Quality of Life Depends on the Drinking Pattern in Alcohol-Dependent Patients

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Abstract — Aims: In patients with alcohol dependence, health-related quality of life (QOL) is reduced compared with that of a normal healthy population. The objective of the current analysis was to describe the evolution of health-related QOL in adults with alcohol dependence during a 24-month period after initial assessment for alcohol-related treatment in a routine practice setting, and its relation to drinking pattern which was evaluated across clusters based on the predominant pattern of alcohol use, set against the influence of baseline variables. Methods: The Medical Outcomes Study 36-Item Short-Form Survey (MOS-SF-36) was used to measure QOL at baseline and quarterly for 2 years among participants in CONTROL, a prospective observational study of patients initiating treatment for alcohol dependence. The sample consisted of 160 adults with alcohol dependence (65.6% males) with a mean (SD) age of 45.6 (12.0) years. Alcohol use data were collected using TimeLine Follow-Back. Based on the participant’s reported alcohol use, three clusters were identified: 52 (32.5%) mostly abstainers, 64 (40.0%) mostly moderate drinkers and 44 (27.5%) mostly heavy drinkers. Mixed-effect linear regression analysis was used to identify factors that were potentially associated with the mental and physical summary MOS-SF-36 scores at each time point. Results: The mean (SD) MOS-SF-36 mental component summary score (range 0–100, norm 50) was 35.7 (13.6) at baseline [mostly abstainers: 40.4 (14.6); mostly moderate drinkers 35.6 (12.4); mostly heavy drinkers 30.1 (12.1)]. The score improved to 43.1 (13.4) at 3 months [mostly abstainers: 47.4 (12.3); mostly moderate drinkers 44.2 (12.7); mostly heavy drinkers 35.1 (12.9), to 47.5 (11.4) at 12 months [mostly abstainers: 51.7 (9.7); mostly moderate drinkers 44.8 (11.9); mostly heavy drinkers 44.1 (11.3)], and to 46.6 (11.1) at 24 months [mostly abstainers: 49.2 (11.6); mostly moderate drinkers 45.7 (11.9); mostly heavy drinkers 43.7 (8.8)]. Mixed-effect linear regression multivariate analyses indicated that there was a significant association between a lower 2-year follow-up MOS-SF-36 mental score and being a mostly heavy drinker (β = −6.37, P < 0.001) or mostly moderate drinker (β = −3.73, P = 0.004), and having a Beck Inventory scale score ≥ 22 (β = −5.4, P < 0.001), at baseline. The mean (SD) MOS-SF-36 physical component summary score was 48.8 (10.6) at baseline, remained stable over the follow-up and did not differ across the three clusters. Mixed-effect linear regression univariate analyses found that the average 2-year follow-up MOS-SF-36 physical score was increased (compared with mostly abstainers) in mostly heavy drinkers (+4.44, P = 0.007); no other variables tested influenced the MOS-SF-36 physical score. Conclusion: Among individuals with alcohol dependence, a rapid improvement was seen in the mental dimension of QOL following treatment initiation, which was maintained during 24 months. Improvement was associated with the pattern of alcohol use, becoming close to the general population norm in patients classified as mostly abstainers, improving substantially in mostly moderate drinkers and improving only slightly in mostly heavy drinkers. The physical dimension of QOL was generally in the normal range but was not associated with drinking patterns.

INTRODUCTION

Changes in health-related quality of life (QOL) are observed in a number of disease states and can be used as a measure of treatment efficacy (Lyons et al., 1994; Jenkinson and McGee, 1998). The Medical Outcomes Study 36-item Short-Form Health Survey (MOS-SF-36) is a well-established method for assessing health-related QOL (Ware et al., 1993; Ware and Gandek, 1998). The MOS-SF-36, which provides a generic measure of health status, has been validated extensively, and population-related normative data are available. It has been found to be reliable and valid for use in patients with alcohol dependence (Daeppen et al., 1998; Stein et al., 1998; Romeis et al., 1999).

