12-2005

The Health Status of Southern Children: A Neglected Regional Disparity

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Goldhagen, J. et al. The Health Status of Southern Children: A Neglected Regional Disparity. Pediatrics. 2005. 116(6) 746-753.

The Health Status of Southern Children: A Neglected Regional Disparity

Abstract
Purpose: Great variations exist in child health outcomes among states in the United States, with southern states consistently ranked among the lowest in the country. Investigation of the geographical distribution of children's health status and the regional factors contributing to these outcomes has been neglected. We attempted to identify the degree to which region of residence may be linked to health outcomes for children with the specific aim of determining whether living in the southern region of the United States is adversely associated with children's health status.

Methods: A child health index (CHI) that ranked each state in the United States was computed by using statespecific composite scores generated from outcome measures for a number of indicators of child health. Five indicators for physical health were chosen (percent low birth weight infants, infant mortality rate, child death rate, teen death rate, and teen birth rates) based on their historic and routine use to define health outcomes in children. Indicators were calculated as rates or percentages. Standard scores were calculated for each state for each health indicator by subtracting the mean of the measures for all states from the observed measure for each state. Indicators related to social and economic status were considered to be variables that impact physical health, as opposed to indicators of physical health, and therefore were not used to generate the composite child health score. These variables were subsequently examined in this study as potential confounding variables. Mapping was used to redefine regional groupings of states, and parametric tests (2-sample t test, analysis of means, and analysis-of-variance F tests) were used to compare the means of the CHI scores for the regional groupings and test for statistical significance. Multiple regression analysis computed the relationship of region, social and economic indicators, and race to the CHI. Simple linear-regression analyses were used to assess the individual effect of each indicator.

Results: A geographic region of contiguous states, characterized by their poor child health outcomes relative to other states and regions of the United States, exists within the "Deep South" (Mississippi, Louisiana, Arkansas, Tennessee, Alabama, Georgia, North Carolina, South Carolina, and Florida). This Deep-South region is statistically different in CHI scores from the US Census Bureau– defined grouping of states in the South. The mean of CHI scores for the Deep-South region was >1 SD below the mean of CHI scores for all states. In contrast, the CHI score means for each of the other 3 regions were all above the overall mean of CHI scores for all states. Regression analysis showed that living in the Deep- South region is a stronger predictor of poor child health outcomes than other consistently collected and reported variables commonly used to predict children's health.

Conclusions: The findings of this study indicate that region of residence in the United States is statistically related to important measures of children's health and may be among the most powerful predictors of child health outcomes and disparities. This clarification of the poorer health status of children living in the Deep South through spatial analysis is an essential first step for developing a better understanding of variations in the health of children. Similar to early epidemiology work linking geographic boundaries to disease, discovering the mechanisms/pathways/causes by which region influences health outcomes is a critical step in addressing disparities and inequities in child health and one that is an important and fertile area for future research. The reasons for these disparities may be complex and synergistically related to various economic, political, social, cultural, and perhaps even environmental (physical) factors in the region. This research will require the use and development of new approaches and applications of spatial analysis to develop insights into the societal, environmental, and historical determinants of child health that have been neglected in previous child health outcomes and policy research. The public policy implications of the findings in this study are substantial. Few, if any, policies identify these children as a high-risk group on the basis of their region of residence. A better understanding of the depth and breadth of disparities in health, education, and other social outcomes among and within regions of the United States is necessary for the generation of policies that enable policy makers to address and mitigate the factors that influence these disparities. Defining and clarifying the regional boundaries is also necessary to better inform public policy decisions related to resource allocation and the prevention and/or mitigation of the effects of region on child health. The identification of the Deep South as a clearly defined sub-region of the Census Bureau's regional definition of the South suggests the need to use more culturally and socially relevant boundaries than the Census Bureau regions when analyzing regional data for policy development.

Disciplines
Other Medicine and Health Sciences | Pediatrics

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The Health Status of Southern Children: A Neglected Regional Disparity

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ABSTRACT. *Purpose.* **Great variations exist in child health outcomes among states in the United States, with southern states consistently ranked among the lowest in the country. Investigation of the geographical distribution of children's health status and the regional factors contributing to these outcomes has been neglected. We attempted to identify the degree to which region of residence may be linked to health outcomes for children with the specific aim of determining whether living in the southern region of the United States is adversely associated with children's health status.**

