

## Gender differences between smoking and alcohol use interaction with elevated blood pressure



## Diferencias de género en la interacción entre consumo de tabaco y alcohol con la presión arterial elevada

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**Abstract:** **Objective:** to analyse gender differences in the interaction between tobacco and alcohol consumption and high blood pressure (PAE) in Cochabamba, Bolivia. **Methods:** a cross-sectional study was carried out with n=10704 randomly selected participants. Proportions, odds ratios and robust Blinder-Oaxaca decomposition analysis were calculated. **Results:** 33.5% reported only drinking, 1.8% only smoking and 9.2% both. The odds of having PAE were higher in those who smoke (OR: 2.04); drink and smoke (OR:1.73) or only drink (OR:1.43). Men had higher prevalence of PAE, smoking and harmful use of alcohol; but women who smoke had higher ORs for the development of PAE. Educational level, age, and type of work contributed positively to explain the gap between men and women. **Conclusion:** the likelihood of developing PAE was higher in women, especially in those who smoke, despite their low prevalence.

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**Keywords:** tobacco, alcohol, high blood pressure, gender, Bolivia.

**Resumen:** **Objetivo:** analizar las diferencias de género en la interacción entre consumo de tabaco y alcohol con la presión arterial elevada (PAE) en Cochabamba, Bolivia. **Metodos:** estudio transversal, con n=10704 participantes, seleccionados aleatoriamente. Se calcularon proporciones,

Odds-ratios y análisis robusto de descomposición Blinder-Oaxaca Resultados: 33,5% reportó que solo bebe, 1,8% solo fuma y 9,2% ambos. La probabilidad de presentar PAE fueron mayores en aquellos que fuman (OR:2,04); beben y fuman (OR:1,73) o solo beben (OR:1,43). Los hombres presentaron prevalencias más elevadas de PAE, tabaquismo y consumo nocivo de alcohol; pero las mujeres que fuman presentaron niveles de OR más altos para el desarrollo de PAE. El nivel educativo, la edad, y el tipo de trabajo contribuyeron de manera positiva a explicar la brecha entre hombres y mujeres. Conclusion: la probabilidad de presentar PAE fue mayor en mujeres, especialmente en aquellas que fuman, a pesar de su baja prevalencia.

**Palabras clave:** tabaco, alcohol, presión arterial elevada, género, Bolivia.

Harmful tobacco and alcohol consumption are major risk factors associated with non-communicable diseases (ENT), especially cardiovascular diseases (ECV) such as hypertension<sup>1-4</sup>. While there are many studies examining this interaction, most assess their association separately and very little is known about the combined effect of the two<sup>2,4</sup>, despite the fact that their consumption is generally found to be interrelated.

Most studies show significant differences between men and women<sup>1,3</sup>; However, the contributions of social differences involving vulnerabilities or risk levels related to the construction and evolution of social gender roles<sup>5</sup>, which determine different forms of exposure to smoking and alcoholism, are still unclear and can be expected to have a different effect on the development of high blood pressure.

According to the World Health Organization (OMS), worldwide 34% of men and 6% of women over 15 years of age were smokers in 2016, being more prevalent in the European region (21%) followed by Latin America (12%)<sup>6</sup> where it is estimated that about 1 million people die from causes related to tobacco and passive exposure to tobacco smoke<sup>1</sup>. A similar situation is reported for harmful alcohol consumption, related to more than 3.3 million deaths worldwide<sup>6</sup>, and in the case of Latin America the reported per capita consumption was 6.9 L<sup>3</sup>. It is estimated that 22% of consumers have heavy episodic drinking; 8% of men and 3.2% of women go on to develop alcohol abuse disorders according to the Pan American Health Organization (PAHO)<sup>1</sup>.

Guidelines for the management and treatment of hypertension highlight the use of tobacco and alcohol as modifiable risk factors in the development of cardiovascular disease<sup>7-10</sup>. On the other hand, OMS and PAHO reports show that men have a higher prevalence of hypertension and others ECV<sup>7</sup>. The burden of ECV-associated mortality is higher in men and even higher in low- and middle-income countries<sup>1</sup>.