Studies have found significant impairment of QOL in individuals with alcohol dependence, particularly with respect to their mental health and social functioning (Gillet et al., 1991; Welsh et al., 1993; Longabaugh et al., 1994; McKenna et al., 1996; Volk et al., 1997; Daeppen et al., 1998; Foster et al., 1998, 2000a,b; Stein et al., 1998; Blow et al., 2000).

Determinants of QOL in patients with alcohol dependence who undergo treatment have also been studied. Factors that predict baseline QOL in such studies include severity of alcohol dependence, intensity of alcohol use, employment status, age, gender and psychiatric history, including the presence of personality disorders and post-traumatic stress disorder (Morgan et al., 2004; Colpaert et al., 2012; Goldstein et al., 2012). However, only limited information is available about the effect that reduced alcohol intake due to treatment has on QOL, including the dynamics of QOL changes after treatment initiation, and whether such changes relate to drinking outcomes (Rather and Sherman, 1989; Gillet et al., 1991; Amodeo et al., 1992; McKenna et al., 1996; Foster et al., 1998, 2000a,b; Kraemer et al., 2002; Bertholet and Daeppen, 2006).

A few studies have evaluated QOL as the primary measure in treatment trials of patients with alcohol dependence (Morgan et al., 2004; Lahmek et al., 2009; Martinez Gonzalez et al., 2011; Frischknecht et al., 2013). These studies indicate that QOL, particularly the mental aspect, improves during treatment for alcohol dependence. In addition, changes in QOL during treatment are influenced by baseline QOL, the duration of abstinence from alcohol, the presence/absence of psychotic symptoms and use/non-use of illegal drugs (Morgan et al., 2004; Lahmek et al., 2009). However, these studies generally assessed QOL as part of a trial evaluating a specific treatment with abstinence as the treatment goal. It would also be helpful to observe the dynamics of QOL changes over an extended period in a more naturalistic, clinical practice, setting. Such an opportunity was provided by CONTROL, a prospective observational study evaluating the natural history of consecutive alcohol-dependent patients referred to a specialist treatment center (Daeppen et al., 2013). The primary analysis, which identified three clusters of patients based on...
their predominant pattern of alcohol use, has been reported previously (Daeppen et al., 2013). The objective of the current analysis was to describe the evolution of health-related QOL in adults with alcohol dependence enrolled in CONTROL during a 24-month period after their initial assessment for alcohol-related treatment in a routine practice setting. Associations between QOL and drinking pattern were evaluated across clusters based on the predominant pattern of alcohol use, and the influence of baseline variables (including sociodemographic factors and the severity of dependence) on the dynamics of QOL changes was assessed.

**METHODS**

CONTROL was a single center, prospective, observational study evaluating consecutive adults with alcohol dependence, assessed for the first time at the alcohol treatment center (ATC) at Lausanne University Hospital, Lausanne, Switzerland.

Adult patients who sought treatment for alcohol dependence through the ATC outpatient clinic or inpatient program, or who were referred to the ATC after hospitalization at the general hospital, were eligible for inclusion. Patients were excluded if they did not meet the criteria for alcohol dependence based on the Mini International Neuropsychiatric Interview (MINI) questionnaire (Lecrubier et al., 1997), were aged <18 years, were confused or delirious, did not speak French or had no contact address. Participants provided written informed consent. The study was approved by the Ethics Committee for clinical research at the Lausanne University Medical School (protocol 127/09). Enrolled patients were followed up by ATC research staff.

