Alcohol Consumption and Liver Cirrhosis Mortality: Panel Evidence from Asian Region

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Abstract

Alcoholic beverages, such as wine, beer, and spirits, are widely consumed globally. However, their consumption poses significant risks, including an increased likelihood of injuries and accidents. Even a single episode of heavy drinking can have detrimental effects. Alcoholism and chronic alcohol use contribute to a wide range of medical, psychiatric, and social problems. This article aims to investigate the impact of alcohol consumption on Liver Cirrhosis Mortality as it represents major health issues associated with alcohol use. Furthermore, the study examines the collective impact of the Human Development Index (HDI), Socio-Demographic Index (SDI), and Gross Domestic Product (GDP) on income, aiming to understand how these factors influence the occurrence of Liver Cirrhosis Mortality (LCM). To conduct this research, data from over 46 countries spanning the years 2000 to 2019 were analyzed. Secondary data from reputable sources, such as the World Health Organization database, World Bank database, United Nations Development Program Data Centre, and Institute for Health Metrics and Evaluation database, were collected. The data were subjected to analysis using a panel regression technique.

Keywords: Alcohol consumption, Cirrhosis, Liver Cirrhosis, Liver Cirrhosis mortality

01. Introduction

Alcohol consumption is a widespread and significant behaviour that has far-reaching implications for public health, specifically in relation to liver cirrhosis mortality (LCM). This study aims to explore the enduring association between alcohol consumption, encompassing various types of beverages such as beer, wine, spirits, and others, and the incidence of liver cirrhosis mortality in the Asian region. Furthermore, this investigation incorporates several crucial control variables, namely the Human Development Index (HDI), Socio-Demographic Index (SDI), and Gross Domestic Product (GDP), to assess their influence on LCM. HDI measures a country's overall development based on life expectancy, education, and income. SDI measures the income per capita, fertility rate, and average educational level. Researchers examine the relationship between both HDI and alcohol consumption, and SDI and alcohol

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consumption to understand how socioeconomic factors and socio-demographic factors influence drinking behaviours and potential consequences for health and mortality rates (Collaborators, 2018; UNDP, 2020a). GDP incorporates measures of a country's level of economic development. Researchers analyse the relationship between GDP and alcohol consumption to assess how economic factors influence drinking patterns and health outcomes. Affordability, availability, and marketing of alcohol can be affected by changes in GDP which in turn may affect consumption levels and associated mortality rates (WBG, 2020). By considering the comprehensive impact of HDI, SDI, and GDP, this study brings a novel perspective to the analysis, shedding light on the holistic situation in the Asian region.

02. Research Problem

Liver cirrhosis poses a significant public health challenge in Asia, primarily driven by alcohol consumption. Chronic liver diseases, including cirrhosis, are leading causes of morbidity and mortality in the region, particularly in developing nations. The economic ramifications of liver cirrhosis are substantial, placing a heavy burden on healthcare systems and society as a whole. Although several studies have explored the association between alcohol consumption and liver cirrhosis mortality, there remains a pressing need for up-to-date research that examines the evolving trends and patterns of alcohol consumption and its impact on liver cirrhosis mortality in the Asian region (MKim et al., 2010; Ramstedt, 2001; Roerecke et al., 2019; Yang et al., 2012).

The primary objective of this study is to investigate the influence of alcohol consumption on liver cirrhosis mortality in the Asian region. By employing comprehensive measures of alcohol consumption, this research aims to identify the link between alcohol consumption and liver cirrhosis mortality. Additionally, this study endeavours to create global maps illustrating variations in alcohol-related mortality across the Asian region. Lastly, by analysing a wide range of data collected over an extended period, this research seeks to assess the impact of alcohol consumption on cancer incidence in the Asian region. Through these comprehensive investigations, this study aims to provide valuable insights into the complex relationship between alcohol consumption, and liver cirrhosis mortality in the Asian region.

03. Literature Review

The literature review section provides a comprehensive examination of existing research and scholarly work pertaining to the topic of alcohol consumption and its association with liver cirrhosis mortality in the Asian Region. By synthesizing and analysing relevant studies, this section aims to identify gaps, trends, and key findings in the current body of knowledge.

