Article

The Interaction between Education and Sex with Alcohol Consumption during the COVID-19 Pandemic: A Cross-Sectional Analysis of Two Brazilian Cities

Amanda Popolino Diniz [1] , Raquel de Deus Mendonça [2], George Luiz Lins Machado-Coelho [3] and Adriana Lúcia Meireles [2],*

[1] Postgraduate Program in Health and Nutrition, Nutrition School, Federal University of Ouro Preto, Ouro Preto 35400000, MG, Brazil; amanda.diniz@aluno.ufop.br
[2] Department of Clinical and Social Nutrition, School of Nutrition, Federal University of Ouro Preto, Ouro Preto 35400000, MG, Brazil; raquel.mendonca@ufop.edu.br
[3] Epidemiology Laboratory, Medical School, Federal University of Ouro Preto, Ouro Preto 35400000, MG, Brazil; gmcoelho@ufop.edu.br
* Correspondence: adriana.meireles@ufop.edu.br

Abstract: This cross-sectional study, carried out between October and December 2020 in two Brazilian cities, aimed to evaluate the joint association of education and sex with habitual and episodic excessive alcohol consumption during the COVID-19 pandemic. Habitual alcohol consumption was defined as drinking any quantity of alcohol at least once per week. Excessive episodic alcohol consumption was defined as the consumption of five or more drinks by men or four or more drinks by women at least once in the last 30 days. Adjusted multivariate logistic regression models were used to analyze associations of education and sex with alcohol consumption. Education was not associated with habitual alcohol consumption and excessive episodic alcohol consumption. However, when evaluating the joint effect between education and sex, it can be seen that men with low education were more likely to habitually consume (OR: 5.85; CI95:2.74–14.84) and abuse alcohol (OR: 4.45; IC95:1.54–12.82) and women with high education were more likely to have habitual (OR: 2.16; IC95:1.18–3.95) and abusive alcohol consumption (OR: 2.00; IC95:1.16–3.43). These findings highlight the modifying effect of sex on the relationship between education and alcohol consumption, such that education influenced alcohol consumption differently between sexes during the pandemic.

Keywords: binge drinking; COVID-19; alcohol; socioeconomic level; cross-sectional studies

1. Introduction

Alcohol consumption is a risk factor for morbidity and mortality, both in Brazil and worldwide. According to the Global Status Report on Alcohol and Health published by the World Health Organization in 2018, alcohol consumption is responsible for more than 3 million deaths every year and more than 5% of the total burden of disease and injuries around the world [1].

The consumption of alcoholic beverages varies among the Brazilian population according to factors such as age, ethnicity, skin color, socioeconomic status, education, work, marital status, and neighborhood characteristics, and these factors may differ between men and women [2–5].

Men are more likely to drink than women, and differences in consumption refer to the amount and way they drink, in addition to the social and health aspects to which they are subject [2,6]. The frequency of consumption of once or more per week by the Brazilian population in 2019 was 26.4% (37.1% for men; 17.0% for women) [7].

However, excessive episodic alcohol consumption has increased, particularly among women [1,6]. In Brazil, the frequency of abusive consumption of alcoholic beverages has

Int. J. Environ. Res. Public Health **2024**, *21*, 804

2 of 13

increased from 15.7% in 2006 to 20.9% in 2020 [8]. This growth trend is greater among women, ranging from 7.8% in 2006 to 16.0% in 2020 [8]. Among males, excessive episodic alcohol consumption ranged from 25.0% in 2006 to 26.6% in 2020 [8]. The convergence of prevalence according to sex has been described in the literature [9–11]; however, few studies have investigated this phenomenon in Brazil, especially in the context of a health crisis such as the COVID-19 pandemic.

Furthermore, epidemiological studies have shown divergent associations between education level and alcohol consumption. Some studies have demonstrated an association between high education and/or income and excessive episodic alcohol consumption [3,12], whereas others have revealed a higher proportion of drinkers among individuals with less education [5,13–15] or found no association at all [4]. These findings reflect the complex relationship between education and alcohol consumption patterns, highlighting the need for further investigation.

Although numerous studies have analyzed alcohol consumption according to sociodemographic factors, most have evaluated these factors in isolation and/or stratified by sex [3–5]. In addition, the COVID-19 pandemic has influenced alcohol consumption in the general population, especially in socioeconomically vulnerable groups [16,17]. Studies carried out during the pandemic indicated an increase in alcohol consumption in some countries [18–20]. Data from the Pan American Health Organization's regional survey demonstrated that 65% of individuals had excessive episodic alcohol consumption and that men were more likely to practice this pattern of alcohol consumption during the pandemic [6].

The scenario experienced by the reduction in social interactions and changes in routine and financial conditions predisposed the population to anxiogenic and stressful situations that may have affected health behaviors, highlighting a negative effect on alcohol consumption [21,22]. Furthermore, the multifaceted nature of the impact of the pandemic in the context of the pre-existing social and economic fragility in Brazil [23] suggests analyzing the consumption of alcoholic beverages from the perspective of the population's socioeconomic conditions. Therefore, the hypothesis of this study was that, as a result of social restriction measures, education, together with sex, would worsen the negative scenario for the consumption of this legal psychoactive substance.

Thus, the need to investigate whether the interaction between education and sex is associated with the consumption of alcoholic beverages during the COVID-19 pandemic is reinforced to contribute to the advancement of understanding of a socially complex phenomenon and provide information that improves the effectiveness of health approaches to reducing alcohol consumption during epidemics. Therefore, this study aimed to evaluate the joint association of education and sex with habitual consumption of alcoholic beverages and excessive episodic alcohol consumption during the COVID-19 pandemic.

2. Materials and Methods

2.1. Study Design and Population

This is a cross-sectional study carried out through a population-based household seroepidemiological survey, "Epidemiological surveillance of COVID-19 in the Inconfidentes Region/MG (COVID-Inconfidentes Project)", carried out between October and December 2020.

The study was conducted in Ouro Preto, with a municipal human development index of 0.741, and Mariana, with a municipal human development index of 0.742. These are considered medium-sized cities in the central-south region of Minas Gerais, known as Quadrilátero Ferrífero, which is one of the largest iron ore-producing areas in Brazil. According to the 2010 demographic census, the municipality of Ouro Preto had a total population of 70,281 inhabitants, and Mariana had a total of 54,219 inhabitants living in the urban area, distributed in 17,753 and 14,078 households in Ouro Preto and Mariana, respectively [24].