Participants included in the study were offered standard care, provided at ATC by physicians, nurses and/or psychologists. This included an initial assessment of their alcohol history, the severity and repercussions of their alcohol use disorder, and somatic and psychiatric assessments. Individuals were then invited to participate in the standard care program, and to choose their own objective with regard to their drinking. They received a combination of motivational interviews, relapse prevention measures and medication. If participants decided to abstain from alcohol, they were provided with an oxazepam-based withdrawal regimen (Daeppen et al., 2002). ATC outpatients were offered the opportunity to attend weekly individual and/or group sessions, with the session frequency adjusted based on the needs of the patient as treatment progressed. ATC inpatients took part in a structured 3-week inpatient program including alcohol withdrawal, general medical evaluation and treatment, and individual and group psychotherapy sessions incorporating motivational interviewing and relapse prevention. On discharge, these patients were referred to an outpatient treatment program, an aftercare program, or to their general practitioner. Individuals referred to the ATC from the general hospital were offered 1–3 sessions of motivational interview counseling, after which they decided whether to continue with an inpatient or outpatient program or to decline further treatment.

**Study assessments**

Baseline and 3-, 6-, 9-, 12-, 15-, 18-, 21- and 24-month follow-up data were collected during face-to-face interviews with a trained psychologist.

Baseline sociodemographic information, family history of alcohol dependence, tobacco and drug-use data were collected using direct questions. Information on daily alcohol consumption was collected for each patient using the TimeLine Follow-Back (TLFB) method (Sobell and Sobell, 1992). At baseline and at monthly intervals during the first year and quarterly during the second year, patients provided a retrospective estimate of their daily drinking over the previous month. A consumption profile (curve) was generated for each patient that corresponded to the series of measurements of daily alcohol consumption. Health-related QOL was assessed prospectively using the MOS-SF-36 at baseline, 3, 6, 9, 12, 15, 18, 21 and 24 months.

The age of onset of alcohol dependence was based on subjects’ estimate of occurrence of the first few criteria of dependence while they were invited to review their answers to the MINI. 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 awareness of drink-seeking behavior. Adverse consequences of alcohol dependence were measured using the Drinker Inventory of Consequences (Miller et al., 1995), a self-administered questionnaire that results in an overall score based on five areas (physical, intrapersonal, social, interpersonal and impulse control), with scores interpreted according to the distribution described for project MATCH (Miller et al., 1995). Depression was assessed using the Beck Depression Inventory-Short Form (Beck and Steer, 1987), a questionnaire evaluating depression symptoms (e.g. hopelessness and irritability), cognition (e.g. guilt or feelings of being punished) and physical symptoms (e.g. fatigue, weight loss and lack of interest in sex).

**Statistical analyses**

The association between drinking pattern and MOS-SF-36 summary scores in our cohort was described across three clusters of patients with different dominant alcohol use patterns, based on their consumption profile curves: (a) nearly abstinent patients hereafter referred to as ‘mostly abstainers’, (b) ‘mostly moderate drinkers’ and (c) ‘mostly heavy drinkers’, described in an earlier paper assessing the first 12-month follow-up (Daeppen et al., 2013).

To properly address curve-clustering problems such as curve dependence on time, and to identify participants with the same alcohol consumption profile, a curve-clustering methodology based on a polynomial regression mixture model was used (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. Model parameters and cluster membership are estimated using conditional mixture and an expectation maximization algorithm. Individual trajectories are assigned to each cluster with a certain probability. The model allowed the use of data for patients who did not complete all of the first 24 months. A similar method, applied to the first 12 months of follow-up, is described in an earlier paper (Daeppen et al., 2013).