Methods. **A child health index (CHI) that ranked each state in the United States was computed by using state-specific composite scores generated from outcome measures for a number of indicators of child health. Five indicators for physical health were chosen (percent low birth weight infants, infant mortality rate, child death rate, teen death rate, and teen birth rates) based on their historic and routine use to define health outcomes in children. Indicators were calculated as rates or percentages. Standard scores were calculated for each state for each health indicator by subtracting the mean of the measures for all states from the observed measure for each state. Indicators related to social and economic status were considered to be variables that impact physical health, as opposed to indicators of physical health, and therefore were not used to generate the composite child health score. These variables were subsequently examined in this study as potential confounding variables. Mapping was used to redefine regional groupings of states, and parametric tests (2-sample *t* test, analysis of means, and analysis-of-variance *F* tests) were used to compare the means of the CHI scores for the regional groupings and test for statistical significance. Multiple-regression analysis computed the relationship of region, social and economic indicators, and race to the CHI. Simple linear-regression analyses were used to assess the individual effect of each indicator.**

Results. **A geographic region of contiguous states, characterized by their poor child health outcomes relative to other states and regions of the United States, exists within the "Deep South" (Mississippi, Louisiana, Arkansas, Tennessee, Alabama, Georgia, North Carolina, South Carolina, and Florida). This Deep-South region is statistically different in CHI scores from the US Census Bureau–defined grouping of states in the South. The mean of CHI scores for the Deep-South region was >1 SD below the mean of CHI scores for all states. In contrast, the CHI score means for each of the other 3 regions were all above the overall mean of CHI scores for all states. Regression analysis showed that living in the Deep-South region is a stronger predictor of poor child health outcomes than other consistently collected and reported variables commonly used to predict children's health.**

Conclusions. **The findings of this study indicate that region of residence in the United States is statistically related to important measures of children's health and may be among the most powerful predictors of child health outcomes and disparities. This clarification of the poorer health status of children living in the Deep South through spatial analysis is an essential first step for developing a better understanding of variations in the health of children. Similar to early epidemiology work linking geographic boundaries to disease, discovering the mechanisms/pathways/causes by which region influences health outcomes is a critical step in addressing disparities and inequities in child health and one that is an important and fertile area for future research. The reasons for these disparities may be complex and synergistically related to various economic, political, social, cultural, and perhaps even environmental (physical) factors in the region. This research will require the use and development of new approaches and applications of spatial analysis to develop insights into the societal, environmental, and historical determinants of child health that have been neglected in previous child health outcomes and policy research. The public policy implications of the findings in this study are substantial. Few, if any, policies identify these children as a high-risk group on the basis of their region of residence. A better understanding of the depth and breadth of disparities in health, education, and other social outcomes among and within regions of the United States is necessary for the generation of policies that enable policy makers to address and mitigate the factors that influence these disparities. Defining and clarifying the regional boundaries is also necessary to better inform public policy decisions related to resource allocation and the prevention and/or mitigation of the effects of region on child health. The identification of the Deep South as a clearly defined subregion of the Census Bureau's regional definition of the South suggests the need to use more culturally and socially relevant boundaries than the Census Bureau regions when analyzing regional data for policy development.** ***Pediatrics*** **2005;116:e746–e753. URL: www.pediatrics.org/cgi/doi/10.1542/peds.2005-0366;** ***child health status, health disparity, spatial analysis, epidemiologic methods, geographic location.***

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Accepted for publication Jun 6, 2005.
doi:10.1542/peds.2005-0366
No conflict of interest declared.

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ABBREVIATIONS. CHI, child health index; AECF, Annie E. Casey Foundation; ANOM, analysis of means.

Large disparities exist in the health status and social well-being of children in the United States.[1] These disparities have been cataloged and characterized in numerous reports and studies,[2–4] and national calls have been made for interventions.[5–7] Although health disparities and inequities are increasingly documented among US children, their etiologies remain poorly defined. Current research focuses primarily on identifying disparities in access to child health services related to race, socioeconomic status, insurance coverage, geography, etc[6,8–10] despite the lack of clear evidence that access to health care is directly related to health status.[6] Research into causation is limited and has targeted poverty and the "intuitive" social, economic, and environmental factors associated with living in poverty.[11,12] However, after decades of study, the pathways through which access to health services and poverty impact health remain unclear.

Although variations in the geographic distribution of health outcomes have been noted, the relevance of the spatial characteristics of children's health have tended to be overlooked.[13] Despite the stark differences in the health status of children living in different regions of the United States, children in the southern states have consistently poorer outcomes for most indicators of children's health and well-being.[1] Only a few studies have included uni- and multifactorial analyses related to the impact of region on access and utilization of child health services.[12,14–16] Even fewer studies have attempted to define the contribution of region as an independent variable to explain variations in child health status.[13]

If region is an independent predictor of child health outcomes, critical questions arise as to how this effect is mediated. These questions will require a review of previous studies and new and/or expanded use of currently used research methods to be answered. Future epidemiologic research could include consideration of the impact of region as a strategy to better define the relationship between region and child health outcomes and disparities. Moreover, new and expanded interdisciplinary and nontraditional research methods could be considered to examine and describe regional health ecologies and their impact on children's well-being. These findings could lead to new interdisciplinary intervention strategies and regional and national health policies to improve children's health and decrease health disparities.

