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Driving Behavior of Alcohol, Cannabis, and Cocaine Abuse Treatment Clients and Population Controls

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ABSTRACT

Background/Introduction: A paucity of research exists on driving after use of cannabis or cocaine among clients in substance abuse treatment and changes in this behavior after treatment. *Objectives:* The objectives of this research are to compare treatment clients and population controls before and after treatment in terms of: 1) amount of driving; 2) alcohol, cannabis, and cocaine consumption; 3) driving after use of alcohol, cannabis, and cocaine; and 4) driving infractions. *Method:* Telephone

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interviews were conducted with a sample of 110 clients who received treatment in 1995 for a primary problem of alcohol (n = 44), cannabis (n = 37), or cocaine (n = 29) abuse. A random sample of 104 drivers from the general population, frequency matched by age and sex was also interviewed. Participants were asked to describe their driving habits and driving infractions before and after 1995. *Results:* Both treatment and control groups reported about the same amount of driving. The treatment group reported significantly more consumption of alcohol, cannabis, and cocaine than did the control group before treatment. Significant declines in use for each substance were found for the treatment group after treatment, but use for the control group remained stable over the two time periods. Similarly significant declines in driving after use of alcohol, cannabis, and cocaine were found for the treatment group but the control group remained stable. Finally driving infractions, including speeding tickets, collisions, and license suspensions, significantly declined for the treatment group but not the control group. *Discussion:* The results confirm that before treatment, the treatment subjects drove more frequently after consuming alcohol, cannabis, or cocaine than the control group. Declines in substance use and driving after treatment were accompanied by reductions in some types of driving infractions. Differences between groups, and over time in terms of driving while under the influence of psychoactive substances better explain the results than differences between groups in impulsivity/risk-taking or sleep problems.

Key Words: Substance abusers; Driving risks; Cannabis abusers; Alcohol abusers.

INTRODUCTION

Research has shown that individuals entering treatment for alcohol abuse were more likely to drink and drive, and have more collisions and driving under the influence of alcohol (DUI) convictions than did the general population (1–4). Furthermore, research indicates that DUI rehabilitation or alcoholism treatment leads to reductions in DUI recidivism and other traffic incidents. A meta-analysis of over 200 studies found that DUI rehabilitation programs produce, on average, a 7% to 9% reduction in alcohol-related collisions and recidivism compared to conventional criminal justice approaches (4).

In contrast, little is known about the driving risks posed by users of cannabis and cocaine. Only a few studies were found that examined the incidence of cannabis use and driving. In a population survey of Ontario adults, 1.9% reported driving after using cannabis at least once in the previous 12 months (5). Elliott (6) found that 43% of young marijuana

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smokers reported driving while high. For those in treatment for cannabis abuse, Albery et al. (7) found 62% reported driving at least once after use. No surveys were found in the literature on the percent of people who drive under the influence of cocaine.

Similarly, few studies have examined the relationship between cannabis or cocaine use and collision history. In one study, Chipman (8) found significant associations between self-reported cannabis or cocaine use and driving infractions such as collisions. One study observed that young adults who reported cannabis use had significantly more traffic collisions than others (9) and another study found those who reported driving under the influence of cannabis were significantly more likely than controls to have collisions (10).

Some authors have postulated that these elevated rates of driving infractions in substance-abuse groups may be due to higher levels of impulsivity/risk-taking among treatment subjects (1,11,12). In fact, prior research has shown that treatment subjects have higher levels of impulsivity/risk-taking than does the general population, and that impulsivity/risk-taking is also related to elevated rates of collisions (13). Whether substance abuse or impulsivity/risk taking better explains driving infractions is largely unknown.

A useful approach to understanding the driving risks associated with substance use is to examine clinical samples of substance abusers. Treatment samples consume large amounts of the drugs in question, and therefore represent an ideal group for studying the effects of substance use on driving infractions. Surprisingly few studies have utilized this approach. Mann et al. (14) found abusers of stimulants (primarily cocaine) had collision rates about 2–3 times what would be expected, while the collision rates of cannabis abusers appeared to be about the same as that observed for the general population. Interestingly, the subjects estimated that about 50% of their collisions in the preceding year occurred while they were under the influence of alcohol and/or drugs. Mann et al. (14) subsequently examined driver records before and after treatment of 137 males between the ages of 21 and 40. About one third of the sample had a problem with alcohol only, one third had a problem with alcohol plus one other substance, and one third had a problem with one or two substances other than alcohol. Overall, significant posttreatment reductions were found in traffic violations, DUI convictions, and total collisions.

