Florida's Infant Mortality and Low Birth Weight Actual Rate Compared to Expected Rate by County 2016 Update

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Introduction

The public health community uses infant mortality and birth weight statistics extensively as maternal and child health indicators because they are relevant, readily available, and reliable due to a relatively high level of completeness.

The purpose of this analysis is to identify counties in the state that exhibit statistically significant differences in low birth weight (LBW) and infant mortality (IM) rates than would be expected considering the unique demographics of each county.

IM and LBW rates in Florida vary across counties. This variation is due, in part, to the unique demographic characteristics of the county populations. In this analysis, adjustments are made to account for the differences in demographic characteristics. Three demographic characteristics are accounted to calculate the expected IM and LBW: maternal race, marital status, and educational attainment. These variables are used because of their known associations with risk of LBW and IM, and because adjusting provides a way to make valid comparisons among counties with different population sizes based on these characteristics.

Some demographic characteristics associated with IM and LBW, such as young maternal age and smoking status, were not used to adjust IM and LBW estimates, to avoid eliminating differences that could possibly be attributed to public health interventions. For example, counties with lower than expected LBW percentages may have implemented successful smoking cessation programs. If adjustments had been made for smoking status, differences between actual and expected statistics would not be apparent. In another example, births to women under the age of 20 can be influenced by teen pregnancy prevention interventions, and by the same logic, adjustments are not made for maternal age.

IM and LBW rates can also vary randomly, or due to chance. In this analysis, statistical methods are used to distinguish random from non-random variation. Therefore, rates reported as significantly higher or lower than expected are most likely a result of non-random influences. Likewise, rates that are higher or lower than expected, but not statistically significant, are most likely due to random variation.

Methods

The data used in this analysis were extracted from the birth records for Florida residents who were born in calendar years 2015 and 2016. Infant mortality is defined as the death of a child less than one year of age. Infants born weighing less than 2,500 grams at delivery are considered LBW. This analysis uses three demographic variables to perform statistical adjustment on expected IM and LBW estimates: maternal race, marital status, and educational attainment. Each demographic variable has two defined values: maternal race as non-black or black, marital status as married or not married, and educational attainment as high school or above, or less than high school graduation. All possible combinations of the three demographic variables form nine mutually exclusive categories. The ninth category includes birth records for which any of the three demographic variables had a missing value. The nine categories are as follows:

Category	Maternal Race	Marital Status	Educational Attainment
1	Non-Black	Married	High School or More
2	Non-Black	Married	Less than High School
3	Non-Black	Not Married	High School or More
4	Non-Black	Not Married	Less than High School
5	Black	Married	High School or More
6	Black	Married	Less than High School
7	Black	Not Married	High School or More
8	Black	Not Married	Less than High School
9	Unknown	Unknown	Unknown

Calculating IM and LBW Expected Rates:
Using the classification scheme shown above, nine state-level category-specific IM expected rates were calculated from the 2015 vital records (the latest year available at the time of this analysis for complete linked birth and infant death data). The infant death linkage indicator is not recorded on the birth record until up to one year after a birth. Therefore, 2016 linked infant birth-death records were not complete at the time of this analysis and 2015 data were instead used to calculate expected IM estimates. This adjustment technique is referred to as "indirect adjustment." To obtain the 2016 expected number of infant deaths by county, each of the nine state-level category-specific IM rates for 2015 were multiplied by the total number of county-level births in 2016 and then summed. To compute the 2016 expected infant mortality rates for each county, the 2016 expected number of infant deaths was used as the numerator and the total number of births in 2016 was used as the denominator. County-level expected IM counts and rates were estimated using the nine state-level category-specific rates, thereby accounting for the unique distribution of demographic factors in each county.

These methods were applied in the same way to calculate expected LBW counts. However, 2016 state-level birth counts for each category were used to calculate expected county-level LBW percentages because birth weight is recorded at the time of delivery.

The Normal Approximation to the Binomial Distribution was used to test for statistically significant differences between actual and expected rates in most of the counties. In instances where the number of infant deaths or number of low birth weight infants was less than 30, the Poisson formula was used. A correlation analysis was performed to determine the association between LBW and IM actual to expected ratios.

In March 2004, the recording of maternal race on the birth record was changed to allow the selection of more than one race. For the purpose of this analysis, births where the only maternal race recorded was black were classified as black and all others were classified as non-black.