This study addresses 3 questions that seek to better define the relationship between region of residence and the physical health and social well-being of children.

1. Is region in the United States a variable that has a statistically significant relationship to the health of children?
2. Can a geographic region composed of states in the South be characterized and defined based on the region's poorer health outcomes for children as compared with other regions of the country?
3. Is living in the "Deep South" a predictor of child health outcomes?

METHODS

Sequential spatial analyses were used to answer the research questions. These analytic processes included (1) computation of a composite child health index (CHI) for states based on commonly used statistical indices, (2) use of mapping to define regional groupings of states homogeneous for child health outcomes, and (3) statistical analyses using parametric tests for differences and associations.

Development of a Composite Child Health Score

A single aggregated composite child health index (CHI) score for the health of children in each state was developed by using Annie E. Casey Foundation (AECF) indicator data from their *Kids Count Data Book*.[1] Five indicators for physical health were chosen (percent low birth weight infants, infant mortality rate, child death rate, teen death rate, and teen birth rates) based on their historic and routine use to define health outcomes in children[1,3,17,18] and their inclusion as objectives for *Healthy People 2010*.[5] These data are provided by federal agencies and "reflect the best available state-level data for tracking yearly changes in each indicator.[1]" Indicators related to social and economic status were considered to be variables that impact physical health, as opposed to indicators of physical health, and therefore were not used to generate the composite CHI score. These variables were subsequently examined in this study as potential confounding variables, as described in a following section.

The purpose of the aggregation was to construct a composite health index that would facilitate statistical analysis by state for overall physical health, because each AECF indicator reflects only a single health dimension. The 5 physical health indicators were standardized by using the AECF methodology for ranking states for various issues including health.[1,19] First, these physical health indicators were calculated as rates or percentages. Standard scores were calculated for each state for each health indicator by subtracting the mean of the measures for all states from the observed measure for each state. The resulting measure was then divided by the standard deviation (SD) and multiplied by −1. All measures were given the same weight in calculating the overall standard score. The range of scores fell between -3 and 3. Scores closer to 3 represent better health, and those closer to −3 represent poorer health. For each state, the standard scores for each physical health indicator were added together and then standardized by using the same process to obtain the composite score. Finally, states were ranked in order of best to worst (1–50) on the basis of the composite score (Table 1).

Specifically, 5 indicators of health were selected, identifying the measurements by I_{ij} (there are 5 indicators [i] and 50 states [j], ie, I_{ij} is the ith indicator for state j). Then, for each indicator, the mean and SD were calculated and yielded:

$$\bar{I}_i = \sum I_{ij}/50 \quad (1)$$

and

$$S_i = \sqrt{\frac{\sum (I_{ij} - \bar{I}_i)^2}{49}}. \quad (2)$$

Then, the (negative) standardized scores for the indicators were constructed, defined as

$$z_j^i = -\frac{I_{ij} - \bar{I}_i}{S_i}. \quad (3)$$

The CHI was then calculated for each state,

$$HI_j = \sum_{i=1}^{5} z_j^i \qquad \text{for } j = 1, \ldots, 50 \text{ states}, \quad (4)$$

Mapping Analyses

Mapping techniques using ArcGIS 3.1 (ESRI, Redlands, CA) were then used to assess the individual and composite health

TABLE 1. State Composite Score Rank for CHI

Rank	State	Score*
1	New Hampshire	1.62
2	Massachusetts	1.61
3	Vermont	1.35
4	Maine	1.25
5	Washington	1.20
6	Minnesota	1.10
7	Rhode Island	1.10
8	Connecticut	1.08
9	Utah	1.06
10	Oregon	1.05
11	Hawaii	1.02
12	Iowa	1.02
13	California	0.91
14	New Jersey	0.87
15	North Dakota	0.74
16	New York	0.70
17	Alaska	0.54
18	Wisconsin	0.54
19	Nebraska	0.40
20	Virginia	0.33
21	Pennsylvania	0.22
22	Ohio	0.10
23	Michigan	0.09
24	Kansas	0.03
25	Montana	−0.05
26	Colorado	−0.06
27	Idaho	−0.17
28	Delaware	−0.21
29	South Dakota	−0.23
30	Arizona	−0.24
31	Nevada	−0.25
32	West Virginia	−0.30
33	Texas	−0.31
34	Illinois	−0.32
35	Florida	−0.34
36	Kentucky	−0.35
37	Missouri	−0.39
38	Maryland	−0.44
39	Indiana	−0.45
40	Oklahoma	−0.87
41	North Carolina	−0.94
42	Wyoming	−0.96
43	New Mexico	−1.01
44	Georgia	−1.05
45	Tennessee	−1.19
46	Arkansas	−1.35
47	South Carolina	−1.76
48	Louisiana	−1.85
49	Alabama	−2.12
50	Mississippi	−2.69