Previous research indicated a substantial increase in adult per capita alcohol consumption in five middle-income Southeast Asian countries, namely Cambodia, Myanmar, Vietnam, and Timor-Leste (Sornpaisarn et al., 2020). Furthermore, it was found that alcohol-related illnesses such as cancer, liver disorders, and traffic accidents are projected to lead to the loss of approximately 593 million life years in India between 2011 and 2050(Jyani et al., 2019).

The literature encompassed multiple articles that investigated the contribution of middle-income Southeast Asian nations to the mortality rate associated with alcohol-induced liver cirrhosis (Jyani et al., 2019; Sornpaisarn et al., 2020). However, in order to obtain a comprehensive understanding of the relationship between income levels, alcohol

consumption, and the resulting harm, further research studies need to be conducted. A strong positive correlation was observed between heavy drinking and the increased risk of developing all types of cancer, making it the leading cause of mortality in both men and women(Kim et al., 2010). Furthermore, a study conducted in the Hunan province of China highlighted those individuals who regularly consumed alcohol had an odds ratio of 1.56 for the development of oral cancer (Hu et al., 2020). These findings emphasize the detrimental impact of heavy alcohol consumption on cancer risk and reinforce the need for public health interventions to address this significant health concern.

A study conducted from 1990 to 1991 across 45 districts in China explores the alcohol consumption and smoking associated with a slightly elevated risk of total mortality among Chinese men aged 40 to 79 (Hu et al., 2020; Yang et al., 2012). These researches highlight the importance of considering the combined effects of alcohol consumption and smoking on mortality outcomes, emphasizing the need for targeted interventions to mitigate the risks associated with these behaviors in this specific population. The study by (Douds et al., 2003) highlights ethnic differences in cirrhosis, South Asians are over-represented and Afroo-Caribbeans are under-represented among cirrhosis patients. Additionally, (Liangpunsakul et al., 2016) emphasized the need for global strategies to reduce harmful alcohol use and effective treatment for alcoholic liver disease (ALD) based on differences observed across Asia, Europe, and North America. Understanding these differences is critical for developing targeted interventions and public policies to reduce the impact of alcohol consumption on liver cirrhosis mortality.

In a study, the relationships between alcohol consumption and liver health, as well as mortality from various causes including cancer, heart disease, cerebrovascular disease, pulmonary disease, and injury, were thoroughly examined. The results demonstrated a consistent and positive linear association between alcohol use and mortality risk from all causes, as well as an increased risk of cancer and cerebrovascular disease. However, no significant increase in heart disease risk was observed among men. Furthermore, the inclusion of socio-demographic factors, such as different income levels, as variables in future research would be valuable in investigating the impact of alcohol-related liver cirrhosis mortality (Saito et al., 2018).

Despite the existence of several studies which have investigated the impact of alcohol use on liver cirrhosis mortality in selected Asian nations, a comprehensive examination covering the entire Asian region has not yet been documented in the literature. Furthermore, there is a lack of in-depth research examining the combined effects of alcohol intake, HDI, SDI, and income as independent variables on the mortality rate related to liver cirrhosis in Asia. This literature review emphasizes the critical need for a comprehensive understanding of the factors influencing alcohol consumption levels and liver cirrhosis in the Asian region.

The available literature strongly indicates the need for further research on the effect of alcohol consumption on liver cirrhosis mortality. While research on alcoholic liver disease (ALD) in Europe, North America, and other regions has provided valuable insights, there is still a significant knowledge gap regarding the Asian region. Given Asia's unique cultural, genetic, and environmental factors, it is critical to focus and conduct proper studies on this region. Such research will provide valuable information for developing targeted interventions, prevention strategies, and policies to address specific challenges.

