Are Drinkers Prone to Engage in Risky Sexual Behaviors?

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Abstract

Although many studies have explored the link between alcohol use and risky sexual practices, the unobserved differences among individuals make it difficult to assess whether the associations are casual in nature. We have obtained data from the Spanish Health and Sexual Behavior Survey (2003) in order to analyze risky sexual behaviors using four alternative methodologies: controlling results with a rich set of variables; identifying the impact of alcohol use while assuming there is an identical selection outcome for observed and unobserved variables; estimating alcohol consumption and risky sexual behaviors simultaneously based on instrumental variables; and using reduced-form equations to analyze the impact of alcohol policies on the likelihood of risky intercourse. We provide empirical evidence that alcohol abuse might increase the probability of risky sex and, more importantly, different alcohol policies are not only effective tools for reducing alcohol demand but also for controlling risky sexual behaviors.

Keywords: alcohol, sexually transmitted diseases, unobserved individual heterogeneity**.**

JEL Classification: *C3, D1, H3, I1.*

1. Introduction

Risky sexual behaviors have a wide range of extremely negative consequences. Unwanted pregnancies and sexually transmitted diseases (STDs) are just starters which may culminate in social exclusion, a lower life expectancy, or have other far-reaching implications. Preventive strategies to reduce the prevalence of STDs and early pregnancy have usually pointed out alcohol consumption as a determinant of risky sexual behaviors. Thus, a policy aimed at reducing alcohol use (alcohol taxes, minimum legal drinking age or anti-drug education campaigns) might also be effective in controlling the spread of STDs and reducing under-age pregnancies. If alcohol consumption determines risky sexual behaviors, actions taken to reduce alcohol consumption might be a successful tool for combating the spread of STDs and reducing the number of unwanted pregnancies. A recent review of economics literature reveals that this causality is not taken for granted. People might drink to forget their problems or abuse alcohol as an excuse to justify engaging in promiscuous sex. If there are other forces affecting the decision to engage in risky sexual behaviors, adopting measures to address the role of alcohol alone may not be sufficient.

Sponsoring information

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The main goal of this paper is to explore the nature of the link between alcohol use and sexual risky behaviors. The Spanish Health and Sexual Behavior Survey (2003) provides us with a solid source of data for analyzing how socio-demographic characteristics of the most vulnerable population groups affect the prevalence of risky behaviors (Spanish Ministry of Health and Consumption 2003). The valuable data it provides has enabled us to identify and evaluate the factors leading to risky behaviors.

Estimates of the impact of alcohol use on risky sexual behaviors are obtained using four alternative econometric approaches. The first econometric approach uses a rich set of control variables, including attitudes and opinions. The second approach identifies the impact of alcohol use under the assumption that there is an equal selection of observed and unobserved variables. In the third approach we employ instrumental variables for estimating the structural relationship between alcohol consumption and risky sexual behavior. The fourth approach involves estimating reduced-form models of the impact of alcohol prices and other alcohol control policy variables on the likelihood of risky sexual behavior.

The main contributions of this paper are two-fold. First, the majority of studies published on this topic focus on North-American adolescents (Carpenter 2005; Dee 2001; Grossman, Kaestner and Markowitz 2004; Grossman, Kaestner and Markowitz 2005; Grossman and Markowitz 2005; Rashad and Kaestner 2004; Rees, Argys and Haberte 2001; Sen 2002; Strunin and Hingson 1992). Very few studies have been performed on North-American adults (Schribner, Cohen and Farley 1998), or young adults (Donovan and McEwan 1995; Kenkel 2006; Staton et al. 1999). Our study provides empirical evidence on the Spanish population with ages ranging between 18-49 years, thereby allowing us to examine whether the results obtained for North-American adolescents and youth can be extrapolated to other countries or the adult population.

Second, although most surveys designed for similar purposes, such as the North American National Survey of Family Growth (2002), include standardized questions (ever had sex; whether had sex in last 12 months; whether user of contraceptives; ever tested for HIV;etc.), the Spanish survey is unique in that it includes variables relating to attitudes. The set of variables on attitudes allow us to check whether the estimated parameters remain robust after controlling for individual perceptions and opinions.

2. Literature Review

Numerous studies have shown a positive association between alcohol use and risky sexual practices (Donovan and McEwan, 1995). Despite the repercussions of risky sexual behaviors, economists have paid relatively little attention to modeling these behaviors, particularly when we take into account the work of professionals in other disciplines, such as developmental psychology (Gruber, 2000). Nevertheless, in recent years, the literature on the relationship between substance abuse and sexual behavior (in adolescents and youth) has grown extensively.
Almost all studies have found that substance abuse of alcohol and other drugs is positively associated with several adolescent sexual behaviors such as starting to have sexual intercourse at a young age, having multiple sexual partners, and engaging in intercourse without contraception. However, the causal nature of this relationship is difficult to establish. Sexual behaviors and substance abuse are likely to depend on a set of personal and social variables, many of which are not observed or go unmeasured (Rashad and Kaestner, 2004).