In a recent study, driving records of groups with alcohol, cannabis, or cocaine problems were examined for periods before and after entry into treatment (15,16). These studies did not include self-reports of driving and substance use by clients. Individuals were compared to a randomly selected sample, frequency matched for age and gender in the same geographic area.

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The results indicated that the substance abuse groups had significantly elevated collision rates prior to treatment compared to controls, but after treatment collision rates were similar. However, this significant group by time interaction disappeared when rates of collisions were calculated based on the number of months per year that each subject had a valid driver's license. Since a large proportion of treatment subject had their licenses suspended, the reduction in number of collisions for the treatment group may have been due to less time driving. Since other studies have shown that a large proportion of people still drive while their license is under suspension, these latter analyses may have been too conservative. Therefore, in this study we have asked subjects to report the amount of kilometers they drove in different time periods.

CONTRIBUTION OF THIS STUDY AND RESEARCH QUESTIONS

Prior research on the proportion of treatment clients who drive after use of cannabis or cocaine is sparse and no studies were found that included a population control group. Furthermore, no prior research was found where the amount of driving by the treatment and control groups was estimated. Driving exposure is an important determinant of collisions as more driving increases the likelihood of collision involvment (8). Alternatively, some authors have hypothesized that implusivity/risk-taking or sleep problems could account for any observed elevation of collision rates among substance users (1,11,12), but again, little empirical data exists to support this theory. This study addresses these limitations and gaps in prior research by examining the aforementioned variables at two points in time (i.e., periods before and after treatment) for a treatment and control sample.

RESEARCH QUESTIONS

The following research questions are addressed in this study:

1. Do the treatment and control groups differ in terms of impulsivity/risk-taking and sleep problems?
2. Do the treatment and control groups differ between groups and over time (i.e., before and after treatment) in the amount of driving they report?
3. Do the treatment and control groups differ between groups and over time in their alcohol and drug consumption?

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4. Do the treatment and control groups differ between groups and over time in driving after consuming alcohol, cannabis, or cocaine?
5. Do the treatment and control groups differ between groups and over time in their speeding tickets, collisions, and license suspensions.

METHOD

Study Groups and Research Design

In 2001, telephone interviews were conducted with two groups: 1) patients who entered treatment in 1995 at the Center for Addiction and Mental Health in Toronto, for a primary substance abuse problem with alcohol, cannabis, or cocaine; and 2) drivers from the general population. The patients could have received a variety of treatment options, including specialized programs for alcohol, cannabis, or cocaine abuse, or for special groups for women, youth, or African Canadians. Although the clients were referred for a variety of inpatient and outpatient treatment programs, not all clients completed their programs. The control group consisted of a random quota sample of drivers, frequency matched for age, sex, and place of residence. In order to be eligible for the study all participants were required to have a valid driver's license and driven a motor vehicle since 1990.

Data Sources

Two data sources were used: clinical assessment data and telephone interviews. Treatment subjects for this study were identified from clinical assessment records from 1995. These people were telephoned and asked to participate in the research study by completing a short telephone interview.

Sampling Method and Contact Procedures

Attempts were made to obtain valid telephone numbers for 971 randomly selected subjects who entered treatment in 1995. A large proportion of these subjects were untraceable or were not eligible for participation (e.g., because they had not driven or did not possess a drivers licence). Of those who were successfully contacted, 110 treatment subjects agreed to participate and 63 people refused. The final response rate, based on comparing the number of participants to the total number of participants and refusals, was 63.6%.

A randomized quota sample of drivers from the general population was used for the control group. A modified random digit dialing process was

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employed to obtain a control sample from the same geographic area as the treatment sample. Whoever answered the telephone was told about the study and asked whether a person lived in the residence who had a drivers license and was a certain age or sex. The participation rate for the control group was 26.4%, based on 104 successfully completed interviews and 290 refusals.

Measures

Demographics

Four demographic characteristics were collected: age, education, marital, and work status.

Driving History

Participants were asked about their driving behavior, driving experiences including collisions, speeding tickets, and suspensions. Participants were asked to estimate the number of kilometers they drove in 1990, 1995, and within the last 12 months. They were also asked the number of speeding tickets, collisions, and suspensions they received from 1990 to 1994, and from 1996 to 2000. For suspensions, they were asked the year their suspension(s) occurred and the length of their suspension.

