

**Did the Intervention Make a Difference? Using Quasi-Control
Groups to Evaluate Effectiveness of a Social Norming Effort to
Reduce High-Risk Drinking on a University Campus**

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ABSTRACT

Objective: Determine if a social norms marketing approach to reduce high-risk drinking at Michigan State University from 2001 to 2018 resulted in behavior changes that differed from trends nationwide.

Participants: Students at MSU vs. national samples of students and non-students in the BRFSS, students who participated in NCHA nationwide.

Methods: Compare alcohol-related behavior trends at MSU from 2000 to 2018 to corresponding students and non-students nationwide as quasi-control groups regarding non-drinking, drinking frequency, drinking volume, binge drinking, and driving drunk, protective behavior use, and adverse outcomes.

Results: Trends among MSU students differed from those among both non-students and students nationwide over the same time periods with the differences being consistent with the thrust of social norms messages disseminated at MSU.

Conclusions: The social norms marketing efforts produced patterns of change that differed from trends nationwide and consistent with the predicted effects the marketing messages intended, i.e., reducing drinking frequency, volume, and harm.

KEYWORDS: alcohol, high-risk drinking, heavy drinking, college students, social norms, misperception, harm-reduction, time-series, quasi-control group

INTRODUCTION

The social norms approach (SNA) to changing problematic behaviors has been in use for roughly 30 years. SNA has been applied to a variety of unhealthy behaviors (e.g., seatbelt nonuse, smoking, drinking, marijuana use, bullying, sexual assault, etc.) with diverse populations ranging from elementary school pupils to adults, administered as interventions at the personal, group, institution or mass public level, and in multiple countries worldwide. However, two recent systematic reviews of reported studies^{1,2} concluded that the evidence regarding the effectiveness of SNA efforts is mixed.

The SNA assumes a significant portion of the prevalence of problematic behavior results from individuals trying to follow a group's norm which they have misperceived. SNA interventions typically involve communicating actual prevalence information to correct misperceptions and, thereby, reduce the problematic behavior. Studies have consistently documented such misperceptions^{3,4} and that SNA marketing can change the perceived prevalence⁵. However, many studies appear to find little evidence of effectiveness at reducing the problematic behavior⁶⁻⁸. Sometimes, results indicating ineffectiveness of the approach can be attributed to shortcomings in the SNA campaign implementation (e.g., inadequate dosage, too short a duration, unclear or confusing messages, unbelievable messages, etc.), shortcomings of the data gathered, shortcomings of the evaluation (e.g., outcomes measured too soon, poor measures, poor design, etc.), or all three rather than as a consequence of the failure of the theory underlying the approach.

Determining if the problematic behaviors changed is the central issue. Most SNA studies have involved one-group pretest, posttest evaluation designs over relatively short durations with

no control group – randomized or otherwise.² Despite the often-repeated advice to include control groups in intervention designs, it rarely happens. Consequently, even studies' finding evidence of effectiveness cannot rule out an alternative explanation that the same results would have occurred in the absence of the SNA effort because of a secular trend (i.e., a threat to its internal validity⁹). Without a control group, findings that indicate little or no change in the behaviors of the group receiving a SNA intervention would be misjudged as ineffective if the effort had, in fact, prevented the worsening of the problematic behavior a secular trend in the control group would have demonstrated. The absence of randomized control groups for nearly all SNA studies regarding alcohol use among college students was a primary reason Foxcroft et al.² excluded all but two published SNA marketing studies in their review for the Cochrane Institute's database of treatments and effectiveness.

To be sure, the failure to find consistent evidence of effectiveness has pushed SNA researchers to add conceptual elements that have further developed and refined the approach (e.g., types of norms, reference groups, salience, protective behaviors, etc.) But without persuasive evidence of effectiveness, continuing use of the approach seems more an act of wishful thinking than a data-driven decision.

Recently, Hembroff et al.¹⁰ reported detailed findings regarding outcomes and process to evaluate a 13+ year-long SNA marketing campaign to reduce harm from high-risk drinking among Michigan State University (MSU) students. Virtually all the findings reported were consistent with the conclusion that the SNA marketing campaign worked. However, the question lingers as to whether these changes were caused by the SNA marketing efforts or merely reflected secular trends in this age group within American society during this time period.

The evaluation design Hembroff et al.¹⁰ used was a one-group time-series design with biennial measurements over a 14-year time period (baseline plus seven follow-ups). Shadish et al.,¹¹ expanding on Campbell and Stanley's framework⁹ for assessing evaluation designs, contend that adding a quasi-control group with its own time-series of measures on critical dependent variables for the same time periods greatly strengthens the multiple time-series design, making it an "excellent quasi-experimental design, perhaps the best of the more feasible designs (p. 57)."

The purpose of this paper is to introduce a quasi-control group to the time-series design in order to address the research question as to whether the trends in the group receiving SNA treatment at MSU represent something different from the corresponding trends in the equivalent group not subjected to the same treatment. The more specific working hypothesis is that trends do differ and in ways consistent with the thrust of the SNA messaging at MSU as it differs from constraints or programmatic efforts to which similar students and non-students were subjected nationally. To do so, a control group (or groups) is needed – a group of similar subjects not exposed to the social norming campaign but on whom there are at least some of the same measures over the same period of time. The MSU SNA marketing campaign was implemented campus-wide so no quasi-control group is possible from within MSU. Instead, a quasi-control group from outside the MSU student population is needed.

METHODS

Treatment Group Data. Data to evaluate the impact of the campaign at MSU come from its biennial administrations of the National College Health Assessment (NCHA) from 2000 to 2014. The 2000 survey data serve as a baseline to the campaign which began in 2001. For this analysis, the results from MSU's 2016 and 2018 NCHA surveys have also been

incorporated. A detailed description of these surveys for 2000 through 2014 and their samples is provided in Hembroff et al.¹⁰ and, in the interest of space, will not be repeated here. The methodology and samples for 2016 and 2018 were consistent with those from the earlier years.

Quasi-Control Group Data. Two sources for the quasi-control group data were identified. One is the nationwide National College Health Assessment (NCHA) data available from the American College Health Association.¹² The other is the Behavioral Risk Factor Survey (BRFS) generated by the Centers for Disease Control and Prevention (CDC).¹³ There are significant strengths and limitations to each. The area of weakness for one is an area of strength for the other. Consequently, both will be used as separate quasi-control groups.

The strength of the national NCHA data as a control group for MSU's NCHA data is the equivalence of methodologies. The institutions in the national database collected their NCHA data using the same questionnaire and, mostly, the same mode of administration (i.e., overwhelmingly web-based). Consequently, there are roughly 25 alcohol-related items (alcohol consumption and frequency behaviors and perceptions, protective behaviors, and adverse impacts) on which MSU and national NCHA respondents can be compared. For purposes of this analysis, data will only be used from the national surveys conducted on probability samples of the participating institutions' students during a similar field period (i.e., a 3-4 week period of mid-winter/spring semester) as did MSU.

The use of a differing methodology is a weakness of BRFS as a control group source. BRFS collects data through telephone interviews conducted throughout the calendar year. Its principal weakness, however, is that it only includes four alcohol-related questions on which to compare MSU NCHA and BRFS respondents. The BRFS questions are focused primarily on consumption and frequency. Although they are very similar to those in NCHA, they are not

exactly the same.ⁱ The BRFSS interviews include no questions on alcohol-related adverse outcomes, on the use of protective behaviors other than designated drivers, and on the perceived drinking behaviors of others. Thus, the number of items on which MSU's respondents can be compared to BRFSS respondents is limited.

The strength of the BRFSS data is that it is based on national probability samples of all adults (18 or older)ⁱⁱ, but the total sample of respondents can be constrained to include only students or non-students 18 years of age and older up to an appropriate cutoff age, e.g., 18-24. Consequently, it can provide national probability samples of students and of non-students in an age range comparable to the MSU respondents, thereby, effectively creating two quasi-control groups: non-students and students.