Studies that try to estimate the causal link between alcohol use and various measures of risky sex, account for the econometric endogeneity of the alcohol use measures through methods including instrumental variables (IVs) and bivariate probit models (Kaestner and Joyce, 2001; Rees, Argys and Averett, 2001; Sen, 2002; Grossman et al., 2004; Grossman and Markowitz, 2005). For example, Grossman et al. (2004) examine the causal impact of substance abuse on risky sexual behaviors during adolescence. They found that alcohol use does not increase the likelihood of having sex or the likelihood of having multiple partners, although alcohol use does lower the probability of using condoms and other forms of birth control among sexually active teenagers. In their papers, Kaestner and Joyce (2001) and Grossman and Markowitz (2005) acknowledge that their instrumental variable estimations suffer from problems associated with weak instruments. Rashad and Kaestener (2004) raise similar concerns about the results of Rees, et al. (2001) and Sen (2002) who also use the instrumental variable technique.
In fact, Rees et al. (2001) and Sen (2002) reach different conclusions based on the same line of reasoning and similar data bases. Rees et al. (2001), using data drawn from the National Longitudinal Study of Adolescent Health 1995, study the effects of marijuana and alcohol use on two sexual behaviors: being sexually active, and using some contraceptive method the last time sexual intercourse was had.

They find only weak evidence that marijuana and alcohol use influence sexual behavior, which suggests that the link between substance abuse and sexual behavior found by previous researchers may not in fact be causal. Sen (2002), armed with data drawn from the National Longitudinal Study of Youth 1997, reaches a different conclusion. He finds that alcohol use does increase the likelihood of sexual intercourse among adolescents, even after accounting for the potential endogeneity. Sen suggests that one possible reason for the differences between his results and those of Rees et al. could lie on what they consider as a drinking unit. However, Rashad and Kaestner (2004) argue that the estimation strategy employed by Rees et al. (2001) and Sen (2002), while theoretically plausible, might generate biased results if the instruments are weak or invalid.

Given these research limitations, econometric studies of the relationship between alcohol policies and risky sex have also reached mixed conclusions. To overcome these technical problems, one set of econometric studies estimates the reduced-form model or direct relationship between alcohol control policies and adverse outcomes related to risky sex. Scribner et al. (1998) report a negative relationship between gonorrhea rates and the alcohol outlet-population ratio within residential urban areas. Chelson et al. (2000) show that gonorrhea and syphilis rates fall as the state beer and liquor tax rises. Dee (2001) finds mixed evidence that higher drinking minimum ages reduce childbearing among teenagers and youth. Carpenter (2005) demonstrates that the adoption of a Zero Tolerance law -- which makes it illegal for under-age drivers to have any traceable amount of alcohol in their blood -- is associated with a statistically significant reduction of gonorrhea rates among 15 to 19 years old white males. The fact that there is no relationship between the Zero Tolerance laws and gonorrhea rates for slightly older males who were not affected by the laws provides evidence supporting a causal effect. Along the same lines, Grossman et al. (2005) find that higher beer taxes and the existence of Zero Tolerance laws are associated with lower male gonorrhea rates, although other alcohol policies such as Blood Alcohol Content laws or dry counties appear not to have any effect.

The limitation of using reduced-form estimations is that the estimated results inform us indirectly about the influence of alcohol consumption on risky sexual behaviors, but it does not quantify the magnitude of this influence. In this paper we aim to advance our understanding of the causality between alcohol consumption and risky sexual behaviors by following the main guidelines of earlier studies and highlighting the role of the individual's attitudes in the correction of unobserved heterogeneity bias.

3. Data

We use data from the Spanish Health and Sexual Behavior Survey (2003). The HSBS was conducted by the Spanish Ministry of Health and Consumer Affairs between October and December, 2003. The HSBS focuses on persons between 18 and 49 years old living in single family dwellings in Spain. To obtain a specific level of reliability (at both national and regional levels), the survey was given to a sample group of 13,600 individuals distributed among 1,700 census sections. The HSBS survey contains the following sections: (A) Sociodemographic characteristics, including variables such as age, gender, educational level, marital status, economic activity, and professional situation; (B) Lifestyles, including questions related to the frequency of going out at night, alcohol consumption and injected drug use; (C) Information and sexual experience, including questions related to one's first sexual relationship, partners, and current and past sexual relationships; (D) Sexual Health, (E) HIV tests; and (F) Attitudes and Perceptions. (*See Table I*)

The questions related to lifestyles are very important to understand the patterns of risky behaviors. However the consideration of lifestyles in the empirical models is limited because these variables might introduce serious problems of endogeneity. For example, people who enjoy going out at night might drink more, but at the same time, people who like drinking alcoholic beverages might spend more nights going out.

Regarding alcohol consumption, we consider two kinds of measures: if the individual consumes 3 or more alcoholic beverages on one occasion at least once a week, and if the individual has been drunk at least once in the last month. The advantage of the first measure is that it represents a neutral index that combines frequency and quantity. The question is where to draw the line between quantities indicative of moderate alcohol consumption and those of alcohol abuse. Two different quantities should be established for men and women. We use only one quantity for both sexes, because apart from being the only available information we have, it is the simplest way to show the results. In addition, precise measurements would require that other important biological factors such as an individual's height or weight also be taken into consideration. The advantage of the second measure is that it informs us about the influence of alcohol consumption on the individual capabilities.

Some people become inebriated after just one drink, whereas others may not feel any symptoms whatsoever. The problem rests in it being a self-reported measure that depends on the perception of the individuals. On one hand, many people might think they are fine after drinking, but in fact they are drunk. This situation is common seen in car accidents where drivers who were under the influence of alcohol thought they could drive without any problem. On the other hand, the consumption of alcoholic beverages is determined by the addictive characteristics of tolerance and reinforcement (Becker and Murphy, 1988). This explains why individuals who could consume a large number of drinks at one time when they were youths may find that a fewer number of drinks has the same or an even stronger effect on them later in life.