Behavior Patterns

Participants' impulsivity/risk-taking, sleep patterns, and drug use were assessed. The five-point scale developed by Cherpitel (17) was used to measure impulsivity/risk-taking. For sleep patterns, participants were asked how often they experienced difficulty sleeping or staying awake in 1990 and within the last 12 months (e.g., 1 = Never; 5 = Always). Finally, participants were asked the frequency of their drug use in 1990 and within the last 12 months and whether or not they drove a motor vehicle after consuming alcohol, cannabis, or cocaine in the same time periods.

RESULTS

The treatment group consisted of clients who received treatment in 1995 for a primary problem with alcohol (n = 44), cannabis (n = 37), or cocaine (n = 29). Among clients with a primary alcohol problem, 13

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reported a secondary problem with cannabis and one with cocaine. Among clients with a primary cannabis problem, eight had a secondary problem with alcohol and three with cocaine, and among clients with a primary cocaine problem, eight had a secondary problem with alcohol and nine with

Table 1. Background variables for the treatment and control groups: means (M) or percentages and significance levels for between-group comparisons.

Background variable	Treatment group (n = 110)	Control group (n = 104)	Probability based on t-test, or chi square test
Demographics			
Male	82.7%	71.1%	n.s.
Age (*M*)	42.2	41.9	n.s.
Married/common law	45.5%	56.3%	n.s.
Completed at least an undergraduate degree	27.5%	47.0%	< .01
Employed full-time/ part-time	75.0%	84.5%	n.s.
Impulsivity/risk-taking (*M*)	2.7	2.2	< .0001
Sleep problems[a]			
1990	38.3%	33.7%	n.s.
2000	56.0%	51.9%	n.s.
Kilometres driven (*M*)			
1990	18036	13496	n.s.
1995	18284	19631	n.s.
2000	19825	20571	n.s.
Maximum number of drinks consumed per day (*M*)			
1990	11.09	7.31	< .0001
2000	8.38	5.63	< .0001
Number of times consumed alcohol and drugs per month (*M*)			
Alcohol 1990	18.48	8.34	< .0001
2000	9.72	7.49	n.s.
Cannabis 1990	11.99	2.14	< .0001
2000	6.45	1.38	< .0001
Cocaine 1990	1.54	0.10	< .01
2000	0.65	0.00	< .001

[a]At least sometimes reported having trouble sleeping or staying awake.

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cannabis. Six clients reported a problem with all three substances and for most of this group cocaine was the primary drug problem.

In the initial analyses, the treatment and control groups were compared in terms of demographic characteristics and other key behaviors (Table 1). No significant differences were found between the groups for gender, age, marital status, and work status. The groups did differ in education, with a lower proportion of the treatment group reporting completion of an undergraduate degree (27%) than did the control group (47%).

Objective 1: Do the treatment and control groups differ in terms of impulsivity/risk-taking and sleep problems?

Since impulsivity/risk-taking is a stable trait, participants were not asked to report on these characteristics at two points in time. The treatment group scored significantly higher than the control group did on impulsivity/risk-taking ($p < .001$). In terms of sleep problems, the two groups were similar both in 1990 and the prior 12 months (Table 1).

Objective 2: Do the treatment and control groups differ between groups and over time in the amount of driving they report?

One repeated-measures analysis of variance (ANOVA) was conducted to determine whether the treatment and control groups differed in the