By contrast, the national NCHA data sets for each year contain probability samples from within a small self-selected (non-probability) sample of institutions. The principal weakness of this data source as a quasi-control group is that the national NCHA data set includes the data from MSU along with a number of other universities also conducting SN campaigns over this same time period with which MSU confers. There is no mechanism or variable within the NCHA data to identify institutions or which institutions implemented a specific type of alcohol-related campaign or combination of campaigns the year the data were collected. In the aggregate, it is clearly not a 'no treatment' condition.

While it is typically the case that there is little direct measurement of dosage or type of treatment to which members of quasi-control groups have been subjected, in this particular case, some information is available. In the late 1990s and early 2000s, Wechsler and associates¹⁴⁻¹⁷ documented and decried widespread patterns of heavy consumption or binge drinking among college students. In response, many colleges and universities launched efforts to reduce

problematic drinking among their students through various approaches¹⁸ (e.g., limiting access, alcohol education, fear-based approaches, heightened enforcement, environmental management, social norming, etc.)¹⁴⁻¹⁹ By 2004, Wechsler's group reported that most schools they surveyed (84%) conducted some type alcohol education or prevention effort, half (49%) conducted social norms campaigns, a substantial minority (34%) banned alcohol on campus, and many other colleges restricted alcohol in other ways. Schools that focused on reducing demand for alcohol (e.g., through alcohol education or social norming) were less likely to ban alcohol use. Those conducting social norming campaigns and those otherwise needing to monitor the problematic behavior had a critical need for periodic survey data on the behavior.

With no known corresponding national attempt to reduce demand or supply in this time frame outside the college environment, non-students would not have been subjected to 'treatments' like those on many college campuses. But nearly all college students would have been subjected to some type or degree of prevention or intervention effort. While students sampled in BRFS should cover the full gamut of colleges, those participating in NCHA would be more likely to include larger institutions more focused on impacting demand rather than supply. Instituting bans and restrictions are less expensive than implementing programs.

The numbers of colleges and universities included in the national NCHA data set for the Winter/Spring of each relevant year varied appreciably across the years (i.e., 28 in 2000, 44 in 2002, 74 in 2004, 117 in 2006, 106 in 2008, 139 in 2010, 141 in 2012, 140 in 2014, 137 in 2016, and 140 in 2018.ⁱⁱⁱ The total numbers of respondents in the national NCHA data sets varied from only 16,024 in 2000 and 28,258 in 2002 to 95,761 in 2016 and 88,178 in 2018.

For each MSU survey year (i.e., every other year beginning in 2000), the relevant alcohol-related results have been extracted from the published ACHA-NCHA Reference Group

Report for the Spring of the targeted years and entered into Excel. Across all the survey years, males were appreciably underrepresented, making up only 29% (2018) to 38% (2000). To adjust for this apparent non-response bias, the results broken down by sex for each item have been weighted so males represent 48% of the weighted sample in each year. The weighted results for each relevant question across time were graphed, trendlines drawn, and regression coefficients calculated.

The NCHA data sets include only students. The BRFSS data sets include national probability samples of both students and non-students in the same age group, thereby enabling comparisons of the separate trends for both. The BRFSS is administered at the state-level with between 350,000 and 450,000 total respondents each year. For these analyses, the data have been limited to 18-24-year-old respondents. The resulting samples are still quite large. For example, in 2000, there were 16,436 individuals 18-24 years of age interviewed for BRFSS, of whom 3,609 were students and 12,827 were non-students. In 2016, there were 26,267 18-24-year olds interviewed, of whom 8,599 were students and 17,668 were non-students. For comparing BRFSS and MSU NCHA respondents, the MSU's data have also been constrained to include only 18-24-year olds. That age constraint will not be imposed on the data for comparisons between MSU NCHA and national NCHA respondents.

The BRFSS data have been weighted by FINALWT (the specified final caseweight for the landline-only based samples) for all years from 2000 through 2010 and by LLCPWT^{iv} (the specified final caseweight for the landline plus cellphone-based samples) for all years from 2011 through 2018. The 2016 and 2018 NCHA survey data for MSU were added to the 2000-2014 data reported by Hembroff et al.¹⁰ The MSU NCHA data have been weighted by sex, race/ethnicity, and academic class within year to match enrollment profiles.

Analyses of the MSU NCHA data and the BRFSS data were conducted using SPSS 25.0. For each of the variables being compared, the results for BRFSS quasi-control and MSU NCHA respondents for each survey year were entered into EXCEL, graphed, and trendlines drawn with regression coefficients calculated.

In effect, this has created three different quasi-control groups. The BRFSS non-student group is the closest to a 'no-treatment' group. BRFSS students should reflect the proportionate mix of treatments among both the institutions that chose to focus on restricting supply (e.g., enforcement, banning alcohol from campus, etc.) and those that chose to focus on reducing demand. It seems highly likely that the mix of institutions that chose to participate in NCHA was skewed more toward reducing or monitoring demand, especially through alcohol education, or social norming. If so, then the trends in the national NCHA data should be somewhat different from those of the BRFSS students. And since MSU focused heavily (but not exclusively) on a social norming approach (i.e., reducing demand), its trends should be somewhat similar to those of the national NCHA while also different in ways that reflect specific social norms messages distributed. That is, there are an experimental group and three quasi-control groups representing three other types or degrees of treatment with non-students being the closest to a 'no treatment' condition.

This analysis aims to determine if the changes in drinking behaviors over time at MSU differed from the patterns of change that occurred in the other groups nationally. Parallel trendlines indicate that no incremental change occurred in one group over another. However, when the trendlines are not parallel, the trendlines for change at MSU will have to be in the direction consistent with the social norming messages distributed among students. The evidence will be clearer if the trendlines for MSU move in opposite directions as for BRFSS or national

NCHA, but trendlines that differ in their rates of change or slopes will also indicate differences of effect.

Measures. Within NCHA and BRFSS surveys, the alcohol consumption and drinking frequency questions (with one exception to be discussed below) remained the same throughout the time period covered by this analysis, but are not identical between the two surveys. The differences in the questions would be a reason to expect differences between the point estimates they produce but should not account for differences in trends between surveys over time.

The response options provided for the NCHA item regarding the number of days in the month on which the respondent used alcohol included “Do not drink” and “Did not drink in past month.” For this analysis, both coded as “non-drinkers.” The corresponding BRFSS question was preceded in the interview by a question asking whether the respondent had drunk at least one drink of alcohol in the past 30 days. The respondents who reported not having drunk any alcohol in the past month were then skipped past the other alcohol-related questions. Those who said they had not drunk alcohol were coded as “non-drinkers.”

The BRFSS question regarding binge drinking was modified for female respondents to “4 or more drinks” beginning in 2006²⁰; no corresponding change was made in the NCHA question. Consequently, the data from both male and female respondents would not be comparable between NCHA and BRFSS from that year forward. Therefore, for purposes of comparing this question’s trendlines between NCHA and BRFSS, only responses from males will be included.

RESULTS

Figures 1-4 show the graphed comparisons of trends among the BRFs students and non-students and MSU NCHA respondents regarding the percentages who were non-drinkers, who drank three or more days per month, drank ten or more days per month, and drank five or more drinks when they drank. Table 1 summarizes the trends for these and two additional variables. It also provides trend information for the national NCHA.

