations.¹⁸⁻²¹ Poverty is associated with reduced availability of healthy food, poor sanitation in some rural areas, lowered access to quality health care, and less optimal education about proper nutrition and prenatal care.²² Poverty also is known to interact with other factors, such as race/ethnicity and maternal education to produce higher levels of infant mortality in specific sub-populations.²³

Rural residence also is thought to contribute to the risk of infant death. The Rural Infant Care Program found that rural Americans have higher infant mortality rates than their urban counterparts,²⁴ and more recently neonatal and postneonatal mortality has been found to be higher in nonmetropolitan regions compared to the metropolitan counties.²⁵ Rural residence has been found to be associated with less use of preventive services and greater lack of health insurance coverage.²⁶

Studies of the relationship between access to health care and health outcomes, including infant mortality rates, produce mixed findings. Adequate prenatal care is associated with more favorable birth outcomes,²⁷ and prenatal care utilization rates are low in Appalachia.²⁸ It is difficult to measure the association between prenatal care use and birth outcomes precisely, however, due to selection effects (ie, selection into early and regular use of prenatal care by mothers most concerned with promoting healthy outcomes will influence this relationship²⁹). A New York State study found that the number of hospital beds per capita was negatively related to the risk of infant death from exogenous causes and all causes combined, but conversely higher per capita primary care physician rates appeared to be associated with an increased risk of infant mortality due to exogenous causes.³⁰ On the other hand, a recent study in the Mississippi Delta found that the number of physicians per 1,000 residents did not contribute significantly to infant mortality over and above the effects of poverty and geographic location.²²

Greater proportions of minority residents in the population have been shown to be associated with higher infant mortality rates.^{23,31} Part of this effect is likely to be compositional, since

in spite of advances in maternal and neonatal medical care, infant mortality rates among blacks within the United States have consistently remained more than twice those of whites.³² Areal effects also may be important, however, since areas with larger nonwhite populations may have relatively fewer available health-promoting resources including high-quality health care facilities and supportive community services.

Rationale and Goal of the Present Study

This study explores regional disparities in county-level infant mortality rates within the 13 states comprising the Appalachia region (ie, counties both inside and outside Appalachia, see Figure 1). We examine the impact of geographic location, rural residence, poverty rates, and physician resources on regional variation in infant mortality in both the 1976-1980 and 1996-2000 time periods. The purpose of this study is not to infer causality at the individual level based on data measured at the aggregate level. Aggregate analyses, however, can provide useful information for health planning and policy development.³³

The present analyses focus only on white infant mortality, due to the small number of infant deaths among other races in many counties across our study region. The Appalachian population was overwhelmingly white non-Hispanic during the late 1970s, and this population group remained in the majority through the end of the study period. In the 2000 US Census, 89% of the Appalachian population was white.

Based on findings from previous research, a series of hypotheses are posited. First, in view of their socioeconomic and geographic disadvantages, Appalachian counties are expected to report higher infant mortality rates than non-Appalachian counties in the same states and across the study region. Second, significant regional differences in infant mortality rates are hypothesized, with historically disadvantaged Central Appalachian counties exhibiting the highest rates and Northern Appalachian counties the lowest. In light of the substantial nationwide decline in infant mortality, a third hypothesis is that absolute regional disparity in infant mortality has decreased over time. During recent decades, advances in medical technology and maternity and neonatal care, and better access to medical care for poor populations through expansions of the Medicaid program have been associated with reductions in overall infant mortality.^{34,35} More ubiquitous provision of maternal and child health services should have helped areas “catch up” and reduce the variation in infant mortality between the time points of our study. We also hypothesize that after accounting for social and health care-related factors in multivariate analyses, a positive relationship will be found between Appalachian location and infant mortality rate during the earlier time period but not in more recent years.