According to the HSBS, 24% of men consume 3 or more alcoholic beverages per occasion at least once a week, as compared to 7% of women. The percentage of individuals who have been drunk at least once in the month prior to the administration of the survey are quite similar for men and women. With rates around 45%, this self-reported subjective measure reveals greater alcohol abuse than the objective quantitative measure. Because the percentage for alcohol consumption among males was astonishingly high, we performed an analysis by age distribution. As expected, youths abuse alcohol more than adults. The values for women of various ages vary only slightly, whereas the values for men reveal a greater decrease with age.

Regarding risky sexual behaviors we consider two possible measures. The first one identifies individuals who had intercourse with occasional partners in the last 12 months. The risk lies in having relations with strangers, thus their drug use or sexual habits may not be known. The second measure is narrower in that it identifies individuals who had intercourse with occasional partners without using a male condom in the last 12 months. Condom use is the only effective preventative method against HIV, and other sexually transmitted diseases. The mean analysis of Table I reveals that for example, on average 37% and 21% of men and women who drank 3 or more alcoholic beverages per occasion at least once a week had sexual relationships with occasional partners during the 12 months before the survey, versus the 20% and 7% of men and women who did not drink 3 alcoholic beverages per occasion every week. These differences are statistically significant at 5% level.

Along with the individual observations provided by the HSBS, we use contextual data. Contextual variables inform us about alcohol policies which are essential for the econometric approaches of instrumental variables and reduced-form equations. As a measure of the alcoholic beverages' prices we use the figures calculated by the Spanish Ministry of Agriculture, Fisheries and Food from the Household Budget Inquiry (2003). Other control policies we consider include difference between the minimum drinking age and 18, if any, and the regional public expenditure allocated to prevention, health care and social work, research and institutional coordination in anti-drug programs. The Spanish Constitution (art. 4) gives the Regional Authorities the power to intervene in public health affairs.

4. Empirical Framework

We use a standard econometric framework to explore the relationship between alcohol consumption and risky sexual behaviors. The results do not change substantially when we select only those individuals that are sexually active because 95% of the subjects interviewed have already had intercourse. The selection of sexually active individuals might be more meaningful for studies of adolescents and youths. In our sample, for example, 65% of 18 year-old women are sexually active, but this percentage is close to 100% for women above 30.

Our empirical framework is similar to that used in previous econometric studies and falls within the canonical econometric approach for studies using observational cross-sectional data (i indexes individuals) to identify the causal effects of health-related behaviors:

$$H_i = X_i\beta + \delta D_i + u_i$$

H_i is the measure of risky sexual behavior, D_i is a measure of alcohol use, X_i is a vector of sociodemographic characteristics (gender, age, civil status, family composition, level of education, working status, among others) and u_i is a zero-mean disturbance term. The key parameter of interest is δ because it provides information on the causal effect of alcohol use on risky sexual behaviors, controlling for differences in the observed (X_i) and unobserved (u_i) determinants of risky sexual behaviors.

The fundamental challenge in using observational data to estimate δ is the possibility that even after controlling for observed characteristics, the unobserved determinants (u_i) may vary with the health behavior D_i. Consequently, a potential challenge to this research might be that unobserved determinants of risky sexual behaviors could vary with alcohol use.

Our initial response to this challenge is the simplest: we plan to include a very rich set of observed characteristics (X_i) to model the impact of alcohol use on risky sexual behaviors. The rich set of attitude variables included in the HSBS is essential for defining the set of control variables. Within the conceptual economic framework , and in light of the insights of other social science research, it is natural to expect that individual attitudes or preferences are important determinants of both H_i and D_i. For example, individuals with conservative attitudes may be less likely to engage in risky sex or get drunk. Controlling for the range of attitudes and perceived risks reduces unobserved heterogeneity and improves our estimates of δ. We are aware that including attitudes variables in the estimations introduces a problem of endogeneity. We do not analyze the estimated parameters of these variables because they may reflect bias. The importance of this strategy lies on the fact that if the estimation of δ is robust, its value will not vary significantly for the variables we consider in the model.

Our second approach is to develop an unbiased estimation of δ following the approach of Altonji et al. (2005), thus identification is achieved by assuming there is an equal selection of observed and unobserved variables, and not by the introducing instrumental variables. This approach is based on the assumption that the determinants of the outcome can be divided into observed and unobserved determinants. The identification problem is that the endogenous variable is likely to be correlated with the unmeasured component. To solve this problem, Altonji et al. (2005) argue that not only the unmeasured component is likely to be correlated with the endogenous variable, but also the measured component. They assume that the correlation between the unobserved determinants of the outcome and the endogenous variable is equal to the correlation between the observed determinants of the outcome and the endogenous variable (Equal Selection Rule). Equal Selection Rule is justified in the fact that measured variables are chosen randomly from a large set of possible determinants. This assumption is reasonable given that most secondary data sets are not usually designed for the specific research question under investigation but for many other uses. The equal selection rule provides us with an estimation of the correlation between the errors that we introduce in the estimation of the bivariate probit model, thus the instrumental variable technique is no longer required to achieve identification.

