DOCUMENT RESUME

ED 253 807 CG 018 010

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TITLE Evaluation of an Alcohol Abuse Prevention Program Correcting for Self Selection.
SPONS AGENCY National Inst. on Alcohol Abuse and Alcoholism (DHHS), Rockville, Md.
PUB DATE Aug 84
GRANT NIAAA-HS4-AA05513
NOTE 22p.; Paper presented at the Annual Convention of the American Psychological Association (92nd, Toronto, Ontario, Canada, August 24-27, 1984). Data collection for this study was supported in part by funds provided for medical and biological research by the State of Washington Initiative Measure No. 171.
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Alcohol Education; College Students; Drinking; Higher Education; Longitudinal Studies; Place of Residence; Predictor Variables; *Prevention; *Program Effectiveness; *Research Problems; Social Environment
IDENTIFIERS *Self Selection Bias

ABSTRACT

Self-selection bias poses a major threat to the validity of research findings in naturalistic, quasi-experimental, or single-group designs. A new method of addressing self-selection bias in naturalistic evaluations of prevention programs was implemented. The study, involving voluntary exposure to multicomponent interventions, was developed and applied to an evaluation of an alcohol abuse prevention program in which student participation in hall-based programs was conditioned by choice of where to live. A longitudinal mail survey of students in 1978 (N=274) and 1980 (N=197) assessed the impact of the alcohol abuse prevention program implemented in the intervening years. The effects of three interventions were compared: (1) alcohol education; (2) structured drinking environments; and (3) living group self-regulation activities. Choice of living environments and other variables were controlled. Outcome measures included alcohol consumption and alcohol-related problems. Results generally showed a lack of program impact. Aggregate levels of both drinking and problems differed substantially across living groups, and a strong selection rule was found predicting the probabilities of being in each living group. Problem drinkers did not avoid program exposure even though programs were offered in the living groups. The findings suggest that after correcting for possible self-selection bias, differences in alcohol consumption and problems must be accounted for primarily by sorting between living groups rather than by living group climate or other environmental factors. (JAC)

Evaluation of an Alcohol Abuse Prevention Program Correcting for Self Selection

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Presented at the 92nd Annual Convention of the

American Psychological Association,

Toronto, Canada, August 1984.

Data collection for this study was supported in part by funds provided for medical and biological research by the State of Washington Initiative Measure No. 171. The analysis was supported by the Division of Prevention, National Institute on Alcohol Abuse and Alcohol, Grant No., HS4 AA05513. The authors would like to acknowledge the invaluable assistance of Wayne Joerding, Andy Gill, Pete Karzmark, and Nancy Wallace.

Abstract

A new method for addressing self-selection bias in naturalistic evaluations of prevention programs involving voluntary exposure to multicomponent interventions was developed and applied. The impacts on students' drinking patterns of degree of participation in (a) alcohol education, (b) structured drinking environments, and (c) living group self-regulation activities were compared after statistically controlling for codetermined choice of living environments and other variables. Data was drawn from a two-year longitudinal survey bracketing implementation of a comprehensive alcohol use policy in the university's residence halls. Results are presented and implications for planning and evaluating environmentally based prevention policies involving self selection in program exposure are discussed.

Evaluation of an Alcohol Abuse Prevention Program Correcting for Self Selection

Many programs call for evaluation designs which depart from ideal experiment. When naturalistic studies, quasi-experimental or single-group designs must be used, self-selection bias constitutes a major threat to validity of findings (Campbell & Stanley, 1966; Muthén & Joreskog, 1983). For instance, in cases where program participation is determined by the same exogenous factors as predict outcomes, prediction equations for both participation and outcomes are likely to contain correlated error terms (Duncan, 1981). If a goal is to compare outcomes between groups with different participation levels this presents a problem; the samples are non-random, violating important assumptions of linear regression.

Currently, there is much interest in the program evaluation field in methods recently developed by econometricians, notably Heckman (1978, 1979), for estimating population parameters from non-random samples. The authors applied a modified instrumental variable method (Theil, 1971) treating sample selectivity as a proxy-variable problem (Duncan, 1981) to examine program impacts in such a free-choice environment.

