

INFANT MORTALITY RATES COMPARED TO RACE-ADJUSTED EXPECTED RATES

BY STATE FOR 2001

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Introduction

Infant mortality is an important issue in public health because statistics on infant mortality are used as indicators of the overall health of nations around the world. According to the National Center for Health Statistics, infant mortality is associated with a variety of factors such as maternal health, quality and access to medical care, socioeconomic conditions, and public health practices.¹ Racial disparity in infant mortality is also an issue of importance because large disparities continue to exist in many reproductive health outcomes.² For example, the infant mortality rate in the U.S. is two times higher for blacks than for whites. Though infant mortality rates are 40 percent lower than they were 60 years ago, racial and ethnic disparities in infant mortality rates persist.³

The purpose of this analysis is to identify states within the U.S. where infant deaths are statistically, significantly higher than would be expected considering the racial demographics of the state. This analysis should serve as a preliminary investigation of the effect of adjusting for racial demographics on the interpretation and comparability of nationwide infant mortality data. Further analysis of the specific factors influencing the differences in each state should be completed to address an individual state's infant mortality issues.

¹ MacDorman M.F., D.L. Rowley, Solomon I., J.L. Kiely, P.G. Gardner, M.S. Davis. Infant Mortality. From Data to Action. CDC's Public Health Surveillance for Women, Infants, and Children. CDC's Maternal & Child Health Monograph 1994.

² Ngozi F. Anachebe, Madeline Y. Sutton. Racial disparities in reproductive health outcomes. American Journal of Obstetrics and Gynecology. Vol 188, No 4:S37-S42.

³ Arias E., R.N. Anderson, H. Kung, S.L. Murphy, K.D. Kochanek. Deaths: Final data for 2001. National vital statistics reports; Vol 52, No 3. Hyattsville, MD: National Center for Health Statistics. 2002.

In 2001, the U.S. infant mortality rate was 6.8 per 1000 live births.⁴ This rate is calculated by dividing the total number of infant deaths by the total number of live births occurring in the same year. The infant mortality rate statistic is computed in this way for each state in the U.S.; however, because the racial demographics of each state are different, these rates do not allow for a comparable assessment of a state's infant mortality ranking. This rate does not take into account the differences in the risk of death for each subgroup represented in the U.S. population. For example, in Florida the overall infant mortality rate was 7.5 in 2002, but the rate for black infants was 13.6.⁵ A state with a large number of black births will have a higher infant mortality rate overall because the risk of death is greater for black infants.

This analysis takes the racial demographics of each state into account when comparing infant mortality rates by a process of indirect adjustment. Computing the statistic in this way allows for the comparison of rates independently of the influence of racial demographics. Crude infant mortality rates reflect random variation. This means that small variations in rates can occur due to chance alone. In this analysis, statistical methods are used to distinguish the random variation from the non-random variation, so rates that are significantly high are most likely a result of non-random influences. Likewise, actual rates that are higher than the expected rates after adjustment, but not statistically, significantly higher, are more likely to be the result of random variation, or chance, and are said to be within the range of normal variation.

Methods

The data used in this analysis were obtained from the National Vital Statistics Reports published by the National Center for Health Statistics.^{6,7} The data include total numbers of live births by race and state, and total numbers of infant deaths by race and state. Race is categorized as black, white, and other. Other includes American Indian and Asian populations.

The adjusted infant mortality rates were calculated for each race by dividing the U.S. infant deaths by live births in each race category. These rates were used to calculate the expected infant deaths for each race. In other words, the expected number of infant deaths for the race was calculated by multiplying the U.S. infant mortality rate by the total number of live births for the race in each state. For example, the U.S. black infant mortality rate was calculated as 14 per 1000 live births or .014. For Florida, this number was multiplied by 47,186, the number of live black births in 2001, to give the number of black infant deaths that would be expected if Florida had the same black infant mortality rate as the U.S. The expected deaths were calculated for each race (black, white, and other) and were summed to give the expected number of infant deaths for each state. This race-adjusted, expected number of deaths was

⁴ Hamilton B.E., J.A. Martin, and P.D. Sutton. Births: Preliminary data for 2002. National vital statistics reports; Vol 51, No 11. Hyattsville, Maryland: National Center for Health Statistics. 2002.

⁵ Florida Department of Health. Community Health Assessment Resource Tool Set. Accessed 17 March 04. <http://www.floridacharts.com/charts/chart.aspx>.

