INTRODUCTION

Alcoholism, one of the most common chronic disorders in the western world, causes or promotes a plethora of diseases and injuries. The social health care costs of harmful alcohol consumption are enormous (Rice et al., 1986). Since ethanol is a hydrophilic and lipophilic substance, it may harm nearly every organ, but only some disorders are thought to be related to heavy alcohol intake (so-called alcohol-related disorders, such as liver disease, pancreatitis, upper gastrointestinal, and neurological disorders, e.g. polyneuropathy), (Charness et al., 1989; Lieber 1998; Piette et al., 1998). However, until recently, few studies were available which focused on the influence of drinking behaviour on the frequency of alcohol-related disorders. For example, there is little information on whether drinkers with frequent intoxications suffer more often from withdrawal complications, such as delirium or seizures, than continuous drinkers or vice versa. Furthermore, the high amounts of alcohol drunk by frequently intoxicated alcoholics per day may injure the gastrointestinal tract directly and may also harm the liver as a detoxifying organ. Therefore, this study was aimed at evaluating the relationship between drinking pattern and occurrence of medical complications due to alcohol misuse.

METHODS AND SAMPLE

The sample was collected from 322 chronic alcoholics referred consecutively for detoxification to our department. History of alcohol misuse including drinking pattern and physical illnesses, was assessed by a semi-structured interview according to the documentation standards of the German Society for Addiction Research and Therapy (Deutsche Gesellschaft für Suchtforschung und Suchttherapie, 1991) containing 262 items providing data on the socio-economic status, drinking history and behaviour (frequency, amount, etc.), drug abuse, history of somatic and psychiatric disorders, etc. The drinking pattern was classified into three...
categories according to frequency of drinking (during the previous 6 months) and amount of alcohol intake: (1) continuous drinkers = (almost) daily alcohol consumption without binges; (2) frequent heavy drinkers = frequent alcohol consumption (more than 3 days/week) with frequent intoxication (more than one/week); (3) episodic drinkers = less frequent, irregular alcohol consumption with longer (> 5 days) sober periods, and some binges (less than one/week).

It was possible to categorize the drinking pattern in 241 patients (74.8%), as the remaining patients showed irregular drinking behaviour. Thus, 64 females (mean age ± SD: 43.8 ± 8.8 years, mean duration of harmful drinking: 10.4 ± 6.8 years) and 177 males (mean age: 41.0 ± 9.9 years, mean duration of harmful drinking: 11.6 ± 8.7 years) were included in this study. All subjects underwent comprehensive clinical examination including laboratory tests (at admission and 3 weeks after admission) and tests for viral hepatitis A, B, and C. Subjects with viral hepatitis were excluded. Abdominal ultrasound was performed in 194 cases.

The life-time alcohol intake was estimated as the product of the drinking frequency, the mean alcohol intake/drinking day, duration of harmful alcohol intake, and a ‘tolerance factor’. This ‘tolerance factor’ was estimated as the reciprocal of the ratio of reported increase of alcohol intake at the onset of harmful drinking to the index drinking period. Longer abstinence periods (> 3 months) were taken into consideration when estimating the duration of harmful drinking. Alcohol intake was calculated in g/kg. All statistical calculations were performed using the SPSS-PC program package (version 7.5).

RESULTS

Heavy drinking with frequent intoxication was found most often in our sample (44.4%), whereas continuous alcohol consumption (33.6%) and an episodic drinking style (22%) were less frequent. The proportion of females was significantly lower in the group of frequent heavy drinkers (15.0 vs 33.3% in continuous and 39.6% in episodic drinkers, \( \chi^2 = 13.9, \text{ d.f.} = 2, P = 0.0009 \)). The frequent heavy drinkers were significantly younger \( (37.6 ± 9.4 \text{ years}) \) than the continuous drinkers \( (46.5 ± 8.5 \text{ years}) \) and the episodic drinkers \( (42.8 ± 8.3 \text{ years}) \) (Scheffé-test: \( P < 0.05 \)).

