Appendix C, 2014 Analyses

Differences in Proportions/ Percentages for 2014-2011

Example: With regard to the percentage of middle school students who never/rarely wear a helmet when riding a bicycle, 2014 is 10.2 % more than 2011 (0.787-0.685).

Confidence Intervals for Differences in Proportions[Note #1]

Confidence intervals were used to confirm statistical significance. For Macon County YRBS, 95% confidence intervals for differences in proportions (comparing 2014 to 2009 and comparing Macon results with North Carolina state results) were calculated using the following general formula:

$$(p_1 - p_2) \pm CV\sqrt{p_1(1-p_1)/n_1 + p_2(1-p_2)/n_2}$$

in which p_1 is the proportion of 2014 students; p_2 is the proportion of 2011 students; CV is the critical value used to calculate the margin of error for 95% confidence. The Bonferroni correction is used in calculating multiple differences. For example, assuming $\alpha = 0.05$, the critical value for a series of questions, including 12 items in a set, would be 2.8653; n_1 is the total number of 2014 respondents and n_2 is the total number of 2011 respondents.

For example, the 95% confidence interval for the difference in proportions (comparing 2014 to 2011) of middle school students who rarely or never wear a helmet when riding a bicycle is:

0.102 ± 0.105

$2.8653\sqrt{(0.787(1-0.787)/596) + (0.685(1-0.685)/449)}$

$2.8653\sqrt{0.0002813 + 0.0004806}$

$2.8653\sqrt{0.0007619}$

2.8653×0.0276020

0.079 = margin of error

In this case, the 95% confidence interval is statistically significant.

Confidence intervals can be interpreted much like score bands in testing. For example, a test score of 110 may have a score band that locates the student's performance somewhere between 104 and 116. Interpreting this statistically significant confidence interval for the difference between 2014 and 2011 proportions, we would say that we are 95% confident that the percentage of 2014 students who rarely or never wear a helmet when riding a bicycle is between 2.3 and 18.1 percentage points more than 2011 students.

Cohen's h[Note #2]

The measure of effect size is a statistical computation that helps researchers evaluate the practical significance of their results: a result may be statistically significant but people generally want to know if an effect is large enough to matter. Cohen's h is a measure of effect size calculated from proportions that have undergone arcsine transformations, making the differences in proportions comparable with regard to small, moderate, and large effect sizes. The formula for Cohen's h that was used for these analyses is:

h = the absolute value of 2 arcsin $\sqrt{p_1}$ -2 arcsin $\sqrt{p_2}$.

For example the effect size for the difference in proportions between 2014 and 2011 middle school students who rarely or never wear a helmet when riding a bicycle is 0.23:

find the absolute value of 2 arcsin √0.787 – 2 arcsin √0..685.

The following guidelines are used to interpret Cohen's h:

$0.2 < h \leq 0.5$ = small effect
$0.5 < h \leq 0.8$ = medium effect
$h > 0.8$ = large effect

In comparing the proportions of 2014 and 2011 middle school students who rarely or never wear a helmet when riding a bicycle, the effect size of 0.23 is small. Thus, the following interpretation might be made:

2014 is 10.2% more than 2011 with a 7.9% margin of error. The 95% confidence interval is significant. Although statistically significant, the effect size is small, Cohen's h = .23.

Compound Annual Growth Rate[Note#3]

Long-term trend analyses (i.e., 2002-2014) were calculated via compound annual growth rates (CAGR). The CAGR is the geometric average of multiple data points over time. As compared to differences in proportions (that are transformed to percentages), the compound annual growth rates report the rate of change from 2002 to 2014. For example, in 2002 the percentage of students who had property damaged or stolen on school property was 36.9%. In 2014, the percentage had decreased to 19.3%. The difference in proportions between these two benchmark years (as reported in percentage form) is 17.6%. The rate of change, however, is 10.2%. Again, this rate is calculated by taking the geometric average of the six data points in years 2002, 2005, 2007, 2009, 2011, using the following mathematical formula:

$$\text{CAGR} = \left(\frac{\text{Ending Value}}{\text{Beginning Value}}\right)^{\left(\frac{1}{\text{\# of years}}\right)} - 1$$

$$-10.2 = [(36.9 \div 19.3)^{1/6}]-1$$

Crosstabs

Note that the 2 × 2 crosstab for carrying a weapon gives row percentages for gender. For example, 57.6% of males were at-risk for carrying a weapon.

Crosstab[a]

			Have you ever carried a weapon such as a gun, knife, or club?		
			Yes	No	Total
What is your sex?	Female	Count	120	250	370
		% within What is your sex?	32.4%	67.6%	100.0%
		Std. Residual	-3.7	3.3	
	Male	Count	220	162	382
		% within What is your sex?	57.6%	42.4%	100.0%
		Std. Residual	3.6	-3.3	
Total		Count	340	412	752
		% within What is your sex?	45.2%	54.8%	100.0%

a. Pearson Chi-Square=48.03 with 1 df, p<0.0001.

Chi-Square

The Chi-square test of independence compares observed frequencies in a contingency table with expected frequencies, given a null hypothesis of independence (i.e., that one variable is not contingent upon another). In the weapon × gender question, the chi-square test for independence determines if weapon frequencies are independent of gender. A statistically significant chi-square value provides evidence that carrying a weapon is dependent on gender. In this case, the chi-square statistic of $48.03_{df=1}$ is significant with a p-value less than 0.0001. In this and all analyses, alpha = 0.05 was adopted to control for Type I error.

Standardized Residual Analyses

A statistically significant chi-square indicates that there is evidence for dependence *somewhere* in the table. By comparing cell-by-cell observed frequencies with expected frequencies residual analysis indicates the nature of that evidence. In so doing, the difference between observed and expected frequencies is called a residual. Standardized residuals can be interpreted like a z-statistic that has a mean of zero and a standard deviation of 1. In this report, a standardized residual greater than 1.99 provides evidence that a particular cell significantly contributes to the dependence that was detected by the chi-square test. For example, the standardized residuals of 3.6 indicates that males are far more at-risk for carrying weapons.

IMPORTANT NOTE #1: The Bonferroni adjustment calculated for multiple comparisons controls for Type I error. For example, rather than calculating the margins of error using 1.96 as the critical value for violence-related comparisons, the Bonferroni adjustment sets the critical value to 2.8653. Although this adjustment controls for Type I error, the results may reflect an overly conservative bias. Accordingly, there may be some results that are worth considering, even if they are not reported as statistically significant.

IMPORTANT NOTE #2: Measures of effect size offer an important way to interpret statistical findings. However, the conventional guidelines for evaluating small, moderate, and large effects offer arbitrary indices for examining the practical significance of findings. To best interpret results, readers should consider the context and history, as well as the measures of practical significance given in this report.

IMPORTANT NOTE #3: In this report, CAGRs with rates greater than or equal to 10% are highlighted in the Executive Summary. These trends since 2002 may be worth considering in the context for understanding the efficacy of Macon intervention strategies. The CAGR is a helpful index in that it reports the long-term average of multiple data points; the CAGR, however, does not report the fluctuations from year-to-year.