Figure 1. % of 18-24-year-olds who did not drink alcohol in previous month, BRFs students vs. BRFs non-students vs. MSU NCHA students, by Year (2000-2018)

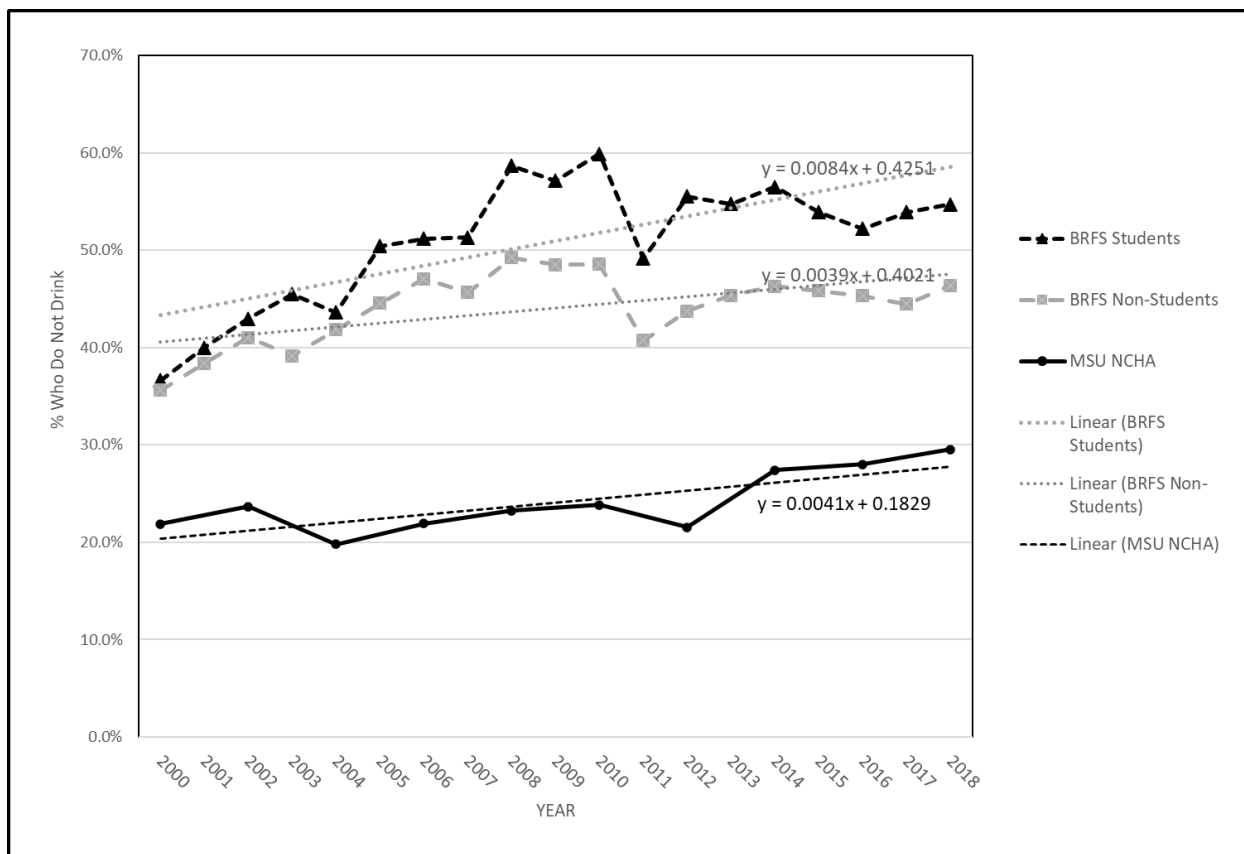


Figure 2. % of 18-24-year-old drinkers who drank 3+ days in past month, BRFs students vs. BRFs non-students vs. MSU NCHA students, by year (2000-2018)

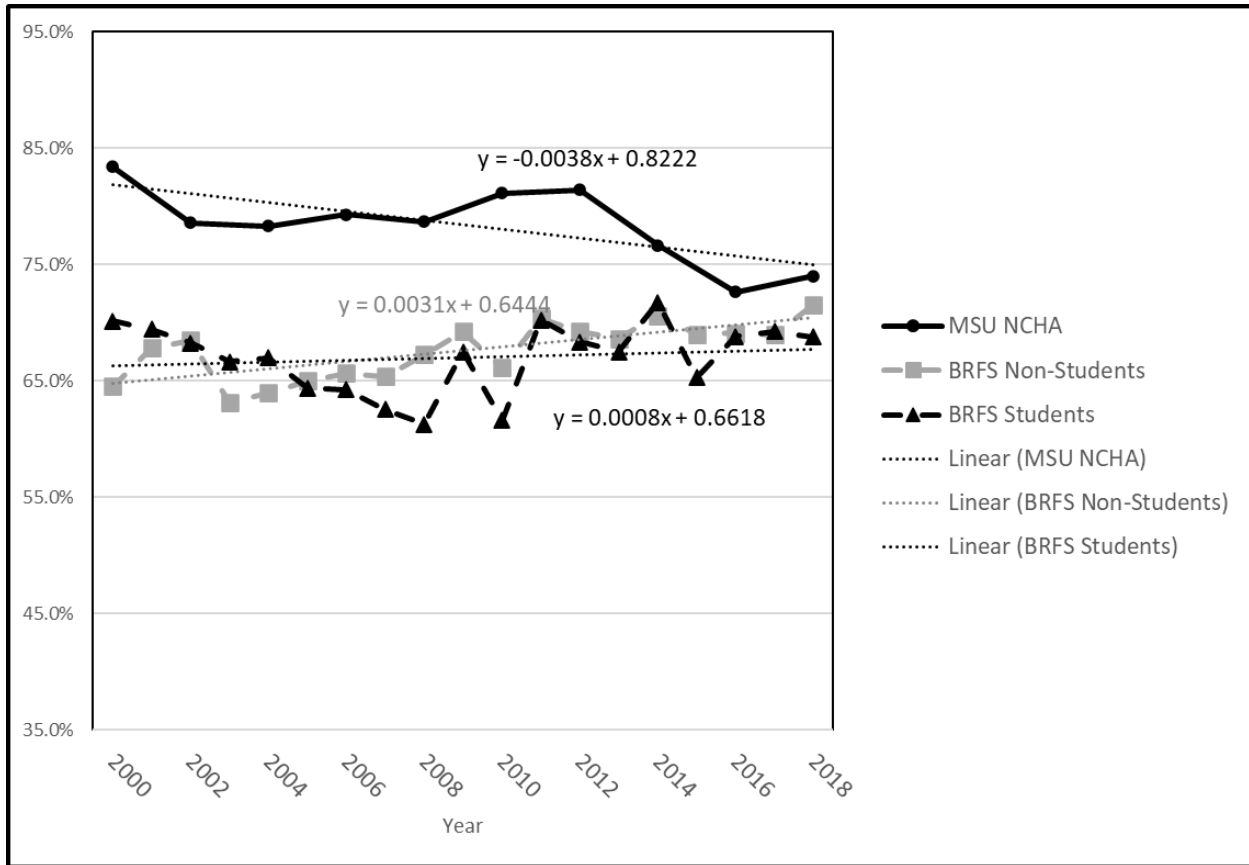


Figure 3. % of 18-24-year-old drinkers who drank 10+ days in past month, BRFs students vs. BRFs non-students vs. MSU NCHA students by year (2000-2018)

