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Co-Use of Alcohol and Cannabis During COVID-19: Associations Between Sociodemographic Factors and Self-Reported Mental Health Symptoms and Heavy Episodic Drinking in Canadian Adults

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Abstract

This study estimates the prevalence of co-use of alcohol and cannabis, assesses the sociodemographic risk factors of co-use, and examines the associations between mental health and heavy episodic drinking (HED) and alcohol–cannabis co-use in Canada during the early years of the COVID-19 pandemic. Nine successive cross-sectional surveys, held from May 2020 to January 2022, of adults (aged ≥18 years) living in Canada were pooled for 9011 participants. The prevalence of co-use was calculated across sociodemographic groups. Logistic regressions were used to assess associations. Alcohol–cannabis co-use was associated with a greater likelihood of engaging in HED and experiencing symptoms of anxiety, depression, and loneliness. The prevalence of co-use of alcohol was different across sociodemographic groups. The highest prevalence was among TGD people (35.5%), followed by individuals aged 18–39 years (14.5%). Additionally, being TGD (aOR = 3.61, 95% CI 2.09–6.25), separated/divorced/widowed (aOR = 1.60, 95% CI 1.23–2.07), living in an urban area (aOR = 1.26, 95% CI 1.07–1.56), and having a high household income (aOR = 1.41, 95% CI 1.09–1.82) increased the likelihood of reporting alcohol–cannabis co-use. These findings underscore the fact that developing public health and clinical interventions for

preventing and treating excessive alcohol or cannabis use must consider both alcohol and cannabis use patterns and should be tailored to the highest-risk TGD and young adults.

Keywords: alcohol; cannabis; marijuana; co-use; concurrent use; mental health; COVID-19

1. Introduction

Alcohol and cannabis are the two most commonly used psychoactive substances in Canada [1,2]. The use of these substances by Canadians leads to a substantial burden of health and social harms. In particular cannabis 287 deaths in Canada in 2012 [3], and alcohol use caused 17,098 deaths in Canada in 2020 [4]. The COVID-19 pandemic and the associated social distancing policies further increased problematic alcohol and cannabis consumption in Canada [1,2,5]. In 2021, 18% of Canadians 15 years of age and or older reported consuming five or more drinks on days they had consumed alcohol in the previous month; this proportion was higher than what was recorded before the pandemic (11% in 2017) [1]. Also, among Canadians who had previously consumed cannabis, 34% reported increased consumption during the pandemic, compared with the pre-pandemic period [1]. Evidence suggests there is a strong association between cannabis and alcohol use [6–9]. Among alcohol users, cannabis is the most widely used substance (excluding alcohol) [10,11]; similarly, most cannabis users report using alcohol [12]. Simultaneous use of alcohol and cannabis is considered a risk for users' safety and well-being [7,13], mainly because of its additive effects [14–16]. The alcohol–cannabis co-use (i.e., the use of both substances within a given period of time [10,16]) is associated with increased risk of serious public health concerns, including unsafe driving behaviours, including heavy episodic drinking (adults in the United States were 3.7 times more likely to binge drink in the past month if they used cannabis in the past month) [16,17], and higher rates of alcohol use disorders [16,18,19].

Alcohol–cannabis co-use is also associated with an increased prevalence of mental illness [16,18]. Indeed, co-use increases the risk of behavioural problems, psychosis, and substance-related harms [20,21]. Although the use of cannabis is associated with the development of mood disorders and anxiety disorders as well as loneliness [16,18,22], and the use of alcohol is causally related to the development of mood disorders and associated with loneliness [22,23], it is currently unknown if anxiety, mood disorders or loneliness are associated with co-use of cannabis and alcohol.

Given that alcohol–cannabis co-use affects the health outcomes for the general population, it is imperative to understand co-users better and provide new insights that may inform interventions and prevention strategies to reduce its burden. However, despite these concerns about the additive harms of alcohol and cannabis co-use, limited research has explicitly examined the prevalence of and the sociodemographic risk factors associated with alcohol and cannabis co-use compared to the exclusive use of either substance among Canadians [24,25]. Most studies investigating risk factors of co-use have focused on adolescents and young adults (aged 12–25), and most of this work has only examined the role of age, gender, and ethno-racial background [24]. Furthermore, results of previous studies have been mixed in terms of which sociodemographic factors affect co-use, particularly regarding gender and ethno-racial background [25–28]. A study examining co-use among adults in the US found that this behaviour was strongly associated with being younger (aged 18–49) and having less than a high school education [29]. The examination of the association between non-binary gender and polysubstance use has focused mainly on transgender and gender-diverse individuals (i.e., those whose gender identity differs from

their assigned sex at birth [30]) [31]. A cross-sectional study on 32,072 students in the US, including 335 transgender and gender-diverse individuals, examined the simultaneous use of alcohol, cigarettes, cannabis or other drugs within the previous 30 days [32]. Transgender adolescents were five times more likely to use multiple substances compared to their cisgender peers (i.e., those whose gender identity aligned with their assigned sex at birth [30]) [31].