Mixed-effect linear regression analysis (Verbeke and Molenberghs, 2000; Diggle et al., 2002) was used to identify
factors that are potentially associated with the mental and physical summary MOS-SF-36 scores at each time point of measurement. If \( Y_{ij} \) is the measured MOS-SF-36 score for subject \( i \) at visit \( j \) (visit\(_i\)), and \( X_i \) is the covariate measured for subject \( i \) at the baseline, the mixed-effect linear model used is given by: \( Y_{ij} = (\beta_0 + u_i) + \beta_1 \cdot \text{visit}_i + \beta_2 \cdot (\text{visit}_i)^2 + \beta_3 \cdot (\text{visit}_i)^3 + \beta_4 \cdot X_i + \epsilon_{ij} \). The fixed part parameters are: \( \beta_0 \) the global mean, \( \beta_1, \beta_2, \beta_3 \) and \( \beta_4 \) the time effect, \( \beta_0 \) the effect of the covariate \( X \) on the MOS-SF-36 score. The random effect \( u_i \) represents the individual deviation from the global intercept, and \( \epsilon_{ij} \) represents the independent measurement errors with mean 0. 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 use, drug use, depression, and ‘drinking cluster’ (mostly abstainers, mostly moderate drinkers, or mostly heavy drinkers). These variables were chosen based on available data in the literature regarding factors associated with QOL in alcohol-dependent individuals. The initial site of recruitment was also included as a variable in the analyses because it could possibly have an effect. The association between the outcome of each factor was tested in a univariate analysis. Significant predictors at a level of 5% were used in a forward procedure to fit a multivariate model.

To account for missing (imputed) data, sensitivity analyses were performed using two imputation techniques (Gaussian normal regression and Hotdeck imputation). For each technique, a total of 10 imputed data sets were generated. To combine results from imputed data sets, we used the mim stata command which allows for working with multiply imputed data sets and combining estimates using Rubin’s rules (Rubin and Schenker, 1986).

**RESULTS**

Among the 160 patients who were enrolled into the study, 59 completed the entire study period up to 24 months. Forty-two patients had discontinued by Month 3, another 22 by Month 12, and 37 discontinued during the second year of the study.

The sociodemographic and baseline drinking characteristics of participants enrolled in the study are summarized in Table 1. The mean age of the participants was 45.6 years, two-thirds were male, just over half were unemployed and almost two-thirds were single or living alone. A family history of alcohol dependence was common (66.9%), and patients’ alcohol dependence started at a mean age of 32.4 years. At baseline, the mean ADS score was 16.5, indicating, on average, an intermediate level of severity of alcohol dependence, across a wider range. Patients reported on average 15 heavy drinking days (a day with alcohol consumption >60 g for males and >40 g for women) in the previous month, and reported consuming a mean of 7.7 drinks per drinking day. Almost three-quarters of patients smoked tobacco, while over a quarter reported using drugs; 50% of patients scored as ‘depressed’.

When patients were divided into three clusters based on their dominant pattern of alcohol use over the 2 years of follow-up, 52 (32.5%) were classified as mostly abstainers, 64 (40.0%) as mostly moderate drinkers and 44 (27.5%) as mostly heavy drinkers.

**Quality of life: MOS-SF-36 mental component summary score**

Baseline MOS-SF-36 mental component summary scores are shown in Table 1. The mean (SD) baseline mental component summary score across the whole study population was 35.7 (13.6) points. Among the three patient clusters, the mean mental component summary score was highest, indicating better QOL, among those who were mostly abstainers [40.4 (14.6)], intermediate for moderate drinkers [35.6 (12.4)], and lowest among patients who were mostly heavy drinkers [30.2 (12.1)].

During the study, mean mental component summary scores improved in the study sample as a whole (Fig. 1) and in each individual cluster (Fig. 2). Improvements were seen by Month 3, and mental component summary scores were generally maintained or increased further during the rest of the study. The mean mental component summary score for the group of mostly abstainers reached the general population norm ~10 months after treatment initiation and remained around that level thereafter. Although mental component summary scores improved in the clusters of mostly moderate and mostly heavy drinkers, they remained below the population norm (Donovan et al., 2005; Lahmek et al., 2009) (Fig. 2). The mean (SD) mental component summary score for the whole population increased to 43.1 (13.4) points by Month 3 (an increase of 7.4 points from baseline), to 47.3 (11.4) at 12 months, and was 46.6 (11.1) at 24 months. The mean mental component summary score for the cluster of mostly abstainers increased to

