ORIGINAL ARTICLE

Drinking Patterns and Their Predictive Factors in CONTROL: a 12-Month Prospective Study in a Sample of Alcohol-Dependent Patients Initiating Treatment

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Abstract — Aims: To describe the drinking patterns and their baseline predictive factors during a 12-month period after an initial evaluation for alcohol treatment. **Methods:** CONTROL is a single-center, prospective, observational study evaluating consecutive alcohol-dependent patients. Using a curve clustering methodology based on a polynomial regression mixture model, we identified three clusters of patients with dominant alcohol use patterns described as mostly abstainers, mostly moderate drinkers and mostly heavy drinkers. Multinomial logistic regression analysis was used to identify baseline factors (socio-demographic, alcohol dependence consequences and related factors) predictive of belonging to each drinking cluster. **Results:** The sample included 143 alcohol-dependent adults (63.6% males), mean age 44.6 ± 11.8 years. The clustering method identified 47 (32.9%) mostly abstainers, 56 (39.2%) mostly moderate drinkers and 40 (28.0%) mostly heavy drinkers. Multivariate analyses indicated that mild or severe depression at baseline predicted belonging to the mostly moderate drinkers cluster during follow-up (relative risk ratio (RRR) 2.42, CI [1.02–5.73, $P = 0.045$] $P = 0.045$), while living alone (RRR 2.78, CI [1.03–7.50], $P = 0.044$) and reporting more alcohol-related consequences (RRR 1.03, CI [1.01–1.05], $P = 0.004$) predicted belonging to the mostly heavy drinkers cluster during follow-up. **Conclusion:** In this sample, the drinking patterns of alcohol-dependent patients were predicted by baseline factors, i.e. depression, living alone or alcohol-related consequences and findings that may inform clinicians about the likely drinking patterns of their alcohol-dependent patient over the year following the initial evaluation for alcohol treatment.

INTRODUCTION

Literature has long been focused on abstinence versus relapse in treatment studies of alcohol-dependent subjects (Helzer *et al.*, 1985; Wallace *et al.*, 1988; Finney and Moos, 1991; Walsh *et al.*, 1991; Soyka and Roesner, 2006). A non-dichotomous approach to alcohol use patterns in studies of treatment of alcohol-dependent patients corresponds to the recognition that many alcohol-dependent patients do not achieve either complete abstinence from, or full relapse to, heavy drinking after treatment initiation, but in-between states of reduced or mostly moderate drinking patterns. Treatment models and research on alcohol-dependent patients have recently included non-abstinence objectives as an alternative to total abstinence programs. This has led to reduced alcohol use as a primary outcome goal. Data from a large alcohol treatment study in the UK indicate that 45.7% of the patients studied expressed a preference for non-abstinence (Adamson *et al.*, 2010). Recognizing that at least three clusters of drinking patterns are encountered during the first year after treatment initiation, i.e. mostly abstainers, mostly moderate drinkers and mostly heavy drinkers, it might be of interest for clinicians to determine the proportion of individuals in each cluster and the factors that predict belonging to each outcome group.

Studies of the factors associated with the drinking outcome after treatment for alcohol dependence have shown that some factors reflect patients' baseline characteristics while others reflect characteristics of the treatment process. Non-baseline within-treatment factors include patients' involvement and perception of treatment efficacy (Long *et al.*, 2000), quality of therapeutic alliance (Ritter *et al.*, 2002), receipt of alcohol treatment (Bertholet *et al.*, 2010), compliance to medication (Koeter *et al.*, 2010), length of stay in inpatient treatment

program (Gottheil *et al.*, 1992), including the significant other in the follow-up (Aguiar *et al.*, 2012), and involvement in alcoholics anonymous groups (e.g. Montgomery *et al.*, 1995). Non-treatment-related perceptions by the patient have been associated with outcomes. For example, a high perception of the level of impaired control over drinking and a high perception of the level of drinking problems have been associated with a better 12-month treatment outcome in 175 middle-aged alcohol-dependent men (Sawayama *et al.*, 2012). Better treatment outcomes have also been associated with patients' perceptions, including drinking refusal self-efficacy, perception of self-control (Long *et al.*, 2000) commitment to change (Bertholet *et al.*, 2010) and intensity of stress induced craving (Higley *et al.*, 2011).