The present study extends the investigation of alcohol–cannabis co-use using repeated cross-sectional surveys conducted in Canada during the COVID-19 pandemic to understand the harms and risk factors associated with this behaviour. The specific objectives of this study are to (1) estimate the prevalence of alcohol–cannabis co-use across sociodemographic groups, including age, gender (i.e., women, men, and transgender and gender diverse people), ethno-racial background and socioeconomic status (i.e., employment status, household income, and educational attainment); (2) identify specific sociodemographic risk factors associated with alcohol–cannabis co-use, and (3) examines the associations between mental health and heavy episodic drinking and alcohol–cannabis co-use in Canada during the early years of the COVID-19 pandemic.

2. Material and Methods

2.1. Participants and Data Collection

Data were obtained from nine repeated web-based cross-sectional surveys conducted with English-speaking Canadian adults aged 18 years and older. The firm Delvinia collected the survey data through Asking Canadians (http://www.delvinia.com/solutions/askingcanadians (accessed on 5 May 2025)), utilizing proportional quota sampling to mirror the distribution of the English-speaking Canadian population by age, sex, and region [33]. Participants completed electronic consent forms prior to starting the survey, and the study received ethics approval from the Centre for Addiction and Mental Health. The surveys were conducted from May 2020 to January 2022, with the following timeline: Survey 1: 8–12 May (n = 1005, response rate (RR) = 15.9%), Survey 2: 29 May–1 June (n = 1002, RR = 17.2%), Survey 3: 19–23 June (n = 1005, RR = 16.4%), Survey 4: 10–14 July (n = 1003, RR = 13.7%), Survey 5: 18–22 September (n = 1003, RR = 17.6%), Survey 6: 27 November–1 December (n = 1003, RR = 16.2%), Survey 7: 19–23 March (n = 1000, RR = 15.8%), Survey 8: 9–13 July (n = 1001, RR = 12.5%), Survey 9: 7–11 January 2022 (n = 1004, RR = 10.3%). Table S1 in the Supplement provides details of the response rate calculations and survey interview information. A total of 9011 participants were analyzed in this study.

2.2. Measures

Alcohol–cannabis co-use was measured by combining the responses to two distinct questions on substance use. (1) "During the past seven days, on how many days did you use alcohol?" and (2) "During the past seven days, on how many days did you use cannabis?". Response categories for each question were recoded to reflect use on at least one day (coded 1) versus use on 0 days (coded 0). Participants who reported using alcohol on at least one day and who also reported using cannabis on at least one day were classified as engaging in alcohol and cannabis co-use in the past week. The co-use binary variable, which reflects the use of alcohol and cannabis, was coded 1 if they used both substances at least once in the past week and 0 otherwise.

Anxiety was measured by the Generalized Anxiety Disorder (GAD-7) scale [34]. The GAD-7 includes seven items using a four-point metric, ranging from 0 = "not at all" to 3 = "nearly every day." The total score ranged from 0 to 21, with higher scores reflecting more severe functional impairments because of anxiety. Participants with a score $\geq$ 10 (cut-off) were defined as experiencing moderate to severe anxiety [35–38].

Depression was measured by a single question from the Center for Epidemiologic Studies Depression Scale (CES-D) [39]: "In the past 7 days, how often have you felt depressed?" Response categories were "rarely or none of the time (less than 1 day)", "some or a little of the time (1–2 days)", "occasionally or a moderate amount of the time (3–4 days)", and "most or all of the time (5–7 days)". Those who reported feeling depressed 3–4 or 5–7 days were identified as experiencing depressive symptoms [39]. A cut-off of 3 days of feeling depressed in 7 days was used to identify individuals experiencing depression.

Loneliness was measured with a single item from the CES-D [39]. This item asked participants, "In the past 7 days, how often have you felt lonely?" with the following response options: "rarely or none of the time (less than 1 day)", "some or a little of the time (1–2 days)", "occasionally or a moderate amount of the time (3–4 days)", and "most or all of the time (5–7 days)" [39]. Participants were considered lonely if they reported feeling lonely for 3–4 or 5–7 days. A cut-off of 3 days of feeling lonely within 7 days was applied to identify individuals experiencing loneliness.