Our final two approaches to studying the relationship between risky sexual behaviors and alcohol use treat alcohol use as econometrically endogenous. These approaches address not only the problem of unobserved heterogeneity, but also the possibility that there may be reverse causation. The main implication of this reverse causality is that the correlation between alcohol intake and the disturbance term is not zero, what might lead to an underestimation of the treatment effect of alcohol intake on risky sexual behaviors.

To correct the problem of reverse causality we will estimate the risky sexual behaviors by treating alcohol intake as an endogenous variable. With this in mind, our focus is on the alcohol demand function:

$$D_i = X_i\beta + \alpha P_i + \omega Y_i + v_i$$

According to the demand function, the individual decision about consuming alcoholic beverages depends on the price of the product (P_i) and the available budget (Y_i). Other alcohol control policies have similar effects to the alcohol price, so the way to introduce them in the alcohol demand function is identical to the alcohol prices. The influence of the monetary variables on alcohol demand are described by α and ω. We also consider a set of socio-demographic variables that we assume to be identical to the one that determines the adoption of risky sexual behaviors. The vector of parameters related to socio-demographic characteristics is β and v_i is the zero-mean disturbance term.

To estimate risky sexual behaviors in reduced-form, we substitute the alcohol intake variable by the expression of the alcohol demand function in the first equation:

$$H_i = X_i\beta + \phi P_i + \varphi Y_i + \varepsilon_i$$

This expression allows us to understand the influence of structural policies on the reduction of risky sexual behaviors. The influence of the monetary variables on risky sex is described by ϕ and φ. The zero-mean disturbance term is reported as ε_i.

To proceed with this methodology we need to introduce variables, commonly referred to as instrumental variables, which affect the demand for alcoholic beverages but not the outcome. The basic instruments introduced for estimating the risky sexual behaviors with alcohol intake as an endogenous variable are the prices of the alcoholic beverages and other alcohol control policies. In the proposed work, we will conduct standard specification tests to determine if our models face the problems associated with weak instruments (Bound, Jeager and Baker 1995).

5. Results

Once the empirical framework has been described, we move on to examine the relation between alcohol consumption and risky sexual behaviors using the four alternative methodologies described in the empirical framework.

In order to know if the estimated impact of alcohol use on risky sexual behaviors is consistent, we estimate risky sexual behaviors with and without individual perceptions and opinions. In the list of attitude variables we include religious attitudes, perceived HIV risk by type of intercourse, perceived HIV risk in general, social acceptance of HIV positive population, perceived effectiveness at preventing spread of HIV, opinions on condoms and blood tests. If the unobserved heterogeneity is important, the estimated parameter of alcohol consumption will be much lower using a rich set of variables. The univariate probit estimations of Table II reveal that after controlling for a rich set of attitude variables the estimated marginal fixed effects of alcohol consumption on risky sexual behaviors drop anywhere from 0.13 to 2.6 percentage points (where the estimated parameters are statistically significant). Therefore, not controlling for unobserved heterogeneity might overestimate the impact of alcohol use on risky sexual behaviors. The role of unobserved heterogeneity seems to be as important for males as for females. Different results come from both the choice of econometrical model and the manner in which the variables are defined. We observe that the impact of the value for frequency and quantity of alcohol intake is greater than the influence of the value indicating whether the individual was drunk. Regarding risky sexual behaviors, the impact of alcohol consumption is greater for the probability of sexual intercourse with occasional partners than for the probability of unprotected sex with occasional partners. (*See Table II*)

In Table III, we show the estimated parameters of alcohol consumption on risky sexual behaviors for male and female respondents imposing different levels of correlation between the residuals of both variables to achieve identification in bivariate probit models. The values of rho are defined in two ways: To begin, we show the estimations of constrained bivariate probits for which values of the correlation coefficient of rho (ρ) are fixed. Secondly, we assume there is an equal selection between observed and unobserved variables.

Fixing different values of rho reveals how necessary it is to select unobserved characteristics in order to eliminate the positive association between alcohol consumption and sexual risky behaviors. We consider that ρ takes values from 0.1 to 0.50. In general, the stronger the correlation between the unobserved characteristics of alcohol consumption and risky sex, the lower the estimated parameter of alcohol consumption in the estimation of risky intercourse is going to be. In fact, the positive relation between alcohol consumption and risky sex might not be taken for granted. Achieving identification by imposing the selection rule reveals that there is an insignificant amount of selection of observed characteristics for males. In the case of males, all four corresponding estimated parameters are statistically significant. For females, the selection of observed characteristic is greater, but the impact of alcohol consumption on risky sex is lower. This result is derived from the only estimated parameter that is statistically significant. Given that only one parameter out of four is statistically significant, the empirical evidence for females is weaker than for their male counterparts (*See Table III*)

The simultaneous equation system allows us to estimate alcohol consumption and risky sexual behaviors at the same time. Where both variables are estimated simultaneously, alcohol consumption is not as strong an indicator of the prevalence of risky sexual behaviors. In fact, only one parameter out of eight remains statistically significant. The first stage of the instrumental variable technique provides us with important information related to the determinants of the demand for alcohol.