Other factors assessed during baseline evaluation that predict drinking outcomes are socio-demographic characteristics, severity of alcohol dependence and health-related conditions. In a sample of 248 patients with alcohol abuse or dependence, higher 3- and 12-month drinking frequencies were associated with higher baseline alcoholism severity measures (Staines *et al.*, 2003). Post-hoc analyses of the COMBINE study found that baseline drinking levels were positively associated with the drinking outcome (Gueorguieva *et al.*, 2012). Additional characteristics measured during the initial phase of alcohol-dependence treatment have been associated with the drinking outcome, including educational level (Greenfield *et al.*, 2003), Axis I and II DSM psychopathology (Pettinati *et al.*, 1999) and anxiety and depression (Hobbs *et al.*, 2011). Psychiatric co-morbidity did not appear to worsen treatment outcomes in another study including 118 alcohol-dependent patients (Mann *et al.*, 2004), while two other studies found a worse outcome in men with depression and anti-social personality disorder, but not in women (Rounsaville *et al.*, 1987;

Compton *et al.*, 2003). An exploration of the factors associated with drinking outcomes was also conducted in non-treatment-seeking subjects with alcohol use disorders. The National Epidemiological Survey on Alcohol and Related Conditions (NESARC) evaluated factors associated with the 3-year evolution of alcohol use disorder in a community sample of 1123 alcohol-dependent patients. Baseline factors associated with heavier drinking outcomes 3 years later included smoking and fulfilling the DSM-IV criteria for tolerance (Sarsour *et al.*, 2012).

Most studies in the literature associate patients' baseline characteristics with a limited number of drinking outcome measures, usually at 3, 6 or 12 months after study intake. Our observational study among 143 alcohol-dependent patients included a calendar-method detailed evaluation of drinking outcomes monthly during the 12-month period following initial assessment. The objective of the study was to identify and characterize three clusters of patients, with dominant alcohol use patterns described as mostly abstainers, mostly moderate drinkers and mostly heavy drinkers and to assess whether the baseline characteristics of patients within each group, in terms of alcohol consumption, co-morbidities and alcohol use consequences, would predict the drinking outcome.

METHODS

At the Lausanne University Hospital, all patients seeking inpatient and outpatient alcohol treatment and those patients who were hospitalized at the general hospital and subsequently referred to the alcohol treatment centre (ATC) were eligible for study inclusion. CONTROL is a single center, prospective, observational study evaluating consecutive patients assessed for the first time at the ATC. CONTROL was funded by Lundbeck to provide background data for a randomized control trial that was conducted in other European countries.

The ATC is a specialized treatment unit within the teaching hospital of Lausanne university medical school, Lausanne, Switzerland. Consecutive new patients consulting or referred to the ATC were assessed clinically by ATC medical staff, before being assessed for final study inclusion by a research assistant using standardized instruments. Patients were recruited at three different sites, the hospital wards/emergency department (general hospital patients referred to alcohol unit), the ATC outpatient clinic (outpatient alcohol unit) and the ATC inpatient program (inpatient alcohol unit). Excluded were patients confused or delirious, those who did not meet the criteria for alcohol dependence on the basis of the Mini International Neuropsychiatric Interview (MINI) questionnaire (Lecrubier *et al.*, 1997), those who did not speak French and those who had no contact address or were aged <18 years (Fig. 1). Participants were only included if they provided written informed consent. The Ethics Committee for clinical research at the Lausanne University Medical School (protocol 127/09) approved the research. Once included, all the patients were followed-up by ATC research staff.

Clinical Assessment and Treatment Programs
All the patients included in the study were offered standard care provided at ATC by physicians, nurses and/or
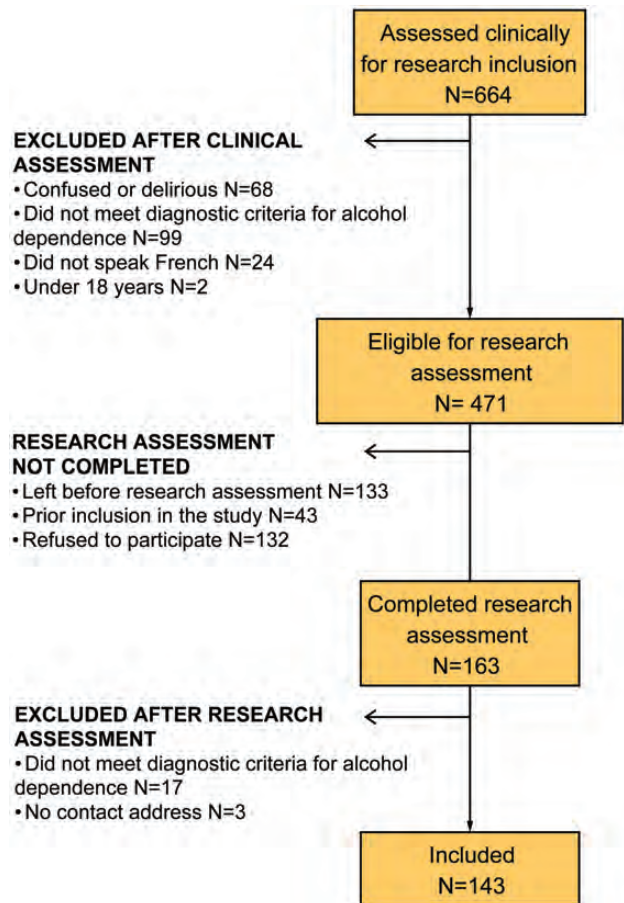