An analysis of the factors contributing to these inequalities can provide a more complete picture for the development of strategies for the promotion and prevention of hypertension, focusing our efforts on those conditions that contribute significantly to smoking, alcohol consumption and their cardiovascular impact. From a quantitative approach, the Blinder-Oaxaca decomposition<sup>11,12</sup> has recently been suggested and exemplified as an appropriate method to clarify the role of indicators that represent the social processes that underpin health inequalities. This analytical approach seeks to explain the distribution of the outcome, in this case the gender difference in the prevalence of high blood pressure (PAE), tobacco and alcohol consumption, between dominant (men) and subordinate (women) groups within the Bolivian social structure, through a set of explanatory factors that vary systematically by social differences between the two genders.

The present study aims to: a) analyse gender differences in the interaction between smoking and harmful alcohol consumption with PAE and b) determine the contributions of socio-demographic and behavioural factors to inequalities in prevalence between men and women in Cochabamba, Bolivia.

## MATERIAL AND METHODS

### Study context

This paper is the third report of the “Departmental Survey on Risk Factors Associated with Hypertension and Obesity” (FRAHO), implemented jointly by the Institute of Biomedical Research and Social Research of the Universidad Mayor de San Simón (IIBISMED-UMSS) and the Departmental Health Service (SEDES) of the department of Cochabamba, Bolivia.

Design, analytical sample and sampling methodology.

This article presents the results of a sub-project of FRAHO, corresponding to an observational, analytical, cross-sectional study; implemented in all municipalities (N=47) of Cochabamba; during the period from July 2015 to November 2016, using the WHO-STEPPS methodology for the surveillance of risk factors associated with ENT<sup>13</sup>.

The sample size (n=10 609) was calculated based on previous estimates of the prevalence of overweight and obesity in the department (around 30%) using a confidence interval of 95%, a margin of error of 0.05; and a design effect of 1.05 as recommended by the STEPPS manual<sup>7</sup>, with a proportional allocation between males and females, for a population of N=1’240’771 subjects over 18 years old estimated for 2015 by the National Institute of Statistics of Bolivia<sup>14</sup>.

All subjects were selected through a three-stage random sampling: (a) 394 primary health care centres (CAPS) were selected to form the population sampling units (UPM); (b) in each UPM, households were selected based on the rapid monitoring technique of care coverage of the Bolivian Ministry of Health, appropriate for the purposes of the study, randomly selecting 3 to 5 communities or neighbourhoods per CAPS; c) in each neighbourhood or community, households with persons meeting the inclusion criteria were selected and in each one an individual aged 18 years or older was selected, using the randomised Kish method recommended in the WHO-STEP manual<sup>13</sup>.

All persons over 18 years of age with at least 6 months residence in the study area were included. Pregnant women and those who did not consent or with partial information were excluded. A total of 12,527 people were selected, of which 85.45% agreed to participate in the study and the final sample used for statistical analysis in this subproject was n=10,704.

### Data collection and measurements.

The procedure was based on the Panamerican version (V2.0) of the STEPPS methodology adapted to the Bolivian context by the research team. This methodology consists of 3 steps<sup>13</sup>: a) STEP 1 uses a questionnaire to collect socio-demographic and lifestyle data or behavioural risk factors. b) STEP 2 involves the assessment and calculation of anthropometric and blood pressure indicators. c) STEP 3 involves the assessment and calculation of laboratory indicators of the metabolic profile; this step was not implemented in the whole department and is not part of this report. Measurements were performed using calibrated and standardised instruments in each CAPS and direct reviews by CAPS health staff previously trained in interview and field visit skills development

### Health outcome indicator: elevated blood pressure.

Blood pressure was measured in both arms after a 5-minute break. A third reading was taken if there was a difference of more than 25 mm Hg for systolic blood pressure or 15 mm Hg for diastolic blood pressure. The mean of all measurements was used, based on the recommendations of the STEPPS methodology protocol. Elevated blood pressure was defined as a systolic blood pressure of  $\geq 130$  mm/Hg or a diastolic

blood pressure of  $\geq 85$  mm/Hg or self-reported use of antihypertensive medication, according to the 2015 OMS and American Society of Cardiology guidelines<sup>7</sup>.

