STUDENT VERSION

Cases in Population-Oriented Prevention (C-POP)

Racial and Ethnic Disparity In Low Birth Weight in Wayne County, NC

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Adapted from:
Lane SD, Teran A, Morrow CB, Novick, LF.
Racial and Ethnic Disparities in Low Birth Weight in Syracuse, New York.
Am J Prev Med 2003; 24 (4S): 128-132

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Abstract:
Low birth weight is a leading cause of infant mortality. Unfortunately, despite declining rates of infant mortality, racial and ethnic disparities in both low birth weight and infant mortality rates persist. In this teaching case, a clinical vignette is used to draw attention to this public health priority in Wayne County, NC. Students learn essential epidemiological skills, such as identifying limitations of sources of data and calculating relative risks, using the example of low birth weight. In performing these skills, students also identify etiologies for such disparity. Finally, students discuss interventions that, when implemented, may decrease infant mortality rates.

Recommended Reading:

- **David RJ, Collins Jr RJ. Differing Birth Weight Among Infants of U.S.-Born Blacks, African-Born Blacks, and U.S. Born Whites. *N Engl J Med.* 1997: 337 (17); 1209-1214.**
- DeClerque JL, Freedman JA, Verbiest S, Bondurant S, North Carolina's infant mortality problems persist: time for a paradigm shift. NC Med J *May/June 2004, Volume 65, Number 3, 138-142.*
- Dillard RG, Improving pre-pregnancy health is key to reducing infant mortality. NC Med J *May/June 2004, Volume 65, Number 3, 147-148.*
- Melvin CL, Malek SH, Making a difference in infant survival: Evidence-based actions to reduce tobacco exposure during pregnancy and infancy in North Carolina. NC Med J *May/June 2004, Volume 65, Number 3, 164-166.*

Objectives: At the end of the case, the student will be able to:

- Calculate infant mortality rates
- Compare Minority and White infant mortality rates in a given population and contrast these figures to national standards
- Understand sources and limitations of data
- Identify possible etiologies for racial/ethnic disparities
- Apply relative risk and population attributable risk
- Develop community-wide recommendations to decrease infant mortality and racial disparities in infant mortality rates

Section A: Infant Mortality

Clinical vignette: ST is a 16-year-old single, African American woman. She began prenatal care during the second trimester of a recent pregnancy and subsequently only had intermittent care with her medical provider. Her pregnancy was complicated by smoking, poor weight gain, a chlamydial infection of her cervix, and ongoing psychosocial stressors (including unemployment, dropping out of high school, and a faltering relationship with the father of the baby).

At 30 weeks gestation, ST developed vaginal spotting associated with lower abdominal cramping. After two days, she called her medical provider and was seen at the hospital. Unfortunately, by the time she sought medical attention, ST was already in advanced preterm labor. Despite medical interventions, labor was not arrested and ST delivered an 1100 gram baby boy. The infant developed Group B Streptococcal septicemia and died on his 5th day of life despite aggressive treatment.

Statement of the problem: Low birth weight (LBW) is one of the greatest contributors to infant mortality and morbidity in the United States. In addition, racial disparity presents a significant challenge in the U.S., where the African American population has a higher rate of LBW births than does the White population.

In 1988 and again in 1997, North Carolina was ranked as the state with the highest infant mortality rate in the United States. Today NC's infant mortality rate is at an historic low, having achieved a 35% reduction in these two decades. To spite these accomplishments, racial and ethnic disparities persist with a current infant mortality rate of 14.2/100 for African Americans and 5.9/1000 for whites, non Hispanics. By far the major cause of infant mortality at this time is extreme prematurity and very low birth weight. Success in further reducing these rates has been elusive. On the 2005 March of Dimes campaign website, "Born Too soon and Too Small in North Carolina", it states that in an average week in North Carolina, 301 infants are born premature, 54 of these are very premature (<32 weeks), 202 are born low birthweight of which 41 are very low birthweight.

Deaths of live born infants born weighing <1000 grams contribute 45% of the infant mortality for white infants and 54% of the total deaths for minorities. The proportion of infants born weighing <1000 grams is **3 times** greater in minorities than whites.

Surles K, Buescher PA, Meyer R. Infant mortality and low birthweight in North Carolina: The last 10 years. SCHC Studies, A special report series by the State Center of Health Statistics, North Carolina Department of Health and Human Services, No.112, January 1999. www.schs.state.nc.us/SCHS/
DeClerque JL, Freedman JA, Verbiest S, Bondurant S. North Carolina's infant mortality problems persist: time for a paradigm shift. NC Med J 2004; 65:138-142.
DeFriese GH and Weisner KK. Infant mortality in North Carolina: A new perspective on a persistent problem. NC Med J 2004;65:137.