Fig. 1. Flow chart of patient disposition.

psychologists. The study focused on the influence of patients' baseline characteristics on follow-up drinking outcomes, without considering the influence of the components and quantity of specialized treatment completed during the follow-up (medication and psychotherapy). Therefore, the standard care offered was independent of the study and data relating to patients' adherence to the standard care components were not reported. The study, therefore, reports on the natural history of patients with alcohol dependence referred to the ATC. Standard care proposed an initial assessment of the alcohol history, severity and repercussions in patients with an alcohol use disorder as well as somatic and psychiatric assessments. After the initial assessment, the patients were invited to continue with the standard care. If they decided so, they were free to choose their own drinking objective and received a combination of motivational interviewing, relapse prevention and pharmacotherapy. A withdrawal regimen using oxazepam was provided when patients decided to abstain from alcohol (Daeppen *et al.*, 2002).

The group 'general hospital patients referred to alcohol unit' was offered 1–3 sessions of motivational interviewing counseling before deciding to continue in the inpatient or outpatient programs or to decline any further treatment. The group 'outpatient alcohol unit' completed the initial assessment and was offered the possibility of attending individual and/or group sessions weekly during the initial phase of treatment. The session frequency was later adjusted as the

treatment progressed and the needs of the patients changed. The group 'inpatient alcohol unit' received a structured 3-week inpatient program including initial assessment, withdrawal, general internal medicine evaluation and treatment, individual and group psychotherapy sessions based on motivational interviewing and relapse prevention. Upon discharge, the patients were referred to an outpatient treatment program or to an aftercare program or to their general practitioner.

Research Assessment

For each patient, daily alcohol consumption was collected using the time line follow back (TLFB) method (Sobell and Sobell, 1992). At baseline and at subsequent interviews (each month and during the 12-month period), each patient provided a retrospective estimate of their daily drinking over the past month. A consumption profile (curve) corresponding to the series of measures (daily alcohol consumption) was then generated for each patient. Profiles were not the length of the patient's curve reflected the duration of follow-up due to drop-outs, this was possible since the polynomial regression mixture model used allows to make use of data in patients who did not complete all the 12 months.

The following measurements were derived from the TLFB procedure: average daily alcohol intake in the last 30 days; heavy drinking days, defined as ≥4 drinks for women and ≥5 drinks for men in a single day during the past 30 days, adapted from the NESARC definition in the US where a standard drink is equivalent to 14 g of alcohol, whereas, in Switzerland, a standard drink is equivalent to 10 g of alcohol (Sarsour et al., 2012); and drinking days over the last 30 days.

Severity of alcohol dependence was measured using the alcohol dependence scale (ADS; Skinner and Horn, 1984), a self-administered questionnaire assessing alcohol withdrawal symptoms, impaired control over drinking, awareness of a compulsion to drink, increased tolerance to alcohol and salience of drink-seeking behavior. Adverse consequences of alcohol dependence were measured using the drinker inventory of consequences (DrInC; Miller et al., 1995), a self-administered questionnaire resulting in an overall score built according to five areas: physical, intrapersonal, social, interpersonal and impulse control. DrInC scores were interpreted according to the score distribution described for project MATCH (Miller et al., 1995). Depression was assessed using the beck depression inventory-short form (BDI-SF; Beck and Steer, 1987), a questionnaire evaluating depression symptoms (e.g. hopelessness and irritability), cognition (e.g. guilt or feelings of being punished) as well as physical symptoms (e.g. fatigue, weight loss and lack of interest in sex). Furthermore socio-demographic, medical history and substance use data were collected using direct questions. Baseline, 3-, 6, 9- and 12-month follow-up data were collected during face-to-face interviews with a trained psychologist. Additional phone call interviews were conducted at months 1, 2, 4, 5, 7, 8, 10 and 11 to collect TLFB data, resulting in drinking data at baseline and monthly over a year.

