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ABSTRACT

The CAGE instrument is a 4-item questionnaire used for routine and rapid screening of alcohol problems. The term "CAGE" is an acronym with each letter representing one of the four items that comprise the instrument. A positive endorsement of two or more items is considered to be the threshold score, indicating the possibility of a drinking problem. The CAGE has demonstrated a high degree of accuracy in identifying alcoholism and excessive drinking in adults. The CAGE has been recommended as a screening test that is useful in identifying college students whose alcohol use may warrant further investigation. Two studies were conducted to examine the validity of the CAGE as a screening instrument for detecting problem drinking in a college student population. The two studies were conducted at a large midwestern university in 1988 and 1992. The 1988 sample consisted of 508 student drinkers, 69 of whom were identified as problem drinkers, 204 of whom were identified as normal drinkers, and 235 of whom fell between these two groups. The 1992 sample consisted of 444 student drinkers, 41 of whom were identified as problem drinkers, 197 of whom were identified as normal drinkers, and 206 of whom fell between these two groups. Sensitivity, specificity, and positive predictive values were calculated for all CAGE cutoff scores. Based on calculations from both studies, the CAGE is not recommended for problem drinking screening with college students of either gender. (NP)

# Problem Drinking Screening in College Students Using The CAGE

by

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## ABSTRACT

This poster session presents two studies examining the validity of the CAGE as a screening instrument for detecting problem drinking in a college student population. Two studies, each utilizing random samples of 1000 students, were conducted at a large midwestern university in 1988 and 1992. Sensitivity, specificity, and positive predictive values (PPVs) were calculated for all CAGE cutoff scores. Based on calculations from both studies, the CAGE is not recommended for problem drinking screening with college students of either gender.

## INTRODUCTION

Concern for the issue of problem drinking and alcohol education programs in higher education has increased considerably in recent years. A recent report by a task force representing a variety of student personnel professional organizations indicates that while the majority of the students drink in moderation, there is a substantial minority that misuse alcohol (Johnston, O'Malley, & Bachman, 1986; NIAAA, 1987). Evidence documenting the negative consequences of alcohol misuse have been noted in several reports (Beck, 1983; Hill & Bugen, 1979; Reisken & Wechsler, 1981), and one direction this concern has taken is the search for valid and efficient screening tests for problem drinkers.

The CAGE attempts to be such an instrument. Developed by Ewing and Rouse (1970), the CAGE is a 4-item questionnaire used for routine and rapid screening of alcohol problems. The term "CAGE" is an acronym with each letter representing one of the four items that comprise the instrument. A positive endorsement of two or more items is considered to be the threshold score, indicating the possibility of a drinking problem (Berndt, Taylor, Mumford, Smith, & Murray, 1982; Mayfield, McLeod, & Hall, 1974). The CAGE has demonstrated a high degree of accuracy in identifying alcoholism and excessive drinking in adults assessed within a variety of medical settings ( GAO, 1991; Mayfield, McLeod, & Hall, 1974; Niles & McCrady, 1991; Wayland & Hardwicke, 1991) and within a more general population (Smart, Adlaf, & Knoke, 1991). Use of the CAGE as a definitive diagnostic test with a college population is not recommended (Kinney & Meilman, 1987), but it is recommended as a screening test that is useful in identifying individuals whose alcohol use may warrant further investigation (Clark, 1985). This recommendation was ultimately challenged in a study of college freshmen (Smith, Collins, Kreisberg, Volpicelli, & Alterman, 1987). Heck and Lichtenberg (1990) provided additional evidence questioning the screening capability of the CAGE with a college student population. This poster session will report on the results of two studies: the Heck and Lichtenberg study that was conducted in 1988 and a replication study conducted four years later.