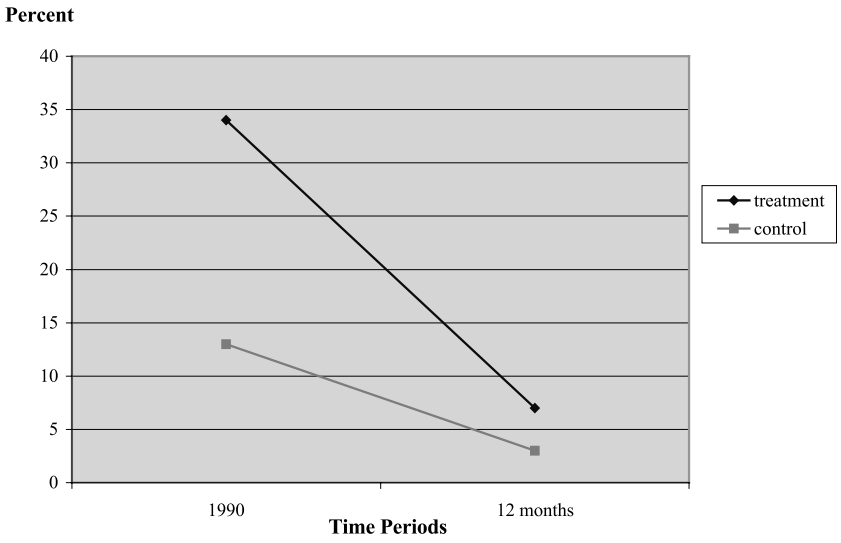

Figure 1. Percentage of subjects who drove after consuming alcohol before and after treatment. 1) Comparisons over time: Treatment group ($p < .001$); Control group (p = n.s.). 2) Comparisons between groups: In 1990 ($p < .001$): Past 12 months ($p < .05$). (*View this art in color at www.dekker.com.*)

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average number of kilometers they reported driving in 1990, 1995, and within the last 12 months (summarized in Table 1). No significant differences were found between the treatment and control groups at any time period; however, both groups significantly increased in the amount they reported driving over the three time periods ($p < .05$). These results indicate that subsequent between-group differences in driving infractions cannot be accounted for by differences in self-reported amounts of driving.

Objective 3: Do the treatment and control groups differ between groups and over time in their alcohol and drug consumption?

Four repeated-measures ANOVAs were conducted to determine whether the treatment and control groups differed in their alcohol and drug consumption in 1990 and within the last 12 months. The treatment group reported consuming a significantly higher maximum number of alcoholic drinks than did the control group in both 1990 and within the last 12 months ($p < .001$). Significant decreases over time were found for both the treatment group ($M = 11.09$ times per month in 1990 to $M = 8.38$ in last 12 months) and control group ($M = 7.31$ in 1990 to $M = 5.63$ in last 12 months). The interaction for maximum number of alcoholic drinks consumed was not significant.

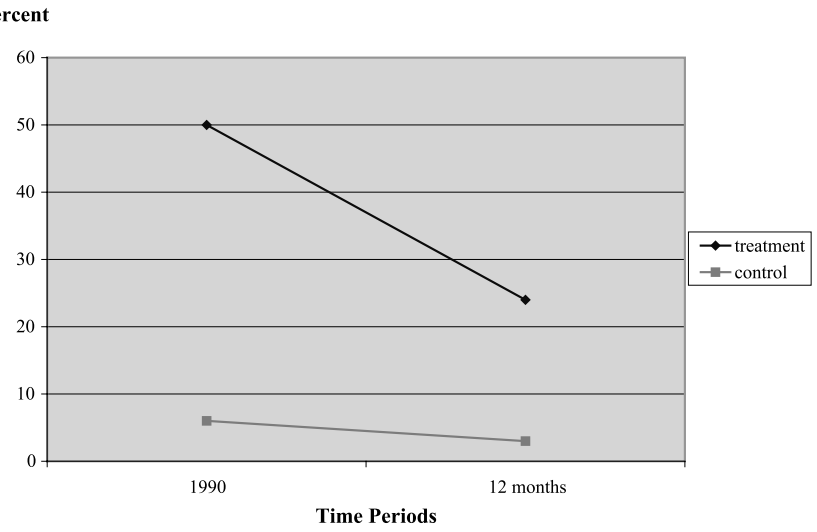

Figure 2. Percentage of subjects who drove after consuming cannabis before and after treatment. 1) Comparisons over time: Treatment group ($p < .001$); Control group (p = n.s.). 2) Comparisons between groups: In 1990 ($p < .001$): Past 12 months ($p < .05$). (*View this art in color at www.dekker.com.*)

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The ANOVAs also revealed three significant group-by-time period interactions for frequency of alcohol, cannabis, and cocaine consumption from 1990 to within the last 12 months ($p < .001$). The treatment group significantly decreased in their frequency of use of each drug from 1990 to the last 12 months ($p < .001$), while drug use remained stable over both time periods for the control group. Significant between-group differences were also found for the consumption of each drug before treatment, and the treatment group used cannabis and cocaine more frequently did than the control group after treatment (Table 1).

Objective 4: Do the treatment and control groups differ between groups and over time in driving after consuming alcohol, cannabis, or cocaine?