Statistical Analyses

Historically, most clustering algorithms have been developed to operate on fixed-dimensional vector data. However, many of these algorithms fail to be useful or practical with curve data, such as chronological alcohol use data. Often, one must preprocess the data in such a way that reduces the curves to fixed-dimensional vectors, which leads to a loss of part of the information. In addition, these methods ignore the dependence of the curve measurements on the dependent variable (time). To address the curve clustering problem properly and to identify groups of subjects with the same alcohol consumption profile, we used a curve-clustering methodology based on a polynomial regression mixture model (Banfield and Raftery, 1993; Gaffney and Smyth, 1999; Gaffney, 2004). In this model, each individual trajectory is assumed to be generated from a finite mixture of polynomial regression model components. Conditional mixture is used together with an expectation maximization algorithm to estimate the model parameters and the cluster membership. Each individual trajectory is then assigned to each cluster with a certain probability.

From our cohort, three clusters of patients were identified with the following curve profiles (i) nearly abstinent patients hereafter referred to as 'mostly abstainers', (ii) 'mostly moderate drinkers' and (iii) 'mostly heavy drinkers'. The three groups are presented in Fig. 2 and corresponding equation parameter estimates for each cluster and the full cohort are shown in the appendix.

Multinomial logistic regression analysis was used to identify factors that are potentially associated with each cluster. In a manner analogous to logistic regression, multinomial logistic regression allows correction for confounders and it expresses the results using RRR and 95% confidence intervals (CI). Associated factors with the drinking groups at a 20% significance level were then selected in a manual backward procedure to fit a multivariate model. The following factors were tested: age, gender, living alone, employment, age of onset of alcohol dependence, family history of alcoholism, alcohol dependence severity and consequences, tobacco, drug use and depression. These variables were chosen according to available data in the literature with regard to factors associated with alcohol use among individuals with alcohol dependence. Considering that the recruitment site might influence the results observed, this variable was also included in the analyses.

RESULTS

As reported in Fig. 1, between October 2008 and June 2009, 664 consecutive new patients consulting or referred to the ATC were assessed clinically for study inclusion. Clinical assessment resulted in the exclusion of 68 patients who were obviously confused or delirious, 99 patients without a clinical diagnosis of alcohol dependence (clinical evaluation based on the International Classification of Diseases, 10th edition, WHO), 24 patients who did not speak French and 2 patients who were aged <18 years, leaving 471 patients eligible for the research assessment. Among them, 133 had left before the research assessment occurred, 43 had prior inclusion in the study and 132 refused to participate, which allowed the research assessment to be completed for 163 patients. Of the remaining 163 patients who completed the research assessment, 17 patients were excluded because they failed to meet the research criteria for alcohol dependence (in the MINI) and 3 because they had no contact address. Thus, this
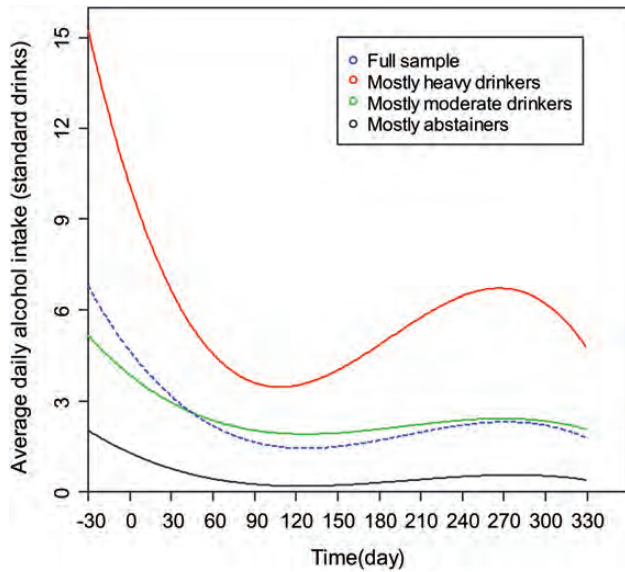
Fig. 2. Daily alcohol intake at baseline and prospectively over 12 months, in the full sample and split into three 12-month follow-up drinking pattern clusters. Data were collected monthly at baseline and 12 months and are presented for the full sample (n = 143, dotted line) and for the three groups: mostly abstainers (n = 47, lower solid line), mostly moderate drinkers (n = 56, middle solid line) and mostly heavy drinkers (n = 40, top solid line).