Results
The results of this analysis are shown in the following tables and maps for IM and LBW. Tables 1 and 2 show actual statistics are compared to expected statistics. The expected statistics are adjusted for the demographic characteristics in each county, as described above. Counties with actual rates that are statistically significantly higher than expected are indicated with an "H" and those with an "L" indicate statistically significant lower than expected rates. The maps provide a visual display of these results. Counties where actual rates are significantly higher or lower than expected are shaded, as indicated by the legend on the maps.

There is a statistically significant correlation between the actual to expected LBW ratios and the actual to expected IM ratios (Kendall's rank correlation coefficient = 0.21; p value of 0.01).

Also included in this report are summary tables for the years 2012 through 2016 that show the Hs and Ls by county for each of the past five years.

Summary
For 2016 IM rates: Actual vs. Expected

- Broward (5.19 vs. 6.89), Dade (5.20 vs. 6.10), and Palm Beach (4.28 vs. 6.26) counties had statistically significant lower than expected IM rates (Table 1). The counties with lower IM rates than expected are located in the southern region of the state (Map, page 10). Broward, Dade, and Palm Beach presented lower IM rates than expected for all five years studied (Table 3).

- Duval (8.35 vs. 6.85), Hillsborough (7.45 vs. 6.03), Lafayette (29.41 vs 4.89), and Marion (10.94 vs. 6.10) counties had statistically significant higher than expected IM rates (Table 1). As can be observed on the map, all counties except Bradford are located in the center of the state. Hillsborough County presented higher IM rates than expected in each of the last five years and Duval presented higher IM in four years, albeit not consecutively (Table 3).

For 2016 LBW percentages: Actual vs. Expected

- Collier (6.74% vs. 8.11%), Manatee (7.61% vs. 8.37%), Monroe (6.55% vs. 8.05%), Palm Beach (8.26% vs. 9.09%), Polk (8.20% vs. 8.74%), and Wakulla (4.82% vs. 8.06%) counties had significantly lower percentages of LBW infants than expected (Table 2). These counties are located in the north, center, and south regions of the state (Map, page 10). Manatee and Palm Beach counties presented lower than expected percentages of low birth weight for four consecutive years. Collier and Monroe also presented lower than expected percentages of low birth weight for four years, albeit not consecutively (Table 4).

- Alachua (10.13% vs. 9.12%), Columbia (12.53 vs. 8.96%), Dixie (13.50% vs. 8.32%), Duval (10.01% vs. 9.56%), Escambia (10.23% vs. 9.29%), and Hernando (9.84% vs. 8.03%) counties had significantly higher percentages of low birth weight infants than expected (Table 2). These counties are located in the north and center regions of the state. Escambia is the only county with four years of higher percentages of LBW infants than expected, albeit not consecutively (Table 4).

Discussion
This analysis should be considered a preliminary step in the continuing endeavor to reduce IM and low birth weight in Florida. The results of this analysis can be used to focus further studies and public health efforts on areas of the state where the risks of poor infant health outcomes are significantly higher and analyze factors that contribute to the lower risks seen in some counties.

One limitation of this analysis is the high variability of rates in smaller counties compared to those in larger counties. Consequently, larger differences in rates for small counties may not be statistically significant while the same or smaller differences may be statistically significant in larger counties. Actual rates that are statistically significantly higher than the expected rates are

most likely not a result of random fluctuations and may indicate a public health problem requiring further investigation and intervention; however, higher rates that are not statistically significant may warrant further investigation as well. Smaller counties with higher than expected rates for a period of several years may also be cause for concern.

Since adjustments were used to account for the differing demographic composition of the study population in each county, further analysis could focus on other factors not included in this report, such as smoking rates and maternal age. Unique factors in each county contribute to IM and LBW. Local area analysis of factors associated with these outcomes should be undertaken to better understand the reasons for statistically significant lower or higher than expected rates with separate analyses performed for each area of concern. Finally, it should be noted that in this analysis, rates for each county are compared to the statewide rates, after adjustment for maternal race, marital status, and education attainment. The issue of whether or not the statewide rates should be used as a baseline in these comparisons is not addressed in this analysis.

