Original Article

Alcohol cost and drinking behavior in patients with alcoholic liver disease

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Background: The incidence of alcoholic liver disease (ALD) in the United States continues to rise. Studies have confirmed that beverage price and alcohol consumption have an inverse relationship in the general population, but the behavior of patients with alcohol related complications is yet to be explored. This study aims to determine if cost affects drinking behavior in patients with ALD.

Methods: Patients with ALD were surveyed at UCLA's Pfleger Liver Institute. The survey included basic demographic information, drinking status, motive, and predominant beverage choice. Patients indicated the average price they pay for a serving of their predominant beverage and how their drinking behavior would change if the price of their beverage were to hypothetically be increased.

Results: Between April 2019 to December 2019, 74 patients with ALD were surveyed. Patients surveyed reported that they would reduce drinking at a factor of 2.39x their average price paid for a drink. In total, 32.2% of patients surveyed would not reduce or discontinue drinking at any price point.

Conclusions: Alcohol price was inversely related to alcohol consumption. The cost threshold at which patients with ALD would reduce drinking fell between double and triple the price of an average drink, and there is a subset of patients who would not reduce or discontinue drinking at any price.

Keywords: Alcoholic liver disease (ALD); cirrhosis; alcohol cost; alcohol consumption

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Introduction

Cirrhosis represents an irreversible stage of hepatic fibrosis that results in a number of complications and a markedly reduced life expectancy. Between 1999 and 2016, there has been a 65% increase in death from cirrhosis in the United States (1). Additionally, cirrhosis is associated with a large economic burden to society through both direct medical costs (drug and hospitalization costs) and indirect medical costs (reduction in health-related quality of life and work productivity). In 2016, the estimated inpatient healthcare cost of cirrhosis in the US was approximately 2 billion dollars (2).

While medical advances have been made in the treatment of certain etiologies of cirrhosis such as chronic viral hepatitis, there has continued to be a rise in the incidence of alcoholic liver disease (ALD). ALD refers to the spectrum of liver damage incurred by alcohol consumption, which includes fatty liver, alcoholic hepatitis, and cirrhosis. The cornerstone of ALD treatment is counseling. In addition, pharmacologic therapy depends on the severity of disease. For preventive therapy, there are agents that help decrease

the craving for alcohol (3). For alcohol hepatitis, there are extensive data using corticosteroids in select patients (4).

The population with the greatest relative increase in mortality related to ALD lies in the younger population (aged 25–34) (1). Alcohol has emerged as the most common indication for liver transplantation in the United States. This increase rate is being partially fueled by the young adult population presenting with alcohol hepatitis (1). Public Health efforts are needed to stem the tide of increased use and worsening survival. The rise of alcohol-related liver diseases in the younger generation has led to the search for systematic, economic, and cultural changes that may explain this rise over the past decade. The global financial crisis of 2008 and the resulting disproportionate socioeconomic vulnerability of younger generations is one potential explanation for the rise in alcohol and substance abuse in young adulthood (5). The young adult (25–34 years old) population also appears to be engaging in higher risk behavior than older generational adult populations. Not only are alcohol liver disease rates higher in this cohort, but so has the use of other illicit substances such as heroine and methamphetamine (6). A rise in alcohol misuse and risky behavior such as binge drinking is seen in students that transition from a home to a college environment, as well in those involved with Greek organizations, due to the increased permissibility of this behavior and peer pressure (7). Binge drinking, characterized by short periods of heavy alcohol consumption, is associated with an increased risk for ALD (8,9). More studies are need to identify tools to reduce young people's drinking. Several potential options to reduce drinking would include increasing the taxation of alcohol and having national public spokesperson discuss the harms of drinking. Other health policies include limitation of alcohol availability and restriction of marketing and advertising (3).

Economic analyses from the public health initiative to reduce cigarette smoking has revealed that price-based policy measures are indisputably the most effective means of reducing tobacco smoking, especially in the younger population. A number of factors such as shorter preceding addiction length and lower income levels lead to more responsive changes to pricing in the younger population (10). As a result, from 2001 to 2015, state-wide cigarette taxes led to a decrease in prevalence of cigarette smoking, the highest effect was seen between the ages of 18 to 24 (11).