Monetary variables affect demand as expected; higher wages and lower prices encourage alcohol abuse. Regarding other alcohol policies, the number of years that a regional government has had the minimum drinking age set at 18 years old is inversely related to the incidence of alcohol abuse. The level of public spending on prevention and health care/social work reduces alcohol abuse. In this table, special attention is also paid to test the instrumental variable technique. The endogeneity test of Durbin Watson confirms that alcohol consumption might act like an endogeneous explanatory variable, because in 5 out 8 times the null hypothesis of non-endogeneity is not accepted. Regarding the instruments, the tests of individual and joint significance show that in general the instruments are statistically significant. These results vary substantially across estimations. The instruments we consider might not improve the results of previous research because they do not provide an explanation for an individual's level of alcohol consumption. For example, the aggregated regional alcohol price scarcely explains the male probability of consuming 3 or more alcoholic beverages per occasion in 0.11%. The general explanatory power of the instruments is around this value, so we might conclude they are weak. This weakness should lead us to consider the results of Table IV with caution. (*See Table IV*)

Lastly, we continue with the reduced-form equation model that avoids the problem of endogeneity by excluding the endogenous explanatory variables from the estimations. The main result is that the price of alcoholic beverages might prove a useful means for decreasing risky sexual behaviors. In addition, individuals with higher wages are more likely to adopt risky sexual behaviors. The number of years that the law establishing 18 as the minimum drinking age has been in force has a direct positive effect on controlling risky sexual behaviors. Policymakers may also be interested in the fact that our results reveal that regions which have invested more money in drug prevention measures have lower individual rates of risky sexual behaviors. (*See Table V*)

6. Conclusions and Policy Implications

Empirical research can provide international and national policy makers with a useful analytical tool to assess the effectiveness of their actions. In this paper we have obtained enough empirical evidence to conclude that alcohol consumption might promote the adoption of risky sexual behaviors, and consequently, that alcohol policies might also reduce the negative outcomes associated with unsafe sex.

Regarding specific alcohol policies, there is empirical evidence that increasing the price of alcoholic beverages reduces the incidence of risky sex. The minimum drinking age is similarly a positive instrument to control not only the alcohol demand but also the prevalence of risky sex. Our results provide evidence that preventive strategies of this nature could become more effective over time. However these results must be interpreted with caution as there may be regions in which policy makers are willing to introduce reforms early if they believe them to be in the best interests of their citizens. In turn, this result might lead to common unobserved characteristics in the area where survey respondents live.

Regarding general anti-drug policies, we also demonstrate that allocating public expenditure to fight against drugs has also positive effects for reducing of risky sexual behaviors. Not only is the size of the budget important, but also how it is allocated among different areas. For example, the area of prevention has positive outcomes in terms of lower rates of risky sexual behaviors, whereas the area of institutional coordination is characterized by its effectiveness in controlling risky sex. The relevance of these results lies in identifying alcohol policies as cost-effective strategies in the promotion of a healthy and stable society. Controlling alcohol use also makes it possible to control other risky activities, such as risky sex.

Bivariate probit estimations in which identification is achieved under the equal selection rule prevent us from taking for granted a causal relationship between alcohol consumption and risky sex. In fact, the unobserved heterogeneity might be important and alcohol consumption is certainly not the only determinant of risky sex. Aside from alcohol controls, it is necessary to implement specific policies to reduce risky sexual behaviors, such as information campaigns aimed at prevention which encourage the use of male condoms. Given the weakness of the instruments, our results using the instrumental variable technique are not better than those obtained in earlier studies.

It would be interesting to check whether the results obtained with cross-section surveys are consistent with the results derived from panel data. The main advantage of using panel data is that individual heterogeneity can be controlled for using fixed effects. In addition, both alcohol consumption and risky sex might be influenced by peer effects, so the omission of peer effects might overestimate the effects of the explanatory variables.

Lastly, it would be interesting to perform a study of the intergenerational effects of habits, means of transmission and social networks on alcohol consumption and sexual intercourse. To address these challenges, we recommend that future surveys be designed to collect rich information including administrative and longitudinal data.

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Table I. Sample means of selected characteristics by gender and alcohol consumption