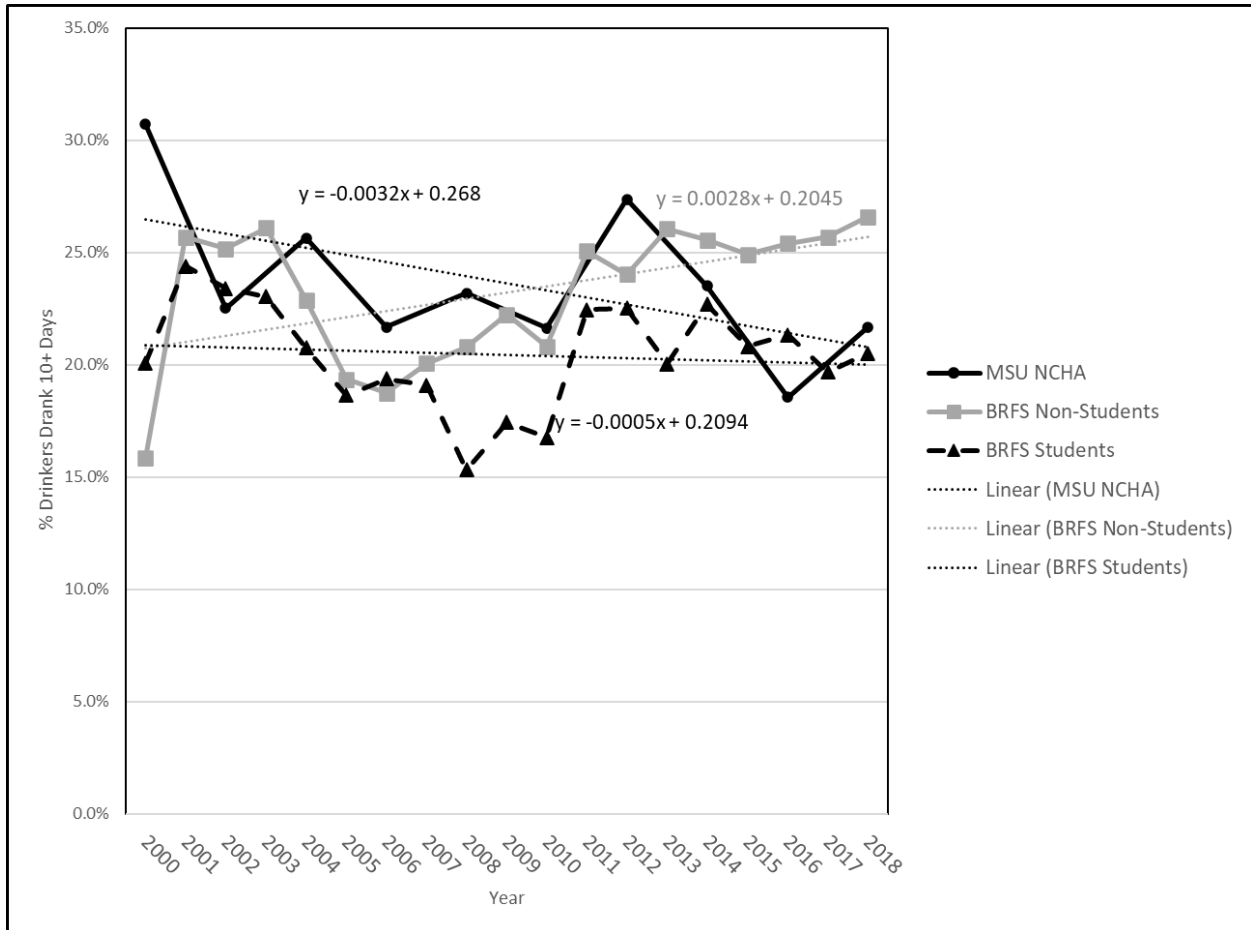


Figure 4. % of 18-24-year-olds who drank 5 or more drinks when drank alcohol, BRFs students vs. BRFs non-students vs. MSU NCHA students, by year (2000-2018)

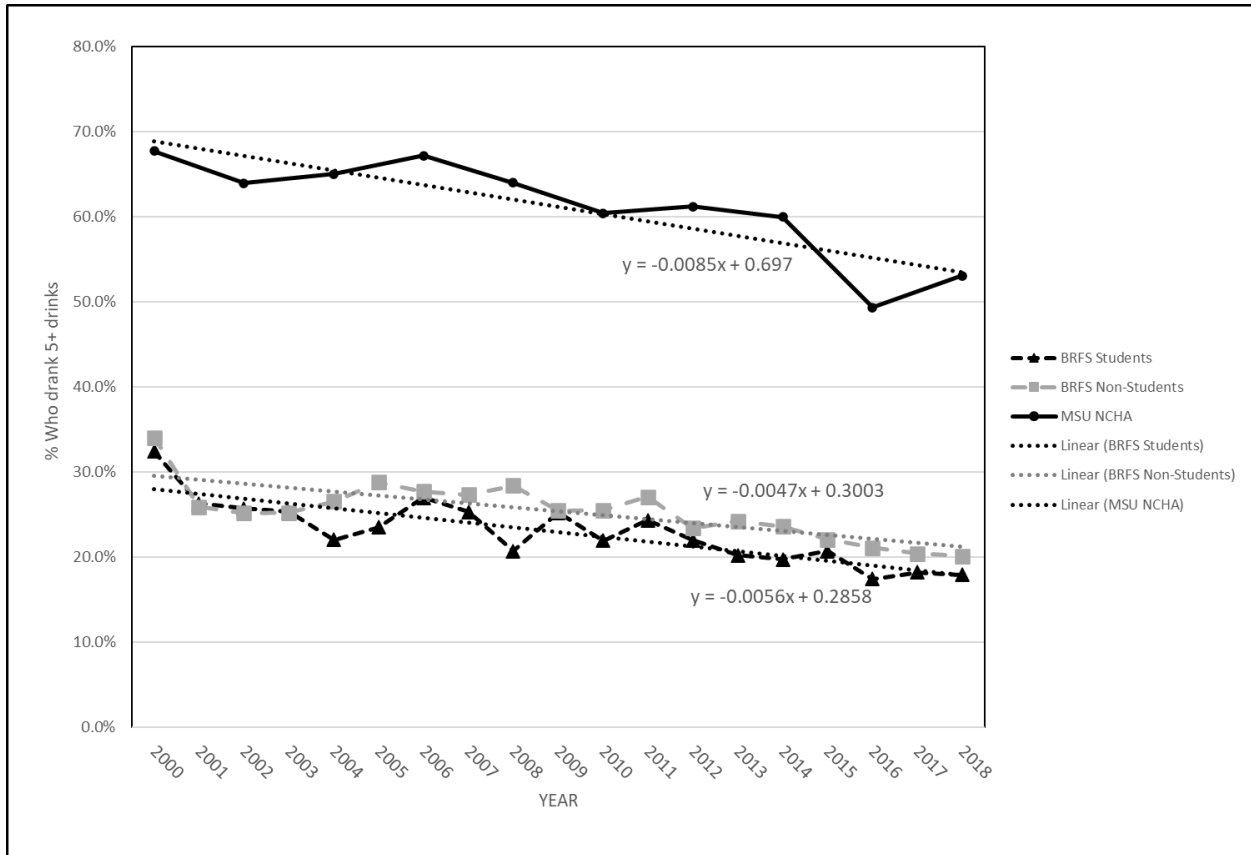


Table 1. Overall Drinking Change 2000 to 2018 and Trendline Slopes Among MSU Students and Quasi-Control Group Populations

Variable	2000	2018	Overall % Change (2018- 2000)	b (slope)
Percent Non-Drinker				
BRFS (18-24 Non-Students)	35.6%	46.4%	30.3%	0.39%
BRFS (18-24 Students)	36.6%	54.7%	49.5%	0.84%
MSU (18-24)	21.8%	29.5%	35.3%	0.41%
MSU (all)	21.6%	29.4%	36.1%	0.44%
National NCHA (all)	30.1%	38.8%	28.9%	0.50%
Percent Drinkers Drank 3+ Days in Month				
BRFS (18-24 Non-Students)	64.5%	71.6%	11.0%	0.31%
BRFS (18-24 Students)	70.1%	68.8%	-1.9%	0.08%
MSU (18-24)	83.4%	74.0%	-11.3%	-0.38%
MSU (all)	82.4%	73.1%	-11.3%	-0.38%
National NCHA (all)	75.7%	71.4%	-5.7%	-0.22%
Percent Drinkers Drank 10+ Days in Month				
BRFS (18-24 Non-Students)	15.9%	26.6%	67.3%	0.28%
BRFS (18-24 Students)	20.1%	20.5%	2.0%	-0.05%
MSU (18-24)	30.7%	21.7%	-29.3%	-0.32%
MSU (all)	30.6%	15.9%	-48.0%	-0.36%
National NCHA (all)	57.6%	37.2%	-35.4%	-1.38%
Percent Drank 5+ Drinks				
BRFS (18-24 Non-Student Drinkers)	34.0%	20.1%	-40.9%	-0.47%
BRFS (18-24 Student Drinkers)	31.2%	17.9%	-42.6%	-0.56%
MSU (18-24 Drinkers)	66.8%	53.1%	-20.5%	-0.85%
MSU (all)	53.4%	33.1%	-38.0%	-1.09%
National NCHA (all)	43.5%	28.8%	-33.8%	-1.00%
Percent Drank 5+ One or More Times Past Month/2 Weeks				
BRFS (18-24 Non-Student Males)	44.3%	21.5%	-51.5%	-0.88%
BRFS (18-24 Student Males)	47.0%	24.4%	-48.1%	-0.97%
MSU (18-24 Males)	62.7%	52.3%	-16.6%	-0.69%
MSU (all, males and females)	51.2%	37.5%	-26.8%	-0.63%
National NCHA (all, males and females)	41.8%	30.6%	-26.8%	-0.76%
Percent Drove after Drinking Too Much				
BRFS (18-24 Non-Student Males)	10.60%	6.10%	-42.5%	-0.19%
BRFS (18-24 Student Males)	9.60%	2.90%	-69.8%	-0.34%
MSU (18-24 Males)	10.90%	0.31%	-97.2%	-0.56%
MSU (all, males and females)	10.20%	0.60%	-94.1%	-0.50%
National NCHA (all, males and females)	12.90%	1.90%	-85.3%	-0.78%

For simplicity, the table shows only the percentages for 2000 and 2018; however, the regression coefficients or slopes for the trendlines are based on all years of data in the figures and have been converted to their percent change per year equivalents. Negative slopes indicate decreasing percentages of respondents over time; positive slopes, increasing percentages of respondents. The larger the absolute value of the slope, the greater the annual rate of change. Comparing the slopes provides an assessment as to among which groups the changes in alcohol-related behaviors were greater, the same, or less than others.