**Exposure factor for health inequality: gender reference.**

Gender identity was based on information collected by the survey, including female and male categories by individual self-identification during data collection.

**Factors explaining inequality:**

Explanatory factors for health inequalities included variables with known or possible links to PAE and gender inequalities and were grouped into:

**1) Socio-demographic factors:**

a) Age classified into four groups as recommended in the STEPS manual: 18-29, 30-44, 45-59 and  $\geq 60$  years.

b) Place of residence classified according to the 5 socio-demographic regions of Cochabamba: Andean, South Cone, Central Valley, Tropic and Upper Valley.

c) Marital status categorised as: single or never married, currently married, common-law, widowed or separate.

d) Level of education, classified into four groups: No formal education, primary, secondary and tertiary education.

e) Occupation classified into six groups: students, self-employed, employed, housework, retired and unemployed.

**2) Behavioural risk factors:**

a) For smoking, subjects were classified as current smoker or non-smoker according to the WHO-STEPS survey manual.

b) Alcohol use was explored through items adopted from the “Alcohol Use Disorders Identification Test (AUDIT)” included in the STEPS survey, which collect information on three different aspects: quantity, frequency and drinking patterns. Participants were classified in the category of harmful alcohol use (1=present; 0=absent) if heavy episodic drinking (6 or more standard drinks each time you drink alcoholic beverages) was reported: a) one or more times per month in the last 12 months; b) two or more times in the last 30 days; or c) if you drank to unconsciousness at least once in the last 7 days.

**Statistical analysis**

Data was entered into a Microsoft Excel® database, followed by cleaning of subjects with missing information and data analysis was carried out using STATA v15.0 (StataCorp LLC-U.S.A.). The normality of quantitative variables was verified using the Kolmogorov-Smirnov test<sup>15</sup>. Descriptive analysis was performed as proportions. For the estimation of the risk of PAE due to tobacco and/or alcohol consumption, crude and adjusted Odds Ratios (OR) were calculated using binary and multivariate logistic regression models.

For the decomposition analysis of inequalities between men and women for PAE as well as tobacco and alcohol use we used the robust version of the Blinder-Oaxaca method for binary outcomes extensively described by Jann<sup>12</sup>, which is based on two logistic regression models that fit separately for each of the groups and then divide the health gap between the groups into a fraction attributable to differences in explanatory factors (the explained part) and differences in coefficients (the unexplained part). For practical purposes, the factors were grouped into 2 domains: socio-demographic factors (age group, ethnicity, residence, education level, marital status and occupation), and behavioural risk factors (smoking and alcohol consumption). The total explained and unexplained part, as well as the independent contribution of each of the explanatory factors, are reported as absolute contributions (on the same scale as the outcome) and as relative contributions (percentages).

**Ethical considerations**

The FRAHO framework project was approved by the ethics committee of the Faculty of Medicine of the Universidad Mayor de San Simón in Cochabamba. All participants signed an informed consent form based on the STEPS methodology consent form. Data collected were coded and administered exclusively by the research team. Participants with PAE or any other illness were referred to the nearest health centre for further diagnosis and treatment.

## RESULTS

The information collected from 10,704 people with a mean age of  $38 \pm 18$  years was analyzed, 57.38% were women and the mean age had no statistically significant differences ( $p > 0.05$ ) between men ( $39 \pm 19$  years) and women ( $37 \pm 18$  years).

### Smoking

Table 1 describes the characteristics of tobacco use. The overall prevalence of smoking (current use) was 11.1%, being higher in men (21.6%). Experiencing tobacco use was also higher in men (35.7%). The mean age of initiation was lower in men ( $19 \pm 6$ ), the age of quitting smoking was lower in women ( $26 \pm 11$ ). Among current smokers, the mean number of cigarettes consumed was higher in men both per day ( $0.42 \pm 1.5$ ) and per week ( $2.5 \pm 9.5$ ) and women reported having received advice to quit (47.0%) or tried to quit (45.5%) in a higher proportion than men.