	Males: *Weekly alcohol consumption (3 or more drinks)*		Females: *Weekly alcohol consumption (3 or more drinks)*	
	Yes Mean: 0.2367	No Mean: 0.7633	Yes Mean: 0.0680	No Mean: 0.9320
Sexual intercourse with occasional partners (12 months)	0.3675**	0.2044	0.2072**	0.0689
Unprotected sex with occasional partners (12 months)	0.1523**	0.0763	0.0921**	0.0291
Sociodemographic characteristics				
Age	30.1214**	33.6030	28.3107**	34.0167
Spanish nationality	0.9475**	0.9281	0.9347**	0.9228
Foreign nationality	0.0524**	0.0725	0.0776	0.0647
Married	0.2838**	0.5009	0.2167**	0.5614
Single	0.6817**	0.4704	0.7363**	0.3785
Divorced/Separated	0.0328	0.0241	0.0444	0.0493
Widow	0.0016**	0.0046	0.0026**	0.0108
Living with partner	0.3749**	0.5784	0.3238**	0.6282
Living with parents	0.5135**	0.3571	0.5849**	0.3216
Living with children	0.1920**	0.3240	0.2037**	0.4761
Living with friends	0.0615**	0.0366	0.0627**	0.0273
Primary education	0.2354	0.2416	0.1137**	0.2490
Secondary education	0.3790**	0.3470	0.3669**	0.3113
Professional training	0.2190	0.2240	0.2610**	0.2030
College studies	0.1665	0.1874	0.2584	0.2367
Working	0.7711**	0.8228	0.6202	0.6084
Unemployed	0.0607	0.0512	0.0827**	0.1104
Studying	0.1575**	0.0975	0.2377**	0.1026
Housewife/husband	0.0008	0.0008	0.0543**	0.1593
Other	0.0057	0.0097	0.0052	0.0131
Religious attitudes				
Catholic	0.8086	0.7912	0.7931	0.8129
Other religion	0.0224**	0.0473	0.0000**	0.0210
Agnostic/Personal beliefs	0.1690	0.1615	0.2069	0.1661
Religious services more than once a week	0.0224**	0.0416	0.0296	0.0381
Religious services once a week	0.0810	0.0999	0.0591**	0.1512
Perceived risk of contracting HIV by type of sexual intercourse				
With a stable partner of the opposite sex	0.0586	0.0605	0.0739	0.0645
With stable partner/occasionally of the opposite sex	0.7000**	0.7612	0.8227	0.8165
With different partners	0.8810**	0.9258	0.9507	0.9627
With a stable partner of the same sex (men)	0.3259**	0.3151	0.2365	0.2712
With stable partner/occasionally of the same sex (men)	0.8362	0.8574	0.8867	0.8778
With different partners of the same sex (men)	0.9155	0.9274	0.9360	0.9224
With partner of the same sex (women)	0.4759	0.5076	0.5025	0.5642
Perceived risk of contracting HIV in general				
Sexual intercourse	0.9707	0.9663	0.9901**	0.9706
Drinking from a glass used by a person with HIV	0.0810	0.0968	0.0640	0.0689
Social acceptance of HIV positive population				
Willing to work with a person with HIV	0.6862	0.6839	0.7833	0.7263
Perceived effectiveness of preventing spread of HIV				
Washing after sexual intercourse	0.2172	0.2230	0.1823	0.1820
Limiting the number of sexual partners	0.4414	0.4566	0.3793	0.4434
Using a male condom	0.9759	0.9774	0.9507	0.9670
Asking sexual partners to take an HIV test	0.2241	0.1941	0.1626	0.1708
Using spermicide	0.6966	0.6875	0.7192	0.7110
Asking sexual partners about sexual past	0.4207	0.3961	0.4680	0.4387
Using a female condom	0.5966**	0.5287	0.5567	0.5373
Condom opinions				
Reduce pleasure for women	0.2258**	0.1588	0.1231	0.1381
Reduce pleasure for men	0.3397**	0.2567	0.2365	0.2219
Make it impossible to feel the other person	0.4190**	0.3535	0.2315	0.2212
Provide additional pleasure because of safety	0.4086**	0.4729	0.4877**	0.5776
Are safe	0.8345	0.8474	0.8128**	0.8212
Blood control				
HIV analysis/blood donation	0.3814	0.3754	0.2816**	0.3779

** indicates that the differences between drinkers and non drinkers is statistically significant (95%)

We have also included regional dummy variables (North, South, Centre, East and Madrid)

This table is susceptible of repetition differentiating the means by alcohol abuse. 43.61% and 45.52% of men and women have been drunk at least once in the last month.

Table II. The influence of alcohol consumption on the probabilities of risky sexual behaviors (Simple probits)

	Males		Females	
Additional Covariates	No	Yes	No	Yes
N	4412	2185	4646	2581
Sexual intercourse with occasional partners in the last 12 months				
Real probability (%)	25.68		7.97	
Weekly alcohol consumption with 3 or more drinks per occasion	0.2687*** (0.0501) [0.0830]	0.2884*** (0.0748) [0.0817]	0.4458*** (0.0929) [0.0663]	0.4068*** (0.1348) [0.0479]
Estimated probability (%)	26.16	22.16	10.93	9.38
Pseudo-R^2 (%)	16.94	18.79	15.10	18.24
Drunk last month on at least one occasion	0.2931*** (0.0470) [0.086]	0.2277*** (0.0707) [0.0608]	0.1999*** (0.0600) [0.0225]	0.2013*** (0.0872) [0.0179]
Estimated probability (%)	26.61	22.30	10.20	8.86
Pseudo-R^2 (%)	17.04	18.48	14.78	18.23
Unprotected sex with occasional partners in the last 12 months				
Real probability (%)	8.15		2.73	
Weekly alcohol consumption with 3 or more drinks per occasion	0.3487*** (0.0582) [0.0521]	0.3190*** (0.0917) [0.0356]	0.4759*** (0.1108) [0.0380]	0.2534 (0.1869) [0.0109]
Estimated probability (%)	9.35	6.59	3.25	2.98
Pseudo-R^2 (%)	7.32	15.19	6.83	15.16
Drunk last month on at least one occasion	0.2551*** (0.0569) [0.0335]	0.2525*** (0.090) [0.0248]	0.0889 (0.0738) [0.0047]	0.1908* (0.1169) [0.0063]
Estimated probability (%)	9.68	6.70	2.83	2.70
Pseudo-R^2 (%)	6.78	15.10	5.81	15.53

Standard errors in parentheses. Marginal effects in brackets
Basic set of covariates: Socio-demographic characteristics
Additional covariates: Religious attitudes, perceived HIV risk by type of sexual intercourse, perceived HIV risk in general, social acceptance of HIV positive population, perceived effectiveness at preventing spread of HIV, opinions on condoms and blood tests.