* Standard scores range from −3 to 3, 3 SD below and above the mean of 0.

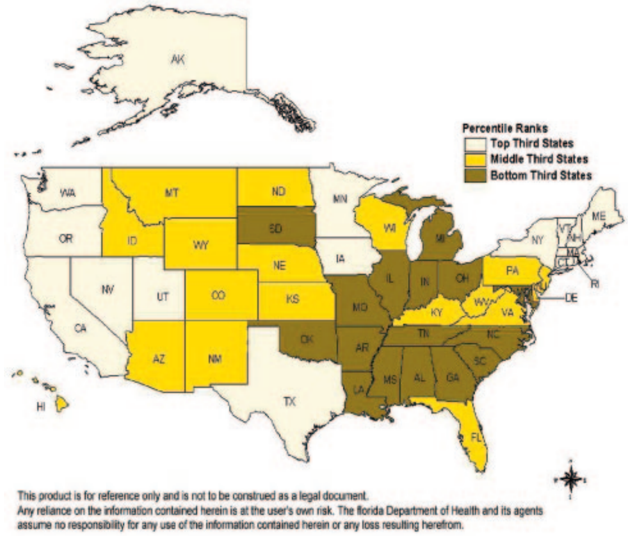

Fig 1. Infant mortality rate by state, 1999. Source of data: Annie E. Casey Foundation. *2002 Kids Count Data Book: State Profiles of Well-Being*. Baltimore, MD: Annie E. Casey Foundation; 2002.

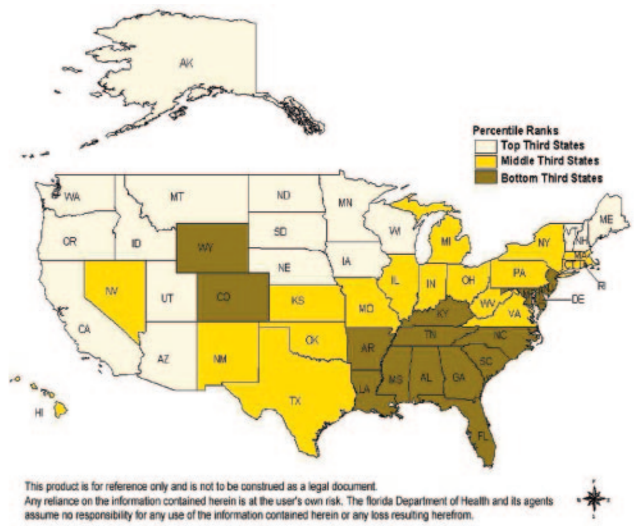

Fig 2. Low birth weight rate by state, 1999. Source of data: Annie E. Casey Foundation. *2002 Kids Count Data Book: State Profiles of Well-Being*. Baltimore, MD: Annie E. Casey Foundation; 2002.

status of each state in the US Census Bureau–defined South, as well as geographically contiguous states that could be linked and included in a region as the South. Analysis included descriptive maps created for each of the 5 standardized scores for the physical health indicators and a map based on the composite health scores (Figs 1 and 2 illustrate variations by state in infant mortality and low birth weight). Based on this analysis, a Deep-South region was identified for additional analyses.

Statistical Comparison of Reconfigured Regions by Health Indicators

A 3-step hierarchical analysis was used to (1) compare health indices by Census Bureau–determined regions, (2) explore the impact of combining states into new regions that maximize the regional effect on child health outcomes, and (3) compare the effect of these redefined regions on predicting health outcomes with and without adjustment for other probable confounding variables related to child health. Commonly used parametric statistics were used to compare means and examine the relative associations of multiple variables. The 2-sample t test, analysis of means (ANOM), and analysis-of-variance F tests were used to compare the means of groups. Dunnett's multiple-comparison test was used to test for differences in the regional means for state CHIs between the Deep South and the other regions (because differences between the other regions [ie, West and Midwest] were not of concern to this study). Multiple regression was used to determine which variables contribute to the outcomes (CHI scores). Because multiple-regression coefficients in the model are meaningful only in the presence of all the variables currently in the model (and because mild multicollinearity existed in the multiple-regression model), simple linear-regression models were used to assess the individual effect of each indicator.