<table>
<thead>
<tr>
<th>Table 1. Baseline characteristics of the cohort by cluster</th>
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<tbody>
<tr>
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<tr>
<td><strong>N</strong></td>
</tr>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>Gender, n (%)</td>
</tr>
<tr>
<td>Family history of alcoholism, n (%)</td>
</tr>
<tr>
<td>Smoking status, n (%)</td>
</tr>
<tr>
<td>Drug use, n (%)</td>
</tr>
<tr>
<td>DrInC Total score</td>
</tr>
<tr>
<td>Alcohol Dependence Scale score</td>
</tr>
<tr>
<td>Beck Depression Inventory ≥ 8, n (%)</td>
</tr>
<tr>
<td>Employment, n (%)</td>
</tr>
<tr>
<td>Age of onset of alcohol dependence</td>
</tr>
<tr>
<td>MOS-SF-36 Mental Component Summary score</td>
</tr>
<tr>
<td>MOS-SF-36 Physical Component Summary score</td>
</tr>
<tr>
<td>Mean total drinks (10 g ethanol) over 30 days prior baseline</td>
</tr>
</tbody>
</table>
47.4 (12.3) at 3 months, 51.7 (9.7) at 12 months, and was 49.1 (11.6) at 24 months. Mental component summary scores at 3, 12 and 24 months among mostly moderate drinkers were 44.2 (12.7), 44.8 (11.9) and 45.7 (11.9), respectively, and among mostly heavy drinkers were 35.1 (12.9), 44.1 (11.3) and 43.7 (8.8).

In univariate linear regression analysis, a number of parameters were associated with the mean mental component summary score (in the direction of a more severe mental score), including younger age, being female, younger age at onset of alcohol dependence, positive family history, higher ADS score, higher daily alcohol intake, having depression and being in the mostly moderate or mostly heavy drinking clusters (Table 2). There was no association between mental component summary score and marital status, employment status, smoking, or drug use.

Multivariate analysis (which included the following variables: age, gender, age at onset of alcohol dependence, depression, family history, severity of alcohol dependence, daily alcohol intake, drinking cluster) found a significant association
between a lower mental component summary score and being a mostly heavy drinker (coefficient $-6.97$, $P<0.001$) or mostly moderate drinker ($-3.34$, $P=0.018$) (versus mostly abusers), being female ($-3.73$, $P=0.004$), and having moderate to severe depression ($-6.54$, $P<0.001$) A 5-point increase in ADS score was associated with a decrease in mental component summary score ($-0.94$, $P=0.044$) (Table 3).

Data from the sensitivity analysis (Table 4) show that, when accounting for missing data, female gender, presence of depression at baseline corresponding to a Beck Inventory Scale score $\geq 8$ indicates moderate to severe depression, and having moderate to severe dependence during 24 months of follow-up after an initial assessment for an alcohol treatment program. An improvement was seen by 3 months, which was then maintained over time. The progression of mental health QOL appeared to be related to participants’ predominant pattern of drinking and also to any

**DISCUSSION**

This study indicates that mental health QOL, measured with the MOS-SF-36, improved in individuals with alcohol dependence during 24 months of follow-up after an initial assessment for an alcohol treatment program. An improvement was seen by 3 months, which was then maintained over time. The progression of mental health QOL appeared to be related to participants’ predominant pattern of drinking and also to any