04. Methods

The primary objective of this research is to examine the impact of various types of alcohol (wine, beer, spirits, and others), along with the control variables of HDI, SDI, and GDP, on liver cirrhosis mortality (LCM) in the Asian region. The independent variables represent alcohol consumption, measured in terms of beer, wine, spirits, and other alcoholic beverages. Additionally, the study incorporates three control variables, namely HDI, SDI, and GDP. The dependent variable of interest is liver cirrhosis mortality (LCM). The level of alcohol consumption varies across countries within the Asian region, thereby exerting an influence on the dependent variables. Additionally, the HDI and SDI encompass indicators reflecting the educational attainment and healthcare quality of individuals, respectively, which are measured using composite indices (IHME; UNDP, 2020b). These indices provide a comprehensive assessment of the overall development and well-being of the population, capturing key factors that contribute to social and economic progress within each country. By considering these important variables, this study aims to examine the complex relationship between alcohol consumption, socioeconomic factors, and liver cirrhosis mortality in the Asian region. GDP, measured in current US dollars, serves as an indicator of the income level within each country. It reflects the overall economic output and prosperity of a nation, allowing for comparisons across different countries within the Asian region. By incorporating GDP as a variable in this study, the research aims to examine the association between income levels, alcohol consumption, and liver cirrhosis mortality. The inclusion of GDP provides insights into the economic dimension and its potential influence on the relationship between alcohol consumption patterns and health outcomes in the region (WBG, 2020). The dependent variable in this study, liver cirrhosis mortality (LCM), is measured using the Death Rate per 100,000 population providing a meaningful and comparable metric to examine the severity of liver cirrhosis mortality across different countries within the region. (IHME).

Data collection for this study encompassed all countries within the Asian region. Comprehensive data on the variables of interest were gathered from reputable secondary databases for the period spanning from 2000 to 2019. A total of 914 observations were collected, encompassing the independent, control, and dependent variables. Table 1 provides an overview of the variables used in the study and their respective data sources.

The dataset comprises observations from various cross-sections, representing different countries, and spans multiple years within the Asian region. The data file used for the analysis of this study is presented in S1 Appendix.

After preparing the dataset, diagnostic tests were conducted to ensure the reliability and robustness of the panel data analysis. The dataset was examined for model specification, heteroscedasticity, autocorrelation, influential observations using Cook's Distance test, functional form, normality of residuals, and multicollinearity. To account for variations in scale and units of measurement, all variables in the dataset were standardized. The analysis was performed using STATA Standard Edition Software.

Table 1: Variables and Data Sources

Variables	Definition	Source
LCM	Liver Cirrhosis Mortality (Death rate per 100,000)	Institute for Health Metrics and Evaluation https://vizhub.healthdata.org/gbd-results/

WINE	Wine consumption (Recorded per capita consumption of litres of pure wine)	World Health Organization Data https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/levels-of-consumption
BEER	Beer consumption (Recorded per capita consumption of litres of pure beer)	
SPIRIT	Spirit consumption (Recorded per capita consumption of litres of pure spirit)	
OTHER ALCOHOL	Other alcoholic beverages consumption (Recorded per capita consumption litters of pure other alcohol)	
HDI	Human Development Index (Composite indices)	United Nations Development Programme Data Centre https://hdr.undp.org/data-center/human-development-index#/indicies/HDI
SDI	Socio-Demographic Index (Composite indices)	Institute for Health Metrics and Evaluation https://ghdx.healthdata.org/record/ihme-data/gbd-2019-socio-demographic-index-sdi-1950-2019
GDP	Income (GDP per capita current US $)	World Bank Open Data https://data.worldbank.org/indicator/NY.GDP.MKTP.CD

The following linear model [Eq 1] was developed considering the conceptual framework and the research questions of the study. The conceptual framework was developed referring to the suggestions of past literature.

$$LCM_{it} = \beta_0 + \beta_1 WINE_{it} + \beta_2 BEER_{it} + \beta_3 SPIRITS_{it} + \beta_4 OTHERALCOHOL_{it} + \beta_5 HDI_{it} + \beta_6 SDI_{it} + \beta_7 GDP_{it} + \varepsilon_{it} \quad (1)$$

On Eq 1 i and t denote the country and the year under consideration respectively. As the data set has variability and it changes over time with country-specific effects, the panel data approach is the most suitable model for data analysis (Gujarati, 2004; Wooldridge, 2019).