METHODS

This study uses county-level data for the years 1976-1980 and 1996-2000 extracted from the 1993 and 2003 versions of the Area Resource File, which contain historical as well as contemporaneous data. The Area Resource File has recently also incorporated data for independent cities, and these data were extracted for cities in Appalachia for 1996-2000. The Appalachian Regional Development Act (1964) established the formal definition of Appalachia but the number of county and county units in Appalachia has gradually expanded over time.³⁶ This study uses the most current definition of Appalachia by the Appalachian Regional Commission (ARC). ARC currently designates 420 counties in 13 states as Appalachian areas, as well as 8 independent cities within these states.⁷ ARC also identifies Northern, North Central, Central, South Central, and Southern sub-regions that are contiguous regions of relatively homogeneous characteristics related to topography, demographics, and economics within Appalachia³⁷ (see Figure 1). Since data on 36

independent cities in Virginia are available for 1992 onwards in the Area Resource File, the Appalachian sample size for 1976-1980 is slightly smaller than the sample size for 1996-2000 (see Table 1).

The 5-year average infant mortality rates for whites in both 1976-1980 and 1996-2000 are the dependent variables of interest. Infant death is a relatively rare event and the 5-year average rates increase reliability of the estimates. We computed the regional infant mortality rate weighted by the number of live births in each county. Though 5-year average rates were used, some counties' infant mortality data are suppressed for death counts of 5 or less in 5 years. This analysis does not utilize the latest 5-year estimates (2003-2007), as parallel data on predictor variables do not currently exist.

Our data includes several explanatory variables: a dummy variable for Appalachian county, categorical variables measuring urbanization and identifying Appalachian sub-regions, and measures of white poverty, percent of the total population that is white, and the number of physicians per 1,000 residents. Appalachian location and sub-region designations were developed by the Appalachian Regional Commission. Rural-Urban Continuum Codes (RUCC) developed by the US Department of Agriculture were used to measure degree of rurality. These codes form a classification scheme that distinguishes metropolitan (metro) and nonmetropolitan (non-metro) counties by population size, degree of urbanization and adjacency to metro areas.³⁸ We grouped counties into 4 categories based on RUCC: 1) Large Metro: codes 0 and 1, indicating large metropolitan areas with a population of 1 million or more; 2) Small Metro: codes 2 and 3, indicating metropolitan areas of 250,000 to 1 million, or fewer than 250,000, respectively; 3) Smaller Urban: codes 4, 5, 6, and 7, indicating counties with smaller urban populations, either adjacent or not adjacent to a metro area; and 4) Rural: codes 8 and 9, indicating counties that are completely rural or with an urban population of less than 2,500.

Our analysis has 3 stages. We start with descriptive analyses. The statistical significance of differences in infant mortality rates between sub-regions was examined by student *t* tests with Bonferroni adjustment for multiple comparisons. Linear contrasts were used to calculate mean differences and statistical significance determination was adjusted to ensure that the overall probability is no greater than 0.05 that a result will appear to be statistically significant when there are no true underlying differences. Thus, the significance level for each comparison in Bonferroni testing was set at $P = .0033$.

Our second stage includes exploratory spatial data analysis. We were interested in mapping and describing the overall spatial structure in infant mortality and the predictors. We visualized the spatial distribution of infant mortality rates across Appalachian states (Figures 2 and 3), and we calculated Moran's *I* for all variables used in our models.

Our final stage included weighted multiple regression modeling, estimated to determine the association between infant mortality rates and the predictors. Two different regression models were estimated. The first models include Appalachian location, urbanization levels, white poverty rate, percent of the population that is white, and number of physicians per 1,000 residents. Our second models also include 5 regional dummy variables to represent the 6 sub-regions of our study area (these sub-regions include the 5 Appalachian sub-regions defined by ARC plus the non-Appalachian area). In models not shown we included an interaction term (between Appalachian sub-regions and both urbanization level and poverty). The interactions were not significant, and adding them to models did not change the associations.