TOBACCO CONSUMPTION			
	Women	Men	Global
Age (years)	37.18	39.19	38.18
Experienced			
No	5472 (52.3)	2294 (64.5)	8066 (58.4)
Yes	4737 (45.7)	3627 (103.7)	2060 (150.4)
Advice use			
Starting age	20.81	19.81	20.01
Advice to quit	107 (2.0)	420 (11.3)	527 (25.3)
Tried to quit	126 (2.3)	473 (13.0)	599 (28.3)
Age at which was stopped	36.01	35.01	35.51
Time (years)	38.01	38.01	38.01
Time (months)	33.1	43.1	43.1
Current use			
No	5442 (96.7)	3277 (90.6)	9029 (83.7)
Yes	20 (0.4)	348 (9.4)	368 (17.2)
Advice to quit	18 (0.9)	42 (11.2)	60 (27.6)
Tried to quit	11 (0.5)	47 (12.6)	58 (26.5)
ALCOHOL CONSUMPTION			
	Women	Men	Global
Age (years)	37.18	39.19	38.18
Experienced			
No	323 (54.1)	1238 (33.2)	1561 (45.3)
Yes	207 (34.0)	1056 (29.0)	1263 (35.7)
Advice use			
Starting age	18.81	17.81	18.31
Advice to quit	109 (18.0)	107 (23.6)	216 (19.3)
Tried to quit	12 (1.6)	42 (9.3)	54 (4.7)
Current use			
No	884 (58.1)	246 (15.3)	1130 (17.2)
Yes	202 (13.0)	208 (13.7)	410 (6.3)
Current frequency of consumption			
Every day	15 (0.8)	11 (0.4)	26 (0.6)
Several days per week	21 (1.0)	45 (1.8)	66 (1.6)
1 and 4 days per week	8 (0.4)	1 (0.0)	9 (0.0)
1 and 7 days per week	18 (1.1)	25 (1.2)	43 (1.1)
1 and 1 day per month	10 (0.6)	42 (1.0)	52 (1.3)
1 or less a month	180 (11.7)	124 (6.0)	277 (8.0)
Average consumption per year			
Minimum (1 to 3 portions)	150 (10.3)	145 (7.4)	147 (10.3)
Maximum (4 to 6 portions)	44 (2.9)	49 (27.4)	93 (12.7)
High (7 to 10 portions)	20 (1.3)	17 (0.8)	37 (5.0)
No Answer	2 (0.1)	1 (0.0)	3 (0.0)
Frequency of consumption			
1 to 3 per year	150 (10.3)	150 (10.3)	300 (10.3)
4 to 12 per year	44 (2.9)	76 (3.8)	120 (16.7)
> 12 per year	10 (0.6)	42 (2.0)	52 (7.4)
No Answer	2 (0.1)	1 (0.0)	3 (0.0)
Most frequent type of beverage			
Artisanal fermented	127 (14.1)	126 (13.6)	253 (18.7)
Beer	73 (8.5)	301 (14.1)	374 (26.4)
Distilled	17 (1.9)	18 (0.8)	35 (2.5)
Other drinks	42 (5.0)	41 (2.1)	83 (6.0)
No Answer	15 (1.7)	10 (0.5)	25 (1.8)
Probably alcohol	1 (0.1)	9 (0.4)	10 (0.7)

\*Statistical significance calculated by Fisher's Y for quantitative variables and Chi-square categorical variables.

TABLE 1:  
Prevalence and characterization of tobacco and alcohol consumption.  
own elaboration

Alcohol consumption Table 1 also breaks down the characteristics of alcohol consumption disaggregated by gender, highlighting statistically significant differences between men and women for all the variables assessed. 66.5% of men and 45.9% of women reported having consumed alcoholic beverages at some point in their lives, with a mean age of onset earlier in men ( $17 \pm 7$ ). 51.7% received advice to quit, but only 19.6% attempted to quit. The prevalence of current alcohol consumption was 54.7% in men and 33.9% in women. 71.7% of women reported drinking less frequently than once a month; in contrast to men, nearly 50% reported drinking more than once a month. Minimal use per event was more frequent in women (65.5%). The prevalence of binge drinking (to the point of unconsciousness) more than 6 times a year was higher in men (54.1%). The most frequently consumed type of alcoholic beverage was handcrafted beverages (chicha, guarapo, garapiña, guindal or similar) in both men (54.1%) and women (51.6%).