The figures indicate that the prevalence estimates for BRFs students and non-students were similar to each other in 2000 and 2001 but diverged continually through 2018, suggesting that the national trend among students differed from the national trend among non-students regarding non-drinking, drinking frequency, and amount. There was less change (i.e., smaller slopes) among the non-students than among students.

Consistent with Wechsler et al.'s finding that a significant minority of colleges responded to the alcohol concerns in the early 2000s by banning alcohol or restricting its use, Table 1 indicates the slope for the non-drinker trend among BRFs students increased at a faster rate than the trends for either BRFs non-students or MSU students. It also shows that the slope of the trend for NCHA respondents ($b=0.50\%$) was more similar to the trend for MSU respondents ($b=0.44\%$) than it was for BRFs student respondents ($b=0.84\%$).

The SNA campaign at MSU did not urge students to not drink. Its most common message distributed was that the majority drink 0 to 4 drinks (i.e., the actual norm) – the underlying message being that it is normal to drink moderately; abstinence is part of what is normal but so is drinking up to a moderate amount. Consequently, its increase in non-drinking was comparable to that of non-students nationally.

Among respondents who did drink, the percentage who drank three or more days in the previous month increased among BRFs non-students, was virtually unchanged among BRFs students, and declined among both MSU and NCHA respondents, with the decline being slightly greater among MSU than among NCHA respondents. Messages regarding how often students drink were distributed during most years of the MSU SNA effort.

Drinking ten or more days a month represents a higher-level risk of alcohol-related harm, mitigation of which was the particular focus of the SNA at MSU. Figure 3 and the table indicate the trends in the percentage of drinkers who drank ten or more days in the previous month. The figure and table indicate there was an increasing prevalence among BRFs non-students, virtually no change among BRFs students, and, again, a declining prevalence among both MSU and NCHA respondents. The declines were somewhat steeper among the NCHA respondents than among the MSU students.

Alcohol volume consumed per occasion (i.e., drank five or more drinks) declined among all groups, but it declined least among BRFs non-students, followed by BRFs students, and declined most steeply (and similarly) among MSU and NCHA respondents. Messages regarding the majority of students drinking four or fewer drinks when they drink were distributed virtually every semester as a part of MSU's SNA campaign.

While there was little difference in the slopes of their declining percentages of students who drank five or more drinks (i.e., MSU: $b = -1.09\%$ and NCHA: $b = -1.00\%$), there was an appreciable difference in their trends regarding the percentage of respondents who had an estimated Blood Alcohol Concentrations (eBAC) greater than or equal to 0.08 for those occasions (not shown in Table 1). Among MSU respondents, the slope of the trendline for eBAC greater than 0.08 was -1.28% compared to -0.57 among NCHA respondents.

As a social norming approach, messages that correct a misperception of a norm are the intervention expected to alter the subject's understanding of what is normal and, consequently, to change behavior. The messages about the number of drinks most students consume were intended to correct students' over-estimate of the percentage of their peers who drink larger amounts. The mean estimated percentage of students MSU respondents thought drank five or more drinks when they partied declined at a faster rate ($b = -1.23\%$) than was the case among NCHA respondents ($b = -0.88\%$).

Table 1 also indicates that, from 2000 to 2018, the trends among males regarding binge drinking (see Figure 5 also) declined most rapidly among the BRFs students, then NCHA respondents, then MSU respondents and BRFs non-students. The MSU SNA campaign did not distribute messages about this behavior specifically. Messages addressed this only obliquely by representing that most students drink 0-4 drinks when they party. However, from 2010 to 2018, the decline was greatest among MSU respondents ($b = -2.51\%$), was unchanged among BRFs students ($b = -0.03\%$), and increased among BRFs non-students ($b = 1.75\%$). The decline among MSU students ($b = -1.46\%$) was greater than among NCHA respondents ($b = -0.97\%$).

Figure 5. % of 18–24-year-old male drinkers who binge drank 1+ times in previous 2 weeks/month, BRFs students vs. BRFs non-students vs. MSU NCHA students, by year (2000 - 2018)