Int. J. Environ. Res. Public Health **2024**, 21, 804

3 of 13

A sampling design was adopted using probabilistic sampling stratified by a conglomerate in three stages: census, household, and residential. This design was based on large national household surveys, such as the National Household Sample Survey [25], the Family Budget Survey [26], the Health in Beagá Survey [27], and, more recently, the EPICOVID19 study [28].

The sample calculation was performed using the OpenEpi tool based on the 2010 population estimate [24] for each city, adopting a confidence level of 95% and an effect size of 1.5. In addition, 20% was added to the sample size of each city for possible refusals, absence of selected residents, or people who were not at home during the visit. Participants eligible for the study were permanent residents of households in the urban areas of the municipalities, aged ≥ 18 years, who consented to participate in the study. Individuals with compromised cognitive function, difficulty in responding to the questionnaire, or inability to provide blood samples due to difficulties with venous access were excluded [29].

The sampling weight of each selected unit (census sector, household, and individual) was calculated to correlate with the 2019 population projection. For more details on the sample calculation and field logistics, see Meireles et al. [29]. A total of 1789 individuals were recruited, of which 27 (1.5%) were excluded for not completing the interview or not collecting a blood sample, totaling 1762 individuals, of which 764 were from the municipality of Mariana (43.4%) and 998 from Ouro Preto (56.6%). Of this total, nine individuals were excluded for not answering the question regarding alcohol consumption, totaling a final sample of 1753 individuals.

2.2. Data Collection

In each municipality, data were collected on three weekends (Friday, Saturday, and Sunday) with an interval of 21 days between cities, considering the incubation period of SARS-CoV-2. Data collection was carried out in person at home, and the interviews lasted 30–45 min using a questionnaire in the DataGoal application via tablets. The questionnaire included questions on sociodemographic and economic variables, lifestyle habits, and general health status.

2.3. Habitual Consumption and Excessive Episodic of Alcohol

Two patterns of alcohol consumption were analyzed as outcome variables: habitual consumption of alcoholic beverages and excessive episodic alcohol consumption. All questions regarding alcohol consumption were based on questionnaires from the 2013 National Health Survey [30] and the 2019 Surveillance of Risk and Protective Factors for Chronic Diseases by Telephone Survey [7].

Regarding the habitual consumption of alcoholic beverages, the question was, "Currently, how often do you usually consume an alcoholic beverage?". The responses were dichotomously grouped as follows: do not regularly consume alcoholic beverages when participants responded once or twice a month, three to four times a month, or did not use alcohol at all; habitual consumption was when participants responded that they consumed alcoholic beverages one to two times a week, three to four times a week, five to six times a week, or daily.

Excessive episodic consumption of alcohol, known as binge drinking, constitutes an excessive volume of alcohol in a short space of time and is characterized by five or more doses of standard drinks (one dose of alcoholic beverage or equivalent contains 12 g of pure alcohol, approximately 60 g) for men and four or more doses for women (48 g) in the last 30 days [1,8]. This variable was assessed using the question, "For men: in the last 30 days, have you consumed five or more doses of alcoholic beverages on a single occasion? For women: In the last 30 days, have you consumed four or more doses of alcoholic beverages on a single occasion?" and the answer options were no and yes.

Int. J. Environ. Res. Public Health **2024**, *21*, 804

4 of 13

2.4. Education and Sex

The explanatory variables included in the study were education level (<8 years, 9–11 years, and ≥12 years of study) and sex (female and male) [31].

Education was assessed through the following question: "To what grade and level did you study?" For a descriptive analysis of the sample, responses were grouped into the categories of less than eight years of study when the participants answered never having attended school, adult literacy, or incomplete and complete elementary school I (first to fourth grade) and II (fifth to eighth or ninth grade); between nine and eleven years of study when the participants answered incomplete and complete high school or incomplete higher education; and more than twelve years of study when participants responded having completed higher education, specialization, or postgraduate studies Latu Sensu, as well as postgraduate studies Stricto Sensu (master's and/or doctorate).

For interaction analysis, responses were grouped dichotomously into the categories of less than nine years of study when participants responded having never attended school, adult literacy, or incomplete and complete elementary school I (first to fourth grade) and II (fifth to eighth or ninth grade), and greater than or equal to nine years of study when participants answered complete or incomplete high school, incomplete higher education, or completed higher education or specialization or postgraduate studies Latu Sensu, as well as postgraduate studies Stricto Sensu (master's and/or doctorate).

2.5. Socioeconomic Characteristics

Socioeconomic characteristics consisted of age (18–34 years, 35–59 years, and ≥60 years), marital status (married and not married), children (no and yes), family income (≤2 minimum wages, >2 to ≤4 minimum wages, or >4 minimum wages) where the value of the minimum wage in force during 2020—the period of data collection—(BRL 1045.00) was considered, and skin color was self-reported (White or BBYI). Self-reported skin color was based on categories proposed by the Brazilian Institute of Geography and Statistics, which are White, Brown, Black, Yellow, and Indigenous. BBYI is an anacronym used in English for Black, Brown, Yellow, and Indigenous people. This evaluation was valid and consistent, as demonstrated by Travassos et al. [32].

2.6. Statistical Analysis

Statistical analyses were carried out considering the weighting factors of sampling and study design, using the package "svy" of software Stata®, version 15.1 (Stata Corporation, College Station, EUA). Categorical variables are described as relative frequencies and 95% confidence intervals (95%CI). The relationship between descriptive variables and outcomes was analyzed using Pearson's chi-squared test.

Univariate and multivariate analyses were performed using logistic regression and odds ratios (OR), and their respective 95% confidence intervals were estimated. The models for habitual alcohol consumption and binge drinking were adjusted for age based on the literature [33,34].

An interaction analysis was performed to investigate the combined effect of education and sex on habitual consumption and excessive episodic of alcohol. The additive interaction evaluated two dichotomous exposures: education (A) and sex (B); that is, the interaction on an additive scale means that the combined effect of the two exposures was greater than the sum of the individual effects of the two exposures [35]. The interaction was analyzed using the logistic regression command following the dependent variable, variable A, variable B, and the adjustment variable. A significance level of 5% was used for all analyses. For the interaction analysis, the dichotomized education variable (<9 and ≥9 years of study) was used [31].

2.7. Ethical Aspects

Free and informed consent was obtained from all subjects involved in the study at the time of the interview, and all procedures were performed in accordance with the

Int. J. Environ. Res. Public Health **2024**, *21*, 804

5 of 13

Brazilian guidelines and standards for research involving human beings in the Declaration of Helsinki. This study was approved by the Research Ethics Committee (Ethics Submission Certificate Nº. 32815620.0.1001.5149). This study adhered to the STROBE guidelines (Strengthening the Reporting of Observational Studies in Epidemiology).