RESULTS

Health Status of Children

Using the CHI ranking scores generated for each state, 12 of the 16 worst states were from the Census Bureau–defined South. The results show that children in many southern states have poorer overall physical health outcomes than children in other regions of the country (Table 1). The Census Bureau–defined West and Midwest regions each had 2 states and the Northeast had none in the bottom-16 ranking. Overall, the states in the Census Bureau–defined South have poorer child physical health outcomes than the other Census Bureau–defined areas (Northeast, Midwest, and West) of the country.

Defining the South

States within the South were then examined to determine if the current Census Bureau definition of the South (Delaware, Maryland, Virginia, West Virginia, Kentucky, Arkansas, Oklahoma, Texas, Louisiana, Mississippi, Tennessee, Alabama, Georgia, North Carolina, South Carolina, and Florida) uniformly reflects/predicts health outcomes for children.

A Deep-South region was defined based on the health index for the purpose of comparison to the states included in the Census Bureau's Southern region. The states included in the Deep South (North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, and Tennessee) are both geographically contiguous and inclusive of the states with the worst composite scores for overall child health. Delaware, Maryland, Virginia, West Virginia, Kentucky, Oklahoma, and Texas are not included in the Deep-South region in this analysis. Of the 9 Deep-South states, 7 are at the very bottom of the composite rank list (44th–50th). The remaining Deep-South states (Florida and North Carolina) were ranked 35th and 41st. Delaware, Maryland, Virginia, West Virginia, Kentucky, Oklahoma, and Texas were ranked 28th, 38th, 20th, 32nd, 36th, 40th, and 33rd, respectively.

The use of choropleth (area shaded) maps illustrates the differences in state rates for the composite scores (Fig 3). Areas with darker shading indicate worse rates, most of which were located in the Deep South. The *t* test was then used to compare composite scores for states in the redefined Deep-South region to the remaining states in the Census Bureau–defined South. With equal variances assumed, the results indicate that the composite score for child health in the Deep-South region is significantly different (lower) ($P = .0001$) than the other states included in the Census Bureau–defined South (Table 2).

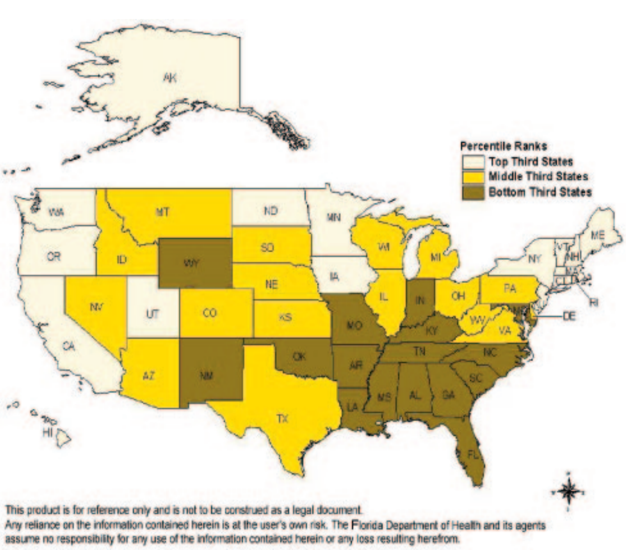

Fig 3. Composite health score by state. Source of data: Annie E. Casey Foundation. *2002 Kids Count Data Book: State Profiles of Well-Being*. Baltimore, MD: Annie E. Casey Foundation; 2002.

Comparison of Regions in the United States

Analysis of differences between the redefined Deep-South region and the other Census Bureau–defined regions (North, Midwest, and West) was conducted after reconfiguring the regions by placing the remaining Census Bureau–defined Southern states (other than the Deep-South states) in other contiguous regions. Texas, Oklahoma, West Virginia, and Kentucky were included in the Midwest region, and Delaware, Maryland, and Virginia were included in the Northeast region. The ANOM decision chart (see Fig 4) indicates that at the .001 level of significance, the average CHI score for the Deep South (mean: −1.48) is significantly below the overall mean (0) for the 50 states. The average score for the Northeast (mean: 0.79) is significantly higher than the overall mean, and the means for 2 other regions are higher than the overall mean but were not statistically significant variations from the overall mean. The ANOM has the same assumptions and approximately the same power as the analysis-of-variance *F* test (which yielded $P < .001$ for these data) but has the advantage of providing a decision chart to aid in interpretation.[20]

To control the type I error rate at 5% for the set of 3 pairwise comparisons, Dunnett's multiple-comparison test was run to compare the Deep South with each of the other 3 regions. Because direction was important (we anticipated that states in the Deep South had a worse outcome than the other regions), a 1-sided test was run. The Deep-South region was statistically different from each of the 3 other regions. This test confirmed that children in this Deep-South region have significantly worse health outcomes than children in other regions of the country (Table 3). Figure 5 illustrates the differences between the Deep South and other combined regions for each of the health indicators.