Heavy episodic drinking (HED) was assessed using the question: "On how many of the past seven days did you drink five/four or more drinks on one occasion?" Heavy episodic drinkers were defined as the consumption of 5 or more standard drinks ($\geq$68.0 g of alcohol) for cisgender men and transgender and gender diverse (TGD) participants and 4 or more standard drinks ($\geq$54.4 g of alcohol) for cisgender women [40,41].

2.3. Covariates

Sociodemographic covariates included gender (cisgender men, cisgender women, and TGD), age (18–39, 40–59 and 60+ years), ethno-racial background (White and Non-white (i.e., Asian/Black/Indigenous/Arab/Latinx and other ethnicities)), marital status (married/living with a partner, separated/divorced/widowed, single and marital status not stated), and residential environment (urban, suburban, and rural). Note that the gender identity question had the following response options: "Man," "Woman," "Transgender man," "Transgender woman," "Two-Spirit," "Non-binary (genderqueer, gender fluid)," "Questioning/Not sure of my gender identity," "Identity not listed," and "Prefer not to answer." Individuals who self-identified as transgender, two-spirit, or non-binary and those who selected "Questioning/Not sure of my gender identity" or did not find their gender listed were categorized as TGD. We excluded participants who responded "prefer not to answer" from the main analysis (i.e., 21 participants).

Additional covariates included socioeconomic status measured by household income (less than $40,000 as the reference category, $40,000–$79,999, $80,000–$119,999, $120,000 or more, and income not stated), educational attainment (post-secondary as the reference category, high school diploma or less, college degree/diploma, university degree/diploma, and education attainment not stated), and employment status during COVID-19 (employed (no change due to the pandemic) as the reference category, unemployed (no change due to the pandemic), and other impacts on employment (i.e., participants working from home due to the pandemic and returning to their usual workplace or participants who were unemployed/laid off/let go due to the pandemic who were back working with the same or a new employer).

2.4. Statistical Analyses

We calculated the prevalence of the use of alcohol only, cannabis only, co-use and no-use of both substances by sociodemographic characteristics. We performed multivariate logistic regressions on the pooled data from May 2020 to January 2022 to assess (i) the sociodemographic risk factors for alcohol–cannabis co-use, and (ii) associations of mental health symptoms and HED with co-use during the pandemic. To evaluate the risk factors,

four multivariate logistic regression analyses were conducted to compare alcohol–cannabis co-use with: (1) non-co-use of both substances, (2) use of alcohol only (i.e., alcohol use and no cannabis use), (3) use of cannabis only (i.e., cannabis use and no alcohol use), and (4) no use of either substance. Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were provided for each regression analysis. We also reported average marginal effects for the main analyses in the Supplement, as well as some results of interaction analysis. All analyses were performed using Stata version 16.1 (StataCorp, College Station, TX, USA).

3. Results

3.1. Description of Participants and Prevalence of Alcohol–Cannabis Co-Use

Table 1 shows study respondents' sociodemographic characteristics and substance use prevalence across socio-demographic groups. Most of the 9011 participants were White (68.9%), married (62.5%), employed (85.0%), and had a university degree (52.2%). Approximately 48% of participants reported drinking alcohol only (without cannabis); 3.1% used only cannabis, and 10.1% used alcohol and cannabis during the past week. The prevalence of co-use was higher among individuals aged 18–39 years (14.5%), unemployed individuals (13.3%), individuals with a high household income of $80,000–$119,000 (12.8%), higher among TGD people (35.5%) followed by cisgender men (11.9%), individuals living in an urban area (11.0%), and individuals with less than a university degree (10.5–11.9%).

Table 1. Sociodemographic characteristics of respondents and prevalence of alcohol, cannabis, and co-use across socio-demographic groups.

