



Short communication

Understanding the prevalence of lifetime abstinence from alcohol: An ecological study

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ABSTRACT

Background: The level of alcohol consumption and related burden in a country are strongly impacted by the prevalence of abstinence from alcohol use. The objective of this study was to characterize the association of lifetime abstinence from alcohol use with economic wealth (as measured in the gross domestic product [GDP]) and Muslim religion on a country level.

Methods: An ecological study was performed using aggregate data of 183 countries for the year 2010. Lifetime abstinence among men and women was predicted using fractional response regression models with the natural logarithm of GDP-PPP (purchasing power parity) and the proportion of Muslim population as predictors. The models were further adjusted by the country's median age and World Health Organization region. Precision of prediction was investigated.

Results: Descriptive analyses showed a strong negative association between GDP-PPP and lifetime abstinence in countries without a Muslim majority and a GDP-PPP up to 20,000 international dollars. Regression models confirmed the negative association with GDP-PPP and showed a strong positive association between lifetime abstinence and the proportion of Muslim population. Stratified sensitivity analyses showed that in countries without a Muslim majority only GDP-PPP showed a statistically significant association whereas in Muslim majority countries only the proportion of Muslims was associated with the prevalence of lifetime abstinence.

Conclusions: Particularly in countries with a lower GDP and without Muslim majority the prevalence of lifetime abstinence from alcohol use is strongly negatively associated with GDP-PPP. Future research should analyze the accordance in trends of GDP and lifetime abstinence over time.

1. Introduction

Alcohol is one of the top ten most important risk factors for burden of disease globally, accounting for about 5% of the global burden of disease in 2015 (Forouzanfar et al., 2016; World Health Organization, 2014). However, alcohol-attributable burden varies strongly across geographies: in North Africa and the Middle East alcohol use accounted for less than two percent of the total disease burden and ranked outside the top ten risk factors, while in Eastern Europe it was the fifth most important risk factor, accounting for over 13% of the total burden of disease (Forouzanfar et al., 2016).

Prior studies have shown that the levels of consumption are relatively similar between drinkers across different countries, so that the

discrepancy in alcohol-attributable burden is strongly linked to the prevalence of abstinence from alcohol use (Room et al., 2005). There is great variation in the prevalence of abstinence across countries, which is seemingly linked to the gross domestic product (GDP) of the country (Shield et al., 2011; World Health Organization, 2014). While in low-income countries about 18% of the adult population were current drinkers in 2010, about 70% of the adult population were current drinkers in high-income countries (Schmidt et al., 2010; Shield et al., 2011; World Health Organization, 2014). The underlying causes for the apparent association have not been explored in much detail yet. A possible contributor is the affordability of alcohol. In most low- and middle-income countries, alcohol can be considered a luxury product available predominantly to the more prosperous layers of society. As an

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example, a study found that in Zurich, Switzerland or in Brussels, Belgium less than a quarter of the median daily income of low earning occupations was required to buy 700 ml of low-priced Scotch whisky (chosen as benchmark for comparison based on a high correlation with the prices of other alcoholic beverages). In Jakarta, Indonesia or Mumbai, India over five times the median daily income of a low earning occupation were required to afford the same amount and type of alcohol (Kan and Lau, 2013). Further, positive associations between changes in the affordability of alcohol and alcohol consumption as well as alcohol-attributable mortality were found in European countries (Herttua et al., 2008; Rabinovich et al., 2009). Overall, in most high-income countries, alcohol is highly affordable and affordability is overall lower in middle- and low-income countries (Kan and Lau, 2013), which matches with the crude pattern of prevalence of abstinence.

Another important factor that might impact the prevalence of lifetime abstinence from alcohol use in a country is the predominant religion. The Quran prohibits alcohol use and in 15 of the about 50 Muslim majority countries (where over 50% of the population are Muslim) alcohol use is either banned completely or prohibited with concessions, e.g., for non-Muslims or tourists (Al-Ansari et al., 2016). While there is some evidence relating Buddhist beliefs to alcohol use in Thailand (Assanangkornchai et al., 2002), as well as restrictions of alcohol use based on Hindu traditions for certain casts (Sharma et al., 2010) neither of these examples apply to a larger number of countries or consistently relate to national alcohol policies.

Based on the variation of drinking patterns across the life span (World Health Organization, 2014), the prevalence of lifetime alcohol use in a country might also depend on the age of initiation and the age-distribution (characterized by the median age in the total population) in a country (Wilsnack et al., 2009). It should be noted, however, that median age and GDP of a country are positively associated (Harper, 2014). Finally, countries in geographical proximity (e.g., within the same World Health Organization (WHO) region) might share relevant characteristics above and beyond the religion, economic development, and age-distribution.

