Beer Purchasing Behavior, Dietary Quality, and Health Outcomes among U.S. Adults

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Research in health, epidemiology, and nutrition has long suggested a link between moderate alcohol consumption and health. Early studies (Klatsky et al., 1977; Marmot et al., 1981) established a "U-shaped" relationship between alcohol consumption and health outcomes and mortality. That is, alcohol confers health protective benefits up to a point, typically defined in conjunction with identifiers such as age, gender, and bodyweight, but excessive consumption leads to adverse health effects. Renaud and de Lorgeril (1992) were among the first to highlight wine in particular as having specific health benefits beyond those attainable through beer or spirits consumption. The authors identified wine consumption as being partially responsible for the "French paradox," or the observation that adults in France consume more saturated fats, yet experience lower rates of coronary heart disease (CHD), than adults in many other developed countries.

However two lines of research in recent decades have raised questions regarding the exceptionalism of wine as an alcoholic beverage with potential protective effects. In one, a series of studies have found a significant and robust inverse relationship between mortality or the incidence of adverse health effects with beer or alcoholic beverages broadly defined. For example, Hermann et al. (2001) found evidence for a strong protective effect against CHD of alcohol among beer drinkers in Germany. The other line of research, e.g. Johanen et al. (2005), has shown that predominantly wine drinkers tend to have healthier diets and lifestyle choices, on average, as compared to beer drinkers and spirits drinkers. Therefore at least some of the

protective benefits of wine, specifically, may have been overestimated in the literature due to confounding effects.

While specific linkages and determinants still need to be identified and quantified, evidence is growing to support the notion that beer may confer specific health protective benefits. Much as the antioxidants specific to wine, including resveratrol, have been found to support health and reduce mortality, beer is likely to contain its own protective agents. For example, beer and hops feature xanthohumol, a flavonoid that has been shown to have broad protective benefits for humans (Stevens and Page, 2004). And there is reason to believe that, with respect to health benefits, not all beers are the same. Craft beer differs fundamentally from the typical American adjunct lager macro beer (e.g. Budweiser), in that it typically features a significantly larger amount of hops per gallon, higher alcohol content, silicone and other minerals, and is generally non-pasteurized allowing for the digestive aid of brewers yeast, among other factors.

We use household-level scanner data on food and beverage purchases, merged with self-reported health outcomes, to investigate relationships between alcohol purchasing behavior and CHD and Type-2 diabetes (T2D). We measure alcohol purchasing behavior by using expenditure shares, by alcohol type. We are thus able to measure the associations between the incidence of CHD and T2D with shifts in expenditures among beer, wine, and spirits. Importantly, given that we have purchase data at the UPC level, we are able to differentiate between craft beer, macro beer, and additional categories of beer purchases in an effort to identify the various health impacts.

Our results provide further evidence for the health protective benefits of moderate alcohol consumption. Craft beer, macro beer, and wine expenditures are all significantly associated with

the decreased likelihood of CHD and T2D, after controlling for a large number of demographics, lifestyle choices, and other potential confounders. Particularly for CHD, the craft beer effect may be significantly stronger than that found for either wine or macro beer. We find no relationships between spirits and CHD, nor any relationship linking imported beer or malt beverages and cider with the estimated health outcomes.

Data and Statistics

We use two rich datasets to measure consumer expenditure and health outcomes. To measure purchase behavior we use the IRI Household Panel, 2008-2012, which includes comprehensive point-of-sale records for all UPC-coded food and beverage purchases. Participants use handheld scanners to scan the barcodes for all purchases made for at-home consumption, and purchases records include prices, quantities, detailed product descriptors, any relevant promotional activity, and the retailers. The Household data are reported by purchase frequency, meaning that each shopping trip yields observations coded by date. We aggregate food and beverage purchases annually for the purposes of our analyses.