3. Results

A total of 1753 individuals were evaluated. The prevalence of habitual alcohol consumption was 37.92%, and excessive episodic alcohol consumption was 30.17% (Figure 1). The majority were female (51.91%), aged between 35 and 59 years (45.52%), identified as non-White (74.33%), married (53.24%), and with children (74.07%). Furthermore, most participants reported having nine or more years of education (68.85%) and a family income of up to two times the minimum wage (40.97%; Table 1).
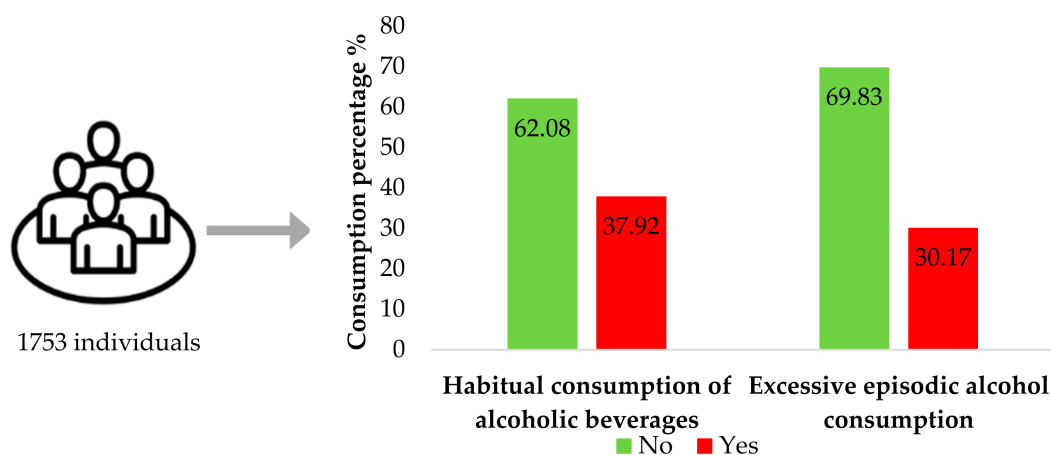

Figure 1. Prevalence of habitual alcohol consumption and excessive episodic alcohol consumption according to education and sex during the pandemic. COVID-Inconfidentes, 2020.

Table 1. Socioeconomic characteristics according to habitual consumption of alcoholic beverages, COVID-Inconfidentes, 2020 (n = 1753).

Characteristics	Total % (95%CI)	No % (95% CI)	Yes % (95% CI)	*p*-Value **
Sex				
Female	51.91 (44.73–59.01)	60.39 (54.37–66.11)	38.03 (26.2 8–51.37)	**0.002**
Male	48.09 (40.99–55.27)	39.61 (33.89–45.63)	61.97 (48.63–73.72)	
Age				
18–34 years	35.65 (31.19–40.37)	33.17 (28.17–38.58)	39.70 (30.85–49.29)	
35–59 years	45.52 (41.00–50.12)	44.48 (38.51–50.60)	47.23 (38.47–56.17)	0.088
>60 years	18.83 (15.49–22.70)	22.36 (18.56–26.67)	13.06 (08.58–19.39)	
Skin color [a]				
White	25.67 (20.82–31.21)	26.41 (21.81–31.59)	24.46 (15.82–35.82)	0.722
BBYI	74.33 (68.79–79.18)	73.59 (68.41–78.19)	75.54 (64.18–84.18)	
Marital status [b]				
Married	53.24 (47.19–59.19)	51.00 (45.68–56.31)	56.89 (44.37–68.59)	0.387
No married	46.76 (40.81–52.81)	49.00 (43.69–54.32)	43.11 (31.41–55.63)	
Children				
No	25.93 (22.00–30.29)	27.47 (23.09–32.33)	23.41 (16.85–31.55)	0.366
Yes	74.07 (69.71–78.00)	72.53 (67.67–76.91)	76.59 (68.45–83.15)	

Int. J. Environ. Res. Public Health **2024**, *21*, 804

6 of 13

Table 1. *Cont.*

Characteristics	Total % (95%CI)	No % (95% CI)	Yes % (95% CI)	*p*-Value **
Education level				
0–8 years	37.73 (32.52–43.25)	40.91 (34.92–47.18)	32.53 (24.01–42.40)	
9–11 years	41.47 (36.69–46.42)	39.85 (34.62–45.33)	44.13 (36.98–51.53)	0.206
≥12 years	20.79 (16.49–25.87)	19.24 (15.00–24.34)	23.34 (16.21–32.38)	
Family income [c]				
≤2 MW	40.97 (35.46–46.72)	42.91 (36.41–49.67)	37.89 (30.12–46.33)	
>2 to ≤4 MW	32.03 (26.95–37.58)	32.97 (28.00–38.35)	30.55 (20.93–42.22)	0.264
>4 MW	27.00 (22.03–32.61)	24.12 (18.74–30.46)	31.56 (25.44–38.40)	

Ingesting alcoholic beverages at least once a week is considered habitual consumption, regardless of the amount of alcohol; CI: confidence interval; MW: minimum wage; [a] BBYI: Brown, Black, Yellow, and Indigenous; [b] not married: widowed, divorced, single; [c] value of the minimum wage at the time of data collection (2020): USD 1045,00 194.25 (1 USD = 5.3797 BRL); ** *p*-value for the chi-square test. Values in bold indicate statistical significance ($p < 0.05$).

Habitual consumption was more prevalent among male participants (Table 1). Excessive episodic alcohol consumption was also more prevalent among male participants aged 35–59 years and among those with children (Table 2).

Table 2. Socioeconomic characteristics according to excessive episodic alcohol consumption, COVID-Inconfidentes, 2020 (n = 1753).