TABLE 1. ACTUAL INFANT MORTALITY RATES PER 1000 BIRTHS COMPARED TO EXPECTED[1] RATES PER 1,000 LIVE BIRTHS, FLORIDA 2016

Mother's Resident County	*2016 Births[3]*	*2016 Expected[1] Infant Deaths*	*2016 Actual Infant Deaths*	*2016 Expected Infant Mortality Rate Per 1000 Births*	*2016 Actual Infant Mortality Rate Per 1000 Births*	*H=Actual Rate Signif.Higher [2] L=Actual Rate Signif.Lower [2] Than Expected*
ALACHUA	2,862	18	24	6.26	8.39	
BAKER	343	2	1	5.69	2.92	
BAY	2,341	16	15	6.65	6.41	
BRADFORD	301	2	2	6.05	6.64	
BREVARD	5,273	29	29	5.57	5.50	
BROWARD	22,563	155	117	6.89	5.19	L
CALHOUN	142	1	1	6.26	7.04	
CHARLOTTE	1,037	6	8	5.43	7.71	
CITRUS	1,064	6	9	5.31	8.46	
CLAY	2,207	12	12	5.57	5.44	
COLLIER	3,323	18	16	5.42	4.81	
COLUMBIA	806	5	8	6.31	9.93	
DADE	32,679	199	170	6.10	5.20	L
DESOTO	368	2	1	5.94	2.72	
DIXIE	163	1	1	5.67	6.13	
DUVAL	13,293	91	111	6.85	8.35	H
ESCAMBIA	3,967	26	33	6.58	8.32	
FLAGLER	798	4	2	5.46	2.51	
FRANKLIN	88	1	1	5.93	11.36	
GADSDEN	568	5	7	8.99	12.32	
GILCHRIST	200	1	2	5.42	10.00	
GLADES	66	0	2	5.78	30.30	
GULF	121	1	2	6.37	16.53	
HAMILTON	157	1	2	6.72	12.74	
HARDEE	386	2	0	5.58	0.00	
HENDRY	570	3	2	6.06	3.51	
HERNANDO	1,586	8	6	5.35	3.78	
HIGHLANDS	938	6	3	6.02	3.20	
HILLSBOROUGH	17,327	105	129	6.03	7.45	H
HOLMES	186	1	1	5.10	5.38	
INDIAN RIVER	1,245	11	10	8.81	8.03	
JACKSON	529	3	2	6.43	3.78	
JEFFERSON	121	1	0	7.51	0.00	
LAFAYETTE	68	0	2	4.89	29.41	H
LAKE	3,268	19	16	5.72	4.90	
LEE	6,751	39	43	5.72	6.37	
LEON	2,989	22	16	7.31	5.35	
LEVY	396	2	5	5.95	12.63	
LIBERTY	77	0	0	6.31	0.00	
MADISON	197	2	3	8.00	15.23	
MANATEE	3,445	20	24	5.85	6.97	
MARION	3,472	21	38	6.10	10.94	H
MARTIN	1,273	7	9	5.77	7.07	
MONROE	733	4	5	5.25	6.82	
NASSAU	817	4	4	5.03	4.90	
OKALOOSA	2,784	14	14	5.05	5.03	
OKEECHOBEE	485	3	3	5.76	6.19	
ORANGE	16,649	103	118	6.20	7.09	
OSCEOLA	4,329	23	26	5.35	6.01	
PALM BEACH	14,963	94	64	6.26	4.28	L
PASCO	5,108	27	31	5.25	6.07	
PINELLAS	8,479	53	58	6.20	6.84	
POLK	7,805	48	55	6.10	7.05	
PUTNAM	852	6	5	6.77	5.87	
SAINT JOHNS	2,120	10	11	4.80	5.19	
SAINT LUCIE	2,998	20	16	6.64	5.34	
SANTA ROSA	1,906	9	11	4.58	5.77	
SARASOTA	2,927	17	12	5.73	4.10	
SEMINOLE	4,753	26	19	5.37	4.00	
SUMTER	460	3	3	6.20	6.52	
SUWANNEE	489	3	2	5.88	4.09	
TAYLOR	248	2	0	6.49	0.00	
UNION	152	1	0	5.48	0.00	
VOLUSIA	5,033	30	33	6.05	6.56	
WAKULLA	353	2	0	5.54	0.00	
WALTON	758	4	2	4.86	2.64	
WASHINGTON	246	2	3	6.17	12.20	
TOTAL[4]	225,001	1,380	1,380	6.13	6.13	