### Combined use of tobacco and alcohol

Table 2 shows the distribution of isolated or combined use of tobacco and alcohol, disaggregated by gender and the socio-demographic variables assessed in the WHO-STEPs methodology

	Tobacco				Alcohol				Tobacco and Alcohol			
	Never	Former	Current	Total	Never	Former	Current	Total	Never	Former	Current	Total
Gender												
Male	10,123	1,123	1,234	12,480	1,234	1,123	1,234	3,591	10,123	1,123	1,234	12,480
Female	11,234	1,234	1,234	13,702	1,234	1,123	1,234	3,591	11,234	1,234	1,234	13,702
Age												
15-24	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
25-34	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
35-44	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
45-54	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
55-64	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
65+	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Race												
Mixed	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
White	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Black	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Indigenous	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Region												
Urban	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Rural	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Education												
No formal	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Primary	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Secondary	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Higher	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Marital status												
Single	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Married	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Widowed	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Divorced	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Occupation												
Housewife	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Self-employed	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Employed	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Retired	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702
Student	1,234	1,234	1,234	3,702	1,234	1,123	1,234	3,591	1,234	1,234	1,234	3,702

TABLE 2:  
Prevalence of tobacco and alcohol use disaggregated by sociodemographic variables  
own elaboration

A total of 55.4% of the population reported that they neither drink nor smoke, 33.5% only drink, 1.8% only smoke, and 9.2% drink and smoke at the same time. Combined consumption of tobacco and alcohol was more frequent in men (18.3%). In the case of women, prevalence was higher among those aged 45 to 59 years (3.5%), women of mixed race (3.5%), women residing in the tropic (3.9%) and metropolitan regions (3.0%), women with higher education (5.7%), single women (3.3%), retired women (6.2%) and self-employed women (4%); In contrast, prevalence was lower among housewives (1.3%) and among those living in the upper Valley (1.5%).

In the case of men, combined consumption was more frequent among those aged 30 to 44 years (22.7%), among those living in the tropic region (24.2%), with higher education (20.4%) and among the self-employed (20.7%); on the other hand the frequency was lower among the elderly (over 60 years: 11.3%), residents of the upper valley (14.1%), among those with no formal education (10.9%), among the labor categories of retired (9.9%), students (8.9%) and housework (2.9%).

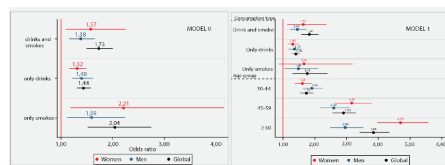


FIGURE 2  
Odds ratios for EAPs for tobacco and alcohol use  
own elaboration

### Elevated blood pressure

The prevalence of PAE was 25%, being higher in men (30.7%) than in women (21.2%); the association between PAE and combined tobacco and alcohol consumption was statistically significant ( $X^2=29.36$ ;  $p<0.001$ ). The prevalence of PAE was highest among those who only smoke (36.1%), followed by those who smoke and drink simultaneously (32.4%). Disaggregation by gender highlights differences in the prevalence of PAE among those who neither drink nor smoke (Women:19.4%; Men:26.4%), those who only drink (Women:24.2%, Men:33.8%) and those who smoke and drink simultaneously (Women:27.4%, Men:33.4%). (Figure 1).