Characteristics	No % (95% CI)	Yes % (95% CI)	*p*-Value **
Sex			
Female	56.81 (49.45–63.88)	40.57 (31.51–50.31)	
Male	43.19 (36.12–50.55)	59.43 (49.69–68.49)	**<0.001**
Age			
18–34 years	34.59 (27.51–42.43)	38.09 (29.12–47.97)	
35–59 years	42.05 (35.93–48.43)	53.55 (42.25–64.49)	**0.019**
>60 years	23.36 (19.23–28.05)	8.36 (05.45–12.63)	
Skin color [a]			
White	26.49 (20.95–32.88)	23.79 (17.78–31.06)	
BBYI	73.51 (67.12–79.05)	76.21 (68.94–82.22)	0.477
Marital status [b]			
Married	55.42 (49.32–61.36)	48.18 (37.47–59.07)	
No married	44.58 (38.64–50.68)	51.82 (40.93–62.53)	0.177
Children			
No	23.38 (19.73–27.47)	31.84 (23.70–41.26)	
Yes	76.62 (72.53–80.27)	68.16 (58.74–76.30)	**0.044**
Education level			
0–8 years	39.85 (33.18–46.93)	32.83 (21.14–47.12)	
9–11 years	40.87 (34.16–47.93)	42.88 (33.50–52.80)	0.453
≥12 years	19.28 (15.01–24.42)	24.29 (17.14–33.23)	
Family income [c]			
≤2 MW	39.41 (32.74–46.50)	44.50 (32.23–57.47)	
>2 to ≤4 MW	32.08 (26.43–38.31)	31.93 (23.56–41.65)	0.602
>4 MW	28.51 (21.67–36.52)	23.58 (16.91–31.86)	

Excessive episodic alcohol consumption constitutes an excessive volume of alcohol in a short time; CI: confidence interval; MW: minimum wage; [a] BBYI: Brown, black, yellow, and indigenous; [b] Not married: widowed, divorced, single; [c] Value of the minimum wage at the time of data collection (2020): USD 1045,00 194.25 (1 USD = 5.3797 BRL); ** *p*-value for chi-square test. Values in bold indicate statistical significance ($p < 0.05$).

In Figure 2, it can be seen that in isolation, education is not associated with habitual alcohol consumption, whereas sex is associated, with males having 2.48 (95% CI: 1.39–4.42) times the chance of habitual alcohol consumption when compared to females. The interaction

Int. J. Environ. Res. Public Health **2024**, 21, 804

7 of 13

between education and sex stands out; it can be identified that participants with education greater than or equal to nine years and males (OR: 3.81; 95% CI: 2.22–6.53), education greater than or equal to nine years and female (OR: 2.16; 95% CI: 1.18–3.95), and less than nine years of education and male (OR: 5.85; 95% CI: 2. 74–14.84) were more likely to consume alcohol regularly than those with less than nine years of education and females.

Regarding the pattern of excessive episodic alcohol consumption, it was observed separately that education is not associated with this pattern of consumption and that male individuals presented 1.92 (95% CI: 1.32–2.79) times the chance of reporting excessive episodic alcohol consumption when compared to females. However, the combination of education and sex increases the chances of this pattern of alcohol consumption; thus, individuals with education greater than or equal to nine years and males (OR: 2.74; 95% CI: 1.48–5.05); education greater than or equal to nine years and female (OR: 2.00; CI95%: 1.16–3.43); and education less than nine years and male (OR: 4.45; CI95%: 1.54–12.82) were more likely to have excessive episodic alcohol consumption when compared to individuals with less than nine years of education and females (Figure 3).
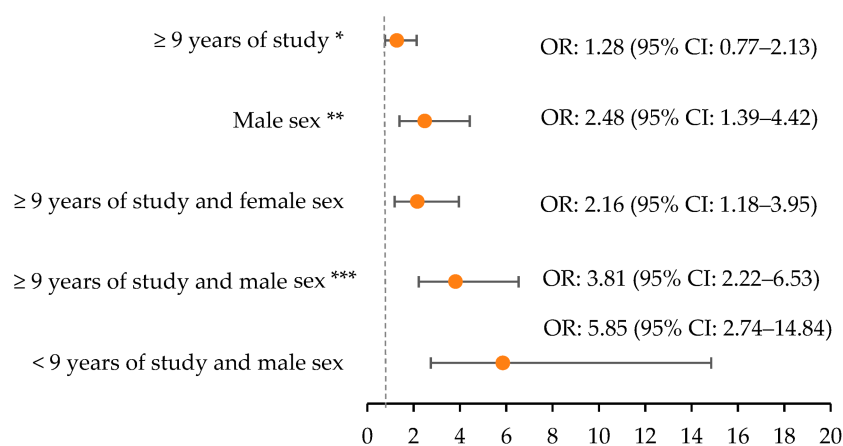

Figure 2. Multivariate logistic regression between years of study, sex, and habitual consumption of alcoholic beverages, 2020, COVID-Inconfidentes, Brazil (n = 1753). Note: CI, confidence interval; OR, odds ratio; age-adjusted analysis. * Reference category: <9 years of study; ** Reference category: female; *** Reference category: <9 years of study and female.
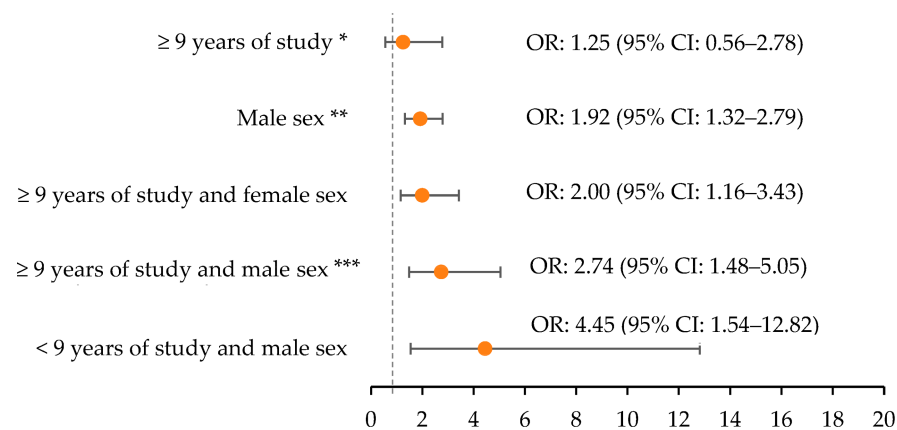

Figure 3. Multivariate logistic regression between years of study, sex, and excessive episodic alcohol consumption, 2020, COVID-Inconfidentes, Brazil (n = 1753). Note: CI, confidence interval; OR, odds ratio; age-adjusted analysis. * Reference category: <9 years of study; ** Reference category: female; *** Reference category: <9 years of study and female.

Int. J. Environ. Res. Public Health **2024**, *21*, 804

8 of 13

4. Discussion

To the best of our knowledge, this is the first study to investigate the joint association between education and sex in alcohol consumption during the period of social restrictions caused by the COVID-19 pandemic. The results showed a high prevalence of alcohol consumption by the study population during the pandemic and that education influenced alcohol consumption differently in men and women. Regarding the study hypothesis, the results suggest that the combination of education and sex increased the chances of habitual and episodic excessive alcohol consumption during the pandemic.