In sum, prevalence of lifetime abstinence from alcohol use is a core factor for alcohol-attributable burden in a country and the investigation of related factors would improve the understanding of its global distribution. Thus, the objective of this study was to investigate GDP and the proportion of Muslim population as explanatory variables for the prevalence of lifetime abstinence in an ecological study. Specifically, the following hypotheses were investigated:

- A higher GDP is associated with a lower prevalence of lifetime abstinence from alcohol use.
- A higher proportion of Muslim population is associated with a higher prevalence of lifetime abstinence from alcohol use.

2. Method

2.1. Design and data sources

Data on the prevalence of lifetime abstinence from alcohol use came from the Global Information System on Alcohol and Health (World Health Organization, 2013). For more methodological details to derive these data see (Poznyak et al., 2014).

The prevalence referred to the adult population (15+) in the year 2010. Data on the GDP at purchasing power parity *per capita* (GDP-PPP) in 2010 were retrieved from the World Bank (2016). The proportion of the population of Muslim faith in 2010 was obtained from the Pew Research Center (2011). Countries where the Muslim population constitutes more than 50% of the population were defined as Muslim majority countries. The median age in 2010 was retrieved from the World Factbook (Central Intelligence Agency, 2013).

2.2. Statistical analysis

Descriptive statistics were used to investigate univariate and bivariate distributions of the variables. Different regression models were investigated for fit including fractional response regression with a logit or a probit link, and beta regression. Model fit was investigated using AIC/BIC, pseudo R squared, and residual-versus-fitted plots. Transformations of explanatory variables were explored for an improved fit. A fractional response model with a probit link and using the natural logarithm of GDP-PPP (log GDP-PPP) showed the best fit.

The following three steps were performed: First crude models were calculated for GDP-PPP and the proportion of Muslim population separately (Model 1); secondly a multivariate model including both covariates was fitted (Model 2); thirdly the multivariate model was adjusted for WHO region and median age (Model 3). A sensitivity analysis was performed, fitting Model 3 stratified for Muslim majority countries and countries without a Muslim majority.

Precision of each model was evaluated as the proportion of countries for which the prevalence of lifetime abstinence was predicted within ± 5 percentage points of the 'observed' prevalence. For example if the lifetime abstinence reported by WHO was 45% a predicted prevalence between 40% and 50% was considered precise. All analyses were performed using Stata 14 (StataCorp., 2015).

3. Results

3.1. Descriptive statistics

Complete data were available for a total of 183 countries. Descriptive analyses showed that the prevalence of lifetime abstinence declined steeply with increasing GDP-PPP up to about 20,000 International Dollars *per capita* (Fig. 1). However, this seemingly did not apply to Muslim majority countries. GDP-PPP and median age showed a high positive correlation (Spearman's correlation coefficient $r_s = 0.78$, $p < 0.001$).

3.2. Modeling

The results of the fractional response models are shown in Table 1. As expected (Hypothesis 1), a higher GDP-PPP was associated with a lower prevalence of lifetime abstinence. Based on the crude model with log GDP-PPP as the only predictor (Model 1), lifetime abstinence was predicted precisely for about one in ten countries for both sexes. The proportion of Muslim population was associated with a higher prevalence of lifetime abstinence (Hypothesis 2). With the crude model using the proportion of Muslim population as the only predictor (Model 1) precise predictions were achieved for about two in ten countries for both sexes.

After combining both predictors in Model 2, the regression coefficients remained essentially unchanged. The proportion of countries with precise predictions increased to over a quarter of all countries for both sexes. After adjusting for WHO region and the median age (Model 3) the regression coefficients were attenuated and the association with the log GDP-PPP did not remain statistically significant. The precision of Model 3 increased to about half of all countries for males and 44% for females.

As an example, based on Model 3 a country from the European region with a GDP-PPP *per capita* of 25,000 International Dollars, 5% Muslim population and a median age of 40 years would have a predicted lifetime abstinence of 8% among men and 20% among women. For a country from the Eastern Mediterranean Region with a GDP-PPP of 15,000 International Dollars *per capita*, a Muslim population of 90% and a median age of 25 years, the predicted lifetime abstinence would be at 85% and 92% for males and females, respectively.

Looking at the proportion of 'precisely' predicted countries by WHO region showed that for males the precision was achieved in over 50% of

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