To measure health outcomes we use the 2010-2012 IRI Medprofiler data. This includes a wide array of self-reported ailments and health concerns at the individual level. Participants in Medprofiler are asked to respond to questions regarding common ailments with one of five possible responses: suffer but do not treat, suffer and treat with a prescription, suffer and treat with over-the-counter medication, suffer and treat with both prescription and over-the-counter medications, or do not suffer. For both CHD and T2D, we created annual binaries equal to one if the respondent indicated that he or she suffers at all. Medprofiler also includes responses to a number of questions that provide insight into lifestyle choices and overall healthiness. These include the frequency of exercise, eating dessert, eating fast food, eating organic foods, or

experiencing stress. Approximately 30,000 households participated in both the Household Panel and the Medprofiler data.

The IRI datasets provide rich information on demographics and other important descriptors, providing us with key controls, as suggested by past studies on alcohol and health. The Household data include household-level characteristics, including annual income, the education level and occupation of the household head(s), race, geographic location, marital status, and the age and number of children. The Medprofiler data include individual descriptors, including height and weight (which with we can calculate BMI), age, and gender.

To control for diet quality, we calculate the annual USDAScore, by household. The USDAScore was devised by Volpe and Okrent (2012) and measures the extent to which shopping baskets conform to the Dietary Guidelines for Americans (DGA), assuming parity between purchases and consumption. The USDA Center for Nutrition Policy and Promotion (CNPP) has produced the Thrifty Food Plan, which is intended to inform households on any budget how to best apportion food dollars in order to meet the DGA. The CNPP organized all foods and nonalcoholic beverages into 24 comprehensive categories and assigned recommended expenditure shares, by category and by age and gender. The USDAScore is calculated by comparing observed expenditure shares with household-specific recommendations, and higher scores reflect greater adherence to the DGA. The full details of the variable construction are available from Volpe and Okrent (2012).

Our alcohol preference variables are based on expenditure shares. For each household and year, we calculate total alcohol expenditures and from that measure the share of alcohol expenditures attributed to beer, wine, and spirits. In light of the potential health effects of hops and alcohol, two beer ingredients that can vary dramatically depending on the brewing process,

we further distinguish beer as either macro beer, craft beer, imported beer, or malt beverages and cider. Hence we measure the health impacts of a total of six varieties of alcoholic beverages.

Relative to the general population, the IRI households sampled for our study are older, have higher incomes, and are better educated. The average age in our sample is 53 and the average annual household income is $63,663. About 18% of respondents completed some graduate school. Our dataset is also 84% white. These aspects of our sample should be kept in mind while interpreting the results and considering further research.

With respect to health, approximately 10% of respondents have CHD and T2D, respectively. Over a third suffer from high cholesterol and hypertension, respectively. The average BMI is nearly 29, indicating that the average respondent is nearly clinically obese. Almost 72% of respondents indicated that they experienced stress throughout the time series. Hence we have a range of health risks and indicators within the sample.

Among alcoholic beverages, wine dominates slightly, with an average expenditure share of 23%. Hence there are more overall wine drinkers than any other variety in the sample. Macro beer is second, with an average 17% expenditure. Spirits are third with 12%, followed by craft beer with 3%, malt beverages/cider with 2%, and imported beer with 1%, on average.

Methodology and Results

Following Adjemian et al. (2015), who also used IRI data and similarly controlled for overall diet quality, we estimate logistic regressions to identify the impacts of alcohol preference on the prevalence of CHD and T2D. Our indicators for CHD and T2D are binaries, reporting 1 for sufferers and 0 for non-sufferers, hence limited dependent variable regression is appropriate for our purposes. The likelihood of suffering from the ailment of interest (CHD or T2D) for individual i in household h at time t is modeled as:

(1) $\text{Ailment}_{iht} = \theta_1 + \theta_2 \text{USDAScore}_{ht} + \theta_A \mathbf{AlcoholShares}_{\mathbf{ht}} + \theta_H \mathbf{HealthIndicators}_{\mathbf{it}} + \theta_D \mathbf{Demographics}_{\mathbf{ht}} + \theta_L \mathbf{Lifestyle}_{\mathbf{it}}$.