Our findings found that sex is a factor associated with habitual and episodic excessive alcohol consumption, with men being more likely to consume alcohol than women in both patterns. This is in line with the scientific literature, where recent results from a home health survey indicated that the percentage of alcohol consumption was higher among men than among women in the different consumption patterns investigated [8]. Excessive episodic alcohol consumption was estimated at 17.1%, with differences between sexes (men, 26%; women, 9.2%) [8]. Data from the World Health Organization also corroborate these findings regarding the disparity between sexes, showing that men consume more alcoholic beverages and are more involved in episodes of excessive consumption than women [1].

Therefore, differences in alcohol consumption between sexes have been widely explored in the literature, with consistent findings that males have a higher frequency and quantity of consumption than females, both globally and nationally [1,2]. In general, men are more likely than women to excessive episodic alcohol consumption in different societies [36]. Differences in the ethanol metabolization process and body composition partly explain the lower consumption of alcoholic beverages by women than men [37].

Furthermore, a review study discussed that differences in excessive episodic alcohol consumption by sex might be related to the social role of men and women in society, motivated by cultural factors, which may explain the greater consumption by men [38]. The wide variation in the magnitude of the male/female ratio observed in different contexts suggests that cultural influences, socioeconomic context, work, and the fact that alcohol is considered a symbol of masculinity contribute to the greater exposure of men to its consumption [39,40].

Although excessive episodic consumption was predominant among men, there was a greater tendency for this type of consumption to increase among women [8,41,42]. One hypothesis for this phenomenon is a change in women's social roles and excessive workloads, which could lead to alcohol consumption as a mistaken form of self-medication for anxiety and stress [43]. Cultural prohibitions on alcoholic beverage consumption by women, children, and adolescents are common in most cultures. However, for those who break traditional prohibitions, vulnerability to the social consequences of alcohol consumption, particularly stigmatization, may increase, even becoming a barrier to treatment [41].

Furthermore, it is necessary to consider the synergism of socioeconomic inequalities in the health impacts observed in Brazil. Studies have shown that the pattern of alcohol consumption and its impact on health vary in the Brazilian population according to age, race/skin color, socioeconomic status, and/or education and that these factors may act differently between men and women [3–5].

Our results did not indicate an isolated association between education and alcohol consumption, which contradicts some studies in the literature where they found an association between education and alcohol consumption [14,44–48]. Brazilian surveys by Vigitel from 2019 prior to the pandemic and from 2020 and 2021 [7,49], as well as the data from the 2019 National Health Survey [7], demonstrated that excessive episodic alcohol consumption was higher in more educated individuals [50]. This indicates that high socioeconomic levels appear to be associated with a greater risk of alcohol consumption, which can be explained by the greater purchasing power of the population [12,51]. However, individuals with lower socioeconomic status are more susceptible to consequences related to alcohol dependence, with socioeconomic inequalities in mortality attributable to alcohol being greater than those from all causes [51].

When observing the combination of socioeconomic factors, the difference in the influence of education on alcohol consumption between the sexes found in the present study is notable. For females, having a high level of education increases the chance of drinking alcoholic beverages, while for men, there is no significant influence of education on alcohol consumption. These findings demonstrate that alcohol consumption among women is possibly related to purchasing power and opportunities, as higher levels of education generally result in better working conditions and higher income [52]. Among men, this is not strongly evident, given that alcohol consumption has always been high [6,8] and may have been accentuated as a result of psychological consequences in response to the stressful and anxiogenic situations experienced during the pandemic [21,22].

The intensification of alcohol consumption in circumstances of great financial and emotional instability and mourning situations has been previously documented in the literature, reinforcing the evidence that the occurrence of trauma or post-traumatic stress increases substance use disorder [53,54].

Furthermore, the data presented here encourage reflection on the reality of women during the pandemic, which refers to historical and cultural issues. With regards to working conditions, women's vulnerability is manifested both in the greater probability of leaving the job market and becoming economically inactive than men, as well as in the overload of work in the domestic environment in the context of isolation. These make them more economically helpless or more prone to working in worse conditions [55,56]. This may also be related to fewer purchasing opportunities and is one of the possible explanations why women with less education are less likely to consume than women with more years of education.

Changes in socioeconomic conditions and lifestyles resulting from the COVID-19 pandemic provide a unique opportunity to explore the combined relationship between education and sex and how this affects alcohol consumption patterns. Although the results are paradoxical, the findings of the present study can be explained by the exacerbation of socioeconomic fragility resulting from the health crisis, as there is a greater risk of worse health behaviors in populations from lower socioeconomic strata [57].

Our findings confirm the hypothesis that education combined with sex (i.e., being male) would increase the consumption of alcoholic beverages during periods of social restrictions, given the inequalities in the impacts of the pandemic on the labor market [55,58] and the living conditions of the population [44]. Fear of becoming ill, financial uncertainty, and stress were common conditions during this period and were associated with increased alcohol use, depressive symptoms, increased stress, having children at home, and job loss [59–61]. The results showed that alcohol consumption could be reduced by interventions that consider the socioeconomic context and the most vulnerable groups.

In this study, the measurements were obtained through self-report and, therefore, were subject to memory bias. However, this research has several strengths, such as a robust sampling methodology with probabilistic selection and sample weights, which provides statistical power for the study. The interviews were conducted face-to-face, allowing greater precision in the information obtained. Furthermore, the data in the present study were derived from a population survey conducted during the pandemic, which is an important source of information on health situations and determinants.

The hypothesis addressed in this study was delimited and guided according to the current literature. Despite the methodological robustness, these findings must be interpreted with caution, for this study may not have national representatives, as they were conducted in only two municipalities in Brazil.

5. Conclusions

The high prevalence of alcohol consumption found in this study highlights a political, economic, social, and public health problem in the Brazilian population, which requires attention from government agencies and public policies. It is urgent to adopt strategies to reduce alcohol consumption; reinforce the importance of improvements in the implementa-

Int. J. Environ. Res. Public Health **2024**, 21, 804

10 of 13

tion of labeling, pricing, and tax increase policies; support the intensification of inspection actions in relation to the sale of alcoholic beverages to minors aged <18 years; and adopt educational actions aimed at preventing and reducing alcohol consumption.

