**ABSTRACT**

**Introduction:** Alcohol dependence syndrome is a major public health issue globally and is responsible for significant morbidity and mortality. The total dose of alcohol consumed has been linked to liver diseases, pancreatitis, and other alcohol-related medical consequences. However, this has not been studied in relation to severity of dependence; although it is well known that alcohol causes neuronal damage, which in turn potentiates dependence. Thus, there is a need to study the relationship between the amount of alcohol consumed and severity of dependence. **Materials and Methods:** A total of 165 consecutive cases of alcohol dependence syndrome were studied in a General Hospital Psychiatry Unit at a tertiary care hospital. Addiction Severity Index (ASI) was used to evaluate the severity of alcohol dependence, and Life Time Alcohol Consumption (LTAC) was evaluated by taking careful history. Correlation coefficients were calculated between ASI and LTAC. Group differences were analyzed using t-test. **Results:** There was a significant correlation between ASI and LTAC ($r = 0.162$, $P = 0.032$), which was highly significant in the subgroup without medical complications ($r = 0.250$, $P = 0.003$). A similar correlation in the medical complications subgroup was not significant. **Conclusions:** Lifetime alcohol consumption co-related with the severity of alcohol dependence, particularly in those presenting without medical complications (i.e., those with behavioral and social consequences, and injuries).

**Keywords:** Alcohol, dependence, lifetime consumption, severity

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Alcohol accounts for about 4% of the global burden of disease.\(^1\) It has long been recognized that alcohol consumption is a modifiable risk factor for pancreatitis.\(^2\) The association of alcohol use with liver cirrhosis and other abnormalities of the digestive system is well established.\(^3\) Alcohol use is also related to increased risk of injury in a wide variety of situations.\(^4\) However, the dose-response relationship remains poorly studied.\(^5\)

Heavy alcohol consumption is associated with a cycle of cognitive decline and impulsivity mediated by damage to frontal cortical regions of the brain, which oversee behavioral control through executive functions. Dysfunctional impulsivity includes deficits in attention, lack of reflection, and insensitivity to consequences, all of which occur in dependence.\(^6,7\)

The syndrome of alcohol dependence exists in degrees of severity rather than as a categorical absolute. To quantify the severity of alcohol dependence, various scales have been used. Addiction severity Index (ASI) and Severity of Alcohol Dependence Questionnaire (SADQ) are examples of scales with good psychometric properties. Severity has also been studied in terms of symptom counts; however, this method is not found to be a valid indicator of severity.\(^8-10\)

The total quantity of alcohol consumed has a bearing on effects produced in terms of physical morbidity and social consequences.\(^11\) While the total quantity of alcohol consumed during individual’s lifetime, has been used by the medical fraternity to prognosticate and evaluate the harm caused by alcohol in diseases like alcoholic liver disease, this...
has not been studied much in psychiatry, in terms of the harm caused psychiatrically or socially. Alcohol-dependent persons seem to be a heterogeneous group, and patients who develop physical complications appear to differ from those presenting with social or psychological problems. \[12\]

This study aimed to assess if there was a correlation between lifetime alcohol consumption (LTAC) and severity of dependence in cases of alcohol dependence syndrome. In addition, an attempt was made to find out a similar correlation, if any, in the various groups and to find out if there was a difference.

**MATERIALS AND METHODS**

This observational, cross-sectional study was carried out in a General Hospital Psychiatry Unit of a large (700-bedded) tertiary care multi-speciality hospital. All consecutive male in-patients, freshly diagnosed with alcohol dependence syndrome, between August 01, 2013 and July 31, 2015, were enrolled in the study. Those patients who were unable to cooperate due to the severity of complications and those who were transferred to other wards/hospitals for any reason were excluded. Informed consent of patients was obtained for participation in the study and approval of the Institutional Ethics Committee was taken.

ASI was used to assess severity and screen for problems/impairments that commonly accompany substance abuse and dependence. \[13\] These include, among others, interpersonal difficulties with family, friends, and co-workers; medical conditions; and legal troubles. ASI has been recommended for use in clinical settings as well as research purposes and has been found to have good reliability and validity. \[13\]

LTAC has been infrequently used in previous studies. By calculating LTAC, we intended to calculate the cumulative dose of alcohol ingested by the patient in his lifetime till current presentation. Studies have measured broad patterns of alcohol use with various instruments. \[9\] In the current study, the total amount of alcohol consumed over the lifetime was calculated using the phases of drinking, the type of beverage used and the quantity used during these phases [Appendix A]. This is akin to the timeline follow-back method developed by Sobell and Sobell, in which respondents report what they drank on a day-by-day basis. \[14\] Reliability of such self-reports was demonstrated in a study by Chaikelson *et al.* in which they demonstrated significant correlation between self-reports of alcohol consumption in a longitudinal survey with cross-sectional retrospective survey in the same individuals. \[13\] Significant periods of change in the pattern of alcohol use were recalled with amounts of alcohol consumed (mL). This was aided by recalling significant life events. Periods of abstinence were also noted. The total amount of alcohol consumed during various phases was summed up to arrive at LTAC data.