An evaluation of a multi-component campus alcohol abuse prevention program for the National Institute on Alcohol Abuse and Alcoholism faced self-selection difficulties. Students' exposure to hall-based interventions was conditioned by their choices of where to live--residence hall, Greek system, or off-campus. Past studies had shown residence choice and outcome measures (alcohol-related problem and drinking levels) to be co-determined (Greenfield, Karzmark, Haymond, Wyatt & Gunns, 1980). At the university in question, a housing rule required virtually all freshmen to

live in a residence hall during their first semester on campus. The alcohol abuse prevention program capitalized upon this fact by focusing all efforts in residence halls. The evaluation assumed all subjects could potentially chose to participate, but to an extent conditioned by subsequent choices of where to live.

The hall-based program involved three components: (a) alcohol education programs in the dormitories; (b) negotiation and planning between staff and students regarding hall alcohol use regulations; and (c) an environmental intervention, designed to promote responsible drinking, which structured hall floor parties at which alcohol could be served (Greenfield, Joerding & Duncan, 1982). The evaluation goal was to assess the incremental contribution of exposure to each component in a context in which the subject's choices of where to live could affect both program exposure and outcomes. Thus, compared to a student remaining in a hall, one moving to a Greek house might be expected (a) to have reduced (but not zero) opportunity to participate in the hall programs, (b) to be influenced by fraternity or sorority peers to increase drinking and problem involvement, and possibly (c) to have self-selected into Greek housing on the basis of a pre-existing propensity for heavy alcohol use.

Method

Subjects

Data were drawn from a longitudinal mail survey of a random sample of undergraduate and graduate students enrolled Fall, 1978, at a large Western state university, and resurveyed exactly two years later in November, 1980. The three-faceted alcohol abuse prevention program was implemented

in residence halls during the intervening years. After multiple follow-up efforts, response rates were 73% and 49% respectively. It was possible to link 55% of the initial respondents to a Time 2 questionnaire using an anonymous self-generated code (Greenfield & Nelson, 1982). For present purposes, we excluded graduate and married students (who could not live in residence halls) and those few who reported never drinking. Analysis involved the 197-245 resultant cases with complete data at both times (depending on the model).

Given the potential for bias due to nonresponse and attrition, univariate distributions of this final group were compared with those of the initial respondents and, where possible, with the nonexcluded population. Women (58%) were over-represented in the final sample compared to the population (45%), while on other demographics such as age, family income, and size of home community the groups were not significantly different. The sample used for analysis, though small, appears quite representative. Of equal importance for validity of findings, cases lost because of attrition or incomplete data were not found to have significantly different drinking patterns from those retained.

Procedure

Variables used in the 12-page questionnaires at both times were drawn from previous studies at the University of Michigan and from Cahalans' (Cahalan, Cisin & Crossley, 1969; Cahalan & Treiman, 1976) national studies at the Social Research Group (now Alcohol Research Group), Berkeley. Outcome measures included an interval variable assessing average daily volume of alcohol consumed in the previous month (Greenfield

& Haymond, 1980) and a 25-item alcohol-related problem scale with dichotomous items included on the basis of previous studies using scalogram (Greenfield et al., 1980), cluster (Fillmore, Bacon, & Hyman, 1979), and crossclassification (Knupfer, 1982) analyses. All item-total correlations were high, typically in the .3 to .6 range, yielding a high coefficient of internal reliability (KR-20=.82). Choice of predictor variables was based on the epedemiological literature and previous campus studies of alcohol use (Wechsler & McFadden, 1979; Greenfield et al., 1980). The following factors were selected: age, gender, size of home community, whether urban or rural, whether Catholic, parental family income, age of drinking onset, class cohort, and whether out of school in labor force at Time 2.

The analysis strategy used a novel application of the instrumental variable method to obtain consistent estimates under the conditions outlined above (Duncan, 1982). First, the relative log odds of choosing one of the living groups was estimated using a multivariate logit model including all exogenous variables used in the later outcome analysis. The model is essentially a special form of the log linear model (Bishop, Feinburg, and Holland, 1975). In this step the probabilities of being found in each living group, given personal characteristics, were found. Next, these predicted probabilities were used to adjust the independent variables of the linear model explaining outcomes. (The natural log transform of the dependent measures was used to avoid predictions falling outside the possible range of the dependent variables; however estimates using the untransformed variables were qualitatively similar.) Other work had demonstrated that these adjusted regressors, when used in a least-squares-type procedure, consistently estimate the desired parameters (Duncan, 1981).

