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## **Associations between Birth Outcome Measures and Infant Mortality Rates for Florida Births 2008 – 2012**

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### **ABSTRACT**

In this analysis, Florida birth records for 2008 – 2012 were linked to infant death records and used to quantify the relationship between three birth outcomes and infant death rates. The three birth outcomes were low birthweight, preterm birth, and small-for-gestational-age. Infant death rates were also calculated for all possible combinations of the three outcomes. The overall infant death rate was 5.46 per 1,000 births. The outcome specific rates per 1,000 births were: 42.03 for low birthweight births, 25.12 for preterm births, and 15.74 for small-for-gestational-age births. However, the rate per 1,000 births for small-for-gestational-age infants who were not preterm and not low birthweight was 3.81, and the rate per 1,000 births for small-for-gestational-age infants who were preterm and low birthweight was 68.61. Analyzing infant death rates using any one of the three outcomes exclusively could be misleading since the risk of infant death varies greatly within each of the three outcome categories depending on the specific combinations of the three outcomes.

### **INTRODUCTION**

All births in Florida are registered in Florida's Birth Registration system. The birth record includes the information used for producing birth certificates and also includes information regarding the infant, mother, father, and characteristics of the pregnancy. Birthweight and gestational age are included in the birth record and these are widely used as outcome measures. Low birthweight (LBW) is defined as birthweight less than 2500 grams, and preterm birth (PTB) is defined as a birth before 37 weeks of gestation. The birthweight and gestational age are also used to define another outcome measure called small-for-gestational-age (SGA). Infants who weigh less than 90% of the infants with the same gestational age are classified as SGA in this analysis

These three birth outcomes are associated with increased risk of infant death, which is the death of an infant before his or her first birthday.<sup>1-3</sup> Infants with these outcomes also have higher risks of experiencing health and developmental problems compared to infants who are not LBW, PTB or SGA.<sup>4-6</sup> Consequently, reducing the rates of these outcomes is a major goal of public health and maternal and child health programs.

Rates of LBW, PTB and SGA are most often used independently. For example, LBW statistics generally pertain to all LBW births without regard to preterm birth status.<sup>1,6</sup> However, infants who are LBW and preterm are at greater risk for infant death than infants who are LBW but not preterm. It would be relevant to separate LBW births into those that are preterm those that are not preterm since different programmatic strategies would be used to address the two types of LBW infants.

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The purpose of this analysis is to describe and quantify the relationship between these outcomes and risk of infant death and also to describe and quantify the relationship between combinations of the three outcomes and risk of infant death. Although this is a narrowly-defined descriptive analysis, a review of the research literature indicates either this has not been done before or the results of previous analyses are not readily available.

## **METHODS**

In the Florida Vital Statistics System, birth records are linked to infant death records when the infant dies before age one. In the three year period 2008 – 2012, there were 7,249 infant deaths and 7,113 (98.1%) were linked to Florida births. The infant deaths that were not linked include deaths that occurred to infants born outside of Florida and also links that failed due to limitations of the data and linking process.

In this analysis, the calculated gestational age from the birth record is used to define the PTB and SGA categories. The calculated gestational age is based on the date of last menses and the date of birth on the birth record. Imputations are made when the date of last menses is incomplete. Births with gestational ages below 22 weeks and above 42 weeks were excluded due to low numbers of births and infant deaths, which would result in unstable infant death rates. There were 1,089,495 births in 2008 - 2012 and 41,005 (3.8%) were excluded due to having a calculated gestational age outside of the range of 22 to 42 weeks. This left 1,048,490 birth records linked to 5,722 infant deaths for the analysis.

## **RESULTS**

Table 1 shows unadjusted infant death rates for the three outcomes. LBW has the highest infant death rate at 42.03 per 1,000 live births, followed by PTB with a rate of 25.12, and SGA with a rate of 15.74. Because these are un-adjusted rates, the rates for each of the three outcomes are likely to be influenced by associations with the other outcomes. For example, LBW infants are more likely to be PTB than infants who are not LBW. Since risk of infant death is higher for PTB infants, the higher rate of infant death for LBW infants is partly due to the higher rates of PTB among LBW infants.

Table 2 shows the rates for all combinations of LBW, PTB and, SGA. Two types of risk factor combinations do not appear in the data set used for this analysis and therefore, are not shown in Table 2; infants who are LBW without being PTB or SGA, and infants who are PTB and SGA without being LBW. This leaves six mutually exclusive categories of births. Table 2 shows there is wide variation in the infant death rates depending on which of the outcomes are present or absent. For example, in the categories of PTB only and SGA only, the infant death rates are close at 3.60 and 3.81, respectively. In all of the other categories where two of the three factors are present, the rates are substantially higher. For the two categories that include PTB and LBW, one without SGA and the other with SGA, the infant death rates are extremely high at 53.23 and 68.61, respectively. Additionally, it can be seen in Table 2 there are substantial numbers of births for each combination of the three outcomes. Using PTB as an example, there are 89,394 PTB without LBW or SGA, and there are 60,447 PTB with one or both LBW and SGA.