Table 1. Baseline characteristics of the 143 patients

Socio-demographic characteristics		
Age, mean (SD)	44.6	11.8
Female, *n* (%)	52.0	36.4
Unmarried or living alone, *n* (%)	91.0	63.6
Unemployed, *n* (%)	73.0	53.3
Alcohol dependence, consequences, consumption and related factors		
Age at disease onset, mean (SD)	31.6	12.5
Alcohol problems in family or relatives, *n* (%)	94.0	68.6
Alcohol dependence scale score[a], past 12 months, mean (SD)	17.6	7.3
Average daily alcohol intake (standard drinks), past 30 days, mean (SD)	8.2	8.8
Heavy drinking days[b] last 30 days, mean (SD)	15.5	12.0
Drinking days last 30 days (%)	19.5	10.9
DrInC[c], past 3 months, mean (SD)	48.3	25.2
Current cigarette smoker[d], *n* (%)	105.0	73.9
Drug use[e], *n* (%)	40.0	28.0
Depression mild to severe[f], *n* (%)	86.0	60.1

[a]A score of 14–21 indicates intermediate level of dependence, 22–30 substantial level of dependence.
[b]A heavy drinking day is defined as a consumption of four or more standard drinks in a day for women and five or more standard drinks in a day for men.
[c]A DrInC total score is in the range 0–135, the larger the score, the greater the adverse consequences.
[d]At least one cigarette per day over the last 3 months.
[e]Any drug use over lifetime.
[f]Score of eight or over reflects moderate or severe depression using the short form of the Beck Inventory scale.

manuscript reports data on 143 adults with a diagnosis of alcohol dependence, the inclusion rate being 143/360 (39.7%), the ratio of the number of adult patients with alcohol dependence assessed for the first time at the ATC to the number of patients included. The number of patients for whom data were reported declined to 105 at the 3-month visit, 96 at 6 months, 91 at 9 months and 86 at 12 months. So we were able to report data for 1231 monthly interviews on 1716 expected (143 patients × 12 months), 72% of the follow-up interviews expected. Among the 56 patients who discontinued the study, 23 refused to continue, 32 were not contactable and 1 passed away.

The baseline socio-demographic features of the sample of 143 alcohol-dependent patients are presented in Table 1. Two-thirds of the study participants were men; two-thirds were unmarried or living alone and ~50% were un-employed. Patients included, on average, corresponded to an intermediate level of severity of alcohol dependence, reported more than 15 heavy drinking days on average in the past month and TLFB data recorded for the 30 days before inclusion indicated an average of 8.2 drinks per drinking day. The evaluation of alcohol use consequences using the DrInC questionnaire are presented in Table 1 and show mean scores close to decile 50 for the total score (52 for men and 47 for women).

Our aim was to describe the drinking patterns at baseline and over the 12-month follow-up first for the full sample and then split into three clusters. Figure 2 shows smoothed curves depicting the evolution of daily alcohol consumption over the course of the 12-month follow-up for the full sample (n = 143) and for three drinking clusters with domin-ant alcohol use patterns described as mostly abstainers (n = 47 or 32.9%), mostly moderate drinkers (n = 56 or 39.2%) and mostly heavy drinkers (n = 40 or 28.0%).

Figure 1 indicates a general decrease in alcohol use during the 30 days preceding study inclusion, which continued over the 90 days following inclusion. This trend was observed in the full sample as well as within the three clusters. From day 90 until day 330, we observed smooth curves <3 drinks per day for the 'mostly moderate drinkers' and 'mostly abstai-ners' clusters, while there was a new wave of increase and decrease in alcohol use in the mostly heavy drinkers cluster. Completing the information of Fig. 2 (not reported in tables or figures), we computed within each cluster the average number of heavy drinking days over the 30 days preceding each of the 12 follow-up assessments (excluding the baseline value), which was 1.2 ± 0.5, 4.4 ± 1.0 and 10.8 ± 2.9 for the abstainers, mostly moderate drinkers and mostly heavy drinkers clusters, respectively.