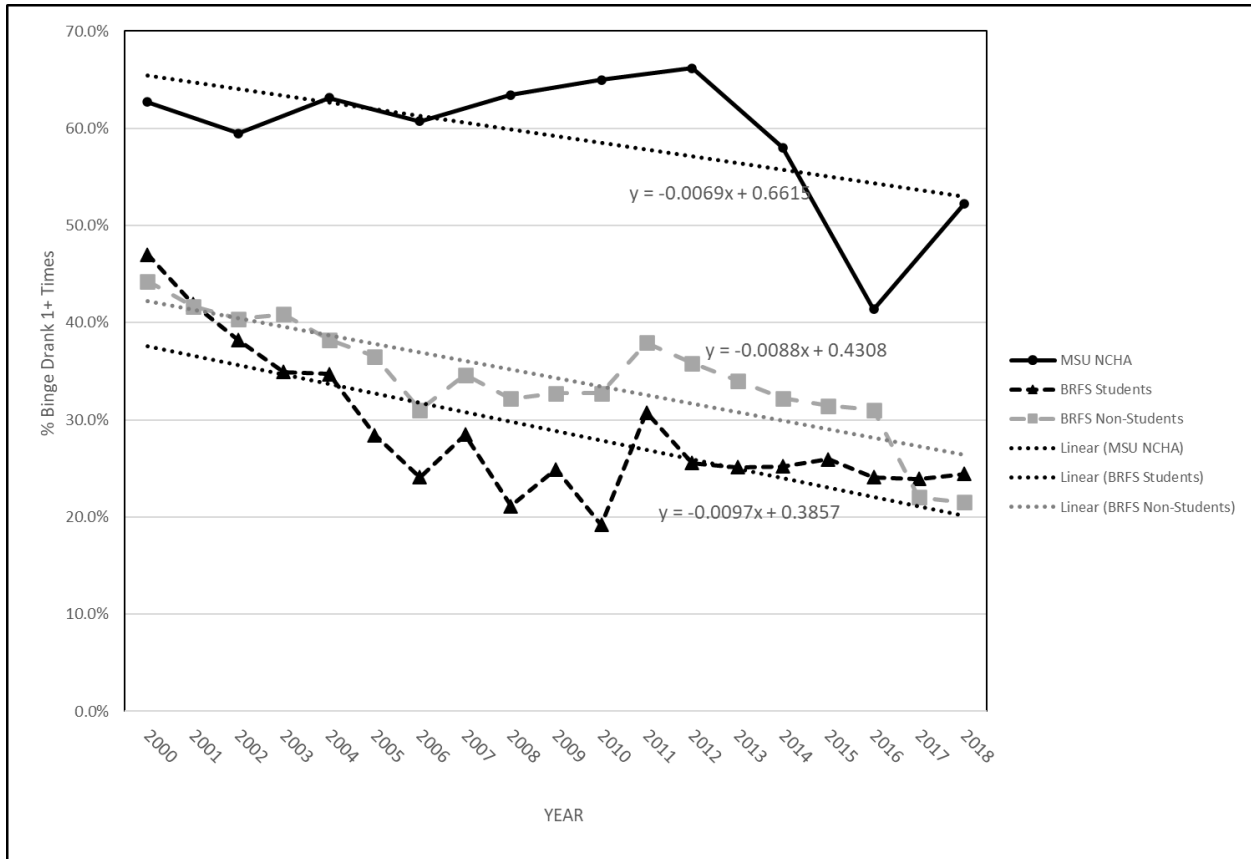
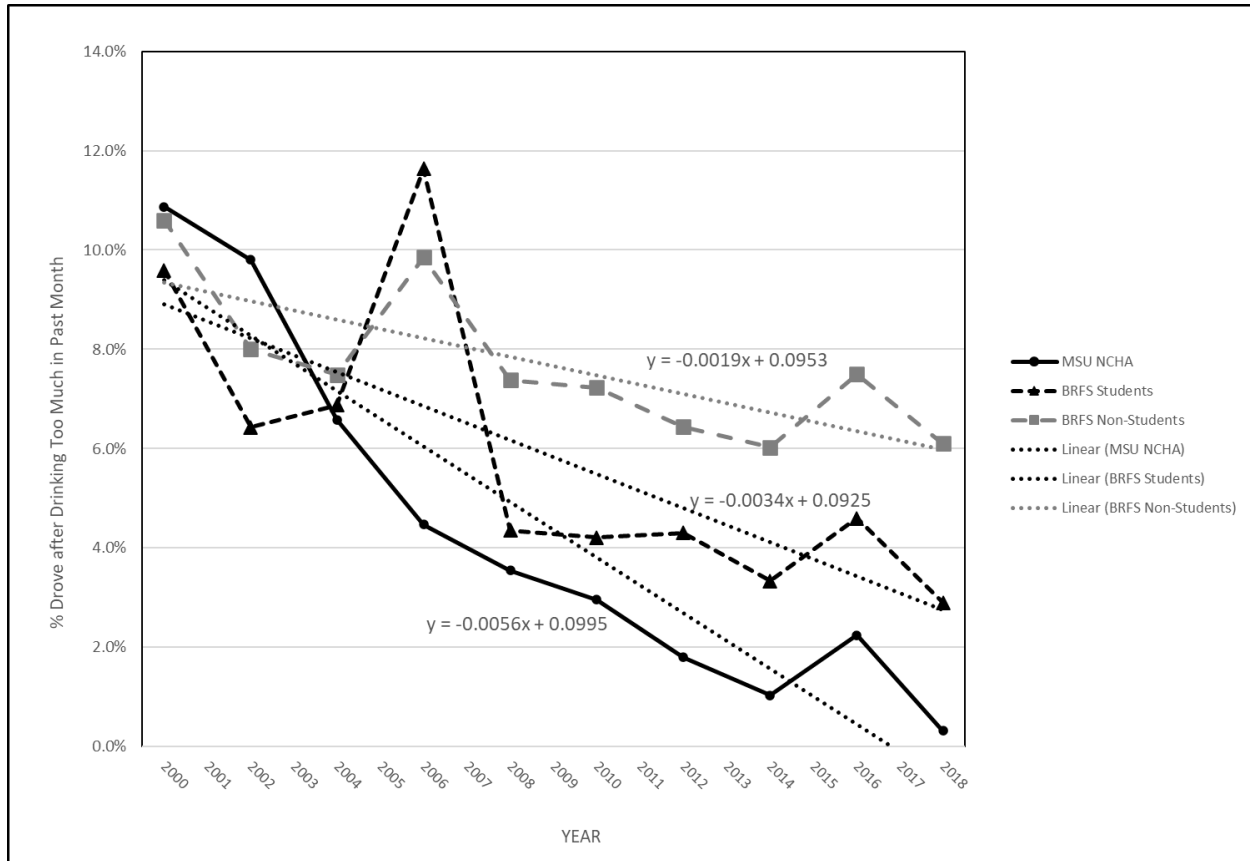


Figure 6. % of 18–24-year-olds who drove after drinking too much in past month, BRFs students vs. BRFs non-students vs. MSU NCHA students, by year (2000-2018)



Finally, Table 1 also compares the slopes regarding percentages of respondents who drove after having had too much to drink^v (see Figure 6 also). Messages regarding not driving ‘buzzed’ or drunk or having a designated driver have been common in the national media. The MSU SNA campaign additionally often distributed messages regarding most students using a designated driver when they party. For this variable, the denominator includes only those who drink and at least sometimes drive. Table 1 indicates that percentages of respondents who reported driving drunk declined among all groups but more steeply among students than non-students, and more so among NCHA respondents than among BRFs respondents. The slope was somewhat less steep among MSU respondents than among the NCHA respondents, but with its 2018 percentage driving drunk being 0.6%, it could not go much lower.

The NCHA data enables comparisons in trends between the NCHA and MSU respondents regarding the use of protective behaviors. While most of the protective behaviors would be addressed in alcohol education programs, only a few can typically be addressed via social norms messages because of the need for majority utilization and a misperception between perceived and actual use.

Table 2 shows the prevalence of always or most of the time using each of the behaviors when partying/socializing. The items are listed in descending order roughly approximating how often social norms messages regarding the behavior were distributed at MSU. Messages regarding the upper six were distributed most years or semesters. Messages regarding the next three were distributed a few times each over the 17 years of the campaign. No message or only a single message was distributed over the course of the campaign regarding the lower three protective behaviors.

The table indicates that the percentages of students who always or often used ten of the twelve protective behaviors increased similarly among both MSU and NCHA respondents. However, among the upper six protective behaviors, the slopes of the trendlines among MSU respondents were steeper on three of the behaviors about which it had often distributed messages, but not as steep regarding use of designated drivers — for which there have also been national promotions throughout this time period — and eating before or while drinking. The slopes of the trendlines among the national NCHA respondents were somewhat greater than those among the MSU respondents for five of the bottom six protective behaviors,^{vi} regarding which MSU seldom or never distributed messages.

Table 2. Overall Change in Use of Protective Behaviors from 2000 to 2018 and Trendline Slopes Among MSU NCHA and Quasi-Control NCHA Respondents

Variable	% Do Always/Most of Time		Overall % Change (2018-2000)	b (slope)
	2000	2018		
Choose not to drink alcohol				
National NCHA	24.8%	22.7%	-8.5%	-0.19%
MSU NCHA	22.0%	17.0%	-22.7%	-0.30%
Use a designated driver				
National NCHA	70.2%	84.1%	19.8%	0.86%
MSU NCHA	77.3%	87.6%	13.3%	0.45%
Eat food before or during drinking				
National NCHA	72.7%	80.8%	11.1%	0.38%
MSU NCHA	76.7%	84.2%	9.8%	0.22%
Have a friend let know when had too much to drink				
National NCHA	28.2%	37.4%	32.6%	0.61%
MSU NCHA	28.7%	41.9%	46.0%	0.72%
Stay with the same group of friends when drinking (2010-2018; Do Always Only)				
National NCHA	41.40%	48.90%	18.1%	0.89%
MSU NCHA	44.10%	52.40%	18.8%	1.20%
Drink only one kind of alcohol (2010-2018; Do Always Only)				
National NCHA	12.8%	15.2%	18.8%	0.28%
MSU NCHA	11.9%	15.3%	28.6%	0.54%
Keep track of the number of drinks consumed (Do Always Only)				
National NCHA	33.8%	41.4%	22.5%	0.40%
MSU NCHA	33.5%	41.3%	23.3%	0.15%
Pace drinks to < 1 per hour				
National NCHA	24.1%	31.7%	31.5%	0.42%
MSU NCHA	23.9%	32.2%	34.7%	0.25%
Avoid participating in drinking games (Do Always Only)				
National NCHA	26.3%	19.9%	-24.3%	-0.35%
MSU NCHA	24.7%	15.1%	-38.9%	-0.54%
Alternate alcohol and non-alcohol beverages				
National NCHA	23.1%	35.3%	52.8%	0.61%
MSU NCHA	21.1%	34.2%	62.1%	0.54%
Set a limit on number drinks ahead of time				
National NCHA	31.0%	40.9%	31.9%	0.59%
MSU NCHA	31.2%	38.7%	24.0%	0.36%
Drink look-alike beverages (2000-2008 Only)				
National NCHA	5.9%	6.0%	1.7%	0.04%
MSU NCHA	5.5%	6.2%	12.7%	0.17%