⁶ Martin J.A., B.E. Hamilton, S.J. Ventura, F. Menacker, M.M. Park, and P.D. Sutton, Ph.D. Births: Final data for 2001. National vital statistics reports; Vol 51, Nno 2. Hyattsville, MD: National Center for Health Statistics. 2002.

⁷ Arias E., R.N. Anderson, H. Kung, S.L. Murphy, K.D. Kochanek. Deaths: Final data for 2001. National vital statistics reports; Vol 52, No 3. Hyattsville, MD: National Center for Health Statistics. 2002.

compared to the actual number of infant deaths for all races in each state and tested for statistical significance.

Comparisons were also made between the actual number of infant deaths in each state and the expected number calculated using the overall U.S. infant mortality rate. The differences were tested for statistical significance.

Results

Three categories were used in the analysis of the adjusted rates after significance testing was completed. Each state had the possibility of their rates staying the same after adjustment, decreasing after adjustment, or increasing after adjustment. The results of this analysis are shown in Table 1, where actual statistics are compared to expected statistics. The expected statistics are adjusted for the racial demographics in each state, as described above. Florida's actual infant deaths are not statistically, significantly higher than the expected deaths after adjusting for race. This indicates that race is a significant factor in the infant mortality rate for Florida.

The actual rates for the U.S. are computed from the infant deaths and live births for the entire U.S. Therefore, each state's rate, when ranked, is relative to the U.S. infant mortality rate. The adjusted, expected rates are rates that would be expected when the state's racial demographics are taken into account. Each state's actual rates are compared to the adjusted, expected rate and to the U.S. rate to give rate ratios. The rate ratios are ranked from one to 51, with a state ranking of one denoting the lowest mortality rate and rank 51, the highest. In Table 2, each set of ranked, rate ratios is compared to determine how a state ranks before adjusting (actual vs. U.S. ratio), and after adjusting (actual vs. adjusted expected ratio).

Discussion

Before adjusting for race, Florida ranked 29th in the U.S. in infant mortality for 2001. After adjusting for race, Florida ranked 14th in infant mortality. This analysis should not be misinterpreted as an effort to justify Florida's infant mortality rate; however, the analysis provides a process to compare infant mortality rates between states that vary in regard to racial demographics. The rationale is that race is a significant factor in infant mortality, and that adjusting for race is a way to compare infant mortality rates across states independently of the influence of racial characteristics. This analysis should be considered a preliminary step in the continuing endeavor to reduce infant death in Florida. The results of this analysis should be used to focus further analysis and efforts to determining the factors contributing to such disparity in Florida and other states, and analysis of other factors such as access to care, quality of care, and pre-pregnancy health.

The tables on the following pages detail the actual and expected infant deaths for each state and whether the differences are statistically significant. The maps that follow highlight the states that were statistically, significantly high at any point in the analysis, and the changes that resulted after adjusting for racial demographics. An objective of this analysis was to identify states that had statistically, significant differences in their infant mortality rates before and after adjusting for racial demographics. For the states with rates that remained statistically,

significantly high after adjustment (H-H), issues other than racial demographics may be affecting their infant mortality rates. Of particular interest are states with rates that were statistically, significantly higher before adjustment, but were not statistically significant after adjustment (H-N). Adjustment for race demonstrated that racial demographics are negatively affecting their infant mortality rates. Also of interest are the states with infant mortality rates that were not statistically, significantly different from the U.S. rate before adjustment; however, after adjustment, their infant mortality rates were statistically, significantly higher than the expected rates (N-H). These states under regular, non-adjusted analysis would be considered to be doing well. In these cases, the racial make-up of the population is a protective factor. However, race-adjusted analysis demonstrates that their infant mortality rates are higher than expected, given the demographics of these states.

Future analyses should include a multivariate analysis of infant mortality. A multivariate analysis would take into account other variables that may be contributing to a higher than expected rate of infant mortality. Variables that may be considered include marital status, education, tobacco use, and adequacy of health care, in addition to race.

Table 1. Actual and race-adjusted infant mortality rates.