Multivariate Analyses

A number of commonly used social, economic, and geographic variables for child well-being (percent of teens who are high school dropouts, percent of children living in poverty, percent of children living in families in which no parent has full-time employment, percent of families with children

TABLE 2. Comparison of Composite Health Index Scores of Deep South to the Remaining States in the Census Bureau–Defined South

Region	No. of States	Health Score Mean	95% CI	*t* Score	*P*
Deep South	9	−1.4774	−1.9378, −1.0170	−3.991	.0001
Rest of South	7	−0.3089	−.5714, −.0464		

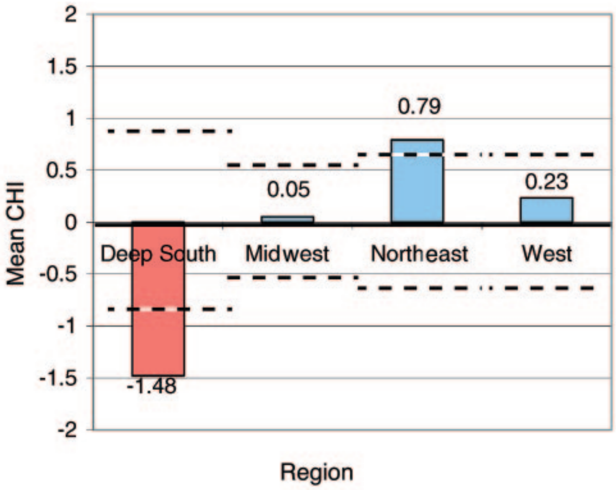

Fig 4. ANOM decision chart for deviation of regional means from overall the mean (0). Level of significance: .001. Adapted from SAS ANOM chart using SAS 9.1 (SAS Institute, Cary, NC). - - - indicates the decision limit (defines statistical significance, similar to the function of confidence interval; limits vary for each region because of the number of states in each region [minimum *n*: 9; maximum *n*: 16]).

headed by a single parent, percent of teens not attending school and not working, percent of those who are black in the population, and region of residence) were examined to assess their relationship to the composite index of physical health (Table 1). Multiple models that included different variables were tested to explain the statistical relationship among the variables using forward and stepwise selection and backward elimination regression methods. The model accounting for the greatest proportion of the variance ($r^2 = .785$; $P = .0001$) included 2 regions, the percent of teens not attending school and not working, the percent of children living with parents who do not have full-time, year-round employment, and percent of the population who are black. Table 4 illustrates the values for each of the variables in the final model for which 5 variables were associated with the composite health index (all variables $<.05$).

Bivariate analyses were then performed for each variable that was identified through the multiple-regression analysis to determine their associations with the computed health index. Bivariate regression analysis for percent of teen dropouts, percent of single parents, percent in poverty, living in the Northeast, and living in the West was not performed because they fell out of the previously described multiple-regression model because of a lack of statistical significance. Living in the South was the best predictor for poor health outcomes in children. Percent of black people in the population and the percent of teens not attending school or not working follow living in the Deep South as predictors of poor health outcomes (Table 5).

DISCUSSION

The findings in this study confirm the existence of a region in the United States of contiguous states in the Deep South that can be defined by its poor health outcomes for children, as compared with other states in the Census Bureau–defined South and other regions of the United States. Living in this region is a powerful predictor of poor child health outcomes.

These findings raise important research questions and have implications for public policy. Future research efforts related to the epidemiology of child health need to take into account the impact of region of residence of the children being studied. By defining and comparing the variables that are associated with the poor health status of children in specific regions of the country, more proximal ecological factors that contribute directly to child health outcomes and/or mediate the impact of poverty, race, gender, etc can perhaps be isolated. This would have an enormous impact on our ability to implement effective region-specific intervention strategies and develop public policies that consider the impact of region in the context of resource allocation and program strategies. Consideration should be given to focusing initial research endeavors in the Deep South, where poor health outcomes and disparities are the most pronounced. Consideration should also be given to configuring regions based on current social, cultural, and geopolitical factors rather than Census Bureau–defined regions, which may not have relevance to the type of analysis being conducted. This would facilitate the generation of more relevant region-specific health data.