Alcohol has consistently been found to inflict the highest overall harm to an individual out of all drugs (12). Hence, similar cost-effectiveness studies have been done on alcohol consumption, which have consistently demonstrated that higher alcohol prices were associated with decreased alcohol consumption in the general population. Chaloupka *et al.* examined price effects on youth and concluded that beer excise taxes could decrease youth alcohol consumption (13). Wagenaar *et al.* performed a meta-analysis of 112 studies which showed an inverse relationship between alcohol prices and alcohol consumption in beer, wine, spirit, and heavy episodic drinkers (14). A study examining the effects of an alcohol excise tax in Alaska found a significant reduction in alcohol related mortality over the course of twenty years (15). Although alcohol taxation has consistently demonstrated to have an effect on reducing consumption in the general population, there continues to be a rise in ALD in the United States despite these public health measures. Our hypothesis for this trend is that patients who develop alcohol related disease have a multitude of factors that contribute to their alcohol consumption and thus do not respond to price increases or taxation in the same way that the general population would.

To our knowledge, there has been no study examining the price elasticity of alcohol in patients who have alcohol-related complications. The objective of our study is to determine if pricing of alcohol affects alcohol consumption in patients with ALD. Through the administration of a survey, the study will assess patients' responses to incremental increases in alcohol price to determine if there is a price at which patients with ALD would decrease or abstain from drinking. We present the following article in accordance with the STROBE reporting checklist (available at http://dx.doi.org/10.21037/dmr-20-81).

Methods

Participants and basic procedure

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional review board of UCLA Research Administration (IRB#19-000413). Inclusion criteria included consentable adults above age 21 with ALD at the University of California, Los Angeles Pfleger Liver Institute between April 2019 and December 2019. Exclusion criteria included patients with active encephalopathy and those who self-report as 'Never drinkers'. After IRB approval, both demographic and clinical information were collected by administering a survey to patients, which asked how drinking patterns would change as price increased in

increments for three main categories of alcoholic beverages: wine, beer, and spirits/cocktails. After providing a concise verbal explanation of the study and an IRB approved study information sheet, informed consent was taken, and patients were administered the survey. Trained volunteers were assigned to assist the patients on survey completion. Participation in the study was voluntary and patients received no compensation for their involvement. Patient medical records were accessed to acquire information on comorbidities, zip code, drinking and smoking status, and recent labs. Patients who had received a liver transplant were still categorized as having a history of cirrhosis.

Survey design

Patients were asked basic demographic information such as age, education, ethnicity, employment, and income as well as their primary motive for drinking, which was divided into four categories:

1. Social (e.g., drinking while engaging in social interactions or for celebration);
2. Enhancement (e.g., drinking to attain a specific feeling);
3. Conformity (e.g., drinking when others are also drinking);
4. Coping (e.g., drinking to cope from loss, relieve stress).

The survey asked patient's current drinking status, and if patients were ex-drinkers they were asked to indicate the last year in which they used to drink. Ex-drinkers were instructed to complete the survey as though they were still drinking, in order to see how these patients would respond to changes in alcohol price when they were actively drinking. The survey also assessed whether or not patients qualified as a binge drinkers.

Patients then chose their predominant alcoholic drink type from the three broad categories of alcohol - wine, beer, and spirits/cocktails – and completed the drink's corresponding section only. For their predominant alcohol type, patients were asked to provide average price they pay for one serving of their drink, rounded to the nearest whole number. The patient's indicated average price was halved, doubled, tripled, quadrupled, and quintupled by the survey administrator using a pre-calculated price chart. The survey administrator then wrote these increasing increments in the corresponding spaces on the survey. Patients were then returned the survey to complete themselves. Patients checked off whether they would continue normal drinking habits, increase drinking, cut down, choose alternative alcohol type, discontinue drinking, or choose an alternative substance as the price increased in intervals. The aim of assessing patients' response as the price increases in intervals was to find a threshold at which patients would decrease or discontinue drinking.

Statistical analysis

Continuous variables are reported as means with their respective standard deviation. Differences of means by groups were analyzed using analysis of variance. Differences of categorical variables was determined using Fisher's exact test. Trajectories of drinking behavior in response to price changes were creating based on the marginal estimates of a mixed effects linear regression model with person random intercept and price change modeled as a categorical fixed effect. All analysis was performed using STATA version 13.2. Significant results were defined as having a P value <0.05.

Operational definitions

Binge drinking

Patients who consumed 5 (if male) or 4 (if female) or more alcoholic drinks in one 2-hour sitting more than once a week were categorized as binge drinkers, which was derived from the National Institute in Alcohol and Alcoholism's criteria (9).

Alcohol cost threshold factor

Patients indicated their drinking behavior in response to changes to the price they initially wrote that they pay on average for a serving of their preferred drink. Each individual's indicated average price per serving was doubled, tripled etc. Alcohol Cost Threshold refers to the mean price that would incur behavior change in the surveyed population (i.e., cutting down on alcohol consumption, quitting, or either cutting down or quitting). The Alcohol Cost Threshold is a factor of the reported average price per drink.