State	Births	Infant Deaths	Infant Mortality Rate¹⁰	Expected Infant Deaths⁸	Race-Adjusted Expected Infant Deaths⁹	Race-Adjusted Expected Infant Death Rate¹⁰	Actual vs. Expected⁸	Actual vs. Race-Adjusted Expected⁹
United States	4025933	27568	6.8	27568	27568	6.8	N ¹¹	N
Alabama	60454	567	9.4	414	502	8.3	H ¹²	H
Alaska	10003	81	8.1	68	57	5.7	N	H
Arizona	85597	592	6.9	586	499	5.8	N	H
Arkansas	37010	309	8.3	253	271	7.3	H	H
California	527759	2830	5.4	3614	3196	6.1	L ¹³	L
Colorado	67007	388	5.8	459	400	6.0	L	N
Connecticut	42648	260	6.1	292	282	6.6	L	N
Delaware	10749	115	10.7	74	83	7.7	H	H
District of Columbia	7625	81	10.6	52	84	11.0	H	N
Florida	205793	1495	7.3	1409	1551	7.5	H	N
Georgia	133526	1146	8.6	914	1116	8.4	H	N
Hawaii	17072	106	6.2	117	88	5.1	N	H
Idaho	20688	129	6.2	142	117	5.7	N	N
Illinois	184064	1413	7.7	1260	1309	7.1	H	H
Indiana	86459	650	7.5	592	568	6.6	H	H
Iowa	37619	212	5.6	258	222	5.9	L	N
Kansas	38869	287	7.4	266	241	6.2	N	H
Kentucky	54658	325	5.9	374	349	6.4	L	N
Louisiana	65352	643	9.8	448	594	9.1	H	H
Maine	13759	84	6.1	94	79	5.7	N	N
Maryland	73218	594	8.1	501	613	8.4	H	N
Massachusetts	81077	405	5.0	555	521	6.4	L	L
Michigan	133427	1069	8.0	914	947	7.1	H	H
Minnesota	67562	361	5.3	463	417	6.2	L	L
Mississippi	42282	445	10.5	290	396	9.4	H	H
Missouri	75464	558	7.4	517	518	6.9	H	H
Montana	10970	74	6.7	75	61	5.5	N	N
Nebraska	24820	168	6.8	170	151	6.1	N	N
Nevada	31382	180	5.7	215	196	6.2	L	N
New Hampshire	14656	56	3.8	100	84	5.7	L	L
New Jersey	115795	747	6.5	793	816	7.0	N	L
New Mexico	27128	174	6.4	186	154	5.7	N	N
New York	254026	1482	5.8	1739	1852	7.3	L	L

⁸ Calculated using U.S. infant mortality rate.

⁹ Calculated using race-adjusted infant mortality rates.

¹⁰ Rates are deaths per 1,000 live births

¹¹ N = Actual number of infant deaths is not significantly different than expected ($\alpha=.05$).

¹² H = Actual number of infant deaths is significantly higher than expected ($\alpha=.05$).

¹³ L = Actual number of infant deaths is significantly lower than expected ($\alpha=.05$).

State	Births	Infant Deaths	Infant Death Rate	Expected Infant Deaths⁸	Race-Adjusted Expected Infant Deaths⁹	Race-Adjusted Expected Infant Death Rate	Actual vs. Expected⁸	Actual vs. Race-Adjusted Expected⁹
North Carolina	118185	1009	8.5	809	901	7.6	H	H
North Dakota	7629	67	8.8	52	43	5.6	H	H
Ohio	151570	1161	7.7	1038	1046	6.9	H	H
Oklahoma	50118	366	7.3	343	315	6.3	N	H
Oregon	45322	246	5.4	310	261	5.8	L	N
Pennsylvania	143495	1033	7.2	983	976	6.8	N	H
Rhode Island	12713	86	6.8	87	80	6.3	N	N
South Carolina	55756	496	8.9	382	472	8.5	H	N
South Dakota	10483	78	7.4	72	58	5.5	N	H
Tennessee	78340	681	8.7	536	580	7.4	H	H
Texas	365410	2171	5.9	2502	2393	6.5	L	L
Utah	47959	232	4.8	328	272	5.7	L	L
Vermont	6366	35	5.5	44	36	5.7	N	N
Virginia	98884	747	7.6	677	739	7.5	H	N
Washington	79570	459	5.8	545	468	5.9	L	N
West Virginia	20428	148	7.2	140	121	5.9	N	H
Wisconsin	69072	491	7.1	473	442	6.4	N	H
Wyoming	6115	36	5.9	42	35	5.7	N	N
Total	4025933	27568	6.8	27568	27568	6.8		