	Total Sample		**Alcohol Only**	**Cannabis Only**	**Co-Use**	**No-Use**
	n	**%**	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**
Total, *n* (%)	9011	100	4353 (48.3)	280 (3.1)	907 (10.1)	3471 (38.5)
Gender						
Man	4456	49.5	2247 (50.4)	137 (3.1)	529 (11.9)	1543 (34.6)
Woman	4472	49.6	2087 (46.7)	139 (3.1)	356 (8.0)	1890 (42.3)
Transgender and gender-diverse	62	0.7	15 (24.2)	4 (6.4)	22 (35.5)	21 (33.9)
Prefer not to answer	21	0.2	4 (19.1)	0 (0)	0 (0.0)	17 (80.9)
Age						
Age 18–39	3467	38.5	1433 (41.3)	162 (4.7)	501 (14.5)	1371 (39.5)
Age 40–59	2846	31.6	1377 (48.4)	82 (2.9)	264 (9.3)	1123 (39.5)
Age 60+	2698	29.9	1543 (57.2)	36 (1.3)	142 (5.3)	977 (36.2)
Ethno-racial background						
White	6209	68.9	3339 (53.8)	197 (3.2)	619 (10.0)	2054 (33.1)
Non-white	2802	31.1	1014 (36.2)	83 (3.0)	288 (10.3)	1417 (50.6)
Marital status						
Separated/divorced/widowed	1126	12.5	517 (45.9)	30 (2.7)	111 (9.9)	468 (41.6)
Married	5631	62.5	2953 (52.4)	147 (2.6)	550 (9.8)	1981 (35.2)
Single	2135	23.7	841 (39.4)	100 (4.7)	233 (10.9)	961 (45.0)
Marital status not stated	119	1.3	42 (35.3)	3 (2.5)	13 (10.9)	61 (51.3)
Residential environment						
Urban	4224	46.9	1955 (46.3)	134 (3.2)	466 (11.0)	1669 (39.5
Suburban	3356	37.2	1714 (51.1)	93 (2.8)	318 (9.5)	1231 (36.7)
Rural	1431	15.9	684 (47.8)	53 (3.7)	123 (8.6)	571 (39.9)
Income						
Income less than $40,000	1080	12.0	346 (32.0)	51 (4.7)	108 (10.0)	575 (53.2)
Income of $40,000–$79,999	2216	24.6	980 (44.2)	91 (4.1)	255 (11.5)	890 (40.2)
Income of $80,000–$119,999	2031	22.5	1026 (50.5)	55 (2.7)	259 (12.8)	691 (34.0)
Income $120,000+	2238	24.8	1280 (57.2)	45 (2.0)	219 (9.8)	694 (31.0)
Income not stated	1446	16.0	721 (49.9)	38 (2.6)	66 (4.6)	621 (42.9)

Table 1. *Cont.*

	Total Sample		Alcohol Only	Cannabis Only	Co-Use	No-Use
	n	**%**	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**
Employment status						
Employed	7660	85.0	3764 (49.1)	229 (3.0)	737 (9.6)	2930 (38.2)
Unemployed	867	9.6	384 (44.3)	38 (4.4)	115 (13.3)	330 (38.1)
Other impact on employment	484	5.4	205 (42.4)	13 (2.7)	55 (11.4)	211 (43.6)
Educational attainment						
Post-secondary	1362	15.1	610 (44.8)	58 (4.3)	155 (11.4)	539 (39.6)
High school	1068	11.9	440 (41.2)	48 (4.5)	112 (10.5)	468 (43.8)
College	1802	20.0	840 (46.6)	71 (3.9)	214 (11.9)	677 (37.6)
University	4703	52.2	2438 (51.8)	102 (2.2)	420 (8.9)	1743 (37.1)
Education attainment not stated	76	0.8	25 (32.9)	1 (1.3)	6 (7.9)	44 (57.9)

3.2. Associations of Sociodemographic Factors with Alcohol–Cannabis Co-Use

Table 2 shows the results of logistic regressions between sociodemographic characteristics and alcohol–cannabis co-use. Comparing co-use and non-co-use, TGD people (aOR = 3.61, 95% CI 2.09–6.25 representing an 11% increase in the likelihood of alcohol-cannabis co-use—detailed results in Table S2 in the Supplement), people who were separated/divorced/widowed (aOR = 1.60, 95% CI 1.23–2.07), people living in urban areas (aOR = 1.26, 95% CI 1.07–1.56), and people with a high household income of $80,000–$119,000 (aOR = 1.41, 95% CI 1.09–1.82) were at greater odds of reporting co-use of alcohol and cannabis during the pandemic compared to men, single individuals, people living in rural areas, and those with income less than $40,000., respectively. However, women (aOR = 0.63, 95%CI 0.55–0.73), people aged 40–59 years (aOR = 0.53, 95% CI 0.45–0.63) and 60+ (aOR = 0.27, 95% CI 0.22–0.33 or a decrease of 11% on the probability of co-use), and non-White people (i.e., Asian/Black/Indigenous/Arab/Latinx and other ethnicities) (aOR = 0.77, 95% CI 0.66–0.91), unemployed individuals (aOR = 0.74, 95%CI 0.59–0.92) and those with university degree (aOR = 0.67, 95%CI 0.54–0.82) were at lower odds of reporting alcohol–cannabis co-use during the pandemic compared to men, younger adults, white people, employed individuals, and people with high school diploma, respectively. These results are generally qualitatively similar to those obtained when the co-users group was compared to the alcohol only users, cannabis only users and non-users groups.