From a public health perspective, evaluating the modifying effect of sex on the relationship between education level and alcohol consumption allows us to expand our understanding of the combination of socioeconomic factors on health outcomes beyond traditional forms of analyzing these categories separately. Therefore, the need for future studies that evaluate the relationship between education and sex and alcohol consumption in other regions of Brazil is highlighted.

Furthermore, it is expected that this study will contribute to expanding the knowledge about the complex relationship between socioeconomic factors in determining the consumption of alcoholic beverages and will serve as support for proposing policies and actions aimed at reducing health inequalities.

References

1. World Health Organization. *Global Status Report on Alcohol and Health 2018*; World Health Organization: Geneva, Switzerland, 2018.
2. Plens, J.A.; Valente, J.Y.; Mari, J.J.; Ferrari, G.; Sanchez, Z.M.; Rezende, L.F.M. Patterns of alcohol consumption in Brazilian adults. *Sci. Rep.* **2022**, *12*, 8603. [CrossRef] [PubMed]
3. Silveira, C.M.; Siu, E.R.; Anthony, J.C.; Saito, L.P.; De Andrade, A.G.; Kutschenko, A.; Viana, M.C.; Wang, Y.P.; Martins, S.S.; Andrade, L.H. Drinking patterns and alcohol use disorders in São Paulo, Brazil: The role of neighborhood social deprivation and socioeconomic status. *PLoS ONE* **2014**, *9*, e108355. [CrossRef]
4. Moura, E.C.; Malta, D.C. Alcoholic beverage consumption among adults: Sociodemographic characteristics and trends. *Rev. Bras. Epidemiol.* **2011**, *14*, 61–70. [CrossRef] [PubMed]
5. Kerr-Corrêa, F.; Tucci, A.M.; Hegedus, A.M.; Trinca, L.A.; Oliveira, J.B.; Floripes, T.M.F.; Kerr, L.R.F.S. Drinking patterns between men and women in two distinct Brazilian communities. *Rev. Bras. Psiquiatr.* **2008**, *30*, 235–242. [CrossRef] [PubMed]
6. Pan American Health Organization. *Regional Status Report on Alcohol and Health 2020*; Pan American Health Organization: Washington, DC, USA, 2020.
7. Ministério da Saúde. *Vigitel Brasil 2019: Estimativas Sobre Frequência e Distribuição Sociodemográfica de Fatores de Risco e Proteção Para Doenças Crônicas nas Capitais dos 26 Estados Brasileiros e No Distrito Federal em 2019*; Ministério da Saúde: Brasília, Brazil, 2020.
8. Ministério da Saúde. Vigitel Brasil 2006–2020: Tabagismo e consumo abusivo de álcool. In *Vigilância de Fatores de Risco e Proteção Para Doenças Crônicas por Inquérito Telefônico: Estimativas Sobre Frequência e Distribuição Sociodemográfica de Tabagismo e Consumo Abusivo de Álcool nas Capitais dos 26 Estados Brasileiros e No Distrito Federal Entre 2006 e 2020*; Ministério da Saúde: Brasília, Brazil, 2022.

9.   Malta, D.C.; Silva, M.A.G.; Prates, E.J.S.; Alves, F.T.A.; Cristo, E.B.; Machado, I.E. Convergence in alcohol abuse in Brazilian capitals between genders, 2006 to 2019: What population surveys show. *Rev. Bras. Epidemiol.* **2021**, *24*, e210022. [CrossRef] [PubMed]

10. Grucza, R.A.; Sher, K.J.; Kerr, W.C.; Krauss, M.J.; Lui, C.K.; McDowell, Y.E.; Hartz, S.; Virdi, G.; Bierut, L.J. Trends in Adult Alcohol Use and Binge Drinking in the Early 21 st Century United States: A Meta-Analysis of Six National Survey Series. *Alcohol. Clin. Exp. Res.* **2018**, *42*, 1939–1950. [CrossRef]

11. Grant, B.F.; Chou, S.P.; Saha, T.D.; Pickering, R.P.; Kerridge, B.T.; Ruan, W.J.; Huang, B.; Jung, J.; Zhang, H.; Fã, A.; et al. Prevalence of 12-month alcohol use, high-risk drinking, and DSM-IV alcohol use disorder in the United States, 2001–2002 to 2012–2013: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *JAMA Psychiatry* **2017**, *74*, 911–923. [CrossRef] [PubMed]

12. Machado, I.E.; Monteiro, M.G.; Malta, D.C.; Lana, F.C.F. Brazilian Health Survey (2013): Relation between alcohol use and sociodemographic characteristics by sex in Brazil. *Rev. Bras. Epidemiol.* **2017**, *20*, 408–422. [CrossRef] [PubMed]

13. Ribeiro, L.S.; Damacena, G.N.; Szwarcwald, C.L. Prevalence and sociodemographic factors associated with heavy drinking in Brazil: Cross-sectional analyses of the National Health Survey. *Rev. Bras. Epidemiol.* **2021**, *24*, E210. [CrossRef] [PubMed]

14. Laranjeira, R.; Pinsky, I.; Sanches, M.; Zaleski, M.; Caetano, R. Alcohol use patterns among Brazilian adults. *Rev. Bras. Psiquiatr.* **2010**, *32*, 231–241. [CrossRef] [PubMed]

15. Barros, M.B.A.; Botega, N.J.; Dalgalarrondo, P.; Marín-León, L.; Oliveira, H.B. Prevalence of alcohol abuse and associated factors in a population-based study. *Rev. Saúde Pública* **2007**, *41*, 502–509. [CrossRef] [PubMed]

16. Garcia, L.P.; Duarte, E. Nonpharmaceutical interventions for tackling the COVID-19 epidemic in Brazil. *Epidemiol. Serv. Saúde* **2020**, *29*, e2020222. [CrossRef] [PubMed]

17. Wilder-Smith, A.; Freedman, D.O. Isolation, quarantine, social distancing and community containment: Pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak. *J. Travel Med.* **2020**, *27*, taaa020. [CrossRef] [PubMed]

18. Sohi, I.; Chrystoja, B.R.; Rehm, J.; Wells, S.; Monteiro, M.; Ali, S.; Shield, K.D. Changes in alcohol use during the COVID-19 pandemic and previous pandemics: A systematic review. *Alcohol. Clin. Exp. Res.* **2022**, *46*, 498–513. [CrossRef] [PubMed]

19. Valente, J.Y.; Sohi, I.; Garcia-Cerde, R.; Monteiro, M.G.; Sanchez, Z.M. What is associated with the increased frequency of heavy episodic drinking during the COVID-19 pandemic? Data from the PAHO regional web-based survey. *Drug Alcohol Depend.* **2021**, *221*, 108621. [CrossRef] [PubMed]