Additional predictor variables available in the Area Resource File were also of conceptual interest, including measures of hospital beds per 100,000 residents, median income,

unemployment rates, and percent of the population with a high school education. Due to high multicollinearity with the other variables of interest, however, these variables were not included in the final models.

RESULTS

Table 1 shows white infant mortality rates for the overall study area (Appalachia and non-Appalachia) and by Appalachian sub-region during each of the 2 time periods, and regional variation in infant mortality is illustrated in the choropleth maps in Figures 2 and 3. Consistent with the first study hypothesis, overall white infant mortality rates in Appalachian counties were significantly higher than in non-Appalachian counties during both 1976-1980 and 1996-2000.

We find significant regional differences in infant mortality rates during both time periods, displaying patterns that are partially consistent with our second hypothesis. Bonferroni-adjusted test results in Table 1 reveal that Central Appalachia had higher white infant mortality rates than non-Appalachian counties as well as Northern and Southern Appalachian counties during both study periods. North Central and South Central Appalachian counties also had higher infant mortality rates than non-Appalachian counties. The mortality rates in Northern and Southern Appalachian counties were not significantly different from the rates in non-Appalachian counties. The absolute gaps or differential between regions declined, though the relative risk or differences between regions did not decrease over our study time period. The rate ratio of Appalachia to non-Appalachia increased slightly from 1.09 to 1.13, and the rate ratio of Central Appalachia to non-Appalachia increased from 1.18 to 1.28.

Table 1 also shows that poverty rates were significantly higher in Appalachia than the non-Appalachian regions during both 1976-1980 and 1996-2000. As expected, Appalachia, especially Central Appalachia, was less urbanized than non-Appalachia. Appalachian/non-Appalachian rate ratios reveal that comparative poverty levels did not improve (1.44 in 1979, 1.45 in 1999), but physician availability did improve modestly in Appalachia counties relative to the non-Appalachian counties (0.58 during 1976-1979, 0.64 during 1996-1999). The number of physicians per 1,000 residents remained significantly lower in Appalachia vs non-Appalachian regions during both time periods. The Appalachian population, especially in Central Appalachia, was also characterized by a higher percentage of white residents than the non-Appalachian areas at both time points.

Exploratory spatial data analyses revealed no significant spatial autocorrelation for infant mortality in Appalachia, nor for the number of physicians per 1,000 residents. However, poverty in Appalachia and the white population percentage have global spatial structure, based on Moran's I values. Moran's I was calculated based on a first-order queen weights matrix. The global Moran's I are reported in Table 1 (we note that similar Moran's I values were observed using a first-order rook weights matrix and a k-nearest neighbor matrix using 6 neighboring counties).

Table 2 summarizes the results of our regression models. We ran separate models depending on the specification of the regional variable (an Appalachian dummy in Model 1 and the incorporation of 5 Appalachian sub-regions in Model 2 where the comparison group is non-Appalachia) and for each time period. Looking first at results for Model 1 in 1976-1980, a significant positive association was found between the Appalachian dummy and the infant mortality rate when controlling for urbanization level (which was not itself significant), white poverty rates, percentage of population that was white, and the number of physicians. In Model 2 for 1976-1980, Northern, North Central, and South Central Appalachia

compared to the non-Appalachian regions were associated with higher infant mortality rates. As expected, poverty rate was positively associated with infant mortality rates in both 1976-1980 regression models. This was also true of the number of physicians per 1,000 residents. The adjusted R^2 for the regression models ranged from 0.210 to 0.211; model fit did not improve significantly with the addition of dummy variables in Model 2.