ASI and AUDIT were administered after withdrawal subsided (Short Alcohol Withdrawal Scale [SAWS]) was used to assess alcohol withdrawal which was considered subsided when the SAWS score was <7). LTAC was calculated in the 3rd week of in-patient stay, after adequate rapport was established. Data was analyzed using Statistical Package for Social Sciences, Version 20 (IBM). Correlation coefficient was calculated for finding out correlation between LTAC and severity measures. In addition, the patients were divided into two groups based on the presence or absence of medical complications and a correlation between ASI and LTAC was also calculated separately for the two groups since it was expected to differ. *T*-test was used to arrive at differences between groups. Sample size was calculated considering a correlation coefficient of 0.3 with a 95% confidence interval half width of 0.2, the sample size required was 133. Sample size in the current study was 151.

**RESULTS**

One hundred and sixty-five patients were enrolled in the study. Twelve patients were lost to follow-up due to various reasons, and two patients were excluded from the study because of inability to cooperate, due to complications. The study was carried out on 151 patients. They included major medical complications: Hepatitis (26, 17.21%), pancreatitis (30, 19.86%), seizures (23, 15.23%), and those with no complications (72, 47.68%). Medical complications together comprised of 52.32% (79) of the total. A comparison of ASI and LTAC across groups is depicted in Figure 1 and Figure 2 respectively. The average age of the patients was 36.4 years. 111 (73.5%) patients had an additional medical diagnosis at admission. Three patients (1.98%) had a family history of mental illness in first degree relatives, and 69 patients (49.6%) had a family history of regular alcohol consumption in first degree relatives. Tobacco use was present in 31 (20.52%) patients, and 1 patient used Cannabis (smoked).

There was a significant correlation, \(r = 0.162, P = 0.047\) between the LTAC and ASI [Figure 3]. A similar correlation was not found to be significant in the medical consequences sub-group. In the “no medical complications” sub-group \(r = 0.250, P = 0.034\), there was a significant positive correlation between LTAC and AUDIT \(r = 0.259, P = 0.003\). There were no significant differences in LTAC between early onset drinkers and late onset drinkers (early onset taken as 25 years or less, as per cloninger’s typologies). When all four groups (hepatitis, pancreatitis, seizures, and
no complications) were compared, there was a significant difference in LTAC across groups. The hepatitis sub group had higher mean LTAC (188.89 kg), whereas the Pancreatitis sub group had the lowest (110.89 kg) [Figure 2]. Patients with family history of alcohol use disorder had a significantly higher mean LTAC, compared to those without similar family history [Table 1].

**DISCUSSION**

The severity of dependence (measured with both ASI and AUDIT) was found to be positively correlated with LTAC. It was more strongly correlated in the group with no medical complications. This essentially implies that higher the total dose of alcohol consumed over lifetime, greater is the severity of dependence. This effect is more pronounced in the group with social/behavioral consequences of alcoholism.

It is commonly believed that a relatively smaller cumulative dose of alcohol, presumed by the quantity-frequency measures in the previous studies, is required for producing acute effects like injuries and social consequences. Existing studies also suggest that a higher cumulative dose of alcohol over the lifetime produces deleterious effects on the target organs such as liver and pancreas. However, the current study contrarily indicated that a higher cumulative dose of alcohol was associated with injuries and social consequences. Earlier studies have attributed this to increase in impulsivity and changes in neurocircuitry due to neurotoxic effects of alcohol. This study found that a lower cumulative dose was associated with medical complications such as pancreatitis and hepatitis.

In earlier studies, AUDIT has been used to assess the severity of dependence. Mean AUDIT score in the current study was 23.3 which indicates moderately severe dependence. The AUDIT scores were highest for the “no medical complications” sub-group and lowest for the hepatitis sub-group. This is in concordance with existing literature seeking to find a correlation between AUDIT/SADQ scores and the severity of complications of alcohol dependence.