## **DISCUSSION**

LBW, PTB, and SGA statistics are available from birth record data. All of these birth outcomes are associated with increased risks for infant death. These three birth outcomes are also closely associated with each other, even though each measures something different. LBW is fundamentally different from PTB and SGA because the condition is a consequence of PTB, SGA, or both. This is evident in Table 2 where there are no births with only LBW; all of the LBW births are combined with PTB, SGA, or both. PTB and SGA can occur in the absence of LBW. However, it is important to note that the risk of infant death associated with PTB and SGA is substantially higher when combined with

LBW. Using PTB and SGA as outcome measures without also considering LBW could be misleading since relatively low risk PTB and SGA births without LBW would be in the same category as the much higher risk births that are LBW. Ideally, analyses of birth outcomes based on birth record data should address all three of these outcomes.

The main strengths of this analysis are the large, population-based data set and the inclusion of all combinations of the three birth outcomes, LBW, PTB, and SGA. In most analyses of birth outcomes, these birth outcomes are examined independently although the three are closely associated. One limitation is the data comprise of Florida births and infant deaths so the results may not be generalizable to national, other states or international populations. Additionally, since the data are from Florida Vital Statistics records, the data used in this analysis are subject to the limitations inherent to vital statistics birth and infant death data.

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Table 1

**Infant Death Rates per 1,000 Births for  
Preterm, Low Birthweight, and Small for Gestational Age Births  
Florida Resident Births 2008 - 2012 Linked to Infant Deaths  
Gestational Ages 22 to 42 Weeks**

<b>Birth Outcome</b>	<b>Infant Deaths</b>	<b>Births</b>	<b>Percent Births</b>	<b>Infant Death Rate per 1,000 Live Births (95% CI)</b>	
<b>Not LBW</b>	1,862	956,655	91.24%	<b>1.95</b>	(1.86, 2.03)
<b>LBW</b>	3,860	91,835	8.76%	<b>42.03</b>	(40.73, 43.33)
<b>Total</b>	5,722	1,048,490	100.00%	<b>5.46</b>	(5.32, 5.60)
<b>Not Preterm</b>	1,958	898,649	85.71%	<b>2.18</b>	(2.08, 2.28)
<b>Preterm</b>	3,764	149,841	14.29%	<b>25.12</b>	(24.33, 25.91)
<b>Total</b>	5,722	1,048,490	100.00%	<b>5.46</b>	(5.32, 5.60)
<b>Not SGA</b>	4,081	944,228	90.06%	<b>4.32</b>	(4.19, 4.45)
<b>SGA</b>	1,641	104,262	9.94%	<b>15.74</b>	(14.98, 16.49)
<b>Total</b>	5,722	1,048,490	100.00%	<b>5.46</b>	(5.32, 5.60)

Table 2

**Infant Death Rates per 1,000 Births for Combinations of  
Preterm, Low Birthweight, and Small for Gestational Age Births  
Florida Resident Births 2008 - 2012 Linked to Infant Deaths  
Gestational Ages 22 to 42 Weeks**

<b>Preterm Birth</b>	<b>Birth &lt; 2500 grams</b>	<b>Small for Gestational Age Birth</b>	<b>Infant Deaths</b>	<b>Births</b>	<b>Percent Births</b>	<b>Infant Death Rate per 1,000 Births (95% CI)</b>	
<b>No</b>	<b>No</b>	<b>No</b>	1,318	808,977	77.16%	<b>1.63</b>	(1.54, 1.72)
<b>Yes</b>	<b>No</b>	<b>No</b>	322	89,394	8.53%	<b>3.60</b>	(3.21, 3.99)
<b>No</b>	<b>No</b>	<b>Yes</b>	222	58,284	5.56%	<b>3.81</b>	(3.31, 4.31)
<b>No</b>	<b>Yes</b>	<b>Yes</b>	418	31,388	2.99%	<b>13.32</b>	(12.05, 14.59)
<b>Yes</b>	<b>Yes</b>	<b>No</b>	2,441	45,857	4.37%	<b>53.23</b>	(51.18, 55.29)
<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	1,001	14,590	1.39%	<b>68.61</b>	(64.51, 72.71)
<b>Total</b>			5,722	1,048,490	100.00%	<b>5.46</b>	(5.32, 5.60)