In contrast to the earlier time point, no significant association was found between Appalachian status and infant mortality rates in 1996-2000 when controlling for the other covariates. Model 2 reveals that sub-regional variation was not important either. Higher white poverty rates and living in less urbanized areas were positively associated with infant mortality rates in 1996-2000. The effect associated with number of physicians per 1,000 residents reversed sign, and it was negatively associated with infant mortality rates during the later period. The estimated adjusted R^2 for models ranged from 0.167 to 0.179. Residuals were visually inspected for spatial patterning, which showed only minor clusters in parts of Central Appalachia at Time 1. Moran's I of residuals for Model 2 were insignificant (0.0328 for 1976-1980 and 0.0301 for 1996-2000).

In a sensitivity analysis, we repeated our analyses after excluding some of the largest metropolitan counties (ie, the 5 counties that constitute New York City: Bronx, Kings, New York, Queens, and Richmond). When these counties were excluded the infant mortality rates for the non-Appalachian region were 11.89 and 5.95 per 1,000 live births for the 2 study periods, respectively, and remained significantly lower than rates in Appalachia. Appalachian status remained a significant contributor of infant mortality in 1976-1980 but not in 1996-2000. In summary, our results were similar to those derived from analyses including large metropolitan areas in non-Appalachia. Additional sensitivity analysis excluded the 36 Virginia independent cities in the period 1996-2000. The exclusion of independent cities did not change the findings.

DISCUSSION

The goal of this study was to examine trends and potential explanatory factors related to white infant mortality variation in the 13 Appalachia states, including in the analyses counties both inside and outside of "Appalachia." Several findings emerge about the patterns and the predictors studied. First, descriptive analyses of county-level infant mortality and related risk factors demonstrate the existence of statistically significant differences in infant mortality across Appalachian and sub-regional groupings of counties and increased exposure to potential health risk factors including poverty, rurality, and lower physician availability. Consistent with previous research, Appalachian counties were found to have persistently higher infant mortality rates than non-Appalachian counties.¹⁷ In addition, in the aggregate the comparative infant mortality disparity between Appalachian and non-Appalachian counties did not improve over the 2 decades of study.

Although white infant mortality rates decreased substantially in all sub-regions over the last 2 decades, the descriptive analyses revealed persistent disparities in mortality rates in some regions, especially Central Appalachia. This sub-region also displays a pattern of comparatively higher poverty, a lower level of urbanization, and relatively fewer available physicians than other sub-regions over time. These findings are consistent with earlier research examining mortality and risk factor patterns in Appalachian areas, underscoring the importance of targeting public health improvement efforts within this region.⁵

Multivariate analyses provide further clues about the importance of the measured risk factors in influencing white infant mortality rates. When other variables are taken into account, a significant infant mortality disadvantage was associated with Appalachian

counties in 1976-1980. As shown in analyses with regional indicators, this net disadvantage was especially pronounced for the Northern, North Central, and South Central Appalachian regions. More recently, residing in Appalachia in general or in particular Appalachian sub-regions is no longer in and of itself a significant risk factor for higher infant mortality. Recent investment and infrastructure development focused on Appalachia may have had a beneficial effect on the health of those living in this region. For example, since 1965 the Appalachian Regional Commission (ARC) has funded projects in Appalachian counties to improve telecommunications, community development, housing, transportation, local water and sewer systems, and expand access to health care including recruitment of physicians that encompasses those trained in non-US medical schools. Such investments may be bearing fruit in reducing adverse health outcomes including infant mortality.

Regarding the other measured factors, multivariate analyses suggest that residence in areas characterized by higher poverty rates continues to convey increased infant mortality risk, and that risk appears to increase along the urban/rural continuum such that residents in the most rural areas experience the most mortality disadvantage. The number of physicians per 1,000 residents in Appalachia increased from 1.1 to 1.8 over the study period, and higher physician supply was associated with lower infant mortality risk during the 1996-2000 period. This is consistent with evidence from international studies suggesting that increasing the density of physicians leads to improvement in infant mortality, presumably through mechanisms including more maternal access to preventive health care prior to and during pregnancy and greater access to pediatric care.³⁹ The finding that higher physician density was related to greater infant mortality risk at the early study time point, however, seems counterintuitive and warrants further study with more detailed measures of health care resources including the availability of physicians by practice type and subspecialty.