Table 2. Associations of sociodemographic factors with alcohol–cannabis co-use during the pandemic.

	Co-Use vs. Non Co-Use	Co-Use vs. Alcohol Use Only	Co-Use vs. Cannabis Use Only	Co-Use vs. No-Use
	aOR (95% CI)	**aOR (95% CI)**	**aOR (95% CI)**	**aOR (95% CI)**
Gender				
Women	0.63 *** (0.55–0.73)	0.71 *** (0.61–0.83)	0.74 ** (0.55–0.99)	0.54 *** (0.46–0.63)
TGD	3.61 *** (2.09–6.25)	4.73 *** (2.36–9.49)	1.72 (0.56–5.27)	3.42 *** (1.81–6.46)
Age				
Age 40–59	0.53 *** (0.45–0.63)	0.51 *** (0.42–0.61)	1.10 (0.79–1.52)	0.54 *** (0.45–0.65)
Age 60+	0.27 *** (0.22–0.33)	0.23 *** (0.18–0.29)	1.44 (0.91–2.28)	0.30 *** (0.24–0.37)
Ethno-racial background				
Non-White	0.77 *** (0.66–0.91)	1.10 (0.92–1.30)	1.07 (0.78–1.47)	0.48 *** (0.41–0.58)
Marital status				
Separated/divorced/widowed	1.60 *** (1.23–2.07)	1.46 *** (1.10–1.94)	1.77 ** (1.07–2.95)	1.59 *** (1.20–2.11)
Married	1.19 (1.00–1.42)	1.08 (0.89–1.31)	1.44 ** (1.04–1.99)	1.34 *** (1.11–1.62)
Marital status not stated	1.85 (0.96–3.57)	2.25 ** (1.07–4.74)	2.21 (0.54–9.09)	1.87 (0.91–3.84)

Table 2. *Cont.*

	Co-Use vs. Non Co-Use	Co-Use vs. Alcohol Use Only	Co-Use vs. Cannabis Use Only	Co-Use vs. No-Use
	aOR (95% CI)	**aOR (95% CI)**	**aOR (95% CI)**	**aOR (95% CI)**
Living area				
Urban	1.26 ** (1.01–1.56)	1.11 (0.88–1.40)	1.37 (0.91–2.06)	1.40 *** (1.11–1.78)
Suburban	1.07 (0.85–1.34)	0.92 (0.72–1.17)	1.38 (0.91–2.10)	1.21 (0.95–1.55)
Income				
Income: $40,000–$79,999	1.24 (0.97–1.59)	0.91 (0.69–1.20)	1.32 (0.86–2.03)	1.51 *** (1.17–1.96)
Income: $80,000–$119,999	1.41 *** (1.09–1.82)	0.93 (0.70–1.23)	2.06 *** (1.28–3.32)	1.89 *** (1.44–2.48)
Income: $120,000+	1.06 (0.81–1.38)	0.65 *** (0.48–0.87)	2.01 *** (1.20–3.37)	1.59 *** (1.20–2.12)
Income not stated	0.51 *** (0.36–0.71)	0.35 *** (0.25–0.51)	0.78 (0.45–1.35)	0.64 ** (0.45–0.90)
Employment				
Unemployed	0.74 *** (0.59–0.92)	0.79 ** (0.62–1.00)	0.96 (0.63–1.46)	0.69 *** (0.54–0.88)
Other impacts on employment	1.04 (0.73–1.49)	1.15 (0.78–1.70)	1.46 (0.70–3.03)	0.90 (0.61–1.33)
Educational attainment				
High school	0.96 (0.73–1.25)	1.00 (0.75–1.33)	0.95 (0.59–1.53)	0.89 (0.67–1.18)
College	1.01 (0.81–1.27)	0.97 (0.76–1.24)	1.19 (0.78–1.81)	1.06 (0.83–1.36)
University	0.67 *** (0.54–0.82)	0.58 *** (0.46–0.72)	1.48 (1.00–2.20)	0.75 ** (0.60–0.95)
Education attainment not stated	0.85 (0.33–2.17)	0.84 (0.30–2.36)	2.73 (0.27–27.93)	0.77 (0.28–2.1)
Survey waves				
Wave 2	1.14 (0.84–1.56)	1.07 (0.77–1.49)	1.02 (0.56–1.87)	1.26 (0.90–1.76)
Wave 3	1.27 (0.93–1.72)	1.20 (0.86–1.65)	1.74 (0.90–3.35)	1.37 (0.98–1.91)
Wave 4	1.28 (0.94–1.74)	1.18 (0.85–1.63)	1.25 (0.67–2.31)	1.43 ** (1.02–1.99)
Wave 5	1.17 (0.85–1.60)	1.19 (0.85–1.67)	1.36 (0.72–2.56)	1.11 (0.79–1.56)
Wave 6	1.43 ** (1.06–1.93)	1.48 ** (1.07–2.04)	0.82 (0.46–1.44)	1.44 ** (1.04–2.00)
Wave 7	1.31 (0.97–1.78)	1.38 (0.99–1.91)	1.06 (0.58–1.94)	1.32 (0.95–1.84)
Wave 8	1.09 (0.80–1.50)	1.05 (0.75–1.46)	1.01 (0.55–1.87)	1.20 (0.86–1.69)
Wave 9	1.32 (0.97–1.80)	1.29 (0.93–1.79)	0.82 (0.46–1.47)	1.43 ** (1.02–1.99)
Constant	0.21 *** (0.14–0.33)	0.65 (0.41–1.03)	1.03 (0.46–2.31)	0.39 *** (0.25–0.63)
Observations	8990	5256	1187	4361
Pseudo R-squared	0.06	0.08	0.05	0.08
Goodness-of-fit (Hosmer–Lemeshow), Chi 2 (*p* value)	7.10 (0.53)	7.40 (0.50)	11.66 (0.17)	8.36 (0.40)