Severity of alcohol dependence

The frequent heavy drinkers showed more severe alcoholism according to ICD-10 criteria (World Health Organization, 1992) for alcohol dependence than the other groups. Nearly all of them (91.6%) qualified for at least three of the six ICD criteria, so that they were diagnosed as alcohol-dependent, whereas only 75% of the continuous drinkers and about 60% of the episodic drinkers fulfilled ICD-10 criteria for alcohol dependence. Each ICD-10 criterion was fulfilled by frequent heavy drinkers more often than by other groups, particularly an impaired capacity to control drinking (66.4 vs 16% in continuous and 26.4% in episodic drinkers, \( \chi^2 = 54.1, \text{ d.f.} = 2, P < 0.0001 \)), evidence of tolerance (70.1 vs 34.6% and 26.4%, \( \chi^2 = 36.6, \text{ d.f.} = 2, P < 0.0001 \)), and preoccupation with drinking (74.8 vs 49.4% and 41.5%, \( \chi^2 = 20.8, \text{ d.f.} = 2, P < 0.0001 \)) respectively.

Alcohol history

The alcohol history (Table 1) revealed that frequent heavy drinkers tended to start drinking alcohol earlier than episodic drinkers and experienced their first inebriation earlier than the other groups. However, the mean duration of harmful alcohol drinking was higher in the continuous drinkers. The mean alcohol intake per drinking day in the last 6 months was much higher in the frequent heavy drinking group (290 g) than the other two groups (169 or 186 g of alcohol/drinking day).

Laboratory parameters

The measurement of laboratory parameters often used as alcohol markers yielded elevated average levels of \( \gamma \)-glutamyltransferase, alanine aminotransferase, aspartate aminotransferase, and carbohydrate-deficient transferrin (only available in a few subjects) in all groups. Continuous drinkers always had the highest levels and frequent heavy drinkers second highest (at both measures both at admission and 3 weeks later). However, significant differences were found only for mean corpuscular volume: continuous drinkers 99.8 ± 7.0 fl, frequent heavy drinkers: 95.4 ± 4.6 fl, and 94.8 ± 6.4 fl in episodic drinkers (Scheffé-test \( P < 0.05 \)).
Alcohol-related medical disorders

The frequency of alcohol-related medical disorders was similar in all groups (Table 2). The continuous and the frequent heavy drinkers showed a history of pancreatitis and oesophageal varices more often than episodic drinkers. Furthermore, the frequent heavy drinkers’ group suffered from chronic gastritis and gastrointestinal bleeding more frequently. Polyneuropathy as well as erectile dysfunction occurred more often in continuous and frequent heavy drinkers. The rates of withdrawal delirium or seizures were no different between the groups. In summary, the frequent heavy drinkers tended to show a higher number of alcohol-related disorders than episodic drinkers, but no more than continuous drinkers. In particular, more upper gastrointestinal and neurological disorders were detected in frequent heavy drinkers. Furthermore, they required emergency treatment and had a history of severe brain trauma with unconsciousness more often. They also attempted suicide more often than continuous drinkers.

Dose relationship

In order to evaluate the impact of cumulative alcohol consumption on the occurrence of alcohol-related disorders, the life-time alcohol intake was estimated (see the Methods and sample section). The estimated average life-time alcohol intake was similar in continuous drinkers (8.8 ± 13.1 kg alcohol/kg body weight) and in frequent heavy drinkers (8.5 ± 9.1 kg/kg), whereas that of episodic drinkers was significantly lower (3.3 ± 7.1 kg/kg). Female alcoholics drank significantly less alcohol (4.4 ± 5.6 kg/kg body weight) than male alcoholics (8.5 ± 11.6 kg/kg) (U-test, \( P = 0.0062 \)).

The number of alcohol-related disorders was strongly related to life-time alcohol intake (Table 3). Alcoholics with none of these disorders had an estimated life-time alcohol consumption of 4.9 ± 10.0 kg alcohol/kg body weight, those subjects with one alcohol-related disorder had drunk 6.0 ± 6.9 kg/kg, those suffering from two disorders 6.8 ± 8.9 kg/kg, and the most affected alcoholics (having three or more disorders) 12.9 ± 13.9 kg/kg (Scheffé-test, \( P < 0.05 \)). There was a strong relationship between long-term alcohol intake and chronic gastritis, gastrointestinal bleeding, pancreatitis, withdrawal seizures, delirium, polyneuropathy, and severe brain injury.