20. Pollard, M.S.; Tucker, J.S.; Green, H.D. Changes in Adult Alcohol Use and Consequences during the COVID-19 Pandemic in the U.S. *JAMA Netw. Open.* **2020**, *3*, e2022942. [CrossRef] [PubMed]

21. Stanton, R.; To, Q.G.; Khalesi, S.; Williams, S.L.; Alley, S.J.; Thwaite, T.L.; Fenning, A.S.; Vandelanotte, C. Depression, Anxiety and Stress during COVID-19: Associations with Changes in Physical Activity, Sleep, Tobacco and Alcohol Use in Australian Adults. *Int. J. Environ. Res. Public Health* **2020**, *17*, 4065. [CrossRef] [PubMed]

22. García-Álvarez, L.; Fuente-Tomás, L.; Sáiz, P.A.; García-Portilla, M.P.; Bobes, J. Will changes in alcohol and tobacco use be seen during the COVID-19 lockdown? *Adicciones* **2020**, *32*, 85–89. [CrossRef] [PubMed]

23. Silber, S.D. A fragilidade econômica e financeira na pandemia do Sars-Covid-19. *Estud. Avançados* **2020**, *34*, 107–115. [CrossRef]

24. Instituto Brasileiro de Geografia e Estatística. *Censo Brasileiro de 2010*; Instituto Brasileiro de Geografia e Estatística: Rio de Janeiro, Brazil, 2013.

25. Silva, P.L.D.N.; Pessoa, D.G.C.; Lila, M.F. Statistical analysis of data from PNAD: Incorporating the sample design. *Cien Saúde Colet.* **2002**, *7*, 659–670. [CrossRef]

26. Instituto Brasileiro de Geografia e Estatística. *Pesquisa de Orçamentos Familiares 2017–2018: Análise do Consumo Alimentar Pessoal No Brasil*; IBGE, Coordenação de Trabalho e Rendimento; Instituto Brasileiro de Geografia e Estatística: Rio de Janeiro, Brazil, 2020.

27. Meireles, A.L.; Xavier, C.C.; Proietti, F.A.; Caiaffa, W.T. Influence of individual and socio-environmental factors on self-rated health in adolescents. *Rev. Bras. Epidemiol.* **2015**, *18*, 538–551. [CrossRef] [PubMed]

28. Hallal, P.C.; Hartwig, F.P.; Horta, B.L.; Silveira, M.F.; Struchiner, C.J.; Vidaletti, L.P.; Neumann, N.A.; Pellanda, L.C.; Dellagostin, O.A.; Burattini, M.N.; et al. SARS-CoV-2 antibody prevalence in Brazil: Results from two successive nationwide serological household surveys. *Lancet Glob. Health* **2020**, *8*, e1390–e1398. [CrossRef]

29. Meireles, A.L.; Lourenção, L.G.; Menezes-Júnior, L.A.; Coletro, H.N.; Justiniano, I.C.; Moura, S.S.; Diniz, A.P.; Sabião, T.D.S.; Rocha, A.M.S.; Batista, A.P.; et al. COVID-Inconfidentes -SARS-CoV-2 seroprevalence in two Brazilian urban areas in the fourth quarter 2020: Study protocol and initial results. *Poblac. Salud Mesoam.* **2023**, *21*. [CrossRef]

30. Szwarcwald, C.L.; Malta, D.C.; Pereira, C.A.; Vieira, M.L.F.P.; Conde, W.L.; Júnior, P.R.B.S.; Damacena, G.N.; Azevedo, L.O.; Silva, G.A.; Filha, M.M.T.T.; et al. Pesquisa National Health Survey in Brazil: Design and methodology of application. *Cien. Saúde Colet.* **2014**, *19*, 333–342. [CrossRef] [PubMed]

31. Instituto Brasileiro de Geografia e Estatística. *Pesquisa Nacional de Saúde 2013: Indicadores de Saúde e Mercado de Trabalho*; IBGE, Coordenação de Trabalho e Rendimento; Instituto Brasileiro de Geografia e Estatística: Rio de Janeiro, Brazil, 2016.

32. Travassos, C.; Laguardia, J.; Marques, P.M.; Mota, J.C.; Szwarcwald, C.L. Comparison between two race/skin color classifications in relation to health-related outcomes in Brazil. *Int. J. Equity Health* **2011**, *10*, 35. [CrossRef] [PubMed]

33. World Health Organization. *Global Status Report on Alcohol and Health 2014*; World Health Organization: Geneva, Switzerland, 2014.

Int. J. Environ. Res. Public Health **2024**, *21*, 804

12 of 13

34. Schimidt, L.A.; Mäkelä, P.; Rehm, J.; Room, R.; Blas, E.; Kurup, A.S. Alcohol: Equity and social determinants. In *Equity, Social Determinants and Public Health Programs*; World Health Organization: Geneva, Switzerland, 2010.

35. Ni, A.; Satagopan, J.M. Estimating the additive interaction effect in two-phase stratified case-control design. *Hum. Hered.* **2019**, *84*, 90–108. [CrossRef] [PubMed]

36. Macinko, J.; Mullachery, P.; Silver, D.; Jimenez, G.; Morais-Neto, O.L. Patterns of Alcohol Consumption and Related Behaviors in Brazil: Evidence from the 2013 National Health Survey (PNS 2013). *PLoS ONE* **2015**, *10*, e0134153. [CrossRef] [PubMed]

37. Baraona, E.; Abittan, C.S.; Dohmen, K.; Moretti, M.; Pozzato, G.; Chayes, Z.W.; Schaefer, C.; Lieber, C.S. Gender differences in pharmacokinetics of alcohol. *Alcohol. Clin. Exp. Res.* **2001**, *25*, 502–507. [CrossRef]

38. Erol, A.; Karpyak, V.M. Sex and gender-related differences in alcohol use and its consequences: Contemporary knowledge and future research considerations. *Drug Alcohol. Depend.* **2015**, *1*, 1–13. [CrossRef] [PubMed]

39. Wilsnack, R.W.; Wilsnack, S.C.; Kristjanson, A.F.; Vogeltanz-Holm, N.D.; Gmel, G. Gender and alcohol consumption: Patterns from the multinational GENACIS project. *Addiction* **2009**, *104*, 1487–1500. [CrossRef]