[1] The expected number of infant deaths is calculated with adjusting for the maternal race, marital status and education characteristics of the births in each county

[2] The significance level used is .05

TABLE 2. ACTUAL LOW BIRTH WEIGHT (<2,500 GRAMS) PERCENTAGES COMPARED TO EXPECTED[2] PERCENTAGES FLORIDA 2016

Mother's Resident County	2016 Births[4]	2016 Expected[2] LBW Births	2016 Actual LBW Births	2016 Expected LBW Percent	2016 Actual LBW Percent	H=Actual Rate Signif.Higher [3] L=Actual Rate Signif.Lower [3] Than Expected
ALACHUA	2,862	261	290	9.12%	10.13%	H
BAKER	343	28	34	8.15%	9.91%	
BAY	2,341	202	208	8.63%	8.89%	
BRADFORD	301	25	29	8.41%	9.63%	
BREVARD	5,273	432	412	8.20%	7.81%	
BROWARD	22,563	2,151	2,194	9.53%	9.72%	
CALHOUN	142	11	9	7.96%	6.34%	
CHARLOTTE	1,037	84	95	8.12%	9.16%	
CITRUS	1,064	83	79	7.83%	7.42%	
CLAY	2,207	178	172	8.05%	7.79%	
COLLIER	3,323	269	224	8.11%	6.74%	L
COLUMBIA	806	72	101	8.96%	12.53%	H
DADE	32,679	2,817	2,809	8.62%	8.60%	
DESOTO	368	32	41	8.81%	11.14%	
DIXIE	163	14	22	8.32%	13.50%	H
DUVAL	13,293	1,271	1,330	9.56%	10.01%	H
ESCAMBIA	3,967	368	406	9.29%	10.23%	H
FLAGLER	798	67	71	8.34%	8.90%	
FRANKLIN	88	7	10	8.25%	11.36%	
GADSDEN	568	66	65	11.69%	11.44%	
GILCHRIST	200	16	16	7.77%	8.00%	
GLADES	66	6	8	8.58%	12.12%	
GULF	121	10	8	8.66%	6.61%	
HAMILTON	157	16	17	10.03%	10.83%	
HARDEE	386	31	27	8.10%	6.99%	
HENDRY	570	49	52	8.60%	9.12%	
HERNANDO	1,586	127	156	8.03%	9.84%	H
HIGHLANDS	938	83	76	8.86%	8.10%	
HILLSBOROUGH	17,327	1,498	1,541	8.65%	8.89%	
HOLMES	186	15	14	7.89%	7.53%	
INDIAN RIVER	1,245	115	109	9.26%	8.76%	
JACKSON	529	49	43	9.20%	8.13%	
JEFFERSON	121	12	12	10.26%	9.92%	
LAFAYETTE	68	5	8	7.98%	11.76%	
LAKE	3,268	269	291	8.22%	8.90%	
LEE	6,751	565	581	8.36%	8.61%	
LEON	2,989	299	278	10.01%	9.30%	
LEVY	396	35	38	8.91%	9.60%	
LIBERTY	77	6	3	7.95%	3.90%	
MADISON	197	20	18	10.21%	9.14%	
MANATEE	3,445	288	262	8.37%	7.61%	L
MARION	3,472	302	327	8.70%	9.42%	
MARTIN	1,273	108	96	8.45%	7.54%	
MONROE	733	59	48	8.05%	6.55%	L
NASSAU	817	62	65	7.58%	7.96%	
OKALOOSA	2,784	218	215	7.84%	7.72%	
OKEECHOBEE	485	40	35	8.22%	7.22%	
ORANGE	16,649	1,483	1,465	8.91%	8.80%	
OSCEOLA	4,329	344	343	7.94%	7.92%	
PALM BEACH	14,963	1,360	1,236	9.09%	8.26%	L
PASCO	5,108	396	411	7.75%	8.05%	
PINELLAS	8,479	727	719	8.57%	8.48%	
POLK	7,805	682	640	8.74%	8.20%	L
PUTNAM	852	79	91	9.24%	10.68%	
SAINT JOHNS	2,120	158	151	7.44%	7.12%	
SAINT LUCIE	2,998	275	262	9.16%	8.74%	
SANTA ROSA	1,906	141	150	7.40%	7.87%	
SARASOTA	2,927	234	223	8.01%	7.62%	
SEMINOLE	4,753	387	378	8.13%	7.95%	
SUMTER	460	40	34	8.60%	7.39%	
SUWANNEE	489	42	51	8.51%	10.43%	
TAYLOR	248	22	23	9.05%	9.27%	
UNION	152	13	10	8.62%	6.58%	
VOLUSIA	5,033	427	436	8.49%	8.66%	
WAKULLA	353	28	17	8.06%	4.82%	L
WALTON	758	57	52	7.55%	6.86%	
WASHINGTON	246	21	23	8.48%	9.35%	
TOTAL[4]	225,001	19,659	19,660	8.74%	8.74%	