Definitions: Infants: a child of < 1 year
LBW: low birth weight; infants born at < 2500 grams
VLBW: very low birth weight; infants born at < 1500 grams
Preterm: ≤37 weeks gestation

Healthy People 2010
Goal 2: Eliminate Health Disparities

The second goal of Healthy People 2010 is to eliminate health disparities among segments of the population, including differences that occur by gender, race or ethnicity, education or income, disability, geographic location, or sexual orientation. This section highlights ways in which health disparities can occur among various demographic groups in the United States.

Race and Ethnicity

Current information about the biologic and genetic characteristics of African Americans, Hispanics, American Indians, Alaska Natives, Asians, Native Hawaiians, and Pacific Islanders does not explain the health disparities experienced by these groups compared with the white, non-Hispanic population in the United States. These disparities are believed to be the result of the complex interaction among genetic variations, environmental factors, and specific health behaviors.

Even though the Nation's infant mortality rate is down, the infant death rate among African Americans is still more than double that of whites. There are differences among Hispanic populations as well. For example, whereas the rate of low birth weight infants is lower for the total Hispanic population compared with that of whites, Puerto Ricans have a low birth weight rate that is 50 percent higher than the rate for whites. American Indians and Alaska Natives have an infant death rate almost double that for whites. Asians and Pacific Islanders, on average, have indicators of being one of the healthiest population groups in the United States. However, there is great diversity within this population group, and health disparities for some specific segments are quite marked. Women of Vietnamese origin, for example, suffer from cervical cancer at nearly five times the rate for white women. New cases of hepatitis and tuberculosis also are higher in Asians and Pacific Islanders living in the United States than in whites.

Income and Education

Inequalities in income and education underlie many health disparities in the United States. Income and education are intrinsically related and often serve as proxy measures for each other (see figure 4). In general, population groups that suffer the worst health status also are those that have the highest poverty rates and the least education. Disparities in income and education levels are associated with differences in the occurrence of illness and death, including heart disease, diabetes, obesity, elevated blood lead level, and low birth weight. Higher incomes permit increased access to medical care, enable people to afford better housing and live in safer neighborhoods, and increase the opportunity to engage in health-promoting behaviors.

Achieving Equity—The Healthy People Perspective

Although the diversity of the American population may be one of the Nation's greatest assets, it also represents a range of health improvement challenges—challenges that must be addressed by individuals, the community and State in which they live, and the Nation as a whole.

Healthy People 2010 recognizes that communities, States, and national organizations will need to take a multidisciplinary approach to achieving health equity—an approach that involves

improving health, education, housing, labor, justice, transportation, agriculture, and the environment, as well as data collection itself. In fact, current data collection methods make it impossible to assess accurately the health status for some populations, particularly relatively small ones. However, the greatest opportunities for reducing health disparities are in empowering individuals to make informed health care decisions and in promoting communitywide safety, education, and access to health care.

Healthy People 2010 is firmly dedicated to the principle that—regardless of age, gender, race or ethnicity, income, education, geographic location, disability, and sexual orientation—every person in every community across the Nation deserves equal access to comprehensive, culturally competent, community-based health care systems that are committed to serving the needs of the individual and promoting community health.

http://www.healthypeople.gov

North Carolina 2004

Characteristic	African-American	White	Hispanic/ Latino
Population (2000 census)	37,422 (33%)	69,452 (61.3%)	5,604 (4.9%)
Maternal age (per 1000 females)			
15-19	54.9	29.4	104.0
18-19	144.8	99.5	288.8
20-44	87.2	78.9	169.5
% Low birth weight	14.1	7.4	6.2
% Smoked during pregnancy	11.0	13.9	1.4
Prenatal care began after the 1st Trimester	21.9	12.3	28.5
Infant deaths per 1000 births	15.0	6.0	6.0

Data source: http://.factfinder.census.gov
http://www.ncchild.org
http://marchofdimes.org

Table 1: Data for Minority and White Births, Wayne County, NC, 2004
Data source: North Carolina State Center for Health Statistics

	Minority	White	HP 2010
Total number of infants born:	606	1154	
LBW (includes VLBW):	81	92	50
VLBW:	20	17	14
Total infant deaths (Neonatal and Post-neonatal):	12	7	4.5