Differences between the treatment and control groups in the number of people who reported driving after drug use were assessed with chi-square tests. Significant differences were found between the groups in both 1990 and within the last 12 months. In 1990, 34% of the treatment group and 13% of controls reported driving within one hour of consuming three or more alcoholic drinks ($p < .001$) (Fig. 1), 50% of the treatment group and

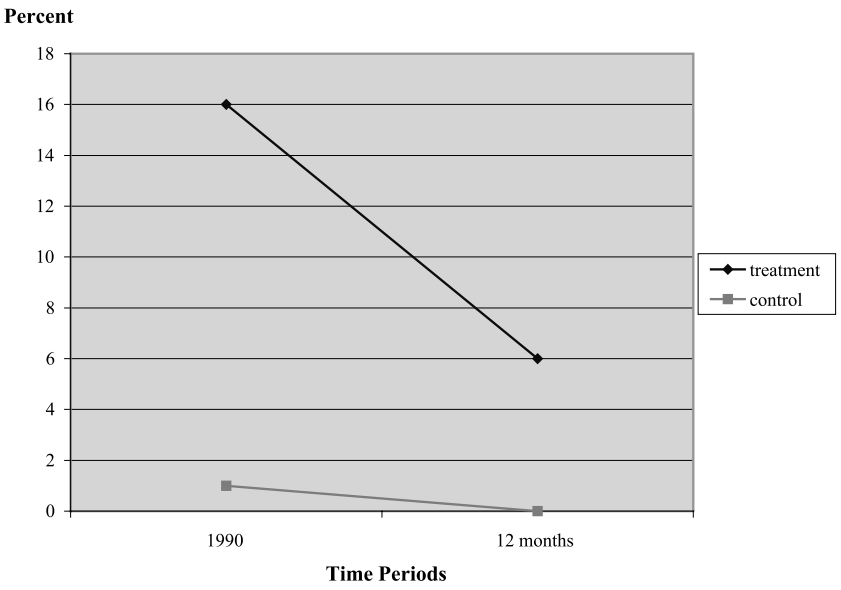

Figure 3. Percentage of subjects who drove after consuming cocaine before and after treatment. 1) Comparisons over time: Treatment group ($p < .001$); Control group (p = n.s.). 2) Comparisons between groups: In 1990 ($p < .001$): Past 12 months ($p < .05$). (*View this art in color at www.dekker.com.*)

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6% of controls reported driving within one hour of consuming cannabis ($p < .001$) (Fig. 2), and 16% of treatment participants and 1% of controls reported driving within one hour of consuming cocaine ($p < .001$) (Fig. 3). Within the last 12 months, a significantly greater proportion of the treatment group reported driving after consuming cannabis and cocaine, but no significant differences were found for driving after consuming alcohol. Specifically, 24% of the treatment group and 3% of controls reported driving after cannabis use ($p < .001$), 6% of treatment participants and 0% of controls reported driving after cocaine use ($p < .05$) and 7% of the treatment group and 3% of controls reported driving after alcohol use ($p =$ n.s.).

McNemar's chi-square tests for repeated-measures were also conducted to determine whether the treatment and control groups changed over time (i.e., from 1990 to within the last 12 months) in their driving habits after drug consumption. As can be seen in Fig. 1, both the treatment and the control group reported significant declines in driving after alcohol consumption ($p < .01$). Similar declines were found for driving after consuming cannabis and cocaine for the treatment subjects ($p < .001$,