Spatial Analysis

The methodologies used in this study to address the research questions include an adaptation of spatial analysis. Spatial analysis, the linking of diseases to geographic areas, is a fundamental epidemiologic tool dating back to the earliest days of epidemiology when John Snow linked a London cholera epidemic to a contaminated well.[21–23] It has continued to be used as an essential tool in defining the epidemiology of a wide range of infectious diseases[24–28] and is evolving as an important approach to environmental and other areas of epidemiology.[29–37] Its relevance to a broad range of health issues such as diabetes,[38] childhood lead poisoning,[39] pediatric burn injuries,[40] fertility,[41] cancer screening,[42] general chronic disease prevention,[43] and health services research[44] is also unfolding.

Spatial analysis is an important first step in developing a better understanding into variations in the health of children. Similar to Snow's early epidemiology work, discovering the mechanisms/pathways/causes by which region influences health outcomes is the next step in addressing disparities and inequities in child health and is one that is an important and fertile area for future research. Although much of the emphasis on spatial epidemiology has been recently related to the challenges faced in the study of rare diseases, such as specific forms of cancer,[45] the challenges posed by research questions concerning the impact of region on the health of children relate more to simpler forms of spatial analysis associated with large-scale mortality mapping than to those related to the study of rare diseases. Sophisticated approaches to spatial analyses that are

TABLE 3. Pairwise Comparison of the Deep South to Each of the Other Regions

	Control	Mean Difference	SE	Significance	Upper Bound
Northeast and Mid-Atlantic	Deep South	2.2669*	0.2988	2.1626×10^{-5}	2.8910
Midwest	Deep South	1.5267*	0.2824	2.4315×10^{-5}	2.1164
West	Deep South	1.7108*	0.2939	2.2233×10^{-5}	2.3245

Dunnett *t* tests treat 1 group as a control and compare all other groups against it.
* The mean difference is significant at the .05 level.

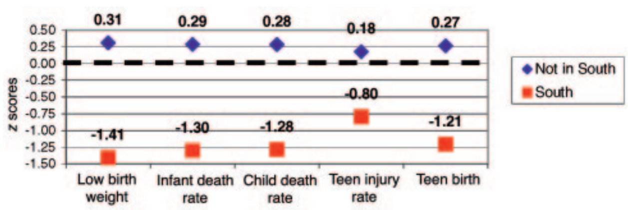

Fig 5. Standardized scores by health indicator. Source of data: 2002 Kids Count Report. Prepared by the Institute for Health, Policy and Evaluation Research, Duval County Health Department, January 2004.

necessary for the study of rare diseases (eg, Bayesian [maximum-likelihood] techniques, parametric bootstrapping, and penalized quasi-likelihood models) are not necessary for the relatively simple approaches to mapping and the analysis of data for comparisons and associations that are used in this study. These simpler forms of spatial analysis, designed to identify locations in which health policy changes are needed and explore patterns to "generate etiologic clues for further study"[22] will continue to have utility.

Public Policy

The public policy implications of the findings in this study are substantial. The identification of the Deep South as a clearly defined subregion of the Census Bureau's regional definition of the South suggests the need to use more culturally and socially relevant boundaries than the Census Bureau–defined regions when analyzing regional data for policy development. The historical basis for this grouping of states[46] has lost its relevance in the context of contemporary political, social, economic, demographic, etc factors that currently characterize this region. The links between Maryland and Mississippi and the links between Delaware and Alabama that may have had some foundations in pre–Civil War regional definitions do not seem to be sound foundations for categorizing regions today. Regional comparisons of health, social, economic, etc issues using the current Census Bureau–defined regions will greatly underestimate the important differences between the Deep South and other states included in this region. It will preclude the opportunity to identify differences among states and clarify causation of these differences.

Improved clarity of the variation among states and regions in the United States with respect to health outcomes and determinants could inform public policy decisions related to resource allocation and opportunities to prevent and/or mitigate the effects of region on child health. A better understanding of the depth and breadth of disparities in health, education and other social outcomes among and within regions of the United States is necessary for the generation of policy that ensures the equitable distribution of resources. Without an in-depth understanding of the etiology of these disparities, the ability to target resources and interventions will be limited. The identification of subregions as the unit of inquiry and the reorganization of Census Bureau regions into units that reflect both the uniqueness and commonality of member states are required to optimize the translation of research findings into evidence-based public policy.