Legend: *** and ** Odds ratios are significant at the 1% and 5% significance level, respectively. 95% confidence intervals in parentheses. Reference categories: Gender (Men), Age (18–39), Ethno-racial background (White), Marital status (Single), Living area (Rural), Income (less than $40,000), Employment (Employed), Educational attainment (Post-secondary), Survey waves (Wave 1).

To assess the temporal trend and how associations between alcohol-cannabis co-use and age group may change over the course of the pandemic, we added an interaction term between age group and survey waves in the regression. The results are presented in Table S3 in the Supplement. The joint test of significance for the Wave binary variables displayed a *p*-value greater than 0.05, suggesting no temporal effect. Similar results were found for age groups and interaction terms with Waves, indicating no differential impact over time across age groups.

3.3. Associations with Heavy Episodic Drinking, Anxiety, Depression, and Loneliness

Table 3 shows the results of multivariate logistic regressions of co-use on self-reported: anxiety, depression, loneliness, and HED (controlling for sociodemographic characteristics). Alcohol–cannabis co-use (vs. non co-use) was strongly associated with self-reported HED (aOR = 7.58, 95% CI 6.50–8.84 or an 34% increase in the likelihood of engaging in HED—detailed results in Table S4 in the Supplement), anxiety (aOR = 1.93, 95% CI 1.65–2.25 or an 10% increase in the likelihood of experiencing anxiety), depression (aOR = 1.96, 95% CI 1.67–2.29 or an 10% increase in the likelihood of experiencing depression), and loneliness (aOR = 1.87, 95% CI 1.60–2.19 or an 10% increase in the likelihood of experiencing

loneliness). Being a woman, TGD, and unemployed increased the likelihood of reporting anxiety, depression, and loneliness. Those who were separated/divorced/widowed, had a household income higher than $40,000, and unemployed were more likely to report heavy alcohol drinking.

Table 3. Associations of co-use of alcohol with heavy episodic drinking and mental health symptoms.