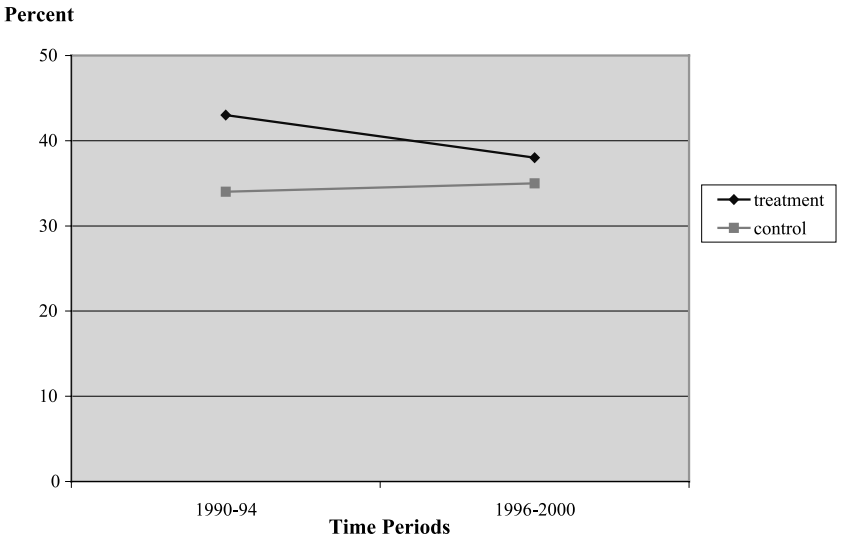

Figure 4. Percentage of subjects with speeding tickets before and after treatment. 1) Comparisons over time: Treatment group ($p < .01$); Control group ($p =$ n.s.). 2) Comparisons between groups: 1990–94 ($p < .05$); 1996 –2000 ($p =$ n.s.). (*View this art in color at www.dekker.com.*)

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$p < .05$, respectively) (Figs. 2 and 3); however, the control group remained stable over the two time periods.

Objective 5: Do the treatment and control groups differ between groups and over time in their collisions, convictions, and moving violations?

Chi-square tests were conducted to examine differences between the treatment and control groups in their number of speeding tickets, collisions, and suspensions from 1990 to 1994 and from 1996 to 2000. A significantly higher proportion of the treatment group reported receiving speeding tickets than the control group from 1990 to 1994 (43%, compared to 34% of controls; $p < .05$), but no significant difference was found between the groups in the period after treatment (Fig. 4). Similarly, a significantly higher proportion of the treatment group reported collisions than the control group from 1990 to 1994 (36% vs. 20% of controls; $p < .001$), but no significant difference was found afterwards (Fig. 5). A significantly higher proportion of the treatment group reported having a license suspension than did those in the control group from 1990 to 1994 (19% for the treatment group, 3% for the control group; $p < .001$) and also from 1996 to 2000

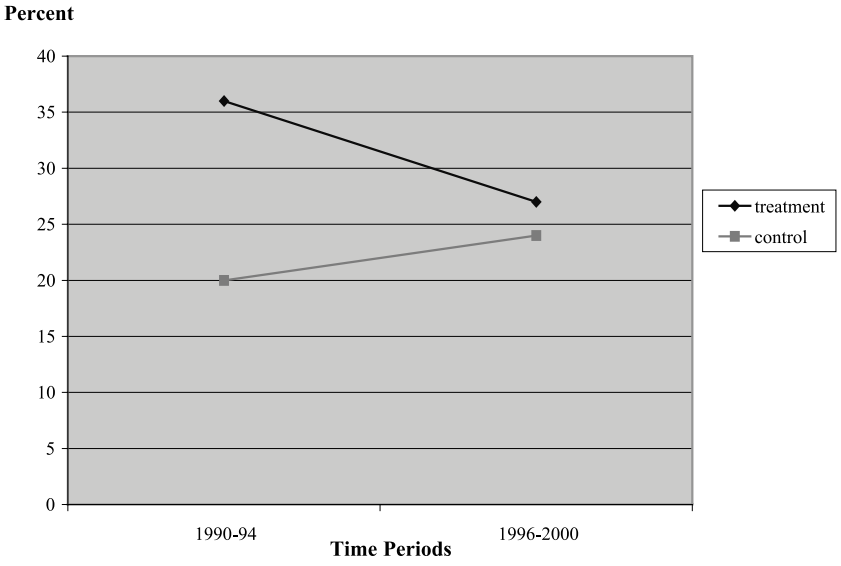

Figure 5. Percentage of subjects with collisions before and after treatment. 1) Comparisons over time: Treatment group ($p < .001$); Control group ($p =$ n.s.). 2) Comparisons between groups: In 1990–94 ($p < .001$):1996–2000 ($p < .05$). (*View this art in color at www.dekker.com.*)