At this stage, an F-test was performed of how likely it was that a model estimating parameters separately for each living-group subsample differed from the model in which parameters were restricted so as to take one value regardless of living group. This test determined whether data could be pooled after correction for sample selectivity. The use of instruments corrects for the effects of self-selection so that the parameter estimates overall, and in each subsample, are consistent and will tend to be unbiased in large samples (Greenfield et al., 1982).

As a final check, given the assumption that self selection in degree of program exposure exerted its primary influence through living group choice, the ability of personal characteristics and initial drinking levels to predict program participation was examined in a linear regression framework, taking program participation as dependent.

Results

The aggregate levels of both drinking and problems differed substantially across living groups. For example, fraternity men consumed an average of 1.97 drinks per day compared to .88 for men remaining in residence halls (see Table 1). A strong "selection rule" was found

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Insert Table 1 about here

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predicting the probabilities of being in each living group, relative to the others (see Table 2). The overall likelihood ratio test

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Insert Table 2 about here

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was highly significant ($\chi_2(42) = 399.84$, $p < .0001$), indicating that

the logit-predicted choice (85% accurate) was much greater than that expected by chance.

In the second stage of the analysis, we examined the question: were different models for predicting outcomes estimated for each living group? F-tests for restrictions gave values considerably below those required to reject the null hypothesis of no differences, after correcting for biases that self selection could have introduced (e.g. $F(38,145) = .5212$; F-critical = 1.39 in the case of average drinking volume; $F(38,145) = .6930$, F-critical = 1.39 for Number of Problems). Thus, the estimated parameters for the complete sample were found to be an adequate set of estimates (i.e., regardless of living group). Results for the two models (one taking consumption volume, the other, number of problems, as the dependent variable) in the restricted case are given in Tables 3 and 4, respectively.

Insert Tables 3 and 4 about here

None of the three program variables--number of alcohol education programs attended, degree of involvement in negotiating hall alcohol-use regulations, and number of structured-drinking parties attended--was found to reduce drinking or problem levels (see Tables 3 and 4). In fact, party attendance had positive standardized parameter estimates (e.g., $\beta = .18$, $p < .05$ for drinking volume) in models predicting both outcomes. This indicated that greater party attendance predicted higher volume and problem levels. The other two components were not found to affect outcomes

significantly and only involvement in living-group self regulation had estimates in the desired direction (but with large standard errors, making interpretation unwise).

Lastly, none of the six models that were tried were found to predict program attendance well. Drinking levels and age of first drinking were not significant in these models. Therefore, on this campus where programs were offered in the living groups and holding parties with alcohol was made contingent upon program attendance, more problematic drinkers were not found to avoid program exposure.

Discussion

The present analysis is based on a small sample and should best be considered a methodological pilot study. Substantive findings are tentative. The lack of positive change attributable to this campus-based multistrategy prevention program is less novel than the attempt to compare several prevention methods in a natural setting. These methods included both traditional information dissemination, not expected to be effective by these evaluators (Alden, 1980), and policy or environmentally based interventions of great interest to prevention specialists today (De Luca, 1981; Moore & Gerstein, 1981). Data external to this analysis suggests that one reason for the lack of positive impacts in this case was the lack of staff monitoring of the structured-drinking environments (Greenfield et al., 1982). Students didn't perceive party guidelines being adequately enforced. Such policy and environmental strategies therefore require further testing.

Given the large between-living-group differences in aggregate drinking and problem levels, the finding that different models were not estimated

for each residence type can be interpreted as evidence in support of an agglomeration, rather than a peer influence, process accounting for the significant differences in living-group drinking patterns. This implies that after correcting for possible self-selection bias, differences in alcohol volumes and problems must be accounted for primarily by sorting (on person characteristics) between living groups rather than by a living-group climate or other environmental factor, or else the parameters would have been found to differ between living groups.