Gender differences

Although in our sample females drank significantly less alcohol than males, no clear gender differences in the number of alcohol-related disorders could be found (males 1.7 ± 1.6,
females: 1.4 ± 1.2; U-test, not significant). Nevertheless, male alcoholics showed a trend towards a higher rate for most alcohol-related disorders than did female alcoholics, probably due to their higher alcohol intake (males: 3.4 ± 2.2 g/kg vs females: 2.4 ± 1.3 g/kg body weight/drinking day; U-test, \( P = 0.0015 \)) and a higher drinking frequency (males: about 24 vs females: 21 days/month; U-test, \( P = 0.0615 \)). Females showed a tendency towards a lower rate of pancreatitis (males 14.1%, females 7.8%), gastrointestinal bleeding (males 7.3%, females 1.6%), and seizures (males 25.4%, females 12.5%; \( \chi^2 3.9, \text{d.f. 1, } P < 0.05 \)), whereas liver cirrhosis and oesophageal varices were diagnosed more frequently in female alcoholics (males 1.7%, females 7.8% and males 2.8%, females 6.3% respectively).

**Contributing factors**

In order to evaluate the influence of contributing factors, such as age, duration of harmful alcohol consumption, gender and drinking pattern as well as estimated life-time alcohol intake, on the occurrence of alcohol-related disorders, a stepwise logistic
regression was performed. The statistical analysis revealed no significant contributory factor for oesophageal bleeding, gastric ulcer or fatty hepatitis. Life-time alcohol intake had the highest influence on the rate of withdrawal delirium, gastrointestinal bleeding, and pancreatitis, the duration of harmful alcohol consumption on brain injuries and withdrawal seizures, and age on gastrointestinal bleeding, chronic gastritis, alcoholic hepatitis, and liver cirrhosis. The drinking pattern only contributed to the rate of polyneuropathy and to a tendency to a higher number of brain injuries.

DISCUSSION

Heavy alcohol intake is known to be a common cause of medical disorders. Much empirical data indicate that a relationship exists between alcohol-related disorders and the amount of alcohol drunk (Anderson, 1995; Lemmens, 1995). The frequency of alcohol-related disorders, however, shows different relations to daily alcohol intake (Lemmens, 1995). There is a paucity of literature concerning the relationship between drinking patterns and the occurrence of alcohol-related disorders, perhaps due to difficulties in assessing drinking habits adequately. Thus, definitions of drinking patterns vary widely between most studies. Moreover, alcohol consumption may be unstable over longer periods (Skog and Duckert, 1993; Schuckit et al., 1997). Using 6-month pretreatment drinking data, we developed definitions of frequent heavy, continuous, and episodic drinking patterns. We avoided the term 'binge drinking', since the definitions applied in the literature are rather different (Epstein et al., 1995). Probably due to the drinking habits in northern Germany, which has a very high average per capita level of alcohol consumption (12 l/year), frequent heavy drinking was the most common pattern in our sample.

Since ethanol is almost entirely detoxified in the liver (Lieber, 1998), hepatic disorders are very common in alcoholics. In about one-third of our sample, a liver disease, most often fatty hepatitis, was diagnosed. As in most other studies, the few