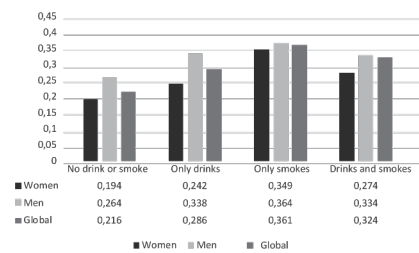


FIGURE 1:  
Proportional distribution of PAE prevalence by type of tobacco and alcohol consumption disaggregated by sex.  
own elaboration

Figure 1 describes the probability of presenting PAE against the different types of tobacco and alcohol consumption compared to those who neither drink nor smoke. The probability of presenting PAE was higher and statistically significant in those who only smoke (OR:2.04-IC95%:1.51-2.75), drink and smoke (OR:1.73 IC95%:1.49-2.01) and those who only drink (OR:1.44 IC95%: 1.31-1.58) compared to those who neither drink nor smoke; disaggregation of the ORs by gender shows a marked difference in the group of people who only smoke with the risk level being higher in women (OR:2.21 CI95%: 1.17-4.16) compared to men (OR:1.58 CI95%:1.12-2.24). The age-adjusted model for the assessment described in Figure 1 shows a similar pattern, with the probability of presenting PAE being statistically significant for the 3 subgroups of tobacco and alcohol consumption, being higher in the group of people who drink and smoke (OR:1.82 CI95%:1.56-2.11), especially in women (OR:1.63 CI95%:1.12-2.37) compared to men.

It also highlights the increase in the probability of presenting PAE as age increases, with the probability being higher in people over 60 years of age (OR:3.85 CI95%:3.39-4.35) compared to people under 30 years of age; being higher in women (OR:4.70 IC 95%:3.95-5.58) compared to men of the same age group.

#### Blinder-Oaxaca decomposition by gender reference

Table 3 reflects the decomposition of the absolute and relative contributions of the sociodemographic and behavioral factors assessed by the WHO STEPS methodology to explain the gender differences in the prevalence of PAE, tobacco and alcohol use.

Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	47.5	15.2	47.5	15.2	47.5	15.2	47.5	15.2
Sex	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Education	7.2	2.1	7.2	2.1	7.2	2.1	7.2	2.1
Work activity	1.2	0.8	1.2	0.8	1.2	0.8	1.2	0.8
Alcohol consumption	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3
Tobacco consumption	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3
PAE	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.4
Unexplained	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3
Explained	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3
Total	0.2	0.4	0.2	0.4	0.2	0.4	0.2	0.4

TABLE 3  
Blinder-Oaxaca decomposition by gender reference for PAE, current tobacco and alcohol use  
own elaboration

A difference of 9.62% is observed in the prevalence of PAE between men and women; this difference is explained by 24.89% by the associated factors evaluated in this study; the most important factors explaining this gap are the differences in tobacco and alcohol consumption (63.99%) and age group (56.94%); a very important negative contribution of the type of work activity (-37.28%) is also observed, in the sense of reducing the gap in the prevalence of PAE between men and women.

In the case of smoking prevalence, a difference of 18.39% was observed between men and women, with an explained fraction of 47.31% for the associated contributing factors evaluated in this study, the most important factors explaining this gap being alcohol consumption (54.04%) and type of work activity (42.09%).

The difference between men and women for the prevalence of alcohol consumption was 20.97%; this difference is explained by 42.89% for the variables studied, the most important factors explaining this difference being tobacco consumption (76.70%) and type of work activity (17.5%).

It also highlights the increase in the probability of presenting PAE as age increases, with the probability being higher in people over 60 years of age (OR:3.85 CI95%:3.39-4.35) compared to people under 30 years of age; being higher in women (OR:4.70 IC 95%:3.95-5.58) compared to men of the same age group.

Blinder-Oaxaca decomposition by gender reference

## DISCUSSION

The association between elevated blood pressure, tobacco and alcohol consumption has been extensively described; however, few studies have analyzed their combined effect and their distribution based on sociodemographic factors. On the other hand, gender differences are also reviewed in most studies on PAE, smoking and/or alcoholism; however, there are few studies that perform a decomposition of the contributing factors that explain these differences between both population subgroups worldwide<sup>16</sup> and none in the Latin American context.