We turned then to the objective of assessing whether patients' baseline characteristics (socio-demographic, alcohol dependence severity, alcohol use consequences and related factors) would predict the drinking outcome, i.e. belonging to one of the three drinking clusters. The alcohol use vari-ables (average daily alcohol intake, percent heavy drinking days and percent drinking days) were not included in the regression analysis, since they were derived from the data obtained with the TLFB and were used to calculate the cluster model reported in Table 2. Though not reported in Table 2, *baseline* alcohol use variables for the three clusters (covering the 30 days before study inclusion) were as follows: 'Mostly abstainers' had had an average daily intake of 3.3 ± 7.1 drinks, median 0; 'Mostly moderate drinkers' had had an average daily intake of 6.0 ± 4.4 drinks, median 5 and 'mostly heavy drinkers' had had an average daily intake of 17.0 ± 8.8 drinks, median 15. Heavy drinking days in the baseline last 30 days were as follows: 6.4 ± 9.2 (mostly abstainers), 15.5 ± 10.9 (mostly moderate drinkers) and

Table 2. Baseline characteristics across the three 12-month follow-up drinking pattern clusters and results from the univariate multinomial regression analysis

	Mostly abstainers, N = 47	Mostly moderate drinkers, N = 56	Mostly heavy drinkers, N = 40	RRR mostly moderate drinkers versus mostly abstainers	95%CI	P-value	RRR mostly heavy drinkers versus mostly abstainers	95%CI	P-value
Socio-demographic characteristics									
Age, mean (SD)	45.9 (11.4)	47.3 (12.0)	39.1 (10.1)	1.01	[0.98–1.05]	0.540	0.95	[0.91–0.99]	0.007
Male, n (%)	27.0 (57.4)	36.0 (64.3)	28.0 (70.0)	1.33	[0.60–2.95]	0.480	1.73	[0.71–4.21]	0.230
Unmarried or living alone, n (%)	27.0 (57.4)	33.0 (58.9)	31.0 (77.5)	1.06	[0.48–2.33]	0.880	2.55	[0.99–6.54]	0.051
Unemployed, n (%)	27.0 (58.7)	26.0 (49.1)	20.0 (52.6)	0.68	[0.30–1.50]	0.340	0.78	[0.33–1.86]	0.580
Alcohol dependence, consequences and related factors									
Age at disease onset, mean (SD)	30.3 (11.8)	35.0 (13.6)	28.2 (10.8)	1.03	[0.99–1.06]	0.070	0.98	[0.94–1.02]	0.400
Alcohol problems in family or relatives, n (%)	28.0 (63.6)	41.0 (75.9)	25.0 (64.1)	1.80	[0.75–4.32]	0.190	1.02	[0.42–2.50]	0.960
Alcohol dependence scale score[a], past 12 months, mean (SD)	17.1 (6.2)	16.1 (7.3)	20.4 (7.8)	0.98	[0.92–1.03]	0.440	1.06	[1.00–1.13]	0.050
DrInC[b], past 3 months, mean (SD)	41.0 (28.3)	46.2 (21.0)	59.8 (23.1)	1.00	[0.99–1.02]	0.280	1.03	[1.01–1.04]	0.001
Current cigarette smoker[c], n (%)	35.0 (74.5)	37.0 (66.1)	33.0 (84.6)	0.57	[0.28–1.57]	0.360	1.89	[0.63–5.60]	0.250
Drug use[d], n (%)	10.0 (21.3)	12.0 (21.4)	17.0 (42.5)	1.00	[0.39–2.59]	0.980	2.73	[1.07–6.99]	0.040
Depression (mild to severe)[e], n (%)	18.0 (38.3)	34.0 (60.7)	24.0 (60.0)	2.49	[1.12–5.52]	0.030	2.41	[1.02–5.73]	0.050
HDDs preceding each monthly assessment, mean (SD)	1.17 (0.51)	4.45 (0.99)	10.82 (2.95)	NA	NA	NA	NA	NA	NA

HDD, heavy drinking day; NA, not assessed.
[a]A score of 14–21 indicates an intermediate level of dependence; 22–30 indicates a substantial level of dependence.
[b]A DrInC total score is in the range 0–135, the larger the score, the greater the adverse consequences.
[c]At least one cigarette per day over the last 3 months.
[d]Any drug use over lifetime.
[e]Score of ≥8 reflects moderate or severe depression using the short form of the Beck Inventory scale.