The disparities in health outcomes between children in southern states in comparison to children in other regions of the country is, in part, a result of the lack of public policies directed at their unique needs. Few, if any, policies identify these children as a high-risk group on the basis of their region of residence. The nation's primary health planning document, *Healthy People 2010*,[19] makes no reference and establishes no special consideration for these children. Other national studies examining health disparities, such as the Institute of Medicine report[6] *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*, neglect these glaring regional disparities.

Limitations

This was a retrospective study based on existing data, with all of the limitations associated with such investigations. The selected variables were chosen on the basis of their national availability and comparability and their use by other recognized authorities for documenting the health of children. Data were obtained from multiple sources (ie, mortality data were from the National Center for Health Statistics, Division of Vital Statistics, whereas poverty data were from the Census Bureau, Current Population Survey). One state, Florida, was included among the states in the Deep South despite its higher ranking for overall child health (35th) compared with other Deep-South states. This was because northern Florida relates historically and demographically to the other contiguous Deep-South states, and its child health outcome statistics also are similar. Although not including Florida in the Deep South would have strengthened the statistical basis for defining the Deep South as a region linked to poor health outcomes for children, Florida was retained because of its contiguous relationship to the Deep South and because it could not logically be placed in another contiguous region.

Another limitation of note relates to multivariate analyses. Specifically related to the multivariate analysis, the final regression model was selected on the basis of main effect variables that were significant

TABLE 4. Variables With Statistical Association to CHI Through Multiple-Regression Analysis

Term	β Coefficient*	SE	P	95% CI of Coefficient
Intercept	0.4541	0.1005	<.0001	0.2515, 0.6566
Not attending school or working	−0.6053	0.0900	<.0001	−0.7865, −0.4240
No parent working full-time	0.2376	0.0822	.0059	0.0720, 0.4032
Deep South	−1.0299	0.2624	.0003	−1.5586, −0.5011
New Midwest	−0.7903	0.1538	<.0001	−1.1002, −0.4804
Percent black	−0.3358	0.0968	.0012	−0.5310, −0.1407

* Positive β scores equal relative good health, and negative β scores equal relative poor health.

TABLE 5. Variables With Statistical Associations Revealed Through Independent Bivariate Analysis

Variables	R	Adjusted R^2	Significance
Living in the South	0.6914	0.478	.0001
Percent of population who are black	0.6870	0.461	.0001
Percent of teens not attending school and not working	0.5771	0.333	.0001
Percent of children living with parents who do not have full-time, year-round employment	0.1414	0.020	.164
Living in the New Midwest	0.0316	−.020	.828

Sources of data: Annie E. Casey Foundation. *2002 Kids Count Data Book: State Profiles of Well-Being*. Baltimore, MD: Annie E. Casey Foundation; 2002; and US Census Data, 2000.

and the model that had the highest aggregated r^2 value (>0.750). Models that were considered were based on a logical fit, without attempting to exhaust all possible combinations of variables. Models that did not show strong associations were discarded. It is presumed that other variables, to be identified through future research, may be as or more directly linked to these poor health outcomes and have stronger predictive associations with poor child health status. This study only included those potential confounding variables that have been commonly used as indicators of the social or economic well-being of children.

The potential for inconsistency in data collection among states is also a limitation, because data are collected independently at the state or local level. Although these data typically have standard procedures for collection and recording, variations are possible. Concerning possible alternative measures, many other hypothetical measures could be more sensitive or more accurate reflections of child health and well-being, but these hypothetical measures are typically not collected and reported with any consistency across states. The measures used in this study were selected because of their widespread recognition, acceptance, and use as indicators of children's health and well-being. Using data consistently collected across the states is critical to be able to make comparisons reflected in this study and the annual reports on children's health.[1,17,18]

CONCLUSIONS

The findings of this study indicate that region of residence in the United States is statistically related to important measures of child health and may be among the most powerful predictors of child health outcomes and disparities. This clarification of the poorer health status of children living in the Deep South is an essential first step to addressing these disparities. The reasons for these disparities may be complex and synergistically related to various economic, political, social, cultural, and perhaps even environmental (physical) factors in the region. Future research related to the reasons that children in the South have such poor health outcomes in comparison to children in other US regions is likely to require interdisciplinary research methods drawn from the social and biomedical sciences. It will require the collaboration of interdisciplinary professionals from medicine, public health, economics, the social sciences, etc and new tools and hypothetical models of the ecology of disease and health causation. We cannot continue to ignore an obvious regional disparity in child health, because research and surveillance efforts focused on these regional differences have the potential to provide the insights that could improve outcomes and reduce disparities.

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The Health Status of Southern Children: A Neglected Regional Disparity

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Pediatrics 2005;116;e746; originally published online November 1, 2005;
DOI: 10.1542/peds.2005-0366