Table III. The influence of alcohol consumption on risky sexual behaviors

	Males				Females			
	Constrained Bivariate Probit			BivariateProbit $\rho = \frac{Cov(X'\beta, X'\gamma}{Var(X'\gamma)}$	Constrained Bivariate Probit			BivariateProbit $\rho = \frac{Cov(X'\beta, X'\gamma}{Var(X'\gamma)}$
	ρ = 0.1	ρ = 0.3	ρ = 0.5		ρ = 0.1	ρ = 0.3	ρ = 0.5	
Sexual intercourse with occasional partners in the last 12 months								
Real probability (%)	25.68				7.97			
Weekly alcohol consumption with 3 or more drinks	0.1189* (0.0745) [0.0080]	-0.2190*** (0.0724) [-0.0170]	-0.5536*** (0.0681) [-0.0500]	0.3620*** (0.0747) [0.0219] $\hat{\rho}$ = -0.0434	0.2194* (0.1341) [0.0010]	-0.1481 (0.1299) [-0.0010]	-0.5055*** (0.1217) [-0.0049]	-0.3995*** (0.1246) [-0.0035] $\hat{\rho}$ = 0.4400
Estimated prob. (%)	20.54	21.48	22.91	20.15	9.09	8.84	9.06	8.96
Drunk last month on at least one occasion	0.0636 (0.0704) [0.0067]	-0.2649*** (0.0685) [-0.0327]	-0.5925*** (0.0645) [-0.0852]	0.2202*** (0.0707) [0.0218] $\hat{\rho}$ = 0.0046	0.0388 (0.0869) [0.0016]	-0.2883*** (0.0846) [-0.0160]	-0.6223*** (0.0799) [-0.0476]	-0.0038 (0.0867) [-0.0001] $\hat{\rho}$ = 0.1262
Estimated prob. (%)	20.33	20.76	21.92	20.36	8.80	9.28	10.69	8.82
Unprotected sex with occasional partners in the last 12 months								
Real probability (%)	8.15				2.73			
Weekly alcohol consumption with 3 or more drinks	0.1500* (0.0917) [0.0041]	-0.1848** (0.0891) [-0.0067]	-0.05173*** (0.0839) [-0.0255]	0.4487** (0.0919) [0.0098] $\hat{\rho}$ = -0.0761	0.0654 (0.1867) [0.0001]	-0.2958* (0.1813) [-0.0007]	-0.6393*** (0.1706) [-0.0028]	-0.0472 (0.1856) [-0.0001] $\hat{\rho}$ = 0.1613
Estimated prob. (%)	6.10	6.67	7.90	6.04	2.80	2.76	3.02	2.76
Drunk last month on at least one occasion	0.0884 (0.0905) [0.0037]	-0.2425*** (0.0881) [-0.0136]	-0.5814*** (0.0831) [-0.0444]	0.2930*** (0.0908) [0.0105] $\hat{\rho}$ = -0.0247	0.0288 (0.1165) [0.0003]	-0.2995*** (0.1135) [-0.0057]	-0.6430*** (0.1075) [-0.0195]	0.1157 (0.1168) [0.0013] $\hat{\rho}$ = 0.0463
Estimated prob. (%)	6.07	6.46	7.69	6.17	2.66	3.01	4.05	2.64

Notes: Table 2

Table IV. Alcohol consumption and risky sexual behaviors under a framework of simultaneous equations (Instrumental Variables Technique)

2ND STAGE				
	Sexual intercourse with occasional partners (12 months)		**Unprotected sex with occasional partners (12 months)**	
	Males	Females	Males	Females
	Prob: 25.68	Prob: 7.97	Prob: 8.15	Prob: 2.73
Weekly alcohol consumption with 3 or more drinks	1.0660 (0.6842) [0.3332]	3.7533*** (1.4178) [0.4900]	1.1618 (0.8571) [0.1748]	1.5813 (1.8651) [0.0969]
Estimated probability (%)	25.16	8.75	9.82	3.06
Pseudo-R^2 (%)	5.93	6.79	3.18	2.84
DW endogeneity test	$\chi^2(1)=8.22$ $Pr>\chi^2=0.0041$	$\chi^2(1)=2.41$ $Pr>\chi^2=0.1208$	$\chi^2(1)=2.50$ $Pr>\chi^2=0.1135$	$\chi^2(1)=3.40$ $Pr>\chi^2=0.0652$
Drunk last month on at least one occasion	0.1779 (0.5213) [0.0559]	1.9413 (1.2540) [0.2564]	-0.8617 (0.6730) [-0.1296]	0.2372 (1.7067) [0.0279]
Estimated probability (%)	25.13	8.77	9.71	3.07
Pseudo-R^2 (%)	5.88	6.61	3.17	2.79
DW endogeneity test	$\chi^2(1)=5.81$ $Pr>\chi^2=0.0159$	$\chi^2(1)=3.08$ $Pr>\chi^2=0.0794$	$\chi^2(1)=1.37$ $Pr>\chi^2=0.2426$	$\chi^2(1)=5.67$ $Pr>\chi^2=0.0173$
1ST STAGE				
	Weekly alcohol consumption with 3 or more drinks		**Ever Drunk last week**	
	Males	Females	Males	Females
Wages	3.9398***	3.4661**	5.1654***	2.9130**
Alcohol price	-1.6838**	-0.7532	-1.4087***	-1.3553**
Years legislation in place	-0.0534**	-0.0384	-0.0885***	-0.0556***
Prevention (t-1)	-0.3881**	-0.2540	-0.4686***	-0.4434***
Health care/Social work (t-1)	-0.4698***	-0.3805	-0.6232***	-0.2751
Research (t-1)	0.0393	0.0711	0.2236***	0.0762
Coordination (t-1)	0.1284***	0.0263	0.0556	0.0239
Test of joint significance	$\chi^2(9)=23.95$ $Pr>\chi^2=0.0044$	$\chi^2(9)=12.02$ $Pr>\chi^2=0.2122$	$\chi^2(9)=34.73$ $Pr>\chi^2=0.0001$	$\chi^2(9)=14.85$ $Pr>\chi^2=0.0952$
R^2 (%)	4.54	8.27	5.33	2.55
R^2-R^2 minus Wages (%)	0.13	0.11	0.20	0.07
R^2-R^2 minus Alcohol price (%)	0.11	0.03	0.07	0.07
R^2-R^2 minus Year legis. (%)	0.10	0.06	0.26	0.11
R^2-R^2 minus Prevention (%)	0.09	0.05	0.12	0.11
R^2-R^2 minus Health care (%)	0.12	0.08	0.19	0.04
R^2-R^2 minus Research (%)	0.23	0.09	0.00	0.00
R^2-R^2 minus Coordination (%)	0.23	0.01	0.04	0.01

