

# Explore Quantitative Methods in Health Disparity Measurement

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## Abstract

Health disparities refer to differences between groups of people, which can affect how frequently a disease affects a group, how many people get sick, or how often the disease causes death. These disparities are gaps in the quality of health and health care that mirror differences in socioeconomic status, racial/ethnic background, and education level. They may stem from many factors, including accessibility of health care, occupational exposure, and underlying genetic/ethnic/familial factors. Indicators of health are measured in terms of rates, percentages, proportions, means, or other quantifiable measures. The measurement of disparity between two or more groups is often used absolute difference or simple relative difference, e.g. percentage change. Both measures do not count study population and thus the estimate is unstable, especially when fewer cases are observed, (i.e. breast cancer incidence rates in small rural areas varies significantly by years). In this study, we explored health disparities in breast cancer incidence in Alabama counties between 2000 and 2010. Several of the explored quantitative methods in health disparity measurement include absolute measures, relative measures and health index measures. We found that introducing a population weight in health disparity measures results in more consistent and reliable comparisons.

**Key words:** health disparity, index, breast cancer incidence, population weight.

## 1. Introduction

There is a strong emphasis in the US public health policymaking community on monitoring progress toward eliminating health disparities. The naïve use of summary measures of health disparity has the potential to lead to confusion among both policymakers and researchers as to whether disparities are increasing or decreasing, which cancer-related outcomes show the largest disparities, and which health disparities might be specifically targeted for increased study.

There are a number of ways to conceptualize and measure health disparities<sup>1</sup>. In this study we explored these methods illustrating an example with Alabama breast cancer incidence between White and Black residents in the Deep South Network for Cancer Control (DSN), a program project funded by NCI since 2000. The purpose of the DSN is to eliminate the disparity in cancer death rates between blacks and whites in the region by increasing breast cancer screening and awareness. The program targets the rural area of the Alabama Black Belt; as well as Jefferson County. The DSN builds upon community

infrastructures, state partnerships and coalitions to: (1) provide cancer awareness activities; (2) support minority enrollment in clinical trials; and (3) promote the development of minority junior biomedical researchers.

It is crucial to consider the conclusions of disparity measures; different disparity measures often contain implicit or explicit value judgments about what dimensions of disparity are important. These value judgments play an important role in understanding why different measures of disparity may give different answers to questions about disparity trends.

## 2. Method

Breast cancer incidence data was obtained from the Alabama Statewide Cancer Registry (ASTR). This data comprised all Alabama female breast cancer patients diagnosed from 2001 through 2010. The Deep South Network counties were comprised of 11 counties: Bullock, Choctaw, Dallas, Greene, Hale, Lowndes, Macon, Marengo, Perry, Sumter, and Wilcox. The remaining 56 Alabama counties were classified as DSN Control counties. County level demographic data used for weighting were obtained from the United States Census Bureau.

The disparity of breast cancer incidence between whites and blacks are evaluated with following methods<sup>2</sup>:

Absolute disparity (AD):  $AD = R_i - R_r$

Between-Group Variance (BGV):  $BGV = \sum_{i=1}^I p_i (R_i - \mu)^2$

Rate Ratio (RR):  $RR = R_i / R_r$

Index of Disparity (ID):  $ID = \left[ \sum_{i=1}^{I-1} |R_i - R_r| / I \right] / R_r * 100$

Mean Log Deviation (MLD):  $MLD = \sum_{i=1}^I p_i [-\ln r_i]$

Where  $R_i$  and  $R_r$  are rates of interest and reference point,  $p$  is population proportion of interested group, and  $\mu$  is the average incidence.

All analyses were carried out using SAS V.9.2 (SAS Institute, Cary, NC, USA).

## 3. Results

In the Alabama DSN counties, breast cancer incidence increased from 2000 to 2010 (Table 1). Whites had higher breast cancer incidence than Blacks but the rate of change was slower comparing to Blacks. Using the measures of absolute disparity in Table 2, Absolute Disparity between Whites and Blacks ranged from -4.6 to 51.3; and the Between-Group Variance between Whites and Blacks ranged from 1.8 to 604.7 during the study period. Using the measures of relative disparity in Table 2, the Rate Ratio of disparity between whites and blacks was higher in 2001 and 2002 (1.3 and 1.4 respectively), and declined and stabilized from 1.0 to 1.2 during the latter years. The Index of Disparity ranged from -2.9 to 39.5, while the Mean Log Deviation was small

and had less variation. Figure 1 and 2 illustrate the Index of Disparity and Mean Log Deviation measures for breast cancer incidence and indicate that there were large racial disparities before 2005 between DSN and Control counties, and that the disparity decreased in the years afterward