Results

Between April 2019 to December 2019, 74 patients with ALD were surveyed. *Table 1* lists the demographic data for patients surveyed. 70.3% of patients were male and the average age was 56.6 (±9.7). 46.0% identified as White, 44.6% identified as Hispanic, and 9.5% Other. The majority of patients were either full-time or part-time employed

Table 1 Demographics (n=74)

Variable	Data
Age (mean ± SD)	56.6±9.7
Sex, n (%)	
Male	52 (70.3)
Female	22 (29.7)
Race, n (%)	
White	34 (46.0)
Hispanic	33 (44.6)
Other*	7 (9.5)
Highest education level, n (%)	
No degree	11 (14.9)
Other	5 (6.8)
High school	18 (24.3)
Some college	24 (32.4)
4 years of college	13 (17.6)
Graduate school or higher	3 (4.1)
Employment status, n (%)	
Unemployed	13 (17.8)
Part time	7 (9.6)
Full time	38 (52.1)
Retired	15 (21.1)
Annual income, n (%)	
<$25k	9 (20.5)
$25k–50k	15 (34.1)
$50k–75k	6 (13.6)
$75k–100k	6 (13.6)
>$100k	8 (18.2)

*, Other includes American Indians and Asian/Pacific Islander.

Table 2 Alcohol-related responses (n=74)

Variable	Data
Predominant alcohol type, n (%)	33 (44.6)
Beer	16 (21.6)
Wine	25 (33.8)
Spirits/cocktails	
Primary motive for drinking, n (%)	38 (54.3)
Social	22 (31.4)
Coping	10 (14.2)
Enhancement	
Binge drinkers, n (%)	41 (61.2)
Alcohol drinking status, n (%)	
Ex-drinker	70 (90.5)
Current drinker	4 (5.4)
Cost per serving of drink (mean ± SD)	
Can of beer	2.22±3.32
Glass of wine	10.8±12.1
Shot of spirits/cocktail	4.44±3.21

(61.7%), while the remainder were either unemployed (17.8%) or retired (21.1%). The number of patients within each income group was fairly evenly distributed, with a little over half earning below $50,000 annually. For alcohol drink of preference, beer drinkers were most represented (44.6%), followed by spirits/cocktails (33.8%), and wine (21.6%). Over half of patients 54.3% identified as social drinkers, and 61.2% qualified as binge drinkers. 90.5% of patients were ex-drinkers. *Table 2* displays that on average, patients paid significantly less for a serving of beer ($2.22±3.32) compared to a serving of wine ($10.80±12.10), while spirits/cocktails ($4.44±3.21) fell between the two in cost.

Table 3 displays the price at which patients first choose to reduce drinking, discontinue drinking, and either reduce or discontinue drinking. 37.0% of patients surveyed would reduce alcohol consumption at double the price of their drink. 32.2% of patients would not reduce or discontinue at any price point. *Tables 4-6* display the same data but stratified by drink choice (i.e., beer, wine, or spirits). By drink choice, 33.4% of beer drinkers, 15.4% of wine drinkers, and 42.1% of spirit drinkers would not reduce or discontinue drinking at any price point.

Table 7 displays the Alcohol Cost Threshold at which patients would reduce or discontinue drinking with 'x' representing the average price they typically pay for a drink of their choice. Patients surveyed reported that they would reduce drinking at 2.39x, and discontinue drinking at 3.22x. When stratified by drink of choice, beer drinkers would reduce at 2.32x, wine drinkers would reduce at 2.25x, and spirit drinkers would reduce at 2.67x. There was no statistically significant difference of the cost threshold factor between the different types of alcohol.

Figure 1 demonstrates a downward trend in report of

Table 3 Price change at which patients first reduce, discontinue, or either reduce or discontinue drinking

Price Change	Reduced (%)	Discontinued (%)	Reduced/Discontinued (%)
Halved	0	0	1.6
Same	0	1.6	1.6
Double	37	4.8	38.7
Triple	19.3	12.9	22.5
Quadruple	1.6	8	1.6
Quintuple	0	8	1.6
Did not reduce or discontinue	41.9	62.9	32.2
Total	100	100	100

Table 4 Price change at which patients first reduce, discontinue, or either reduce or discontinue drinking (beer only)

Price Change	Reduced (%)	Discontinued (%)	Reduced/Discontinued (%)
Halved	0	3.3	3.3
Same	0	3.3	3.3
Double	46.7	3.3	43.3
Triple	13.3	13.3	13.3
Quadruple	3.3	3.3	3.3
Quintuple	0	6.6	0
Did not reduce or discontinue	36.7	66.7	33.4
Total	100	100	100

Table 5 Price change at which patients first reduce, discontinue, or either reduce or discontinue drinking (wine only)

Price Change	Reduced (%)	Discontinued (%)	Reduced/Discontinued (%)
Halved	0	0	0
Same	0	0	0
Double	46.1	0	46.1
Triple	15.4	30.8	30.8
Quadruple	0	0	0
Quintuple	0	15.4	7.7
Did not reduce or discontinue	38.5	53.4	15.4
Total	100	100	100

alcohol consumption with each incremental price increase.