Several limitations should be born in mind in relation to the current analyses. Because this is an ecological study, associations between the measured predictors and infant mortality risk cannot be used to infer associations at the individual level. In addition, health care-related factors such as the availability of tertiary maternal and neonatal care and the professional certification of medical care providers could not be included due to lack of complete information at the county level. Similarly, potentially relevant social factors including median educational attainment and unemployment rates could not be included due to issues of multicollinearity with other variables in the analyses.

One of the goals of this research was to provide information useful to policy makers and health services planners who seek to eliminate health disparities in the United States. County-level analysis serves the purpose of alerting health planners and policy makers to the magnitude and correlates of disparities in regional rates. From the perspective of public health, residents of Appalachia and especially Central Appalachia experience differentially higher rates of infant mortality, as well as greater risks of other adverse health outcomes including cancer,³ heart disease,⁴ and premature mortality.⁵ The current analyses highlight the continued importance of interrelated risk factors including poverty and rurality in influencing infant mortality disparities in Appalachia.

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Figure 1.
Sub-regions in Appalachian States

Note: This study uses the most current definition of Appalachia by the Appalachian Regional Commission (ARC). ARC currently designates 420 counties in 13 states as Appalachian areas, as well as 8 independent cities within these states.

Figure 2.
White Infant Mortality Rates: 1976-1980 and 1996-2000

Table 1

Descriptive Statistics of White Infant Mortality Rates, White Poverty Rates, Rurality, Physician Availability, and Percent of Whites

	Non-Appalachia	Appalachia	Moran's I	Sub-regions in Appalachia				
				Northern	North Central	Central	South Central	Southern
Same size								
1976-1980	644	420		86	63	82	85	104
1996-2000	672 ^a	428 ^a		86	63	83 ^a	92 ^a	104
Infant Mortality (%)								
1976-1980	12.08 (2.26)	13.13 ^{***} (2.56)	0.0560	12.68 (1.89)	13.77 ^b (2.91)	14.30 ^{b, c, f} (3.33)	13.38 ^b (2.61)	12.81 (2.63)
1996-2000	5.97 (1.54)	6.73 ^{***} (1.91)	0.0504	6.39 (1.49)	7.41 ^{b, c} (2.07)	7.62 ^{b, c, f} (2.71)	6.96 ^b (1.83)	6.46 (1.85)
White Poverty (%)								
1979	8.49 (3.52)	12.22 ^{***} (5.37)	0.6560	9.36 (2.36)	13.76 ^{b, c} (3.66)	23.02 ^{b, c, d, e, f} (7.15)	13.30 ^{b, c} (4.11)	11.59 ^{b, c} (3.65)
1999	7.81 (3.82)	11.83 ^{***} (5.08)	0.7017	10.34 ^b (2.35)	15.15 ^{b, c, e, f} (4.52)	22.28 ^{b, c, d, e, f} (6.60)	11.40 ^{b, f} (3.31)	9.31 ^b (3.24)
Urbanization (N (%))								
1974								
Metro	54 (8%)	10 (2%)		4 (5%)	1 (2%)	0 (0%)	0 (0%)	5 (5%)
Small Metro	131 (20%)	71 (17%)		23 (27%)	7 (11%)	7 (9%)	15 (18%)	19 (18%)
Small Urban	322 (50%)	210 (50%)		52 (60%)	32 (51%)	28 (34%)	42 (49%)	56 (54%)
Rural	137 (21%)	129 (31%)		7 (8%)	23 (37%)	47 (57%)	28 (33%)	24 (23%)
1995								
Metro	108 (16%)	20 (5%)		8 (9%)	3 (5%)	0 (0%)	0 (0%)	9 (9%)
Small Metro	147 (22%)	93 (22%)		30 (35%)	8 (13%)	9 (11%)	23 (25%)	23 (22%)
Smaller Urban	298 (44%)	204 (48%)		41 (48%)	30 (48%)	35 (42%)	45 (49%)	53 (51%)
Rural	119 (18%)	111 (26%)		7 (8%)	22 (35%)	39 (47%)	24 (26%)	19 (18%)
Number of physicians per 1,000 residents								
1976-1979	1.89 (1.53)	1.10 ^{***} (0.85)	0.1041	1.28 ^b (0.90)	1.05 ^b (0.97)	0.55 ^b (0.36)	1.14 ^b (0.79)	0.98 ^b (0.75)
1996-1999	2.83 (2.38)	1.82 ^{***} (1.54)	0.1139	2.09 ^b (1.67)	1.74 (1.80)	1.08 ^b (0.86)	2.06 (1.52)	1.56 ^b (1.30)
White Population (%)								
1980	77.60 (16.20)	92.05 ^{***} (9.74)	0.5187	95.70 ^{b, f} (4.15)	96.63 ^{b, f} (2.64)	97.68 ^{b, f} (2.82)	91.98 ^{b, f} (7.38)	81.46 (13.30)
2000	69.89 (19.05)	88.71 ^{***} (10.97)	0.7483	93.00 ^{b, f} (5.15)	95.24 ^{b, f} (2.89)	96.96 ^{b, f} (2.14)	89.68 ^{b, f} (8.62)	78.10 ^b (13.03)