**Table 1 Alabama Breast cancer incidence for Women in DSN counties  
(Rate per 100,000)**

	White			Black		
	Rate/Trend	LCL*	UCL*	Rate/Trend	LCL	UCL
Total PC*	4.0			11.0		
Total APC*	0.9	-0.7	2.6	1.7*	0.1	3.3
2001	174.5	159.5	190.6	134.6	119.0	151.7
2002	181.1	165.7	197.7	129.8	114.5	146.5
2003	153.0	138.8	168.3	150.5	134.1	168.3
2004	156.8	142.4	172.4	141.2	125.4	158.5
2005	156.4	142.1	171.9	161.0	144.3	179.1
2006	172.9	157.6	189.3	141.0	125.6	157.9
2007	172.2	156.7	188.8	154.5	138.3	172.2
2008	179.9	164.2	196.7	151.5	135.5	169.0
2009	184.2	168.3	201.3	166.4	149.5	184.7
2010	181.4	165.6	198.3	149.5	133.8	166.5

\*LCL-Lower confidence limit; UCL-Upper confidence limit; PC-percent change; APC-Annual percent change

**Table 2 Disparity Measurements of DSN Breast Cancer Incidence**

Year	Measures of Absolute Disparity		Measures of Relative Disparity		
	AD	BGV	RR	ID	MLD
2001	39.9	361.6	1.3	29.6	-0.004
2002	51.3	604.7	1.4	39.5	-0.015
2003	2.5	1.8	1.0	1.7	0.004
2004	15.6	57.5	1.1	11.0	0.002
2005	-4.6	5.3	0.97	-2.9	-0.002
2006	31.9	239.9	1.2	22.6	0.008
2007	17.7	77.3	1.1	11.5	-0.006
2008	28.4	192.8	1.2	18.7	0.006
2009	17.8	76.4	1.1	10.7	-0.0003
2010	31.9	239.3	1.2	21.3	0.003

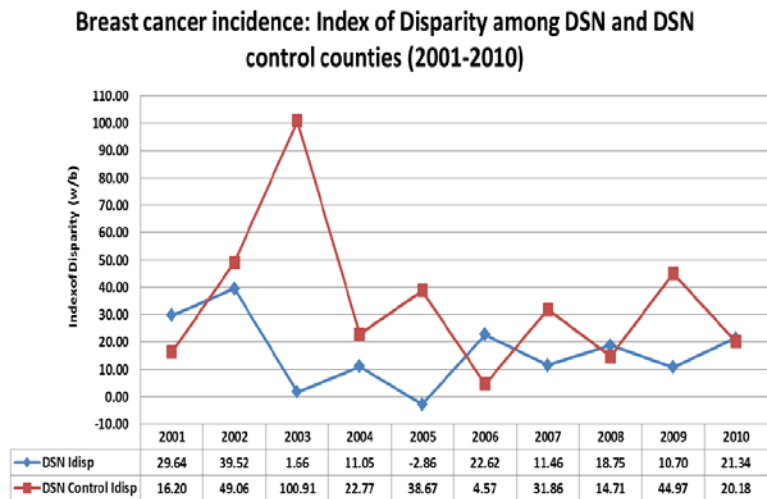


Figure 1 Index of Disparity measures for breast cancer incidence from 2000-2010

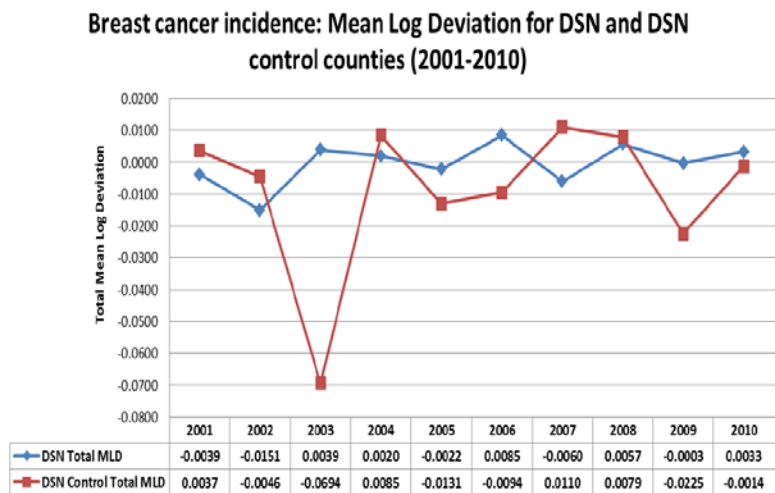


Figure 2 Mean Log Deviation measures for breast cancer incidence from 2000-2010

#### 4. Summary

In health outcomes research, investigators often use absolute differences or relative changes to describe the difference between groups. From the above results we illustrated that the Measures of Absolute Disparity had large variation, which may not be able to provide useful information for decision making. The Index of Disparity has been proposed as a measure of progress toward relative disparity goals for Healthy People 2010. the Index of Disparity is usually consistent with other relative disparity indicators. However the instability of the Index of Disparity is most easily seen in cases where social groups differ substantially in population size. After accounting for population size (weight), the Mean Log Deviation appeared to be the most stable and consistent measure. Among the numerous indicators for disparity measurement<sup>3</sup>, we found that relative disparity indicators have less variation, are more stable and consistent, especially by adding population weight in estimation.

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