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**Table 2. Factors associated with MOS-SF-36 mental and physical component summary score at 2 years: univariate mixed-effects linear regression analysis**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mental score (Regression coefficient (SE)</th>
<th>95% confidence interval</th>
<th>P-value</th>
<th>Physical score (Regression coefficient (SE)</th>
<th>95% confidence interval</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.25 (0.06)</td>
<td>0.13, 0.38</td>
<td>$&lt;0.001$</td>
<td>-0.11 (0.05)</td>
<td>-0.21, -0.004</td>
<td>0.043</td>
</tr>
<tr>
<td>Sex (female; ref = male)</td>
<td>-5.32 (1.65)</td>
<td>-8.55, -2.09</td>
<td>0.001</td>
<td>-1.45 (1.35)</td>
<td>-4.11, 1.20</td>
<td>0.283</td>
</tr>
<tr>
<td>Marital status (married; ref = not married)</td>
<td>1.41 (1.65)</td>
<td>-1.84, 4.65</td>
<td>0.395</td>
<td>-0.78 (1.33)</td>
<td>-3.38, 1.82</td>
<td>0.555</td>
</tr>
<tr>
<td>Employment status (active; ref = not active)</td>
<td>-1.12 (1.63)</td>
<td>-4.32, 2.08</td>
<td>0.492</td>
<td>1.47 (1.29)</td>
<td>-1.07, 4.00</td>
<td>0.256</td>
</tr>
<tr>
<td>Age on onset of alcohol dependency</td>
<td>0.13 (0.06)</td>
<td>0.004, 0.25</td>
<td>0.043</td>
<td>0.02 (0.05)</td>
<td>-0.08, 0.12</td>
<td>0.750</td>
</tr>
<tr>
<td>Family history (yes; ref = no)</td>
<td>-4.44 (1.71)</td>
<td>-7.78, -1.09</td>
<td>0.009</td>
<td>0.73 (1.39)</td>
<td>-1.99, 3.45</td>
<td>0.599</td>
</tr>
<tr>
<td>ADS score*</td>
<td>-0.52 (0.10)</td>
<td>-0.71, -0.33</td>
<td>$&lt;0.001$</td>
<td>0.07 (0.08)</td>
<td>-0.10, 0.24</td>
<td>0.410</td>
</tr>
<tr>
<td>Daily alcohol intake*</td>
<td>-0.82 (0.07)</td>
<td>-0.95, -0.69</td>
<td>$&lt;0.001$</td>
<td>-0.06 (0.06)</td>
<td>-0.16, 0.05</td>
<td>0.306</td>
</tr>
<tr>
<td>Current tobacco smoker*</td>
<td>-1.80 (1.78)</td>
<td>-5.29, 1.69</td>
<td>0.311</td>
<td>-1.16 (1.42)</td>
<td>-3.93, 1.62</td>
<td>0.413</td>
</tr>
<tr>
<td>Drug use*</td>
<td>-0.42 (1.80)</td>
<td>-3.96, 3.11</td>
<td>0.815</td>
<td>1.15 (1.44)</td>
<td>-1.67, 3.97</td>
<td>0.423</td>
</tr>
<tr>
<td>Depression (Beck Inventory Scale score $\geq 8$)</td>
<td>-9.85 (1.41)</td>
<td>-12.61, -7.09</td>
<td>$&lt;0.001$</td>
<td>-1.77 (1.28)</td>
<td>-4.28, 0.75</td>
<td>0.168</td>
</tr>
<tr>
<td>Being in the ‘mostly moderate drinker’ cluster</td>
<td>-5.19 (1.71)</td>
<td>-8.53, -1.85</td>
<td>0.002</td>
<td>2.22 (1.47)</td>
<td>-0.66, 5.10</td>
<td>0.132</td>
</tr>
<tr>
<td>Being in the ‘mostly heavy drinker’ cluster</td>
<td>-10.46 (1.91)</td>
<td>-14.21, -6.72</td>
<td>$&lt;0.001$</td>
<td>4.44 (1.64)</td>
<td>1.23, 7.65</td>
<td>0.007</td>
</tr>
</tbody>
</table>