Per 1000 *live births*
Data Source: North Carolina State Center for Health Statistics

Questions:

1. **Using the data in Table 1, calculate the following: percentage of LBW and VLBW births for Minority and White infants in Wayne County, NC in 2004.**

	Minority	**White**
LBW (include. VLBW)		
VLBW		

Infant Mortality Rate (IMR) has four components:

(1) Numerator—all infants who are born with signs of life and who die before their first birthday in a given geographical area
(2) Denominator—all live births in that geographical area
(3) Multiplier—for IMR it is conventional to use 1,000
(4) Time period during which the deaths and live births occurred- usually one year

2. **Using the data in Table 1, calculate the IMR for Minority and White infants for 2004.**

Minority IMR:

White IMR:

*These rates are expressed as "per 1000 live births".

Table 2: Data for Minority and White Infant Mortality rates, Wayne County, North Carolina and U.S., 2004

IMR	Wayne County 1997	North Carolina 1997	Wayne County 2004	North Carolina 2004	United States 2004	Healthy People 2010
Minority	17.4	14.8	19.8	15.6	13.9	
Whites	11.2	6.9	6.1	6.2	5.8	
Total	13.3	9.2	10.8	8.8	7.0	4.5

* Per 1000 *live births*
Data source: March of Dimes Peristats
North Carolina State Center for Health Statistics

3. How do the IMRs for 2004 compare to the IMRs from Wayne County, N.C. in 1997? What are the implications?

4. How do they compare to U.S. data from 2004?

5. How do they compare to Healthy People 2010 goals? Healthy People 2010 does not set goals specific to race or ethnicity. What is your opinion of this decision?

Section B: Maternal Demographics for All Mothers

In Section A, you calculated the LBW, VLBW and IMR for Minority and White infants using data from Wayne County, NC in 2004.

You are ST's obstetrician and you learn that many of your patients live in areas with high infant mortality rates. In an effort to gain insight into how to prevent further infant deaths in your patient population, you approach your County Health Department and ask them for more information about this problem. The County Health Department provides you with the information in Table 3.

Table 3: Maternal Characteristics of Minority and White Births, Wayne County, NC, 2004

Characteristic	Minority Births	White Births
Total number of infants born:	606	1154
Maternal age 14-17 years:	41	35
Maternal age 18-19 years:	79	96
Maternal age 40+ years:	11	16
Enrolled in WIC:	54.9%	43.7%
Unmarried	404	333
Non-high school completion	123	297
Hypertension	60	81
Tobacco use:	64	168
No prenatal care 1st trimester:	203	251

Data Source: North Carolina Center for State Health Statistics

Questions:

1. How do you think the local health department gathered this information? What are the limitations of data gathered from this source?

2. Using the above data, compare the Minority and White births with regard to the following characteristics:

Characteristic	Minority (% in which the characteristic is present)	White (% in which the characteristic is present)
Maternal age 14-17 years		
Enrolled in WIC		
Unmarried		
Non-high school completion		
Hypertension		
Tobacco use		
No prenatal care 1st trimester		

3. In what way are the indicators "Enrolled in WIC" and "Unmarried" helpful to you?

4. What are the limitations in using these indicators?

5. What do you notice about the proportion of these risk factors by race among Wayne County residents?

Section C: Maternal Demographics for Mothers of Low Birth Weight Infants

The County Health Department was also able to provide you with information about low birth weight births as is shown in Table 4.

Table 4: Maternal Characteristics for Minority and White Low Birth Weight Births, Wayne County, N.C., 2004

Characteristics	Minority Births	White Births
Total number of low birth weight infants born:	81	92
Maternal age 14-17 years:	10	5
Maternal age 18-19 years:	5	11
Maternal age 40+ years:	2	0
Non-high school completion:	24	28
Hypertension:	26	16
Tobacco use:	8	20
No prenatal care 1st trimester:	14	16

Data Source: North Carolina State Center for Health Statistics.

Questions:

1. Using the above data and the answers for Question 2 of Section B, please complete the following table for Minority low birth weight births and compare with the total Minority births. (Answers have been provided for you from earlier section.)