STUDY 1 (1988)

## METHOD

During the spring 1988 semester, a random sample of 1000 degree-seeking students, attending a large, public, midwestern university was mailed a confidential questionnaire soliciting responses concerning their alcohol use. The 17-item survey contained several demographic items, weekly quantity and frequency alcohol consumption items (Hickenbottom, Bissonette, and O'Shea,1987), negative effects items (Smith et al. (1987), and the four items of the CAGE. Excluding non-drinkers and incomplete returns, a total of 508 student drinkers had complete questionnaires which were used for the data analysis.

Within the literature there is no consistent definition of problem drinking.For the purposes of this study, the definition of problem drinking is highly similar to Smith et al (1987) and is based on combining different levels of consumption (i.e., quantity-frequency) and negative effects variables. That is, a problem drinker was defined as one who had at least 7 or more drinks one to two times per week, or 5-6 drinks more than 2 times per week, AND endorsed at least 3 negative effects as a result of drinking. A normal drinker was defined as one who had at least 1-2 drinks less than once a week, or 3-4 drinks less than once a week, or 1-2 drinks 1-2 times per week. Normal drinkers also had to endorse fewer than 3 negative effect items. To avoid ambiguity in the analysis, students who fell between these consumptive and negative effect categories were not included in the data analysis.

The primary purpose of a screening test is to raise one's suspicion, when results are positive, that a possible problem condition in an asymptomatic population exists (Griner, Mayewski, Mushlin & Greenland, 1981). Further testing and possible treatment may be warranted. Using the CAGE as an example, *sensitivity* refers to the probability that the test will be positive when problem drinking is present. It reflects the instrument's ability to identify true problem drinkers and is the single most important test characteristic when the purpose is screening. *Specificity* refers to the probability that the CAGE will be negative when problem drinking is not present. It represents the true negative rate and reflects the ability to confirm the presence of a condition like problem

drinking. It is the more important index for providing a definitive diagnosis. Whether the CAGE is positive or negative is determined by the cutoff or criterion scores used to distinguish between problem and normal drinking groups.

Knowledge of a test's sensitivity and specificity cannot, per se, determine the presence or absence of problem drinking unless the the CAGE is always positive when problem drinking is present (sensitivity=100%) or always negative when problem drinking is absent (specificity=100%). Since neither of these conditions almost ever occur for a test, it is important to know that if a positive CAGE is obtained, what is the likelihood of problem drinking actually being present (positive predictive value). Similarly, if the CAGE is negative, what is the probability that problem drinking is not present (negative predictive value)? Estimating the predictive values of either a positive or negative CAGE requires combining the known operating characteristics (sensitivity or specificity) of the CAGE with prior estimates of the extent of problem drinking in the college population. Because this research was concerned with the screening efficacy of the CAGE, the sensitivity and positive predictive value (PPV) at various cutoff scores was of primary importance.

## RESULTS (STUDY 1)

Sixty-nine students were identified as problem drinkers (13.6%), 204 students were identified as normal drinkers (40.2%), and 235 students (46.3%) fell between these two groups. Of the problem drinkers, 50 were males (19% rate) and 19 were females (8% rate). Sensitivity, specificity, and PPV data for the CAGE is presented in Table 1 (total group) and Table 2 (gender). The PPV values for any of the possible cutoff scores are not sufficiently high to serve as an adequate screening function and this is particularly true for females. At the typical recommended score of >2 for a positive test, the sensitivity and PPV values are too low for both the total group and either gender. At this score, less than 50% will have a problem with alcohol. These results supported the conclusions made by Smith et al. (1987) regarding the inadequacy of the CAGE for screening in a college population.

STUDY 2 (1992)

In 1992 a replication of the 1988 survey was performed at the same university using identical sampling and data analysis methods and criteria for problem drinking. A few items between both surveys were different but the data used for this report was identical.