Table 2. Actual versus adjusted, expected state ranks for infant mortality. ('1' represents the lowest rate and '51' the highest rate)

State <i>(alphabetical)</i>	Actual to US Rate Ratio Rank	Actual to Expected Rate Ratio Rank	State <i>(by rank)</i>	Actual to US Rate Ratio Rank	Actual to Expected Rate Ratio Rank
Alabama	47	37	New Hampshire	1	1
Alaska	39	50	Utah	2	4
Arizona	25	43	Massachusetts	3	2
Arkansas	41	39	Minnesota	4	5
California	5	6	California	5	6
Colorado	11	16	Oregon	6	12
Connecticut	16	10	Vermont	7	15
Delaware	51	49	Iowa	8	13
District of Columbia	50	17	Nevada	9	9
Florida	29	14	Washington	10	19
Georgia	43	21	Colorado	11	16
Hawaii	18	45	New York	12	3
Idaho	19	30	Wyoming	13	22
Illinois	37	28	Texas	14	7
Indiana	34	40	Kentucky	15	11
Iowa	8	13	Connecticut	16	10
Kansas	31	44	Maine	17	25
Kentucky	15	11	Hawaii	18	45
Louisiana	48	29	Idaho	19	30
Maine	17	25	New Mexico	20	38
Maryland	40	18	New Jersey	21	8
Massachusetts	3	2	Montana	22	46
Michigan	38	36	Rhode Island	23	26
Minnesota	4	5	Nebraska	24	33
Mississippi	49	35	Arizona	25	43
Missouri	32	27	Wisconsin	26	32
Montana	22	46	Pennsylvania	27	24
Nebraska	24	33	West Virginia	28	47
Nevada	9	9	Florida	29	14
New Hampshire	1	1	Oklahoma	30	41
New Jersey	21	8	Kansas	31	44
New Mexico	20	38	Missouri	32	27
New York	12	3	South Dakota	33	48
North Carolina	42	34	Indiana	34	40
North Dakota	45	51	Virginia	35	20
Ohio	36	31	Ohio	36	31
Oklahoma	30	41	Illinois	37	28
Oregon	6	12	Michigan	38	36
Pennsylvania	27	24	Alaska	39	50
Rhode Island	23	26	Maryland	40	18
South Carolina	46	23	Arkansas	41	39
South Dakota	33	48	North Carolina	42	34
Tennessee	44	42	Georgia	43	21
Texas	14	7	Tennessee	44	42

State <i>(alphabetical)</i>	Actual to US Rate Ratio Rank	Actual to Expected Rate Ratio Rank	State <i>(by rank)</i>	Actual to US Rate Ratio Rank	Actual to Expected Rate Ratio Rank
Utah	2	4	North Dakota	45	51
Vermont	7	15	South Carolina	46	23
Virginia	35	20	Alabama	47	37
Washington	10	19	Louisiana	48	29
West Virginia	28	47	Mississippi	49	35
Wisconsin	26	32	District of Columbia	50	17
Wyoming	13	22	Delaware	51	49

Table 2. Key for changes in statistical significance.

Actual vs U.S.	Actual vs expected	Result
H	N	Rates were better after adjustment.
N	L	
H	L	
N	H	Rates were worse after adjustment.
L	N	
L	H	
H	H	Rates stayed the same after adjustment.
L	L	
N	N	

N=Not statistically significant.

H=Actual rate significantly higher than expected rate.

L=Actual rate significantly lower than expected rate.