Table 3. Overall Change in Prevalence of Adverse Outcomes from Alcohol Consumption from 2000 to 2018 and Trendline Slopes Among MSU NCHA and Quasi-Control NCHA

Variable	% Experienced		Overall % Change	
	2000	2018	(2018-2000)	b (slope)
Academic Harm				
National NCHA	8.8%	3.6%	-59.1%	-0.39%
MSU NCHA	10.3%	4.5%	-56.3%	-0.34%
Injury to Self				
National NCHA	17.1%	12.1%	-29.2%	-0.41%
MSU NCHA	23.5%	14.3%	-39.1%	-0.53%
Injury to Other				
National NCHA	5.3%	1.5%	-71.7%	-0.30%
MSU NCHA	4.7%	1.3%	-72.3%	-0.27%
Involved in a Fight (2000 - 2008)				
National NCHA	7.9%	7.4%	-6.3%	-0.23%
MSU NCHA	8.5%	7.0%	-17.6%	-0.24%
Did something later regretted				
National NCHA	37.40%	31.80%	-15.0%	-0.40%
MSU NCHA	45.70%	36.10%	-21.0%	-0.29%
Forgot what did/where were				
National NCHA	29.2%	27.8%	-4.8%	-0.13%
MSU NCHA	36.8%	30.6%	-16.8%	-0.16%
Had forced sex				
National NCHA	1.6%	1.0%	-37.5%	-0.10%
MSU NCHA	2.0%	1.0%	-50.0%	-0.13%
Had unprotected sex (2000 - 2008)				
National NCHA	16.7%	21.8%	30.5%	0.26%
MSU NCHA	21.1%	22.8%	8.1%	0.32%
Got in trouble with the police (2010 - 2018)				
National NCHA	4.8%	2.3%	-52.1%	-0.35%
MSU NCHA	5.0%	2.0%	-60.0%	-0.52%
Had sex without giving consent (2010 - 2018)				
National NCHA	2.1%	1.8%	-14.3%	-0.03%
MSU NCHA	1.7%	1.4%	-17.6%	0.05%
Had sex without getting consent (2010 - 2018)				
National NCHA	0.7%	0.4%	-42.9%	-0.05%
MSU NCHA	0.5%	0.8%	60.0%	0.05%
Seriously considered suicide (2010 - 2018)				
National NCHA	1.8%	0.4%	-77.8%	0.26%
MSU NCHA	0.9%	0.8%	-11.1%	0.23%

Table 3 shows that, for both MSU and NCHA respondents, the percentages of students experiencing harm as a result of their drinking declined appreciably for eight of the twelve types of harm listed. There was virtually no change regarding two other types of harm and slight increases on two others.^{vii}

Trends for nine of the twelve items have slopes that differ little between MSU and NCHA respondents. The slopes for the reduction of academic harm experienced were similar for both groups. The experience of having done something the respondent later regretted declined slightly more steeply among NCHA respondents, while injuring oneself and getting in trouble with the police declined slightly more steeply among MSU respondents.^{viii}

DISCUSSION

The comparisons of alcohol-related trends from 2000 to 2018 among the four survey groups indicate distinctly different patterns that varied with their amount and type of drinking-focused treatments. BRFS non-students, those least subjected to attempts to restrict access or reduce demand, changed less than other groups regarding drinks consumed and driving drunk and actually increased in drinking frequency. BRFS students, those most likely to include students at colleges where they would be subjected to limitations on supply or access in addition to those at colleges likely to use programmatic efforts to reduce alcohol demand, had the greatest increase in non-drinking, but, among those who did drink, demonstrated no change in drinking frequency, and less change in drinks consumed and driving drunk than NCHA respondents and MSU students. The latter two groups, more likely subjected to efforts focused on reducing demand via alcohol education or social norming and less on restricting access, demonstrated increases in non-drinking similar to non-students, but appreciably greater declines in drinking

frequencies, drinks consumed and drunk driving than the other groups. The MSU students, those most heavily subjected to an SNA campaign, demonstrated a steeper decline in BAC per occasion and in the perceived drinks consumed by peers.

NCHA participating institutions include many that conduct multi-pronged alcohol harm-reduction efforts and likely differ from MSU with respect to the relative magnitudes of the efforts that involve social norming, environmental management, and alcohol education, with MSU more heavily focused on social norming. The comparisons of trends between them regarding the use of protective behaviors found somewhat steeper increases in use among MSU students regarding behaviors about which many SNA messages were distributed and steeper increases in use among NCHA respondents regarding behaviors typically promoted by alcohol education programs but regarding which MSU could distribute few or no SNA messages.

Importantly, reported alcohol-related harms and adverse academic impacts declined appreciably and similarly among both NCHA and MSU respondents. The decline was somewhat steeper among MSU students regarding injuries to self and getting in trouble with the police and somewhat steeper among NCHA students regarding doing something they later regretted. That is, the somewhat similar efforts to moderate drinking to reduce harm in both appear similarly effective.^{ix}

Overall, the analysis indicated that the SNA campaign at MSU was effective and its trends differed from those among quasi-control groups that varied from it in the degree or type of intervention effort to which group members were subjected.^x

Limitations. The quasi-control groups are not truly the same as randomized control groups. There is no way to know the specific content of whatever intervention efforts were made at other colleges from which the respondents to the BRFS survey were subjected. Similarly,

there is no way to know how many NCHA participating institutions also used SNA efforts, or which use alcohol education efforts, other approaches, or that did nothing. That is, there is no way to gauge the dosage of their interventions compared to the SNA effort at MSU. There were no BRFSS questions with which to assess the use of protective behavior or harmful outcomes to compare the ‘no treatment’ non-students to those at the colleges that did attempt to reduce problem drinking.

Most of these limitations underscore generally the challenges to developing quasi-control groups for evaluations where random assignment to treatment and control conditions is not possible. Measures that are not identical, methodological or sampling changes over time, limited numbers of measures and measures that don’t cover the full range of impacts expected (i.e., the lack of protective behavior measures in BRFSS) make the quasi-control group less than completely satisfying.

Because of the differences in methodologies, sampling, and numbers of surveys involved, it was not feasible to compile all data into a single file. As a result multiple regression models controlling for a variety of demographic characteristics such as sex, age, marital status, Greek status, race/ethnicity, international/domestic status, athletic status, etc. could not be executed to eliminate the possible effects of these other sources of variation on the trends across years or to calculate confidence intervals around the slopes.

Conclusion. The limitations notwithstanding, these results indicate that the changes occurring at MSU were not simply mirrors of national trends. In some cases, the changes were contrary to national trends and in others they exceeded the rate of change occurring nationally. Coupled with the findings reported by Hembroff et al.,¹⁰ these results strengthen the evidence

that the SNA marketing campaign at MSU was an effective intervention to reduce the various harms associated with high-risk drinking.

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APPENDIX A

Since its inception in 1984¹⁴, the Behavioral Risk Factor Survey of the U.S. Centers for Disease Control and Prevention (CDC) has been administered as a telephone interview using samples of landline telephone numbers. Although mobile phones were first commercially available to the public in this same year, their use did not adversely impact the effectiveness of landline-based sampling for telephone surveys because virtually no one was exclusively dependent on their mobile phone for telephone access. This changed as the technology became more commonplace, as service coverage improved, and as service contracts became less limited.

In 2003, the National Health Interview Survey (NHIS) estimated only 3.5% of adult households were cellphone-only, i.e., were reachable by cellphone but had no landline²¹. In 2004, the Current Population Survey estimated the cellphone-only rate had increased to 6.0%²². In 2007, NHIS estimated the cellphone-only rate was 15.8%²³, and, in 2008, NHIS estimated it to be 17.5%²⁴. That is, by 2008, one-sixth of the adult population was not reachable by telephone sampling based exclusively on landline phones.

Behavioral Risk Factor Survey System researchers became concerned about the potentially increasing error in prevalence estimates generated in BRFS by non-coverage error, i.e., the sampling frame not including all the population to which generalization is intended. This would be especially problematic if those not covered by the landline sampling frame differed from those who were covered. Reports^{25,26} indicated that the cellphone-only population did differ appreciably from those reachable by landline sampling. Those who were cellphone-only were disproportionately younger, unrelated to others in their household, renters, African American, etc.