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**Table 3. Factors associated with MOS-SF-36 mental component summary score at 2 years: multivariate mixed-effects linear regression analysis**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regression coefficient (SE)</th>
<th>95% confidence interval</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.06 (0.06)</td>
<td>-0.05, 0.18</td>
<td>0.252</td>
</tr>
<tr>
<td>Gender (female; ref = male)</td>
<td>-3.73 (1.28)</td>
<td>-6.24, -1.22</td>
<td>0.004</td>
</tr>
<tr>
<td>Increase in ADS score by 5 points*</td>
<td>-0.94 (0.46)</td>
<td>-1.85, -0.03</td>
<td>0.044</td>
</tr>
<tr>
<td>Depression (Beck Inventory Scale score $\geq 8$)</td>
<td>-6.54 (1.32)</td>
<td>-9.13, -3.94</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Mostly moderate drinker</td>
<td>-3.34 (1.41)</td>
<td>-6.09, -0.58</td>
<td>0.018</td>
</tr>
<tr>
<td>Mostly heavy drinker</td>
<td>-6.97 (1.64)</td>
<td>-10.18, -3.76</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Visit*</td>
<td>3.94 (0.85)</td>
<td>2.28, 5.60</td>
<td>$&lt;0.001$</td>
</tr>
<tr>
<td>Visit**</td>
<td>-0.44 (0.15)</td>
<td>-0.73, -0.15</td>
<td>0.003</td>
</tr>
<tr>
<td>Visit***</td>
<td>0.022 (0.01)</td>
<td>0.003, 0.040</td>
<td>0.021</td>
</tr>
<tr>
<td>Visit****</td>
<td>-0.0004 (0.0002)</td>
<td>-0.0007, 1.64e-06</td>
<td>0.051</td>
</tr>
</tbody>
</table>

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*Score 14–21 = intermediate level of dependence, score 22–30 = substantial level of dependence.

*Beck Depression Inventory scale short-form score $\geq 8$ indicates moderate to severe depression.

*Coeff Beta1, Beta2, Beta3, Beta4, according to polynomial form for the time [equation reported in the Methods section (Statistical Analyses)].
change in their level of alcohol dependence during treatment. In contrast to mental health QOL, physical QOL did not change during the study and did not differ substantially between individuals with different drinking patterns.

It is well established that QOL is impaired in individuals with alcohol dependence (Welsh et al., 1993; McKenna et al., 1996; Volk et al., 1997; Daeppen et al., 1998; Foster et al., 2000b). Studies specifically evaluating QOL over time have shown that treatment for alcohol dependence is followed by improvements in mental health QOL after 3 weeks to 3 months (Morgan et al., 2004; Lahmek et al., 2009; Eshelman et al., 2010; Martinez-Gonzalez et al., 2011). The largest of these studies evaluated changes in QOL in >1200 patients with alcohol dependence during treatment with acamprosate and psychosocial support, and found that after 3 months the MOS-SF-36 mental component summary score had increased by 28.7 points from a baseline of 37.9 points (Morgan et al., 2004). In our study, improvements in the MOS-SF-36 mental component summary score occurred in a similar timeframe, with an improvement of 11.7 points seen after 3 months (from a baseline of 35.7 points). It should be noted that our study did not evaluate the effect of a specific treatment regimen on QOL, but rather changes in QOL in patients offered the opportunity to receive a standard care program at our center (irrespective of whether they accepted treatment or how well they complied with treatment); consequently, the design of our study does not allow one to draw any causal inferences regarding the effects of treatment for alcohol dependence on QOL.

Several of the studies mentioned also found that improvements in mental health QOL seen after 1 or 3 months were maintained (and in some cases improved slightly further) after 6–12 months (Morgan et al., 2004; Eshelman et al., 2010; Martinez-Gonzalez et al., 2011). The results of our study are in agreement with this, and extend the data further, showing that improvements were maintained out to 24 months.