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Intake (kg of alcohol/kg body weight)</th>
<th>Significance (U-test P)</th>
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<tbody>
<tr>
<td>Liver disease</td>
<td></td>
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<tr>
<td>Fatty hepatitis</td>
<td>7.7 ± 11.5</td>
<td>7.6 ± 9.4</td>
</tr>
<tr>
<td>Alcoholic hepatitis</td>
<td>7.5 ± 10.6</td>
<td>5.6 ± 5.9</td>
</tr>
<tr>
<td>Liver cirrhosis</td>
<td>7.3 ± 10.0</td>
<td>12.0 ± 20.0</td>
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<tr>
<td>Upper gastrointestinal disorder</td>
<td></td>
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<tr>
<td>Chronic gastritis</td>
<td>6.4 ± 9.8</td>
<td>10.5 ± 11.8</td>
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<tr>
<td>Peptic ulceration</td>
<td>7.2 ± 10.3</td>
<td>8.9 ± 12.2</td>
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<tr>
<td>Gastrointestinal bleeding</td>
<td>6.9 ± 10.0</td>
<td>15.3 ± 14.7</td>
</tr>
<tr>
<td>Oesophageal varices</td>
<td>7.2 ± 10.0</td>
<td>12.3 ± 18.3</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>6.7 ± 9.2</td>
<td>12.7 ± 16.1</td>
</tr>
<tr>
<td>Neurological disorder</td>
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<tr>
<td>Withdrawal seizures</td>
<td>6.3 ± 9.5</td>
<td>11.3 ± 12.7</td>
</tr>
<tr>
<td>Withdrawal delirium</td>
<td>6.5 ± 9.3</td>
<td>11.3 ± 14.0</td>
</tr>
<tr>
<td>Polyneuropathy</td>
<td>6.6 ± 10.2</td>
<td>9.8 ± 10.9</td>
</tr>
<tr>
<td>Erectile dysfunction</td>
<td>7.4 ± 10.7</td>
<td>8.2 ± 6.3</td>
</tr>
<tr>
<td>Injury</td>
<td></td>
<td></td>
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<tr>
<td>Brain injury with unconsciousness</td>
<td>6.9 ± 9.7</td>
<td>11.4 ± 14.7</td>
</tr>
</tbody>
</table>

Values are means ± SD. n.s. Denotes not significant.
subjects in our sample with liver cirrhosis tended to have a higher alcohol consumption than those without. Our findings of fatty hepatitis, however, revealed no relationship with the estimated lifetime alcohol intake. In contrast to a similar study (Connors et al., 1986), we did not find that frequent heavy drinkers have more liver problems than continuous drinkers, probably due to the very similar estimated lifetime alcohol intake of both groups in our sample.

The alcoholics suffering from chronic gastritis, gastrointestinal bleeding, pancreatitis, and polyneuropathy had a significantly higher lifetime alcohol intake than those without. Chronic gastritis and gastrointestinal bleeding occurred more often in frequent heavy drinkers than in the other groups, probably due to the damage caused by the high amounts of alcohol drunk per day. Polyneuropathy was diagnosed in about 30% of the frequent heavy and continuous drinkers. Furthermore, complications during alcohol withdrawal, particularly delirium and seizures, occurred more frequently in alcoholics with high alcohol consumption.

Our data revealed no clear gender differences in the rate of alcohol-related disorders. Thus, our results do not agree with studies suggesting a higher vulnerability to alcohol in females (Morgan and Sherlock, 1977; Loft et al., 1987; Mezey et al., 1988). This discrepancy may be due to the fact that our estimations, in contrast to most other investigations, considered the relative alcohol consumption per kg body weight.

The high rate of brain trauma in ‘binge drinkers’ may indicate a higher risk of severe injuries in this group, but in another study drinking measures were not found to be significantly related to injury (Treno et al., 1997). Apart from unintentional injuries, alcoholics often display violent behaviour (Romelsjö, 1995). In view of the high suicide rate in alcoholics (Romelsjö, 1995), the finding that the frequent heavy drinkers more frequently attempted suicide than the other groups becomes relevant in planning therapeutic intervention.

The estimated lifetime alcohol intake is a rough measure, because alcohol consumption is unstable over longer periods (Skog and Duckert, 1993; Schuckit et al., 1997). Nevertheless, our data showed internal consistency, as the subjects with a higher number of alcohol-related medical disorders had drunk significantly more than those suffering from none of these disorders. Furthermore, those subjects who suffered brain trauma with unconsciousness also reported higher alcohol consumption than those with no such history.

**CONCLUSION**

In conclusion, our data showed that frequent heavy drinkers were alcohol-dependent according to the ICD-10 criteria more often than subjects with different drinking patterns. Furthermore, although being significantly younger, they had a higher number of alcohol-related medical disorders than episodic drinkers. Compared with continuous drinkers, frequent heavy drinkers were younger, but their estimated lifetime alcohol intake was comparably high, and they had more upper gastrointestinal disorders and severe brain injuries. Furthermore, they required emergency treatment more often. Thus, a test such as the AUDIT (Bohn et al., 1995) providing data on the drinking pattern should be used for screening for alcoholism (Sharkey et al., 1996), as laboratory parameters do not help in distinguishing frequent heavy drinkers.

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**REFERENCES**