Results of the current study may help to explain the findings from earlier studies that only about 13.5% of heavy drinkers develop chronic liver disease. Patients

| Table 1: Lifetime alcohol consumption differences between various groups |
|---|---|---|---|
| Parameters | Categories | LTAC (kg) | P |
| Complications | Yes | 151.8311 | 0.710 |
| | No | 145.5813 | |
| Early/late onset (25 years) | Early | 157.0499 | 0.184 |
| | Late | 133.7763 | |
| Pattern of drinking | Binge | 133.5855 | 0.001* |
| | Regular | 207.3387 | |
| Complications | Hepatitis | 188.8944 | 0.047* |
| | Pancreatitis | 110.8903 | |
| | Seizures | 168.9600 | |
| | No complications | 145.5833 | |
| Family history | Yes | 175.8094 | 0.002* |
| | No | 122.3462 | |

*Significant values. LTAC – Life-time alcohol consumption
whose mean alcohol intake is high would tend to become more severely dependent and either present at a fairly early stage for treatment or modify their drinking habits on their own. Whereas, those who drink at levels that are insufficient to produce severe dependence but, are still enough to cause systemic toxicity would not realize the need to modify their drinking habits. They would continue to drink over long periods and progress to cirrhosis.\[22\]

On the other hand, those who do not present with medical complications, continue to drink heavily and incur damage to the brain, which in turn is self-perpetuating and makes the individual even more dependent. Such individuals evade detection because of inadequate measures to gauge severity in the absence of major medical complications. Human brain shows significant volume loss in alcoholics resulting in both gray and white matter shrinkage. Frontal lobes are the most afflicted in alcoholic brain injury.\[12\]

Abstinence from ethanol is associated with the reversal of brain volume loss.\[18\] On the other hand, frontal lobe deficits are associated with consumption of dangerous amounts of alcohol, despite the knowledge of negative consequences. Thus, these patients demonstrate impaired judgment, poor insight, social withdrawal, reduced motivation, distractibility, attention, and impulse-control deficits which are all contributory to increased severity of dependence and may help explain why the correlation between severity and LTAC was found to be higher in the group with medical complications compared to the group with medical complications.

Thus, our study indicates that cumulative dose of alcohol consumed over lifetime is directly related to the severity of dependence. Individual differences in physiology might be instrumental in giving rise to different complications. Conventionally, this aspect has been neglected while diagnosing and prognosticating dependence.

**Limitations of the study**
The study was carried out in a tertiary care center, where patients with significant medical complications were referred from other hospitals. This might have introduced a bias toward a higher rate of complications. This sample may not truly represent the general population. Disproportionate representation of various medical and nonmedical complications related to alcohol consumption may be another limitation of the study.

**CONCLUSIONS**

LTAC showed a positive correlation with severity in patients with alcohol dependence syndrome. A higher amount of cumulative dose of alcohol consumed was found to be associated with a greater severity of dependence, possibly due to greater toxic neuronal damage.\[19\] As a secondary outcome, we found that a larger amount of alcohol consumption is highly correlated to an increasing severity in the nonmedical complications group compared to the medical complications group. This aspect needs further research to ascertain the differences in severity of medical versus nonmedical consequences of alcohol dependence and the factors thereof. LTAC might be a useful tool to predict alcohol-related harm and thus devise preventive measures.

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**Conflicts of interest**
There are no conflicts of interest.

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Appendix A: Calculation of lifetime alcohol consumption (example)

| Period             | Beverage | Quantity (mL) | Conversion (gm of Ethanol) | Frequency | Total (g) |
|--------------------|----------|---------------|---------------------------|-----------|-----------|
| October 01 to December 02 | Rum      | 120           | 40                        | 2/weeks   | 4,480     |
| January 03 to April 06    | Rum      | 180           | 60                        | 3/weeks   | 30,240    |
| May 06 to November 10     | Rum      | 240           | 80                        | 4/weeks   | 75,520    |
| December 10 to September 11| Abstinence | 00            |                           |           | 00        |
| October 11 to August 13   | Rum      | 300           | 100                       | Daily     | 67,200    |
| Total                |          |               |                           |           | 177,440   |

Life Time Alcohol Consumption (LTAC) calculation for a patient has been demonstrated in this example. Quantity of the beverage consumed and frequency of consumption has been recorded in ml of beverage, and the same has been converted in grams of ethanol which is multiplied by frequency and duration, to give a total for a particular duration; these figures have been added to arrive at LTAC. Periods of abstinence and periods of change in drinking pattern have been noted. LTAC in this example is 177.44 kg of ethanol.