05. Results

Using STATA Standard Edition software, descriptive statistics were extracted for each variable in the dataset. These descriptive statistics were provided for the Asian Region country-by-country basis. Due to events like political unrest and war in some nations, data gathering was hampered for several variables. However, the interpolation technique was used to clean the

dataset (Jayathilaka et al., 2022). Despite this, the numerical values for each variable give information about the real status of the result.

Table 2 provides detailed information on alcohol consumption patterns in Asia, specifically focusing on per capita (15+) consumption of beer, wine, and spirits measured in litres of pure alcohol. The dataset consists of 914 observations, representing the number of countries or regions included in the analysis. Asian spirits refer to traditional alcoholic beverages consumed in various Asian countries. For beer consumption, the per capita (15+) consumption is reported in litres of pure alcohol. Similarly, wine consumption is measured in litres of pure alcohol per person aged 15 and older. The standard deviation of 1.45 suggests a relatively large variability in the consumption of Asian spirits across the population. The range of recorded consumption varies from a minimum of 0 litres to a maximum of 8.81 litres, indicating diverse drinking habits within the population. The average GDP per capita for the Asian region is reported as US $9940.421 per year. It is worth noting that the Asian region is characterized by poverty, which is often attributed to political conflicts and economic instability. These findings provide insights into the alcohol consumption patterns and economic conditions within the Asian region, highlighting the variability in drinking habits and the economic context in which alcohol consumption occurs.

Table 2: Summary Descriptive Statistics for the Key Variables for Asian Region

	Beer	Wine	Spirits	Other alcoholic beverages	HDI	SDI	GDP	Liver Cirrhosis
Total	485.499	251.319	1074.0232	272.497	613.199	545.109	9145187.456	4445.329
Obs.	920	920	920	920	920	920	920	920
Mean	0.528	0.273	1.167	0.296	0.667	0.593	9940.421	4.832
SD	0.705	0.570	1.451	1.267	0.181	0.153	14879.202	5.037
Min	0	0	0	0	0	0.188	0	0.21
Max	3.62	4.12	8.81	8.22	0.943	0.88	85075.987	20.016

Note: SD represents Standard Deviation.

The results of panel data model specification tests for Eq 1 are summarized in Table 3. The findings of the F-test and Breusch-Pagan LM test for Asian countries indicate a rejection of the null hypothesis. This rejection suggests that the Ordinary Least Squares (OLS) approach is not the most suitable method for the current analysis.

Table 3: Specification Tests for Panel Data Models

Region	Tests		
	F-test	LM Test	Hausman Test (Sigmamore)
	H0: POLS	H0: POLS	H0: Random Effect
	H1: Fixed Effect	H0: Random Effect	H1: Fixed Effect
Asia	339.82***	6666.59***	122.63***

Note: The symbols *, ** and *** represents 10%, 5% and 1% significance level, respectively

To determine the appropriate model, the Hausman test was conducted, comparing the Fixed Effects (FE) and Random Effects (RE) models. The results of the Hausman test suggest that the FE model is more efficient than the RE model. Therefore, based on the significance level of 1% and the results of the panel data model specification tests, it is evident that the POLS approach is not the optimal choice for the current analysis. The FE model is recommended as the more suitable and efficient approach for this study.

Further, Table 4 represents all regression coefficient values with robust standard errors (RBSE) within square brackets which estimates the effect of alcohol consumption (Beer, Wine, Spirits, Other alcohol), HDI, SDI, and GDP on LCM in the Asian Region. RBSE was used to obtain unbiased, efficient estimates of regression coefficients against heteroscedasticity. According to R^2 values on Asian Region over 8% of the variation in LCM can be explained and fits the model for Asian Region.

Table 4: Fixed Effect and Random Effect Estimates.