This finding, suggesting that fraternity excesses were due more to an agglomeration phenomenon than to peer influence once "rush" had taken place is intriguing, if not too surprising. From the prevention standpoint, seeking ways of reducing detrimental features of "birds of a feather to flocking together" might best begin by influencing the flocking process. How to do this without abrogating civil rights is not clear.

Despite the limitations in ability to draw casual inferences inherent in naturalistic studies, the method used allowed the incremental effects of a multifaceted program to be investigated by taking account of potential self-selection bias in a situation where self selection is demonstrably occurring. The method, one of a class of techniques being applied increasingly in program evaluation (cf. Stromsdorfer & Farkas, 1980; Hennessy, 1983) could be particularly useful in evaluating prevention techniques (Joffe, Albee, & Kelly, 1984) which, by their very nature, must involve selectivity inexposure, e.g., mass media health-promotion campaign (Flay, 1981). Such methods may also be useful in comparative evaluation of treatments (e.g., for substance abuse) where different types of patients

may preferentially select or be captured by different kinds of agencies or programs (Moos, Cronkite, & Finney, 1982).

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Table 1. 1980 Means of Average Daily Volume (ADV; units: drinks/day) and Number of Problems broken down by Residence Type and Sex of undergraduates in 1978 who remained unmarried by 1980. (n = 330)

Residence Type	Sex	n	ADV*	Number Problems*
Residence Hall	F	18	.85	1.72
	M	17	.88	2.88
Greek System	F	14	1.10	2.71
	M	20	1.97	5.00
Off campus/Apartment	F	65	.82	1.52
	M	52	1.12	2.69
Left School	F	77	1.02	3.12
	M	65	1.30	3.29

*Two way ANOVA: Res. Type and Sex main effects both significant (p <.01), no interaction. Duncan post-hoc test indicates Greeks and males are higher than others.

Table 2. Results of logit analysis with Residence Type in 1980 as dependent variable for students who were unmarried undergraduate drinkers in 1978. (n = 274)

Independent Variable	Final Logit Coefficients (with respect to 4: out of school) 1 RES. HALL	2 GREEK	3 OFF-CAMPUS
Sex	-.155	-.740	-.950
Size of Home Community	-.942	-1.10	-.039
Rural/Urban Dummy	1.17	1.61	-.276
Semesters in Current Res. Type	2.62	2.31	1.26
Whether Catholic or Not	-.169	1.21	.494
1980 Class Standing	-16.54	-16.53	-15.22
If Left School whether Employed	-1.72	-.472	-.923
Age in 1979	-.168	-.250	.121
Age at First Drink	-.0153	-.0469	-.0133
Family Income	.0000068	.0000091	-.0000018
Alcohol Education Programs Attended	1.15	.826	.569
Degree of Involvement in Self-Regulation	.149	-.0832	-.1135
Floor Parties Attended	.0363	-.146	.0084
Average Daily Volume in 1978	-.00034	.00030	.000130
		T-RATIOS	
Sex	-.180	-.900	-1.62
Size of Home Community	-1.129	1.49	.0927
Rural/Urban Dummy	.731	1.09	-.283
Semesters in Current Res. Type	6.45*	6.23*	4.65*
Whether Catholic or Not	-.174	1.27	.803
1980 Class Standing	-.344	-.344	-.317
If Left School whether Employed	1.12	341	-1.63
Age in 1979	-.844	-. 22	1.007
Age at First Drink	.227	- .21	.281
Income	.198	.283	-.0761
Alcohol Education Programs Attended	3.07*	2.19*	1.76
Degree of Involvement in Self-Regulation	.509	-.231	-.458
Floor Parties Attended	.584	-1.71	.244
Average Daily Volume in 1978	.888	1.02	.602

Percent Correctly Predicted: 85%

Likelihood Ratio Test Overall: $\chi^2(42) = 399.84$

Table 3. Results of regression in restricted case using instrumental variables method with log Average Daily Volume as dependent variable for students who were unmarried undergraduate drinkers in 1978 with complete data. (n = 197)