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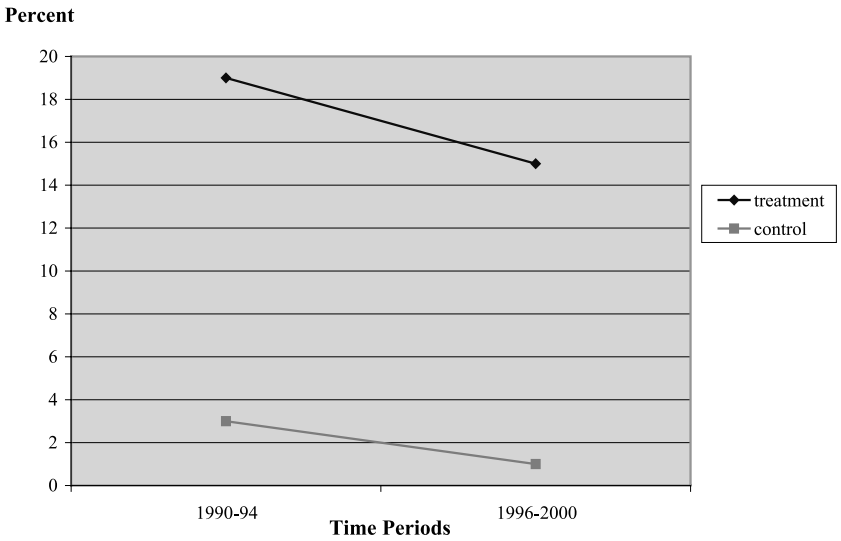

Figure 6. Percentage of subjects with suspensions before and after treatment. 1) Comparisons over time: Treatment group ($p < .001$); Control group ($p =$ n.s.). 2) Comparisons between groups: In 1990–94 ($p < .001$): 1996–2000 ($p < .05$). (*View this art in color at www.dekker.com.*)

(15% for the treatment group, 1% for the control group; $p < .001$) (Fig. 6). McNemar's chi-square for repeated measures showed significant declines for the treatment group in both speeding tickets ($p < .01$) and collisions ($p < .01$). However, the proportion reporting suspensions did not change significantly over the two time periods. No significant changes were found for the control group for any of these variables.

DISCUSSION

Some limitations of this data should be noted. First, they are based on self-reports and thus could be subject to bias. However, other research suggests that self-reports of alcohol and drug-related behaviors have acceptable levels of validity (18,19). Also, in the traffic event measures the results from this sample are in agreement with those from another study employing driver records (15). Finally, use of self-reports is the only feasible approach for collecting information regarding many of the variables investigated in this study (i.e., driving after drug use, impulsivity/risk-taking, etc.). Another possible source of bias could be due to the response

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rate and attrition. The finding that a large proportion of substance abuse clients was lost to follow-up, particularly after an interval as long as six years, is consistent with much other research. Additionally, it seems likely that the individuals who are lost to follow-up, and those in both groups who refused to participate, more likely would be individuals with serious problems or who are more likely to have collisions (20). This possible bias would tend to reduce differences between groups, and thus make comparisons more conservative. For the control group, possible biases were reduced by ensuring that participants had the same age and sex distribution as the treatment subjects. Age and sex are highly related to collisions, but since the groups were similar on these demographic variables results can not be attributed to these factors.

Keeping these cautions in mind, the results of this study contribute to existing research. The results indicated that the treatment and control groups drove a similar amount before and after treatment. This suggests that observed differences in driving infractions cannot be accounted for by differences in amount of driving. The treatment subjects' consumption of alcohol, cannabis, and cocaine and the proportion of treatment subjects who reported driving after consuming alcohol, cannabis, or cocaine before treatment were significantly greater than were controls. In the 12 months preceding the interview, the treatment subjects consumption of cannabis and cocaine was significantly greater than that of controls, and a larger proportion of the treatment group continued to drive after consuming cannabis or cocaine. Despite these between-group differences after treatment, significant declines over the two time periods were found for all measures for the treatment subjects. Specifically, the treatment group showed significant declines over time in average drug consumption and in proportions reporting driving after drug consumption and driving infractions, while the control group did not show any significant change in these variables over the same time periods. These results are consistent with a beneficial effect of treatment.

In this study, the treatment subjects did have significantly higher levels of impulsivity/risk-taking at the time of the study. Despite these findings, the treatment and control groups had similar rates of traffic violations and collisions in the past five years. Before treatment, however, the treatment group had higher rates of traffic violations and collisions than controls did. Since impulsivity/risk-taking is a relatively stable characteristic, the declines in driving infractions are better explained by other factors, such as the declines observed in alcohol and drug consumption, rather than impulsivity/risk-taking. Another factor that might explain differences between groups could be sleep problems. Sleep disruption is a common consequence of heavy use of many drugs. We asked subjects to report their

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degree of sleep problems 10 years ago and within the past 12 months. However, no significant differences were found between groups for sleep problems either in the period preceding treatment entry or in the most recent time period. Again, this finding suggests that elevated collisions among the treatment group were not due to sleep problems induced by heavy substance use.