* Notes: $P < .05$,

** $P < .01$,

$P < .001$: The P values refer to t tests of Appalachia vs non-Appalachia

^aData on 36 independent cities in Virginia are available for 1992 onwards in the Area Resource File. According to the current definition by Appalachian Regional Commission, 8 of 36 independent cities which are considered county-equivalents in Virginia are within the Appalachian Region.

^b P .0033 refers to Bonferroni tests of Appalachian sub-regions versus non-Appalachian.

^c P .0033 refers to Bonferroni tests of Appalachian sub-regions versus Northern Appalachia

^d P .0033 refers to Bonferroni tests of Appalachian sub-regions versus North Central Appalachia

^e P .0033 refers to Bonferroni tests of Appalachian sub-regions versus South Central Appalachia

^f P .0033 refers to Bonferroni tests of Appalachian sub-regions versus Southern Appalachia

Table 2

County-level White Infant Mortality Rates Regressed on Appalachian/non-Appalachian status, Urbanization Level, White Poverty Rates, and Non-federal Active Physicians per 1,000 population

	Model 1		Model 2	
	1976-1980	1996-2000	1976-1980	1996-2000
Number of counties used	1037	1060	1037	1060
Intercept	12.211 ***	5.541 ***	12.272 ***	5.370 ***
Appalachian	0.761 ***	0.100		
Sub-regions				
Northern Appalachia			0.922 ***	0.092
North Central Appalachia			1.188 **	0.498
Central Appalachia			0.306	-0.248
South Central Appalachia			0.775 *	0.375
Southern Appalachia			0.335	0.169
Urbanization	0.241	0.493 ***	0.252	0.477 ***
Small Metro	0.345	0.719 ***	0.309	0.692 ***
Smaller Urban	-0.492	0.780 *	-0.491	0.786 *
Rural	-0.492	0.780 *	-0.491	0.786 *
White Poverty	0.190 ***	0.100 ***	0.199 ***	0.105 ***
Number of physicians per 1,000 residents	0.196 **	-0.053 **	0.181 **	-0.054 *
Percent of White Population	-0.028 ***	-0.006	-0.029 ***	-0.005
R ²	0.215	0.184	0.220	0.176
Adjusted R ²	0.210	0.179	0.211	0.167
F statistics	40.31 ***	33.99 ***	26.23 ***	22.19 ***

* Notes: $P < .05$,

** $P < .01$,

*** $P < .001$