[1] LBW = Low Birth Weight, defined as birth weight below 2500 grams. [2] The expected number of low birth weigth births is calculated with adjusting for the maternal race, marital status and education characteristics of the births in each county. [3] The significant level is .05

[4] Total excludes 17 births with county unknown

TABLE 3. INFANT MORTALITY RATES ACTUAL VERSUS EXPECTED STATISTICAL SIGNIFICANCE[1] SUMMARY BY COUNTY, FLORIDA 2016-2016

Mother's Resident County	*2012*	*2013*	*2014*	*2015*	*2016*	*Total L*	*Total H*
ALACHUA		H	H				2
BAKER		H					1
BAY			H				1
BRADFORD		H		H			2
BREVARD							
BROWARD	L	L	L	L	L	5	
CALHOUN							
CHARLOTTE		L				1	
CITRUS							
CLAY							
COLLIER							
COLUMBIA	H						1
DADE	L	L	L	L	L	5	
DESOTO							
DIXIE							
DUVAL	H	H	H		H		4
ESCAMBIA							
FLAGLER							
FRANKLIN							
GADSDEN							
GILCHRIST							
GLADES							
GULF							
HAMILTON							
HARDEE							
HENDRY							
HERNANDO							
HIGHLANDS	H						1
HILLSBOROUGH	H	H	H	H	H		5
HOLMES	H						1
INDIAN RIVER							
JACKSON							
JEFFERSON		H					1
LAFAYETTE					H		1
LAKE			H	H			2
LEE							
LEON							
LEVY							
LIBERTY							
MADISON							
MANATEE							
MARION			H		H		2
MARTIN							
MONROE							
NASSAU							
OKALOOSA		H					1
OKEECHOBEE							
ORANGE		H	L			1	1
OSCEOLA							
PALM BEACH	L	L	L	L	L	5	
PASCO		H					1
PINELLAS							
POLK	H			H			2
PUTNAM			H				1
SAINT JOHNS	L					1	
SAINT LUCIE							
SANTA ROSA							
SARASOTA							
SEMINOLE							
SUMTER			H				1
SUWANNEE							
TAYLOR							
UNION							
VOLUSIA	L			H		1	1
WAKULLA							
WALTON	H						1
WASHINGTON							