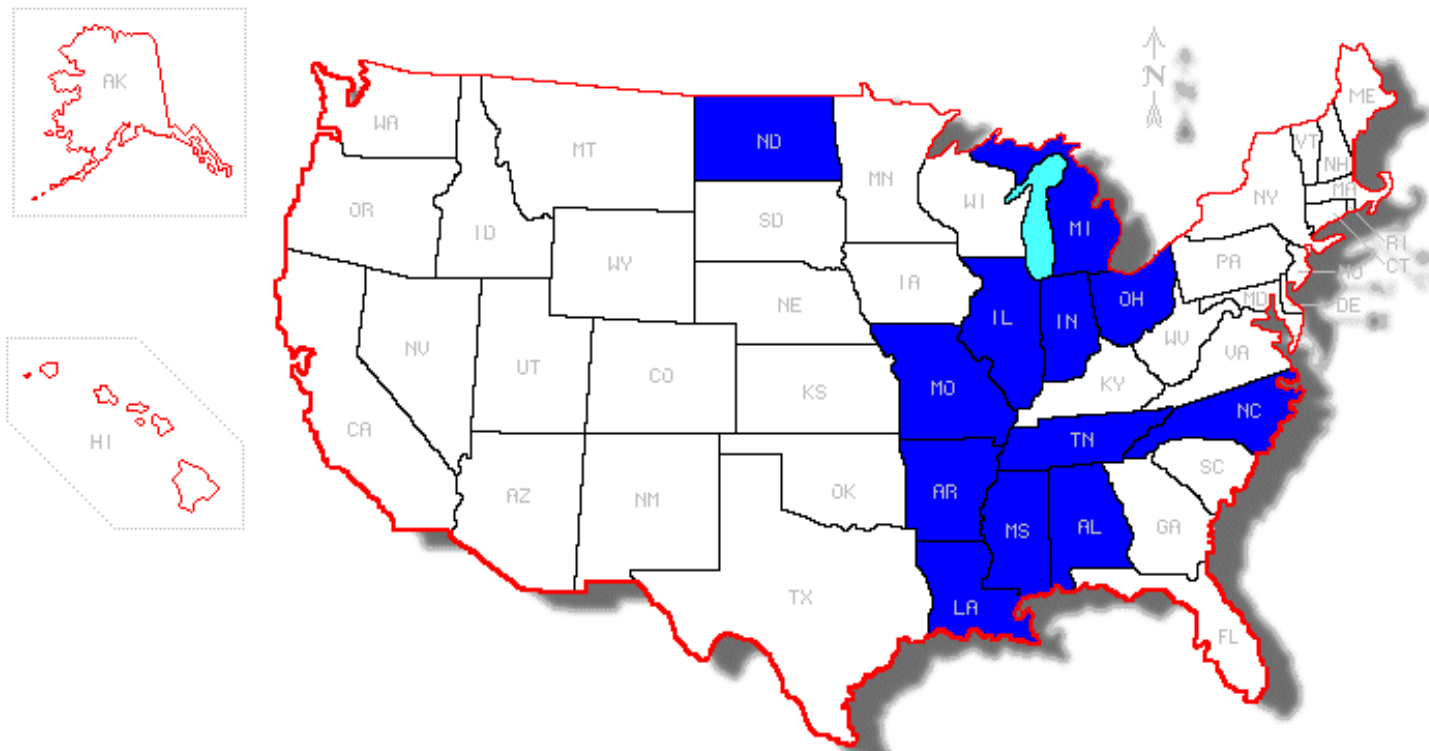
Table 3. Classification of states. Comparison of infant deaths before and after adjusting for race.

Remained high despite adjustment	Became high after adjustment	Became low after adjustment	Not statistically significant from low after adjustment	Remained low after adjustment	Not statistically significant from high after adjustment	Not statistically significant before and after adjustment
(H-H)	(N-H)	(N-L)	(L-N)	(L-L)	(H-N)	(N-N)
Alabama* Arkansas* Delaware* Illinois Indiana Louisiana* Michigan Mississippi* Missouri North Carolina* North Dakota^ Ohio Tennessee*	Alaska^ Arizona^ Hawaii^ Kansas^ Oklahoma^ Pennsylvania South Dakota^ West Virginia^ Wisconsin^	New Jersey	Colorado^ Connecticut Iowa^ Kentucky^ Nevada^ Oregon^ Washington^	California^ Massachusetts^ Minnesota^ New Hampshire^ New York* Texas Utah^	D.C.* Florida* Georgia* Maryland* South Carolina* Virginia*	Idaho^ Maine^ Montana^ Nebraska^ New Mexico^ Rhode Island^ Vermont^ Wyoming^
What does it mean?						
Adjusting for racial demographics does not explain the high infant mortality rates in these states. These states may have other issues which affect their infant mortality rates.	The racial demographic composition in these states may be a protective factor.	Race is a statistically significant factor in infant mortality rates.	The racial demographic composition in these states may be a protective factor.	Adjusting for racial demographics does not explain the infant mortality rates in these states. These states are faring well in their efforts against infant mortality.	Race is a statistically significant factor in infant mortality rates.	Adjusting for racial demographics does not explain the infant mortality rates in these states.