Characteristic	Minority- All births (from Section B, Question 2)	Minority- LBW births (Calculate %)
Maternal age 14-17 years		
Non-high school completion		
Hypertension		
Tobacco use		
No prenatal care 1st trimester		

2. What risk factors seem to be associated with LBW in this population?

3. Now do the same calculations for White low birth weight births.

Characteristic	White- All births (From Section B, Q. 2)	White- LBW births (Calculate %)
Maternal age 14-17 years		
Non-high school completion		
Hypertension		
Tobacco use		
No prenatal care 1st trimester		

4. What risks seem to be associated with LBW in this population?

Finally, using your answers from questions 1 and 2, please compare Minority LBW characteristics with White LBW characteristics.

Characteristic	Minority- LBW births	White- LBW births
Maternal age 14-17 years		
Non-high school completion		
Hypertension		
Tobacco use		
No prenatal care 1st trimester		

5. What differences did you find?

6. If you were given $100,000 to spend on a local program to eliminate racial disparities in LBW, where would you put your money?

Section D: Relative Risk

The Relative Risk measures the strength of the association that a risk factor or exposure has with an outcome. It is interpreted based on 1 representing no association. A relative risk that is greater than 1 indicates that the risk factor/exposure is positively associated with the outcome and may indicate a causal relationship. A relative risk that is less than 1 indicates that the risk factor/exposure is negatively associated with the outcome and may indicate a protective effect.

The formula for Relative Risk (RR) is:

Incidence of the disease (or outcome) with the risk factor present
Incidence of the disease (or outcome) with the risk factor absent

A 2X2 table can be constructed to assist in calculating the relative risk:

	Outcome (or Disease) Present	**Outcome (or Disease) Absent**
Risk Factor Present	a	b
Risk Factor Absent	c	d

Using the 2X2 table, the formula for Relative Risk is:

Incidence of disease in exposed = *a/(a+b)*
Incidence of disease in unexposed *c/(c+d)*

Table 5: Selected Maternal Characteristics for all births and for low birth weight births among Minority and White infants in Wayne County, NC, 2004

Risk Factor	**All births (1760)**	**LBW births (173)**
No 1st Trimester Prenatal Care	454	37
1st Trimester Prenatal Care	1306	136
Tobacco	232	28
No tobacco use	1528	145

Data Source: North Carolina State Center for Health Statistics

Questions:

1. Using information in Table 5, calculate the relative risk of low birth weight in women who do not receive prenatal care in the 1st trimester. In this example, the risk factor (exposure) is no 1st trimester prenatal care (for the combined Minority and White population) and the outcome (disease) is low birth weight.

	Disease (LBW)	No disease (Normal BW)	Totals
Exposure (No 1st Trimester PNC)			
No Exposure (Received 1st Trimester PNC)			
Totals			

Relative Risk calculation: $\frac{\text{Incidence in Exposed}}{\text{Incidence in Unexposed}}$

2. Now calculate the Relative Risk of low birth weight with smoking as the risk factor, for the combined population of Minority and White births.

	Disease (+LBW)	No disease (normal BW)	Totals
Exposure (Tobacco Use)			
No Exposure (No Tobacco Use)			
Totals			

3. Which risk factor has a stronger association with low birth weight?

Section E: Attributable Risk and Population Attributable Risk

ATTRIBUTABLE RISK:

Risk can also be measured by how much a certain exposure contributes to the incidence of an outcome or disease in the exposed population. For example, in women who do not seek prenatal care, how much does the lack of prenatal care contribute to the incidence of low birth weight in infants born to these women? The formula of attributable risk is:

(*Incidence of disease in total population) – (Incidence of disease in non-exposed population)*

Question:

1. Calculate the attributable risk of tobacco for low birth weight.

POPULATION ATTRIBUTABLE RISK:

The Population Attributable Risk (PAR) measures the proportion of the disease *in the total population* that can be attributed to a specific exposure. PAR is an important measurement for clinical practice and for public health. It helps clinicians and public health officials estimate how much the burden of disease for the entire population can be reduced by the elimination of a risk factor or exposure. The formula for PAR is:

$$\frac{(\textit{Incidence of disease in total population}) - (\textit{Incidence of disease in non-exposed group})}{\textit{Incidence of disease in total population}}$$

OR

$$\frac{[(a+c)/(a+b+c+d)] - [c/(c+d)]}{[(a+c)/(a+b+c+d)]}$$

2. Calculate the Population Attributable Risk of tobacco for low birth weight for the total population (Minority and Whites.)

3. Does this provide convincing evidence that smoking cessation should be a part of prenatal care?

The county health department provides you with the following race specific PAR for tobacco and low birth weight in your community:

Minority births: PAR of tobacco for low birth weight rate:
White births: PAR of tobacco for low birth weight rate:

4. What are the implications of this?