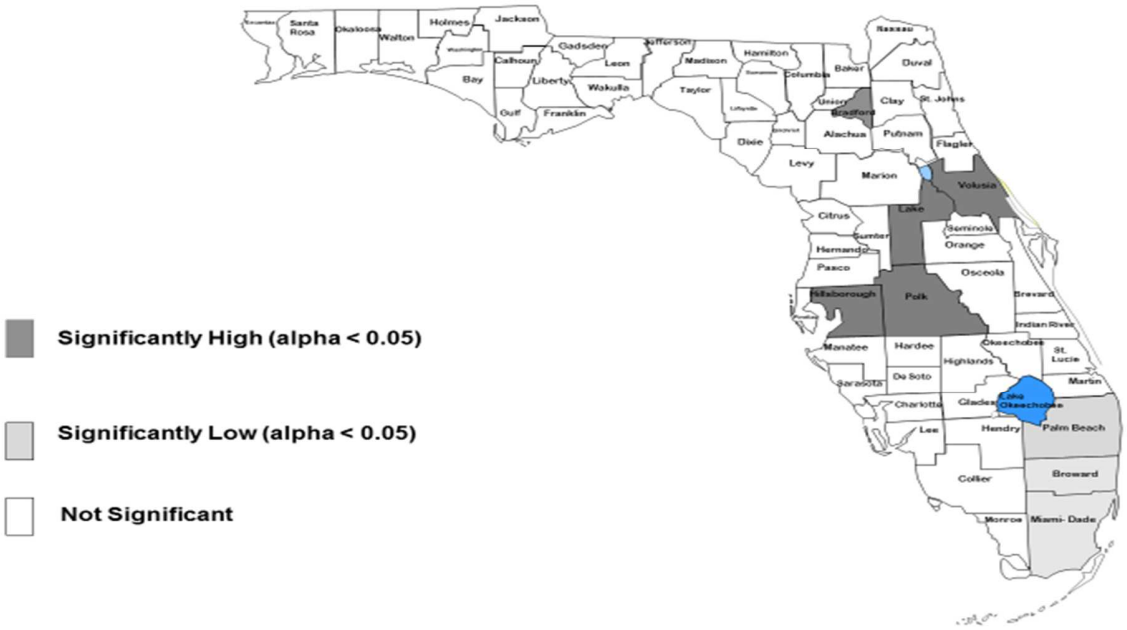
[1] H indicates the actual infant death rate was statistically significantly higher than the expected infant death rate for the county
L indicates the actual infant death rate was statistically significantly lower than the expected infant death rate for the county after adjusting for the race, marital status and education characteristics of the births in each county.
The significance level used is .05

TABLE 4. LOW BIRTH WEIGHT (<2,500 GRAMS) PERCENTAGE ACTUAL VERSUS EXPECTED STATISTICAL SIGNIFICANCE[1] SUMMARY BY COUNTY, FLORIDA 2012-2016

Mother's Resident County	*2012*	*2013*	*2014*	*2015*	*2016*	*Total L*	*Total H*
ALACHUA				H	H		2
BAKER		H					2
BAY							
BRADFORD	H	H		H			3
BREVARD		L				1	
BROWARD							
CALHOUN							
CHARLOTTE							
CITRUS				H			1
CLAY							
COLLIER	L		L	L	L	4	
COLUMBIA					H		1
DADE							
DESOTO	L					1	
DIXIE			L	H	H	1	2
DUVAL	H			H	H		3
ESCAMBIA	H		H	H	H		4
FLAGLER							
FRANKLIN							
GADSDEN			H				1
GILCHRIST				H			1
GLADES							
GULF							
HAMILTON							
HARDEE							
HENDRY	L		L			2	
HERNANDO		H			H		2
HIGHLANDS		L				1	
HILLSBOROUGH		H		H			2
HOLMES							
INDIAN RIVER		L	L	L		3	
JACKSON							
JEFFERSON				L		1	
LAFAYETTE							
LAKE				H			1
LEE		H		L		1	1
LEON				L		1	
LEVY	L			H		1	1
LIBERTY							
MADISON		H					1
MANATEE		L	L	L	L	4	
MARION							
MARTIN			L	L		2	
MONROE	L		L	L	L	4	
NASSAU				H			1
OKALOOSA							
OKEECHOBEE							
ORANGE							
OSCEOLA			H				1
PALM BEACH		L	L	L	L	4	
PASCO			H				1
PINELLAS				L		1	
POLK				L	L	2	
PUTNAM			H				1
SAINT JOHNS	L					1	
SAINT LUCIE	H		L	L		2	1
SANTA ROSA			H				1
SARASOTA	L	L	L			3	
SEMINOLE			L			1	
SUMTER			H				1
SUWANNEE		H					1
TAYLOR							
UNION							
VOLUSIA				H			1
WAKULLA				H	L	1	1
WALTON							
WASHINGTON							

[1] H indicates the actual low birth weight % was statistically significantly higher than the expected low birth weight % for the county
L indicates the actual low birth weight % was statistically significantly lower than the expected low birth weight % for the county after adjusting for the race, marital status and education characteristics of the births in each county.
The significance level used is .05

Actual County Infant Mortality Rates per 1,000 Live Births Compared with Expected Infant Mortality Rates per 1,000 Live Births: Florida 2015



Actual County Low Birth Weight Percentage Compared with Expected Low Birth Weight Percentage: Florida 2016