*These states have at least 20% of births from black women.

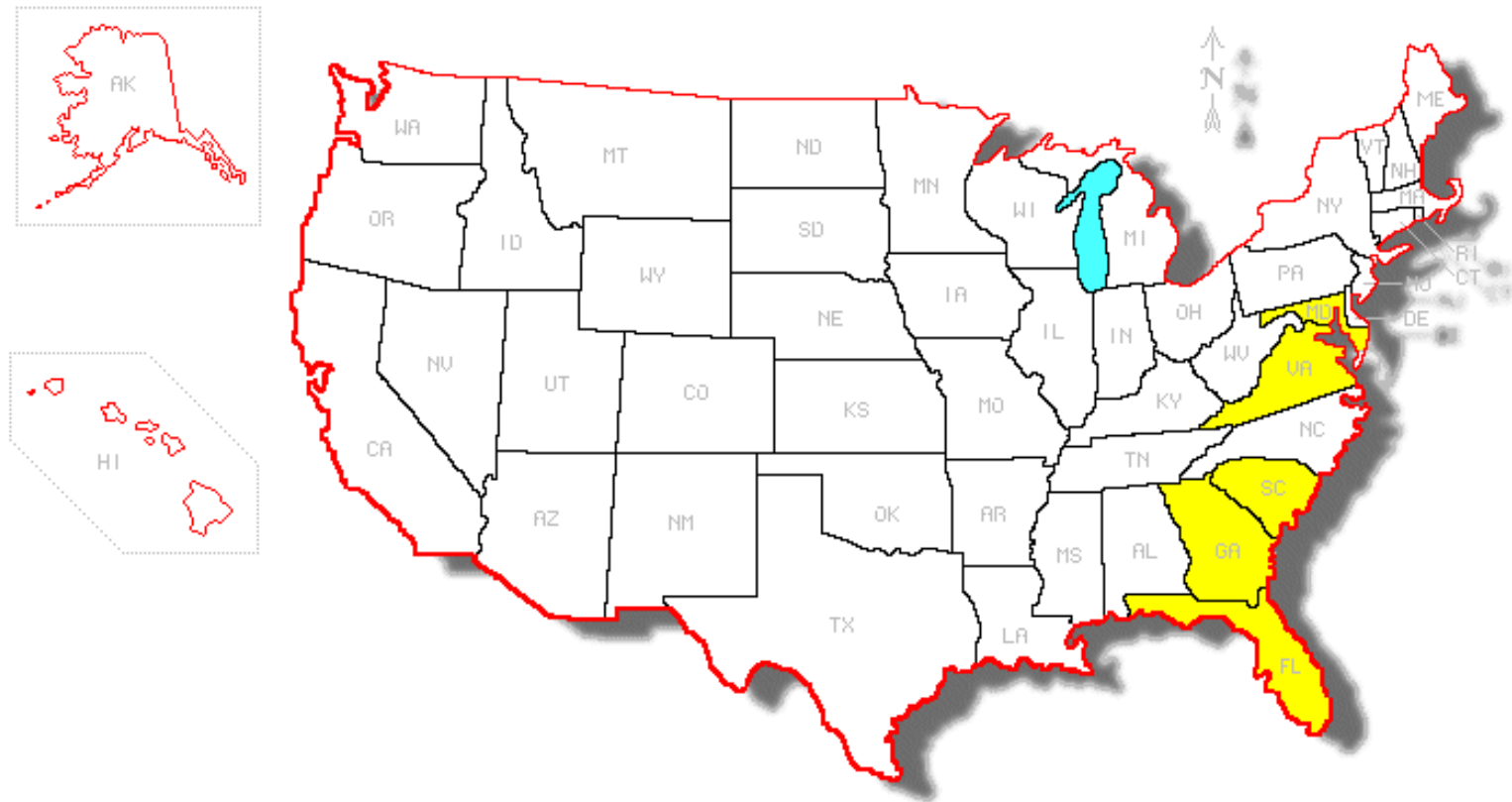
^These states have ≤ 10% of births from black women.

2001 – States with higher than expected infant mortality rates before & after adjustment for race.