Figure 2 compares non-cirrhotic and cirrhotic patients in regards to their alcohol consumption if the price of their drink were to increase. At triple, quadruple, and quintuple the average price per drink, there was a significant difference between drinking behavior between cirrhotic and non-cirrhotic patients. At triple the average price per drink, 32.8% of cirrhotic patients would continue drinking compared to 0% of non-cirrhotic patients ($P<0.05$). At quadruple the average price per drink, 46.27% of cirrhotic

Table 6 Price change at which patients first reduce, discontinue, or either reduce or discontinue drinking (spirits/cocktails only)

Price Change	Reduced (%)	Discontinued (%)	Reduced/Discontinued (%)
Halved	0	0	0
Same	0	0	0
Double	15.8	10.5	26.3
Triple	31.6	0	31.6
Quadruple	0	21.1	0
Quintuple	0	5.3	0
Did not reduce or discontinue	52.6	63.2	42.1
Total	100	100	100

Table 7 Alcohol cost threshold factor

Response	Overall	Beer	Wine	Spirits/Cocktails	P value
Reduced	2.39x±0.55	2.32x±0.58	2.25x±0.46	2.67x±0.50	0.21
Discontinued	3.22x±1.53	2.70x ±1.93	3.67x ±1.03	3.57x±1.13	0.378
Reduce or Discontinue	2.33x±0.91	2.05x±1.01	2.64x±0.92	2.55x±0.52	0.144
Did not Reduce or Discontinue	33.9%	36.0%	15.4%	44.4%	

This table shows the cost threshold for alcohol reduction and alcohol discontinuation as a factor of the mean surveyed price (x) of a drink.

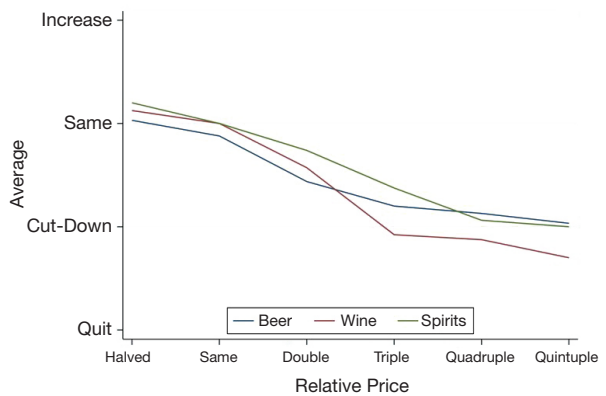

Figure 1 Average trajectory of drinking behavior with changes in price.

patients would reduce or discontinue drinking compared to 66.67% of non-cirrhotic patients (P<0.1).

Discussion

While there have been several studies evaluating the relationship between taxation of alcohol with purchasing behavior and sales, this study is the first to our knowledge to examine this relationship in patients with ALD. The patients we surveyed reported that they would decrease consumption when their price per drink increased, a finding consistent with the economic principle of price elasticity and similarly seen in studies involving the general population (14,15). However, the price at which ALD patients reported they would reduce or abstain alcohol consumption generally fell between double and triple the average price they pay for one drink. For example, the average price factor at which beer drinkers report they would cut down was 2.27x. When multiplied by the average reported price of a glass of beer ($2.64), the result would be a cut down price point of $5.99. This implies that patients with ALD believe that a $3.35 price increase in beer price would result in a reduction in their alcohol consumption. In comparison, the average beer tax per drink noted in 510 state-year strata is less than 3 cents (16). There was also a large subset of patients (33.1%) who would not cut down or quit drinking at any price point. When directly comparing cirrhotic patients to non-cirrhotic counterparts, there was a significant difference in responsiveness to alcohol price increases between the two groups.