The current study also provides additional information, in terms of the effects seen in individuals according to their predominant pattern of alcohol use. Three clusters were...
identified: mostly abstainers, mostly moderate drinkers and mostly heavy drinkers. Improvements in the mental score were seen in all three clusters; however, in patients classified as mostly abstainers, the score increased to the normative level seen in the general population, whereas among mostly moderate and mostly heavy drinkers, scores remained below the norm, particularly in those who were mostly heavy drinkers. With regard to the three clusters, sensitivity analysis showed that only the association between mental component summary score and being in the mostly heavy drinker cluster retained statistical significance when imputing data by two different imputation methods.

Previous studies have identified various factors as being predictive of changes in QOL after treatment for alcohol dependence, including baseline QOL, the duration of abstinence from alcohol, the presence/absence of psychotic symptoms and use/non-use of illegal drugs (Morgan et al., 2004; Lahmek et al., 2009). In our study, factors identified as being independently predictive of the MOS-SF-36 mental component summary score included being in the mostly heavy drinker cluster, being female, the presence of moderate to severe depression and having a high level of alcohol dependence. A study in Spain also found evidence of a relationship between QOL and drinking outcome; in that study, baseline QOL was predictive of the level of alcohol use during the first 3 months of cognitive-behavioral treatment (Martinez-Gonzalez et al., 2011).

The relation between treatment for alcohol dependence and change in physical QOL is not as clear-cut in the literature as the change in mental QOL. Although some studies have found an improvement in physical QOL after treatment (Morgan et al., 2004; Lahmek et al., 2009), a study in liver transplant recipients found no significant improvement in patients with a history of alcohol-use disorder (Eshelman et al., 2010). In our study, there was no significant difference between the mean MOS-SF-36 physical component summary scores at baseline and after 24 months. Nevertheless, it is interesting to note that univariate analysis showed that age and being in the mostly heavy drinking cluster were the only independent variables to be significantly associated with physical component summary score at 2 years.

An important limitation of our study was the attrition rate. Although the sensitivity analysis compensated for the effect of loss to follow-up, the 37% follow-up rate impacts on our ability to draw robust conclusions. However, our sensitivity analyses suggest that missing data are missing at random, indicating that subjects lost to follow-up were similar to counterparts at baseline regarding age, gender, depression, severity of alcohol dependence and repartition in clusters. This means that higher follow-up rate would have resulted in similar findings, except if other baseline differences not included in the sensitivity analyses were considered, i.e. psychiatric conditions not assessed at baseline. Use of the MOS-SF-36 questionnaire represents another potential limitation. Although it is considered valid for use in alcohol-dependent subjects (Daeppen et al., 1998; Stein et al., 1998), it is nonetheless a generic health status measure, and is not based on specific symptoms associated with alcohol dependence. Thus, the information it collects may not be completely relevant or specific for individuals with alcohol dependence, and may not be the ideal quality-of-life measure in this group (Luquiens et al., 2012). However, no specific instrument has yet been developed to assess changes in QOL in individuals with alcohol dependence (Luquiens et al., 2012). The MOS-SF-36 questionnaire was administered every 3 months during the study. Due to no QOL assessment being performed within a 3-month time period, QOL may have deteriorated during the first few weeks of treatment, and this would have been missed in the current study; however, the main purpose of the study was to assess changes over a longer timeframe up to 24 months. There was also no control group in the study; nevertheless, the aim of the study was to obtain data in a naturalistic setting reflecting normal clinical

Fig. 4. Mean MOS-SF-36 physical component summary score according to patient cluster (reporting raw data not including imputation of missing values).
practice. Finally, as alcohol-dependent patients were recruited after initial evaluation for treatment in one center in Lausanne, Switzerland, and included in three different settings, our findings are limited in their generalizability to other patients in other countries, with different recruitment processes or settings.

In conclusion, MOS-SF-36 mental component summary scores improved in alcohol-dependent subjects during the 24 months after an initial evaluation for standard alcohol-related treatment. An early improvement in mental health QOL was observed that was maintained over time. The progression in MOS-SF-36 mental component summary score was related to the predominant pattern of alcohol usage and to drinking outcome.

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