Independent Variable	Parameter Estimate	T-Ratio
Intercept	5.6790	5.7388*
Residence Type Instrument	.0664	.3607
Sex	.3145	2.2867*
Grow Up	.0896	.8512
Rural/Urban dummy	-.1953	-.7960
Semesters in Current Res. Type	.0648	1.3521
Whether Catholic or not	.0774	.4976
Age in 1979	-.0434	-1.1684
Age at First Drink	.00073	.0355
Family Income	.000006	1.0463
Alcohol Educ. Programs Attended	.0472	.9775
Degree of Involvement in Self-Regulation	-.03503	-.8616
Floor Parties Attended	.0238	2.5599*
Average Daily Volume in 1978	.00047	8.8063*

F - Ratio 9.59

R - Square .4051

F - Test For Restrictions

F(38,145) = .5212

F* Critical Level = 1.39

* Indicates Significance at .05 Level

Table 4. Results of regression in restricted case using instrumental variables method with log Number of Problems in 1980 as dependent variable, for students who were unmarried undergraduate drinkers in 1978 with complete data. (n = 197)

Independent Variable	Parameter Estimate	T-Ratio
Intercept	.8541	1.1961
Residence Type Instrument	-.0075	-.0587
Sex	.1591	1.0378
Grow Up	-.0844	-1.1343
Rural/Urban Dummy	.2192	1.2740
Semesters in Current Res. Type	.0260	.7651
Whether Catholic or not	.1932	1.8140
Age in 1979	-.0374	-1.4201
Age at First Drink	-.0066	-.4313
Family Income	.0000018	.3849
Alcohol Educ. Programs Attended	.0300	.8924
Degree of Involvement in Self-Regulation	-.0228	-.8027
Floor Parties Attended	.0137	2.1332*
Number of Problems in 1978	.1550	11.4788*

F - Ratio 13.60

R - Square

F - Test For Restrictions

F(38,145) = .6930

F* Critical Level = 1.39

* Indicates Significance at .05 Level

Appendix

Patterns of Student Life and Alcohol Use Project

TWENTY-FIVE ITEM PROBLEM SCALE FOR USE AT T1 & T2

SCALE 'ITEM'	VARIABLE (T2)	QUESTIONNAIRE LOCATION	CRITERION TO ADD ONE POINT TO SUMMATIVE SCALE
1.	ZMXSLEVL	B4-B p4	any Quantity Per Occasion 8 or more last month
2.	ZMXSLEVL	B4-C p4	any Q.P.O. 12 or more last month
3.	ZAVERHI	B2 p3	"high or tight" at least 1-2 times/wk last yr.
4.	ZAVERHI	B2 p3	"high or tight" at least 3-4 times/wk last yr.
5.	ZEGHTOFT	B5 p3	8 or more drinks at least 1-2 times/wk last yr.
6.	ZHRSDRK8	B6 p3	Time to consume 8 drinks usually ≤ 2.5 hrs.
7.	ZFRGTALL	B10-E p5	drinking to forget everything - very important
8.	ZFRGTALL	B10-E p5	" " " " - at least fairly important
9.	ZNERVOUS	B10-K p5	drinking when tense/nervous - very important
10.	ZNERVOUS	B10-K p5	" " " - at least fairly important
11.	ZDRFIRST	B14-A p7	drinking first thing in a.m. - true now
12.	ZRSNSOBR	B14-B p7	sometimes drunk when important be sober - now
13.	ZQKDRNK	B14-C p7	drink before a party to get enough - now
14.	ZSNKDRNK	B14-D p7	sneaking drinks - now
15.	ZDRBYSLF	B14-E p7	drink more when by myself - now
16.	ZRDHNGR	B14-F p7	drink to get rid of hangover - now
17.	ZDTRBR	B14-G p7	blackouts - now
18.	ZPASOUT	B14-H p7	almost always drink till pass out - now
19.	ZKPTDRNK	B14-I p7	loss of control - now
20.	ZMESMPRO	E2-D p9	I have some drinking problems
21.	ZMEDRUNC	E2-E p9	driven after having too much to drink
22.	ZMEINTSC	E2-F p9	drinking interferes with classes or work
23.	ZMEOBNX	E2-G p9	used drinking as excuse for unaccept. behavior
24.	ZMEWRRD	E2-H p9	worried about own drinking at times
25.	ZMENCDKM	E2-I p9	encouraged another to drink more

(Note: A 32 item scale for use at T2 was constructed by adding items E2 K-Q)

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