26.2 ± 5.9 (mostly heavy drinkers). Drinking days in the baseline last 30 days were: 12.8 ± 11.4 (mostly abstainers), 20.1 ± 10.3 (mostly moderate drinkers) and 26.7 ± 4.8 (mostly heavy drinkers). Indeed, these data indicate that the higher the consumption during the 30 days preceding inclusion, the higher the consumption over the 12-month follow-up with heavier alcohol use for the cluster of patients described as mostly moderate drinkers during the 12-month follow-up (versus mostly abstainers) and heavier alcohol use for the cluster of patients described as mostly heavy drinkers during the 12-month follow-up (versus mostly abstainers).

Table 2 reports the baseline characteristics of the sample across the three drinking patterns clusters, together with the results of the univariate multinomial regression analysis with comparison between mostly moderate drinkers versus mostly abstainers and between mostly heavy drinkers versus mostly abstainers. Mostly moderate drinkers were not different from mostly abstainers in terms of socio-demographics, alcohol use variables, dependence severity and consequences, but were more likely to report mild to severe depression at baseline, compared with mostly abstainers. Compared with mostly abstainers, mostly heavy drinkers were more likely to be younger, living alone, having more alcohol-related consequences and using drugs and also tended to have higher ADS scores and to be depressed.

Variables of Table 2 associated with drinking groups with a P value of ≤ 0.20 were selected in a manual backward procedure to fit a multivariate model, reported in Table 3. Table 3 presents the baseline characteristics found to predict belonging to the mostly moderate drinkers or the mostly heavy drinkers clusters (versus mostly abstainers) during the 12-month follow-up observation. At baseline, subjects who were unmarried or living alone and reporting higher scores on the DrInC were more likely to fit in the mostly heavy drinkers cluster, while subjects with mild or severe depression were more likely to fit in the mostly moderate drinkers cluster.

Although not reported in the Tables, considering that patient recruitment site might influence the results, analyses included recruitment site as a variable in the model. From the 143 patients included, 38 were 'General hospital patients referred to alcohol unit', 42 were 'Outpatient alcohol unit' and 63 were 'Inpatient alcohol unit'. Univariate analysis, using the Chi-square test, indicated that the 'Inpatient alcohol unit' group was less likely to belong to the 'mostly abstainers' group (19.3%), compared with 41.4% in the 'Outpatient specialized group' and with 45.6% in the 'General hospital patients referred to alcohol unit' group ($\chi^2 = 14.7$ and $P = 0.005$). However, in the multivariate multinomial logistic regression analysis, this variable was not retained in the model by the backward selection procedure.

DISCUSSION

The data reported indicate an important reduction in daily alcohol use, with an average initial alcohol intake of 8.2 (8.8) drinks per day reduced to an average consumption under 3 drinks per day for the patients successfully followed-up during 12 months. Similarly, reductions in average daily alcohol consumption of up to 80% have been reported in other treatment trials, including the

Table 3. Baseline factors predicting belonging to mostly moderate drinkers and mostly heavy drinker clusters (versus mostly abstainers) during the 12-month follow-up observation

	Mostly moderate drinkers versus mostly abstainers			Mostly heavy drinkers versus mostly abstainers		
	RRR	95% CI	*P*-value	RRR	95% CI	*P*-value
Unmarried or living alone	1.11	0.50–2.48	0.800	2.78	1.03–7.50	0.044
Depression mild to severe[a]	2.42	1.02–5.73	0.045	1.43	0.55–3.77	0.461
Drinker inventory of consequences (DrInC[b])	1.00	0.98–1.02	0.840	1.03	1.01–1.05	0.004

Variables of Table 2 associated with drinking groups with a *P* value of ≤0.20 were selected in a manual backward procedure to fit a multivariate model. RRR, relative risk ratio; CI, confidence interval.
[a]Score of eight or over reflects moderate or severe depression using the short form of the beck inventory scale.
[b]DrInC total score is in the range 0–135, the larger the score, the greater the adverse consequences.