Variables	Asia	
	Liver Cirrhosis	
	FE	RE
Beer	0.818***	0.825***
	[0.36]	[0.36]
Wine	0.453***	0.474***
	[0.12]	[0.12]
Spirits	-0.220**	-0.187**
	[0.32]	[0.32]
Other Alcohol	-0.0779	-0.0769
	[0.11]	[0.11]
HDI	0.612***	0.617***
	[0.36]	[0.35]
SDI	0.586***	0.549***
	[0.44]	[0.43]
GDP	-0.285***	-0.324***
	[0.12]	[0.12]
Constant	4.832***	4.832***
	[1.2e-09]	[0.71]
N	920	920
No of counties	46	46
No. of years	20	20
R^2 Within	0.322	0.321
R^2 Between	0.0578	0.0755
R^2 Overall	0.0695	0.0864

Note: The symbols *, **, and *** represents 10%, 5%, and 1% significance level, respectively. Square Brackets represent the robust standard error. FE and RE represent the fixed effect and Random effect respectively. N represents the number of observations.

06. Discussion

Focusing on the statistical findings for the Asian region utilizing panel data regression analyses using fixed effects and RE, it is clear that some variables significantly affect the variable LCM. At a 1% level of significance, the analysis in this situation shows that the consumption of beer and wine has a positive and statistically significant impact on LCM for the Asian region. Also, a study illustrates Five nations in South-East Asia rank among the top 12 for having the largest increasing trends in alcohol consumption globally (Sornpaisarn et al., 2020). Also, a couple of articles has been illustrated those middle-income South-East Asian nations played in the mortality rate for liver cirrhosis caused by alcohol (Jyani et al., 2019; Sornpaisarn et al., 2020). Further, spirits consumption has a significant positive impact on LCM at a 5% significance level. Additionally, the findings suggest that, at a significance level of 1%, HDI and SDI have a significant positive impact on LCM, while, GDP has a detrimental effect on the Asian environment. The researchers have illustrated in recent times, Chinese men's alcohol consumption between 2004 and 2011 was influenced by socio-demographic factors, also per capita consumption has decreased in traditional beer-drinking countries while it increased strongly in emerging economies, implying a negative income elasticity (Colen & Swinnen, 2016; Liu et al., 2019). (Razvodosky, 2008) has discovered a significant correlation between alcohol intake and liver cirrhosis death rates in Russia illustrating countries with high alcohol consumption levels could successfully minimize alcohol-related mortality by enacting limited alcohol restrictions. However, in order to obtain a comprehensive understanding of the relationship between income levels, alcohol consumption, and the resulting harm, further research studies need to be conducted.

07. Conclusion

Despite the existence of several studies which have investigated the impact of alcohol use on liver cirrhosis mortality in selected Asian nations, a comprehensive examination covering the entire Asian region has not yet been documented in the literature. The current study is the first of its type to use panel data regression in countries across the Asian region. The study goes on to look at the proportion or weight of consumption of beer, wine, spirits, and other variables that contribute to alcohol use in the Asian region. In this study, a Panel regression technique was used to cover 46 countries and territories over a 20-year period from 2000 to 2019, using the RE model with the FE model. Because the stepwise regression method with bidirectional elimination was utilized, the findings for several nations within the chosen regions differed slightly from the results implicated by the first objective. Not only does alcohol consumption level have an impact on alcohol-associated illness burden, but also, do socio-demographic characteristics, human development of people in the Asian continent, and economic level as measured by GDP level. Alcohol intake in the form of wine, beer, spirits, and other types of alcohol has been linked to liver cirrhosis in practically every country throughout Asia. Because drinking alcohol raises the likelihood of developing a long-term ailment. Policymakers can minimize high consumption levels of the other type of alcohol drinking by providing regular awareness workshops, displaying Harmful Effects, and imposing taxation on people. Policymakers should consider conducting regular awareness workshops targeting individuals with lower education levels. These workshops can educate people about the harmful effects of alcohol consumption, aiming to minimize high levels of alcohol intake among this specific population segment. Displaying the harm caused by alcohol use as aftereffects can effectively discourage excessive alcohol consumption. By visually demonstrating the potential health risks

and societal harms associated with alcohol consumption, policymakers can influence behaviour and promote responsible drinking habits. Imposing new taxes on alcoholic beverages can serve as a deterrent, as it raises their prices. This can result in reduced alcohol consumption, particularly among individuals with lower income levels, which is another good way for the government to grow its revenue. A future research element of this study would be to consider more variables such as age categories and gender of alcohol drinkers that can be associated with LCM.

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