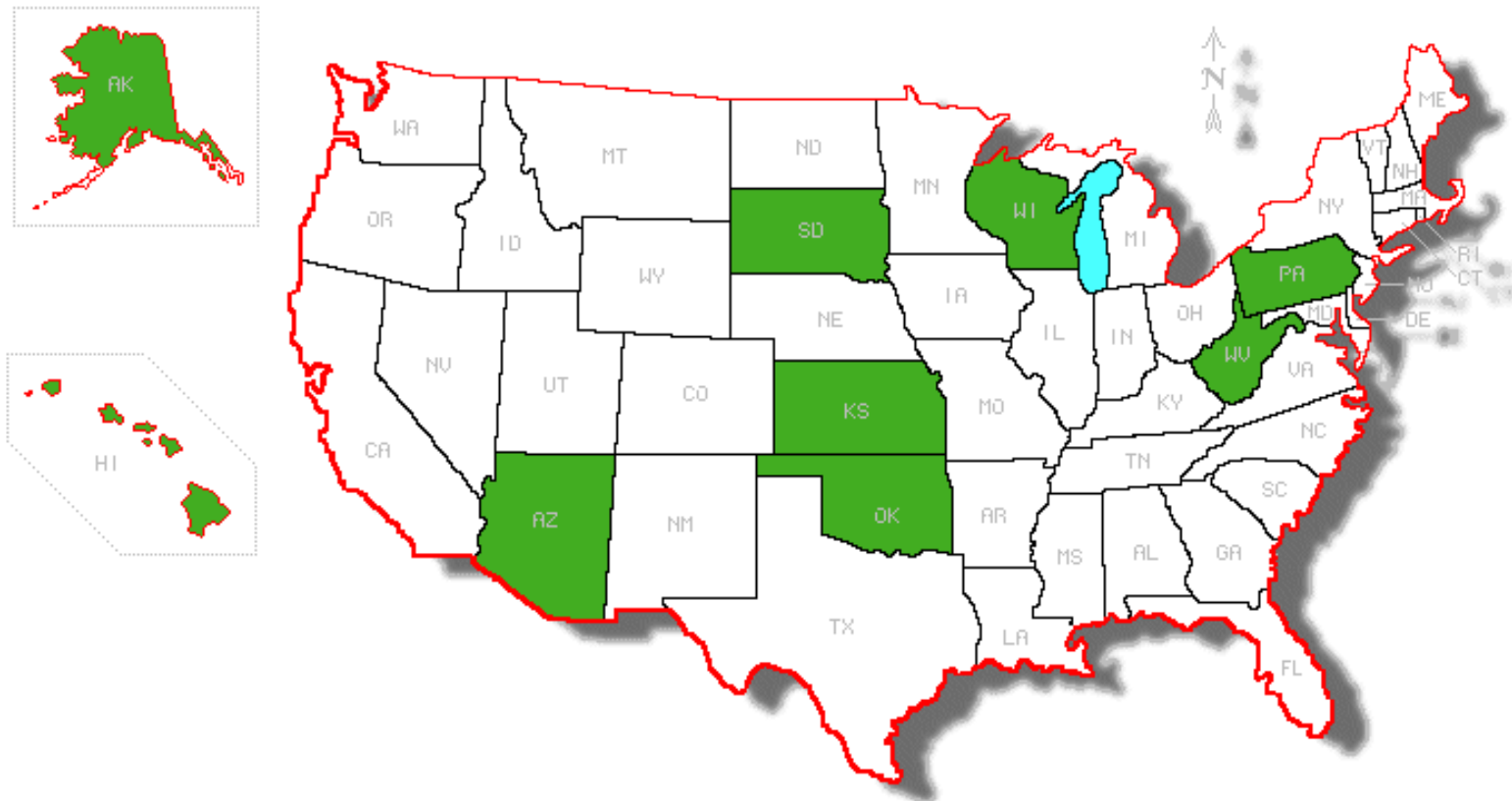
NOTES:
Expected rates are calculated using the race specific U.S. infant mortality rates.

2001 – States with infant mortality rates higher than expected before adjusting for race, but not statistically different after adjusting for race.



NOTES:
Expected rates are calculated using the race specific U.S. infant mortality rates. The statistics used are for the 2001 birth cohort.

2001 – States with infant mortality rates not statistically different before adjusting for race, but higher than expected after adjusting for race.



NOTES:
Expected rates are calculated using the race specific U.S. infant mortality rates. The statistics used are for the 2001 birth cohort.