## RESULTS (STUDY 2)

Excluding non-drinkers and incomplete returns, a total of 444 student drinkers had complete questionnaires which was used in the data analysis. Forty-one students were identified as problem drinkers (9.2%), 197 students were identified as normal drinkers (44.4%), and 206 students (46.4%) fell between these groups. Of the problem drinkers, 32 were males (7.2% rate) and 9 were females (2% rate). There was underrepresentation of males in this study, although both sexes showed a substantial drop in the problem drinking rate from the previous study. There was an increase in the sensitivity values,but the PPV was still quite low--with only minor variations from the 1988 PPV levels. In this replication study, the data on gender indicates the CAGE was less sensitive and predictive with females compared to males. As in the first study, when balancing sensitivity with PPV, the data for the combined groups indicates relatively low values across the range of cutoff scores.

## DISCUSSION and CONCLUSIONS

The data from both surveys supports the findings of many other studies reporting males having a higher rate of problem drinking than females. Also, the data is reasonably consistent between the two surveys regarding the low operating or screening characteristics of the CAGE. It should be noted that in a screening measure there is more acceptance for "false positives" than is accepted in a diagnostic measure, for the screen is meant to raise suspicion, not properly diagnose. In other words, sensitivity and positive predictive values are the most valuable test operating characteristics in screening instruments. In both studies reported here, there was a consistent imbalance between sensitivity and PPV, regardless of sex. The low operating values, in conjunction with the imbalance, is even more apparent with females. The results in these studies suggest the CAGE is not recommended for problem drinking screening with either gender.

It may be the case that any screening test, for this particular problem, will have difficulties showing adequate test operating characteristics. One reason for this could be that problem drinking, as defined by the criteria used in this study, was a reasonably infrequent event in these samples. In a review of 24 studies providing normative estimates of problem and/or heavy drinking in college populations (Heck & Williams, 1993), the prevalence rates of our samples were at the lower end of the 4-72% range found in these studies. In addition to criterion differences that affect the rates, there are regional differences in problem drinking rates. It would be very helpful to future research to use an acceptable and uniform criterion. Until that consistency is achieved, evaluating screening instruments will remain problematic.

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Table 1

CAGE Test Characteristics for 1988, 1992, and Combined Samples at Varying Cutoff Scores

| Sample | Cutoff Score | Sensitivity (%) | Specificity (%) | PPV (%) |
|---|---|---|---|---|
| 1988 | >1 | 57 | 76 | 27 |
| | >2 | 26 | 95 | 46 |
| | >3 | 15 | 99 | 71 |
| 1992 | >1 | 83 | 80 | 29 |
| | >2 | 39 | 96 | 49 |
| | >3 | 15 | 100 | 74 |
| Combined | >1 | 66 | 78 | 29 |
| | >2 | 31 | 96 | 48 |
| | >3 | 15 | 99 | 73 |

Note: Estimate of problem drinking in the population used to calculate PPV was 1988 (14%), 1992 (9%), Combined sample (12%). Percentages are rounded off.

Table 2

CAGE Test Characteristics by Gender at Varying Cutoff Scores

| Group | Cutoff Score | | | | | |
|---|---|---|---|---|---|---|
| | >1 | | >2 | | >3 | |
| | males | females | males | females | males | females |
| 1988 | | | | | | |
| Sensitivity | 56 | 58 | 26 | 26 | 12 | 21 |
| Specificity | 75 | 76 | 93 | 97 | 98 | 100 |
| PPV | 35 | 17 | 46 | 41 | 55 | 100 |
| 1992 | | | | | | |
| Sensitivity | 91 | 56 | 41 | 33 | 16 | 11 |
| Specificity | 83 | 78 | 95 | 96 | 98 | 100 |
| PPV | 53 | 10 | 63 | 27 | 66 | 100 |
| Combined Samples | | | | | | |
| Sensitivity | 70 | 57 | 32 | 29 | 13 | 18 |
| Specificity | 79 | 77 | 94 | 97 | 98 | 100 |
| PPV | 42 | 14 | 53 | 34 | 59 | 100 |

Note. Population estimates of problem drinking used to calculate PPV were: 1988--males (19%), females ((8%); 1992--males (17%), females (4%); Combined Sample--males (18%), females (6%). Percentages are rounded off.