	Anxiety	Depression	Loneliness	Heavy Episodic Drinking
Alcohol–cannabis co-use	1.93 ***	1.96 ***	1.87 ***	7.58 ***
	(1.65–2.25)	(1.67–2.29)	(1.60–2.19)	(6.50–8.84)
Gender				
Women	1.42 ***	1.37 ***	1.34 ***	0.78 ***
	(1.28–1.59)	(1.23–1.53)	(1.20–1.49)	(0.70–0.87)
Transgender and gender-diverse	2.06 ***	2.72 ***	2.31 ***	0.87
	(1.21–3.50)	(1.61–4.60)	(1.37–3.92)	(0.48–1.59)
Age				
Age 40–59	0.78 ***	1.00	0.83 ***	1.03
	(0.69–0.88)	(0.88–1.13)	(0.74–0.95)	(0.91–1.17)
Age 60+	0.34 ***	0.45 ***	0.45 ***	0.71 ***
	(0.29–0.40)	(0.39–0.53)	(0.39–0.53)	(0.61–0.82)
Ethno-racial background				
Non White	1.15 **	1.01	1.04	0.93
	(1.02–1.29)	(0.89–1.13)	(0.92–1.17)	(0.83–1.05)
Marital status				
Separated/divorced/widowed	1.12	1.07	1.21 **	1.22 **
	(0.92–1.36)	(0.89–1.29)	(1.01–1.44)	(1.01–1.48)
Married	1.04	0.86 **	0.50 ***	1.07
	(0.91–1.18)	(0.75–0.97)	(0.44–0.56)	(0.94–1.22)
Living area				
Urban	1.13	1.12	1.02	0.96
	(0.96–1.33)	(0.95–1.32)	(0.87–1.19)	(0.83–1.12)
Suburban	1.07	1.03	0.94	1.01
	(0.91–1.26)	(0.87–1.22)	(0.80–1.11)	(0.87–1.18)
Income				
Income: $40,000–$79,999	0.77 ***	0.68 ***	0.74 ***	1.36 ***
	(0.64–0.91)	(0.58–0.81)	(0.62–0.87)	(1.13–1.63)
Income: $80,000–$119,999	0.63 ***	0.56 ***	0.75 ***	1.34 ***
	(0.52–0.76)	(0.46–0.67)	(0.62–0.89)	(1.10–1.62)
Income: $120,000+	0.57 ***	0.42 ***	0.51 ***	1.53 ***
	(0.47–0.69)	(0.34–0.51)	(0.42–0.62)	(1.25–1.86)
Income not stated	0.57 ***	0.58 ***	0.58 ***	1.01
	(0.47–0.70)	(0.47–0.70)	(0.48–0.71)	(0.82–1.25)
Employment				
Unemployed	1.81 ***	1.74 ***	1.68 ***	1.31 ***
	(1.55–2.13)	(1.48–2.05)	(1.43–1.97)	(1.11–1.55)
Other impacts on employment	1.24	1.23	1.21	1.05
	(0.99–1.55)	(0.98–1.55)	(0.96–1.51)	(0.84–1.32)
Educational attainment				
Post-secondary	1.29 **	1.21	1.06	0.97
	(1.05–1.58)	(0.99–1.48)	(0.87–1.29)	(0.80–1.18)
College	1.14	1.02	0.94	0.96
	(0.94–1.38)	(0.84–1.24)	(0.78–1.13)	(0.80–1.16)
University	1.10	1.04	0.97	0.89
	(0.92–1.31)	(0.87–1.23)	(0.82–1.14)	(0.75–1.05)

Table 3. *Cont.*

	Anxiety	Depression	Loneliness	Heavy Episodic Drinking
Wave 2	0.81 (0.66–1.01)	1.08 (0.87–1.36)	1.05 (0.85–1.31)	1.03 (0.83–1.28)
Wave 3	0.72 *** (0.58–0.89)	0.90 (0.72–1.13)	0.90 (0.72–1.12)	1.15 (0.93–1.43)
Wave 4	0.72 *** (0.58–0.90)	0.95 (0.75–1.19)	1.06 (0.85–1.32)	1.19 (0.96–1.47)
Wave 5	0.84 (0.67–1.04)	1.14 (0.91–1.43)	0.90 (0.72–1.13)	1.13 (0.91–1.40)
Wave 6	0.99 (0.80–1.22)	1.16 (0.93–1.45)	1.09 (0.88–1.36)	1.06 (0.86–1.32)
Wave 7	0.82 (0.66–1.01)	1.05 (0.84–1.31)	0.95 (0.76–1.18)	1.07 (0.86–1.33)
Wave 8	0.73 *** (0.58–0.91)	0.95 (0.76–1.20)	0.80 * (0.64–1.00)	1.19 (0.96–1.48)
Wave 9	1.04 (0.84–1.28)	1.20 (0.96–1.49)	1.14 (0.91–1.41)	1.04 (0.83–1.29)
Constant	0.36 *** (0.27–0.49)	0.34 *** (0.25–0.46)	0.59 *** (0.45–0.79)	0.23 *** (0.17–0.32)
Observations	8990	8990	8990	8976
Pseudo R-squared	0.06	0.06	0.08	0.09
Goodness-of-fit (Hosmer–Lemeshow), Chi 2 (p value)	5.74 (0.68)	13.06 (0.11)	8.37 (0.40)	9.69 (0.29)

Legend: *** and ** Odds ratios are significant at the 1% and 5% significance level, respectively. 95% confidence intervals in parentheses. Reference categories: Non-co-use, Gender (Men), Age (18–39), Ethno-racial background (White), Marital status (Single), Living area (Rural), Income (less than $40,000), Employment (Employed), Educational attainment (Post-secondary), Survey waves (Wave 1).