Standard errors in parentheses. Marginal effects in brackets. Basic set of covariates: Socio-demographic characteristics. Instruments for the variables related to alcohol consumption: Regional alcohol prices, regional salaries, and regional anti-drug policies.

Table V. The influence of alcohol policies on risky sexual behaviors (Reduced-form equations)

	Sexual intercourse with occasional partners (12 months)		**Unprotected sex with occasional partners (12 months)**	
	Males	Females	Males	Females
Wage	3.2481* (1.7308) [1.0191]	0.1085 (2.3170) [0.0142]	1.0134 (2.2370) [0.1513]	4.2668 (4.0813) [0.2474]
Alcohol price	-2.2173*** (0.8433) [-0.6957]	-0.4043 (1.0917) [-0.0530]	-1.4960 (1.0959) [-0.2234]	-3.9502* (2.3412) [-0.2291]
Years legislation in place	-0.0458* (0.0256) [-0.0144]	-0.0141 (0.0351) [-0.0019]	0.0051 (0.0334) [0.0008]	-0.0404 (0.0580) [-0.0023]
Prevention (t-1)	-0.4250** (0.2095) [-0.1333]	-0.2804 (0.2791) [-0.0368]	-0.1109 (0.2731) [-0.0166]	-0.7969 (0.5336) [-0.0462]
Health care/Social work (t-1)	-0.2164 (0.2126) [-0.0679]	0.1739 (0.2883) [0.0228]	0.0087 (0.2705) [0.0013]	-0.0535 (0.4269) [-0.0031]
Research (t-1)	-0.0216 (0.0778) [-0.0068]	-0.0831 (0.1078) [-0.0109]	-0.0967 (0.0999) [-0.0144]	-0.1372 (0.1417) [-0.0080]
Coordination (t-1)	-0.0040 (0.0406) [-0.0013]	0.0918 (0.0578) [0.0120]	0.0242 (0.0494) [0.0036]	0.1339* (0.0763) [0.0078]
Real probability (%)	25.68	7.97	8.15	2.73
Estimated probability (%)	25.08	9.84	8.76	3.06
Pseudo-R^2 (%)	6.16	3.53	6.94	3.87

Standard errors in parentheses. Marginal effects in brackets
Basic set of covariates: Socio-demographic characteristics
Monetary variables are expressed in logarithmic transformations.
Basic set of covariates: Socio-demographic characteristics

Table V. The influence of alcohol policies on risky sexual behaviors (Reduced-form equations)

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Alcohol price	-2.2173*** (0.8433) [-0.6957]	-0.4043 (1.0917) [-0.0530]	-1.4960 (1.0959) [-0.2234]	-3.9502* (2.3412) [-0.2291]
Years legislation in place	-0.0458* (0.0256) [-0.0144]	-0.0141 (0.0351) [-0.0019]	0.0051 (0.0334) [0.0008]	-0.0404 (0.0580) [-0.0023]
Prevention (t-1)	-0.4250** (0.2095) [-0.1333]	-0.2804 (0.2791) [-0.0368]	-0.1109 (0.2731) [-0.0166]	-0.7969 (0.5336) [-0.0462]
Health care/Social work (t-1)	-0.2164 (0.2126) [-0.0679]	0.1739 (0.2883) [0.0228]	0.0087 (0.2705) [0.0013]	-0.0535 (0.4269) [-0.0031]
Research (t-1)	-0.0216 (0.0778) [-0.0068]	-0.0831 (0.1078) [-0.0109]	-0.0967 (0.0999) [-0.0144]	-0.1372 (0.1417) [-0.0080]
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Real probability (%)	25.68	7.97	8.15	2.73
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Standard errors in parentheses. Marginal effects in brackets
Basic set of covariates: Socio-demographic characteristics
Monetary variables are expressed in logarithmic transformations.
Basic set of covariates: Socio-demographic characteristics