COMBINE study, which reported an overall net reduction in alcohol consumption from 66 to 13 drinks per week in 1383 alcohol-dependent individuals (Walsh *et al.*, 1991; Anton *et al.*, 2006). In our sample, the clustering procedure identified 47 (32.9%) mostly abstainers, 56 (39.2%) mostly moderate drinkers and 40 (28.0%) mostly heavy drinkers in the 12-month follow-up. In project MATCH, 12% participants were classified as first-year abstainers (defined as not a single drink during the period of observation), 20% as moderate drinkers (at least one drink but no heavy drinking episode) and 68% as heavy drinkers (at least one heavy drinking day with five or more drinks for men and four for women) (Maisto *et al.*, 2006, 2007). The lower rate of mostly heavy drinkers in our sample might be explained by higher follow-up rates (>90%) in project MATCH, suggesting that a large proportion of our patients lost to follow-up were 'mostly heavy drinkers'.

Our data indicate that some baseline patients' characteristics differed across the clusters with younger age, living alone, heavier alcohol use, more severe alcohol dependence, more drinking consequences, larger proportion of individuals with history of drug use and depression in the drinker clusters (mostly moderate drinkers or mostly heavy drinkers), compared with those classified in the mostly abstainers cluster. The multivariate model found that some of these baseline characteristics predicted the drinking outcome. Indeed, mostly moderate drinkers at follow-up were more likely to be diagnosed with mild to severe depression at baseline and mostly heavy drinkers at follow-up were more likely to live alone and report more alcohol-related consequences at baseline, compared with subjects described as mostly abstainers during follow-up. Our observation using a detailed prospective evaluation of the patients' drinking patterns, converge with prior findings associating higher drinking outcome with higher baseline alcoholism severity measures (Staines *et al.*, 2003; Heather and Dawe, 2005; Aguiar *et al.*, 2012; Gueorguieva *et al.*, 2012), adding the information that the consequences of drinking (one additional point on the DrInC scale increases the risk of belonging to the mostly heavy drinkers cluster by 3%), rather than the drinking volume, predict the outcome. Prior studies found conflicting data associating depression with poorer drinking outcomes, i.e. some authors found an association between depression and outcomes (Kranzler *et al.*, 1996), whereas others did not (Mann *et al.*, 2004) and others found the association in men only (Rounsaville *et al.*, 1987; Compton *et al.*, 2003); surprisingly, our data indicate that mild to severe depression predicts belonging to the mostly moderate drinkers cluster and not to the mostly heavy cluster at follow-up. It is difficult to understand that an association is found between depression and mostly moderate drinkers but not mostly heavy drinking, suggesting that this finding should be interpreted with caution. Our data also indicate that living alone predicts future mostly heavy drinking, an association that had previously been linked with heavier severity of alcohol dependence (Schuckit *et al.*, 1997) but not with the alcohol treatment outcome.

The data reported here add precision to prior measures of the association between baseline and outcomes, associating repeated measures of the drinking outcome over the 12-month follow-up observation with baseline characteristics, while prior studies have linked baseline characteristics to a limited number of drinking outcome measures. However, some limitations to the current findings should be underlined. These observational data cumulate information provided by 143 patients with variable duration of follow-up. Nevertheless, we could only include patients willing to be interviewed monthly for 12 months, which may have limited our recruitment figures. Since our model allowed making use of data for patients who did not complete the 12-month follow-up, we were able to report data for 72% of the interviews expected, therefore compensating for somewhat the rather low 12-month retention in the study (86 of 143). The findings describe a sample of alcohol-dependent patients entering a single treatment setting within a teaching hospital in Switzerland, so these data may not apply to other samples of patients. Although conducted in various treatment settings in the same institution (general hospital liaison, outpatient and inpatient), this sample is limited to one institution, i.e. a teaching hospital, with a treatment program that tolerates that patients choose their drinking objective, based on the principles of motivational interviewing (Ernst *et al.*, 2007). Results might have been different for a strictly abstinence-focused treatment program.

The results and conclusions herein should be of interest to providers of health care for alcohol-dependent patients. Our findings suggest that clinicians consider depression, social isolation and alcohol-related consequences as treatment outcome prognostic factors, inciting them to adjust the treatment when they identify these risk factors.

APPENDIX: EQUATION PARAMETER ESTIMATES FOR FIG. 1

Equation parameters estimates	Mostly abstainers	Mostly moderate drinkers	Mostly heavy drinkers	Full sample
β_0	2.04468471	5.20486604	15.44542914	6.86641776
β_1	−0.02913497	−0.05083871	−0.20394747	−0.08335026
β_2	0.00014174	0.00024582	0.00107453	0.00040124
β_3	−0.00000020	−0.00000036	−0.00000164	−0.00000058
Σ	2.77	15.06	70.45	24.27

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