40. Holmila, M.; Raitasalo, K. Gender differences in drinking: Why do they still exist? *Addiction* **2005**, *100*, 1763–1769. [CrossRef] [PubMed]

41. Keyes, K.M.; Li, G.; Hasin, D.S. Birth Cohort Effects and Gender Differences in Alcohol Epidemiology: A Review and Synthesis. *Alcohol. Clin. Exp. Res.* **2011**, *35*, 2101–2112. [CrossRef] [PubMed]

42. Berridge, V.; Herring, R.; Thom, B. Binge drinking: A confused concept and its contemporary history. *Soc. Hist. Med.* **2009**, *22*, 597–607. [CrossRef]

43. Haighton, C.; Kidd, J.; O'Donnell, A.; Wilson, G.; McCabe, K.; Ling, J. 'I take my tablets with the whiskey': A qualitative study of alcohol and medication use in mid to later life. *PLoS ONE* **2018**, *13*, e0205956. [CrossRef] [PubMed]

44. Malta, D.C.; Szwarcwald, C.L.; Barros, M.B.A.; Gomes, C.S.; Machado, Í.E.; Souza Júnior, P.R.B.; Romero, D.E.; Lima, M.G.; Damacena, G.N.; Pina, M.F.; et al. The COVID-19 Pandemic and changes in adult Brazilian lifestyles: A cross-sectional study, 2020. *Epidemiol. Serv. Saúde* **2020**, *29*, e2020407. [CrossRef] [PubMed]

45. Noronha, B.P.; Nascimento-Souza, M.A.; Lima-Costa, M.F.; Peixoto, S.V. Alcohol consumption patterns and associated factors among elderly Brazilians: National Health Survey (2013). *Cienc. Saúde Coletiva* **2019**, *24*, 4171–4180. [CrossRef]

46. Malta, D.C.; Iser, B.P.M.; Santos, M.A.S.; Andrade, S.S.A.; Stopa, S.R.; Bernal, R.T.I.; Claro, R.M. Lifestyles in Brazilian capitals according to the National Health Survey and the Surveillance System for Protective and Risk Factors for Chronic Diseases by Telephone Survey (Vigitel), 2013. *Rev. Bras. Epidemiol.* **2015**, *18*, 68–82. [CrossRef] [PubMed]

47. Probst, C.; Roerecke, M.; Behrendt, S.; Rehm, J. Socioeconomic differences in alcohol-attributable mortality compared with all-cause mortality: A systematic review and meta-analysis. *Int. J. Epidemiol.* **2014**, *43*, 1314–1327. [CrossRef] [PubMed]

48. Machado, Í.E.; Lana, F.C.F.; Felisbino-Mendes, M.S.; Malta, D.C. Factors associated with alcohol intake and alcohol abuse among women in Belo Horizonte, Minas Gerais State, Brazil. *Cad. Saúde Pública* **2013**, *29*, 1449–1459. [CrossRef]

49. Ministério da Saúde. *Vigitel Brasil 2021: Estimativas Sobre Frequência e Distribuição Sociodemográfica de Fatores de Risco e Proteção Para Doenças Crônicas nas Capitais dos 26 Estados Brasileiros e No Distrito Federal em 2021*; Ministério da Saúde: Brasília, Brazil, 2022.

50. Instituto Brasileiro de Geografia e Estatística. *Pesquisa Nacional de Saúde 2019: Percepção do Estado de Saúde, Estilos de Vida, e Doenças Crônicas*; IBGE, Coordenação de Trabalho e Rendimento; Instituto Brasileiro de Geografia e Estatística: Rio de Janeiro, Brazil, 2020.

51. Wendt, A.; Costa, C.S.; Costa, F.S.; Malta, D.C.; Crochemore-Silva, I. Time trend in inequalities in smoking and abusive alcohol consumption in Brazil's state capitals. *Cad. Saúde Pública* **2021**, *37*, e00050120. [CrossRef] [PubMed]

52. Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira. *Panorama da educação: Destaques do Education at a Glance 2022*; Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira: Brasília, Brazil, 2022.

53. Drabwell, L.; Eng, J.; Stevenson, F.; King, M.; Osborn, D.; Pitman, A. Perceptions of the Use of Alcohol and Drugs after Sudden Bereavement by Unnatural Causes: Analysis of Online Qualitative Data. *Int. J. Environ. Res. Public Health* **2020**, *17*, 677. [CrossRef] [PubMed]

54. Gilpin, N.W.; Weiner, J.L. Neurobiology of comorbid post-traumatic stress disorder and alcohol-use disorder. *Genes Brain Behav.* **2016**, *16*, 15–43. [CrossRef] [PubMed]

55. International Labour Office. *Global Wage Report 2020–21: Wages and Minimum Wages in the Time of COVID-19*; International Labour Office: Geneva, Switzerland, 2020.

56. International Labour Office. *ILO Monitor: COVID-19 and the World of Work*, 7th ed.; International Labour Office: Geneva, Switzerland, 2021.

57. Petrovic, D.; de Mestral, C.; Bochud, M.; Bartley, M.; Kivimäki, M.; Vineis, P.; Mackenbach, J.; Stringhini, S. The contribution of health behaviors to socioeconomic inequalities in health: A systematic review. *Prev. Med.* **2018**, *113*, 15–31. [CrossRef] [PubMed]

58. International Labour Office. *Global Wage Report 2022–23: The Impact of Inflation and COVID-19 on Wages and Purchasing Power*; International Labour Office: Geneva, Switzerland, 2022.

59. Wardell, J.D.; Kempe, T.; Rapinda, K.K.; Single, A.; Bilevicius, E.; Frohlich, J.R.; Hendershot, C.S.; Keough, M.T. Drinking to Cope During COVID-19 Pandemic: The Role of External and Internal Factors in Coping Motive Pathways to Alcohol Use, Solitary Drinking, and Alcohol Problems. *Alcohol. Clin. Exp. Res.* **2020**, *44*, 2073–2083. [CrossRef] [PubMed]

Int. J. Environ. Res. Public Health **2024**, *21*, 804

13 of 13

60.   Biddle, N.; Edwards, A.; Ben, G.M.; Sollis, K. *Alcohol Consumption during the COVID-19 Period: May 2020*; ACT: ANU Centre for Social Research and Methods, Australian National University: Canberra, Australian, 2020.

61.   Szajnoga, D.; Klimek-Tulwin, M.; Piekut, A. COVID-19 lockdown leads to changes in alcohol consumption patterns. Results from the Polish national survey. *J. Addict. Dis.* **2020**, *39*, 215–225. [CrossRef] [PubMed]