Our results show a statistically significant difference between men and women for the prevalence of smoking and harmful alcohol consumption; these are similar to international reports by WHO<sup>4,17</sup>, PAHO<sup>18</sup> and studies in Latin America<sup>19,20</sup>. However, it is noteworthy that the prevalences for current smoking in our study (11.1%) are lower than the estimate for Latin America (Global: 15.3%), but similar to that of the Andean area (11.7%); much lower than the “estimate” for Bolivia in the same report (Global: 23.7%, Men: 30.5%, Women: 17.1%)<sup>18</sup>. In all cases, a higher prevalence in men is highlighted, related to the roles or social stigma about smoking in women, in whom its use is reproached more than in men, since it is socially expected that women do not smoke because of their role as caregivers of the home, reflecting in a lower incidence of lung cancer in women and is considered a protective factor for the development of this pathology<sup>21</sup>. However, the current change in roles, such as the inclusion of women in work activities previously restricted to men, reaching a higher educational and socioeconomic level, as well as birth control, are associated with an increase in the prevalence of smoking among women<sup>16,19,21</sup> and make it difficult for them to stop smoking<sup>22</sup>, which was generally at an earlier age compared to men, as reported in our study.

We observed a similar situation for harmful alcohol consumption, as in other international<sup>4,6,17</sup> and local reports<sup>19,23,24</sup>, our results show a higher prevalence in men; it is also highlighted among our findings, that women with a higher educational level, of working age and in formal employment or self-employment presented higher prevalences, as in other local<sup>23,24</sup> and international reports<sup>4,17</sup>. These results support the hypothesis that a higher sociocultural level and economic position of women introduces them to harmful behaviors considered to be typical of men<sup>25,26</sup> beginning at an early age during adolescence,<sup>27</sup> especially in Latin American countries.

The probability of presenting arterial hypertension was greater in people who only smoke, only drink, and those who drink and smoke simultaneously, compared to individuals who neither drink nor smoke; this association is generally evaluated separately and is included in international guidelines on the management of arterial hypertension<sup>7-9</sup>. Our findings highlight that the isolated use of tobacco presents similar levels of risk to the combined use of alcohol, with women being the group that presented higher OR values in both types



of consumption. This variation could be associated with other risk factors not evaluated in the present study, such as the hormonal component,<sup>28</sup> the presence of obesity,<sup>19,24</sup> stress levels,<sup>29</sup> and a sedentary lifestyle higher in women than in men<sup>19</sup>; since higher risk levels for the development of hypertension have been commonly reported in men<sup>7</sup>.

The Blinder-Oaxaca decomposition analysis provides more light on the factors that explain these differences between men and women, as in the case of tobacco and alcohol consumption, the variables included in this study explain almost 50% of the gender differences, with the most important contributing factors being work activity and behavioral factors, related to the inclusion of women in activities outside the home, as well as a higher level of education, in accordance with the above analysis. However, the gender differences in the prevalence of PAE were only 25% explained by the variables included in the present study, and a more in-depth analysis is needed, including other risk factors such as obesity, sedentary lifestyle and salt consumption, which could increase this explained fraction. Despite the above, it is highlighted that the age group, as well as tobacco and alcohol consumption, are the main factors that contribute to explain the gender differences in the prevalence of PAE, endorsing everything described above.

This study is based on a representative sample of the population of the department of Cochabamba, with information collected through a standardized process validated by WHO/PAHO; however, the cross-sectional nature of the data does not allow causal inferences. It should also be considered that information on tobacco and alcohol use may have been withheld by some participants, for fear of being judged and/or embarrassed to answer affirmatively; consequently, their prevalence may have been underestimated. Oaxaca decomposition analysis can be seen as a useful method for identifying factors underlying health inequalities; however, it cannot illustrate processes or support causal inference to a greater degree than conventional regression models because of the cross-sectional nature of our data.

Finally, our findings show that a low prevalence does not necessarily imply a low level of risk; there are gender differences in the interaction between smoking and alcoholism with PAE, and despite a low prevalence of the factors assessed in women, the probability of presenting PAE was higher, especially in those women who smoke; with the level of education and type of work activity being the factors that most contribute to explaining these differences.

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