Additionally, some of BRFs calling protocols were questioned. Standard procedures involved randomly selecting one respondent from among all adults living in the household reached at the landline called. If one of the adults enumerated was a student away at college but was selected as the respondent, interviewers were not allowed to contact that student at a different phone number where the student lived at college and were not allowed to substitute some other resident as the respondent. Interviewers would have to attempt calling the number back hoping to catch the selected respondent when they were home from college visiting. If the landline number sampled reached a group home (i.e., a household at which more than five unrelated individuals lived such as might be the case with a college dormitory, apartment or fraternity/sorority house), the phone number and all those who could be reached by that number were deemed ineligible. These two protocols made it likely that college students would be disproportionately excluded from the landline samples. These two protocols had been in place even prior to the exacerbating impact of cellphones.

Out of concern for the potentially increasing noncoverage bias in prevalence estimates, BRFs pilot tested the inclusion of a cellphone sampling component in 22 states, one of which was Michigan. The planned protocol for the pilot cellphone sample was to interview respondents on their cellphones only if they had no landline. The researchers conducting the Michigan survey elected divergently to also interview individuals sampled via the cellphone frame but who also had a landline telephone.²⁷

Over the course of 2008, the Michigan BRFs interviewed 260 cellphone-only respondents plus 258 cellphone-plus-landline respondents in addition to 5,863 landline respondents. Because it was experimental, the interview administered to those via cellphone was

an abridged version of the landline interview but included demographic items and several health and health-risk behavior items, including alcohol use, smoking, and exercise questions.

The Michigan cellphone sampling test found that, compared to landline respondents, cellphone-only respondents were more likely to be male, 18-29 years of age, students, never married, heavy drinkers, binge drinkers, drove after drinking, smoke cigarettes, and not exercising. That is, they were the kinds of individuals typically under-represented in landline surveys and they were more likely to engage in higher-risk health behaviors. Their absence from landlines samples then meant the prevalence rates for these activities under-estimated these health risk behaviors. Since the cellphone-only population had been growing, the bias would also have been increasing as cellphone technology became more diffused. It also found that those sampled via a cellphone number but who also had a landline had characteristics that were sometimes more similar to landline sampled respondents and sometimes more similar to cellphone-only respondents, thus suggesting that the bias from not including cellphone-only respondents could not be eliminated by weighting alone.

Based on results from the 22 states, CDC implemented cellphone sampling into the overall survey methodology for BRFSS beginning in 2009. At about the same time, CDC relaxed calling protocols regarding group homes and calling selected respondents on their cellphone when they were initially selected based on a sampled landline phone. These protocol changes occurred in 2008. However, it took roughly two years to work out all the procedures to incorporate the cellphone sample data with the landline sample data and to develop, test and finalize weighting procedures. CDC did not include the cellphone sample data as a part of the official BRFSS data set until 2011²⁸.

These changes in the telephone technology, non-coverage, and sampling procedures mean the BRFSS-related trends for 18 to 24-year olds from 2001 to 2010 were increasingly biased. However, by 2011, the revised BRFSS sampling procedures covered virtually the entire 18 to 24-year old population and, from that point forward, the prevalence estimates should be more nearly accurate regarding national trends.

This potentially complicated direct comparisons of trends in MSU's NCHA results and BRFSS's trends. Two strategies were explored to minimize the impact of the non-coverage error on trendlines. One was to add two additional survey data points prior to 2000 (i.e., 1996 and 1998 surveys' results) to allow the trend prior to 2000 to offset the influence of the increasing noncoverage bias on the overall trendline. The second was to blank out the estimates for 2001 through 2010 so their increasing bias would not affect the regression coefficient of the trendline. In the end, the net difference between the coefficients that included 1996 and 1998 or not, or blanked out the estimates from 2001 to 2010 or not, were so small as to be inconsequential for purposes of this analysis. Therefore, including only the BRFSS surveys from 2000 to 2018 but using data from all years seemed most straightforward.

ⁱ For the question regarding numbers of drinks when drinking, BRFSS defines a drink as “a 12-ounce beer, a 5-ounce glass of wine, or a drink with one shot of liquor“ whereas NCHA defines a drink as “a 12-oz. can or bottle of beer or wine cooler, a 4-oz. glass of wine, or a shot of liquor straight or in a mixed drink.“ Regarding drinking frequency, BRFSS asks “During the past 30 days, how many days per week or per month did you have at least one drink of any alcoholic beverage such as beer, wine, a malt beverage or liquor?” while NCHA asks “Within the last 30 days, on how many days did you use alcohol (beer, wine, liquor)?” Regarding amount consumed, BRFSS “During the past 30 days, on the days when you drank, about how many drinks did you drink on the average?” while NCHA asks “Last time ‘partied’/socialized, how many drinks of alcohol did you have?” Regarding frequency of binge drinking, NCHA asks “Over last two weeks, how many times had five or more drinks of alcohol at a sitting?” while BRFSS asks “How many times during the past 30 days did you have 5 or more drinks on occasion?” However, BRFSS revised this question in 2006 so that females were asked about having 4 or more drinks on occasion instead. No comparable change was made for females in NCHA. Regarding drunk driving, NCHA asks “Within last 30 days, did you drive after drinking five or more drinks of alcohol?” while BRFSS asks “During the past 30 days, how many times have you driven when you have had perhaps too much to drink?”

ⁱⁱ See Appendix A for a discussion of BRFs landline sampling and the introduction of cellphone sampling to address concerns about increasing noncoverage error.

ⁱⁱⁱ For 2016-17, the National Center for Education Statistics reported that there were 4,360 degree-granting institutions of higher education in the U.S. with total enrollments of roughly 19.7 million students. {FOOTNOTE: SOURCE: U.S. Department of Education, National Center for Education Statistics. (2019). Digest of Education Statistics, 2018 (NCES 2020-009), Table 105.50.} The likelihood that a non-random sample of less than 5% of these institutions would be unbiased is relatively low so this will have to be considered in assessing the comparisons.

^{iv} These caseweights are designed to make adjustments so that the final data set correctly represents the demographic characteristics of respondents proportionately compared to known population characteristics, typically regarding gender, age, education, race/ethnicity, state of residence, and, in the case of LLCPWT, telephone type status.

^v The question about driving after drinking too much was only included in the BRFs interview in even numbered years.

^{vi} In terms of reducing the risk of alcohol-related harm, a less steep decline in avoiding participation in drinking games would be more desirable. The slope of the trendline for the national NCHA respondents is less steep than that for the MSU respondents.

^{vii} Two of the twelve adverse outcomes were included in the surveys only from 2000 to 2008, while four others were included only in the surveys from 2010 to 2018. Their slopes were calculated based on only the years in which they were included. It is also noteworthy that the time period during which respondents were to reference experiencing the adverse outcome for items in the 2000 to 2008 surveys was within the last school year whereas it was the previous twelve months in the surveys from 2010 to 2018, a longer period of time during which the harm could occur, a significant portion of which would not be while the respondent would likely be on campus.

^{viii} There are questions as to whether “unprotected sex” meant the same thing in 2000 to 2010 when HIV/AIDS was a very pressing issue in addition to pregnancy prevention and STI’s compared to the more recent decade when treatments and other medical protections for HIV/AIDS are available. Similarly, awareness of issues regarding consent and sexual assault likely greatly altered respondent answers over the last decade to the two questions about sex without consent, especially in the intense media climate at MSU in the past five years.

^{ix} To put the magnitudes of change shown here in context, using the BRFs data, the increasing slope of the trendline from 2000 to 2018 for always using a seatbelt when riding in a car was 0.48% among 18-24 year old students and 0.55% among 18-24 year old non-students. These increases were backed by the force of law as well as public service ad campaigns.

^x With a student body of roughly 40,000, an intervention whose trendline declines annually 0.1% more than another intervention’s results in 400 fewer incidents in the tenth year than under the alternative intervention, 720 fewer in the 18th year, and a cumulative total of 6,840 fewer over an 18 year time period.