These data replicate previous observations of a beneficial impact of treatment for substance abuse on collisions and other road safety measures (14–16). They also suggest that these effects cannot be explained by differences in driving behavior, sleep problems, or impulsivity/risk-taking. Currently, there is increasing concern with the impact of drug use on traffic safety measures. While at present there is very little information available about ways to address this problem, these data suggest that a potentially useful countermeasure for individuals who are identified as drug-using drivers is substance abuse treatment.

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REFERENCES

1. Macdonald S, Mann R. Factors related to drinking and driving: distinguishing between causes and correlates. Contemp Drug Probl 1996; 23:259–290.
2. Metzgerd DS, Platt JJ. Problem drinker drivers: client and service involvement correlates of treatment outcome. Int J Addict 1987; 22(2): 181–186.
3. Mann RE, Vingilis ER, Stewart K. Programmes to change individual behaviour: education and rehabilitation in the prevention of drinking and driving. In: Laurnace MD, Snortum JR, Zimring FE, eds. The Social Control of Drinking and Driving. Chicago: University of Chicago Press, 1988:248–269.
4. Wells-Parker E, Banger-Drowns R, McMillen R, Williams M. Final results from a meta-analysis of remedial interventions with drink/drive offenders. Addiction 1995; 90:907–926.
5. Walsh GW, Mann RE. On the high road: driving under the influence of cannabis in Ontario. Can J Public Health 1999; 90:260–263.
6. Elliott D. Self-reported driving while under the influence of alcohol/drugs

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and the risk of alcohol/drug-related accidents. Alcohol Drugs Driv 1987; 3(3–4):31–43.
7. Albery IP, Strang J, Gossop M, Griffiths P. Illicit drugs and driving: prevalence, beliefs and accident involvement among a cohort of current out-of-treatment drug users. Drug Alcohol Depend 1999; 58:197–204.
8. Chipman M. Risk factors for injury: similarities and differences for traffic crashes and other causes. Accid Anal Prev 1995; 27(5):699–705.
9. Fergusson DM, Horwood LJ. Cannabis use and traffic accidents in a birth cohort of young adults. Accid Anal Prev 2001; 33:703–711.
10. del Rió MC, Alvarez FJ. Illegal drugs and driving. J Traffic Med 1995; 23(1):1–5.
11. Jonah BA. Psychological characteristics of impaired drivers: an integrated review in relation to problem behavior theory. In: Wilson RJ, Mann RE, eds. Drinking and Driving: Advances in Research and Prevention. New York: Guilford Press, 1990.
12. Donovan D, Marlatt A, Salzberg P. Drinking behavior, personality factors and high risk driving: a review and theoretical formulation. J Stud Alcohol 1983; 44(3):395–428.
13. Moeller FG, Barratt ES, Dougherty DM, Schmitz JM, Swann AC. Psychiatric aspects of impulsivity. Am J Psychiatry 2001; 158(11): 1783–1793.
14. Mann RE, Anglin L, Vingilis ER, Larkin E. Self-reported driving risks in a clinical sample of substance users. In: Utzelmann HD, Berghaus G, Kroj G, eds. Alcohol, Drugs and Traffic Safety – T92. Cologne, Germany: TUV Rheinland, 1993:860–865.
15. Macdonald S. Collisions and traffic violations of alcohol, cannabis and cocaine clients before and after treatment. Accid Anal Prev submitted.
16. Chipman ML, Macdonald S, Mann RE. The effects of addiction on risk of traffic crashes and convictions. A study of clients in addiction treatment programs, Proceedings of the Canadian Multidisciplinary Road Safety Conference XII, London, Ontario, June 13, 2001.
17. Cherpitel CJ. Substance use, injury, and risk-taking dispositions in the general population. Alcohol Clin Exp Res 1999; 23(1):121–126.
18. Harrison L, Gfroerer J. The intersection of drug use and criminal behaviour: results from the National Household survey on drug abuse. Crime Delinq 1992; 38(4):422–443.
19. Turner CF, Lessler JT, Gfroerer JC. Survey Measurement of Drug Use: Methodological Studies. Washington, DC: Department of Health and Human Services, 1992.
20. Mann RE, Macdonald S, Chipman ML, Adlaf E, Anglin-Bodrug K, Zhao J. Identifying possible sources of bias introduced in traffic safety research: comparison of blind linkage with volunteer clinical samples. Alcohol, Drugs and Traffic Safety–T'02. 2002.

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