Thus the determinants of the incidence of these ailments are dietary quality and a series of vectors. **AlcoholShares** is the vector of alcohol preference variables, given by the expenditure shares by alcohol type. **HealthIndicators** is the vector of measures of health and well-being, as drawn from the MedProfiler data, including age, BMI, stress, hypertension, and high cholesterol. **Demographics** is the vector of household-level descriptors drawn from the Household Panel, including income, education levels, marital status, the presence of children, race, and a vector of geographical variables including urban vs rural and regional dummies. **Lifestyle** is a vector of variables measuring lifestyle and preferences, in our effort to account for the unobservable demand for health that is likely correlated with health outcomes. These include exercise frequency, consumption of fast foods, organic foods, and dessert.

In settings such as these, endogeneity and dual-causality are persistent concerns. For example, it is easy to imagine that relatively less healthful preferences for alcohol and food, as well as the proclivity towards CHD or T2D, are both determined by underlying preferences for health that cannot be captured in the model. To best circumvent this and to establish a degree of causality, we treat alcohol preferences and diet as stock variables. In our baseline estimation, we model health outcomes in 2012 as a function of each household's overall alcohol expenditure shares and USDAScore for the entire time period during which they participated in the Household Panel. In many cases, this constitutes five years of data. To increase the sample size in the estimation, we also relax this restriction and estimate (1) such that health outcomes for 2010-2012 are functions of aggregate purchasing behavior for all years leading up to and including the year of the outcome.

Broadly, the results support the longstanding contention that alcohol consumption (as proxied by purchase behavior in our study) has health protective effects. With few exceptions, the results are closely comparable across our two specifications of (1), lending robustness to the results. The reported coefficient estimates are odds ratios, which need to be interpreted in relation to one. A value below one indicates factors associated with decreased risk while a value above one indicates heightened risk for the ailment of interest. Craft beer, wine, and macro beer are all associated with the decreased likelihood of CHD and T2D. Moreover spirits are also associated with decreased T2D risk. None of the alcohol variables are significantly associated with increased risk in our framework. We discuss the magnitudes of these estimated impacts below, but it is important to bear in mind that all alcohol odds ratios must be interpreted as the impacts of adjusting alcohol expenditures towards the type of interest. For the most part, the odds ratios for the alcohol varieties with protective effects are not statistically significantly different from one another. However for our baseline, 2012-only CHD estimation, the craft beer impact is greater than the wine and macro beer impacts at the 0.10 level.

Most of our controls have the expected signs and are, for the most part, significant. All of the health factors are positively and significant associated with CHD, while all but stress are significant determinants of T2D. Females are significantly less at risk for both ailments. We find no significant impacts of race, though recall our data exhibit minimal variation in this dimension. Age is a significant risk factor for T2D, married couples are less at risk for CHD, and households with children present are somewhat less as risk for T2D. Households in the West exhibit less risk for CHD, all else equal. Income and dietary quality are both negatively and significantly associated with both ailments.

The lifestyle measurements are jointly important as determinants. Exercise significantly decreases the risk factor for both CHD and T2D. The frequency of fast food consumption, as expected, is positively associated with T2D incidence, and the opposite is true for organic foods. One somewhat counterintuitive finding is that dessert is shown to have a significant protective effect for T2D. But there are multiple potential explanations for this. Dietary quality is already controlled for, thus for food-at-home, sugars and sweets purchased to constitute desserts are already controlled for, meaning that this variable could be capturing, in part, the tendency to eat dinners as a family. Additionally the IRI question on dessert does not specify the type of dessert, meaning this includes individuals eating fruit or cheese for dessert.

Our findings suggest that, with respect to health protective effects, beer consumption is comparable to wine and in some cases may be superior. Increasing the household craft beer expenditure share by 10 percentage points is associated with a 4.6% decrease in risk for CHD and a 3.1% decrease in the risk for T2D in our baseline models. In our multiyear estimation, these values are 2.1% and 4.2%, respectively. A similar adjustment for macro beer is associated with about a 1% decrease in risk for CHD and a 3-4% decrease in T2D risk. For wine the estimated marginal effects are more consistent, by ailment, at just over 1% for CHD and just over 3% for T2D. There is no evidence that malt beverages and cider or imported beer have protective health effects, but these beverages had low average expenditure shares in the data.