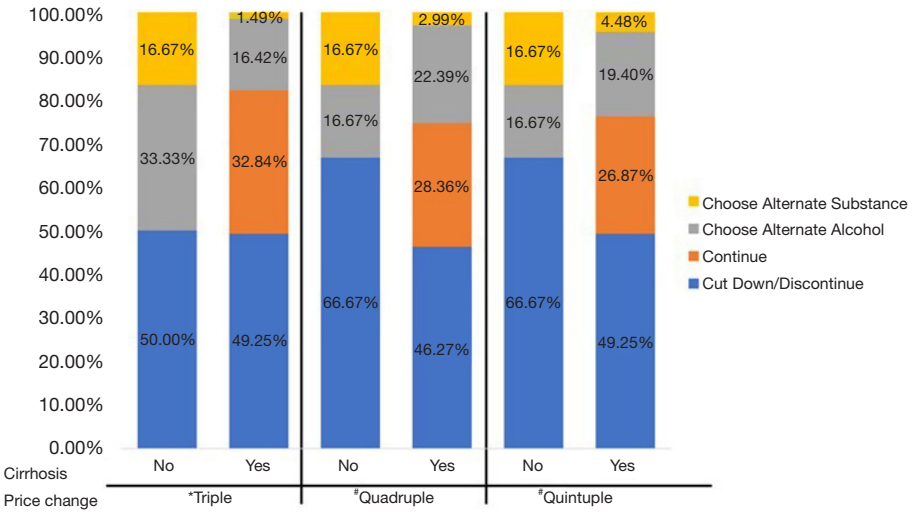

Figure 2 Patient response if the price of their alcohol of choice was tripled, quadrupled, or quintupled by history of cirrhosis status. *, P<0.05; #, P<0.1.

This study provides several implications for public health initiatives aimed at decreasing alcohol consumption and preventing alcohol-related complications. In the general population, taxation on alcohol has led to a decrease in purchasing behavior and sales. However, despite the implementation of state and federal alcohol taxes, there continues to be a rise in the incidence of alcohol related liver disease. The results from our study suggest that while price does have an effect on alcohol consumption in ALD patients, the relative price at which behavioral change is noted is much higher than a realistic amount that can be taxed. It appears that there may be a multitude of factors that play into alcohol consumption in the ALD population and that this population cannot be dissuaded from drinking purely on a financial basis. They may benefit from exposure to national public spokesperson to discuss the harms of drinking.

Our study found that self-identified "Social" drinkers and binge drinkers represented 53.1% and 59.0% of the surveyed population, respectively. Future studies may be directed at examining these specific characteristics of drinkers in both the general population and in patients with ALD. With the average age of patients with cirrhosis trending down, public health initiatives to decrease alcohol consumption may find that targeting the younger population may be an effective means in order to prevent progression to ALD. Our study suggests that early intervention may be warranted as the responsiveness to alcohol taxation may be decreased when patients develop complications related to alcohol use. One way to screen drinking related complications early is to be screened at the primary care level (17). Also, public health policy needs to be at the forefront of this disorder with taxation, public announcements, limitation of alcohol availability, and restriction on marking and advertisement (3).

This study includes a number of limitations. A major limitation to our study was that patients' behavior was measured through surveys of their self-perception of what their drinking patterns would be with an increase in alcohol price. The incremental increases (halve, double, triple, quadruple, and quintuple) of the patient's indicated average price of drink in our survey may not be able to full capture the patient's true cost threshold. The large majority of our population were ex-drinkers. Thus, we asked them to complete the survey as if they would when they were still consuming alcohol. We recognize that this may not correlate directly with actual purchasing behavior in current drinkers.

Patients were surveyed in a single-site with a predominately White and Hispanic population, and the results may not be generalizable. The survey required a general knowledge of drink serving size and price. We tried to minimize for differences in this knowledge by using trained volunteers to help with survey administration. Our study sample size was insufficient to obtain subgroups analyses on different income groups, which may play a

factor in patients' responsiveness to price increases.

Future research may be directed at examining other factors that may influence alcohol consumption in ALD patients, such as binge drinkers and self-identified "social" drinkers as well as socioeconomic factors such as ethnicity, education, and income. Additionally, direct comparisons between the general population and ALD patients in terms of an alcohol cost threshold may be helpful for policy makers.

In conclusion, there is an inverse relationship between alcohol price and consumption in a survey of ALD patients. However, about a third of the surveyed population would not reduce alcohol consumption with any price increase, suggesting that there may be other factors that influence alcohol consumption in this population.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at http://dx.doi.org/10.21037/dmr-20-81

Data Sharing Statement: Available at http://dx.doi.org/10.21037/dmr-20-81

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/dmr-20-81). Sammy Saab serves as an unpaid editorial board member of *Digestive Medicine Research* from Apr 2020 to Mar 2022. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional review board of UCLA Research Administration (IRB#19-000413) and informed consent was taken from all the patients.

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