To evaluate whether the relationship between co-use of substances and mental health outcomes varies by age and gender, interaction terms were included in the model. Specifically, these terms examined the interactions between co-use and age groups, as well as co-use and gender. The complete results are presented in Table S5 of the Supplement. For anxiety, depression, and loneliness, the findings indicate that the associations between co-use and these mental health outcomes did not significantly differ among various age groups or between genders. However, the odds of women who co-use alcohol and cannabis engaging in HED were 5.49 times higher than those for men co-using both substances. Additionally, individuals aged 60 and older who co-use alcohol and cannabis are 3.97 times more likely to engage in HED compared to those aged 18–39 who co-use both substances.

4. Discussion

The present study aimed to assess the prevalence of alcohol–cannabis co-use during the pandemic across sociodemographic groups and identify risk factors of co-use in Canadian adults. We also examined the associations of co-use of these substances with mental health symptoms and HED.

4.1. Prevalence and Sociodemographic Risk Factors of Alcohol–Cannabis Co-Use

We found that the prevalence of alcohol–cannabis co-use during the pandemic varied across sociodemographic characteristics—it was notably higher among TGD people and cisgender men, people aged 18–39 years, unemployed people, individuals living in urban areas, and those with high household income ($80,000–$119,000). Additionally, the multivariate logistic regression results revealed that TGD people (vs cisgender men), people

living in urban areas (vs rural areas), people who were separated/divorced/widowed (vs single), and people with high household income (vs less than $40,000) were more likely to report alcohol–cannabis co-use in the past week. In addition, we found that co-users of alcohol and cannabis were more likely to report anxiety, depression, loneliness and heavy episodic drinking.

The high prevalence of co-use of substances among TGD participants compared to cisgender participants (almost 3 times higher relative to cisgender men and more than 4 times higher relative to cisgender women) is in line with the literature on substance use among TGD people. Previous studies have indicated that TGD people have high rates of alcohol use, cannabis use, illicit drug use, and non-medical use of prescription drugs compared with cisgender people [32,42–45]. Other research has indicated that TGD people were also more likely than cisgender men to co-use alcohol and cannabis during the COVID-19 pandemic, potentially due to increased psychological distress [46,47]. The increase in psychological distress among TGD individuals may be due to the interruption of gender-affirming treatments in Canada during the pandemic. These treatments are known to help alleviate gender dysphoria, which is the distress some TGD individuals feel when their gender identity does not match the sex assigned at birth. However, during the pandemic, these treatments were delayed or put on hold to prioritize medical resources for the increasing number of COVID-19 patients.

Our findings replicate previous results showing that the odds of co-use are higher among cisgender men and those of a younger age group [17,29,48,49]. For example, studies on college-aged drinkers in the US showed that the use of cannabis increased with the level of alcohol consumption [50,51]. We also identified several protective factors for co-using alcohol and cannabis that were found in some studies: women, non-White (i.e., Asian/Black/Indigenous/Arab/Latinx and other ethnicities), and unemployed [27,28,52]. Other socio-demographic correlates of alcohol–cannabis co-use, such as being separated/divorced/widowed, found in this study, were also identified in the literature [29,53–55].

4.2. Co-Use Associations with HED, Anxiety, Depression and Loneliness

The relationship between alcohol–cannabis co-use and HED, anxiety, and depression is consistent with the literature as well [16,20,29,48]. Co-users were at over 7 times greater odds of engaging in HED than those who did not co-use both substances. This result is in line with the findings from a large-scale longitudinal survey data from the US that found that most co-users of alcohol and cannabis were more likely to report heightened HED behaviour and depression [10,19,29]. This suggests that co-users might experience more problems from drinking during the pandemic, such as alcohol dependence and negative alcohol-related consequences like risky driving and mental health problems [29,56]. These results, coupled with the fact that the odds of alcohol–cannabis co-use are higher in younger adults and the TGD population, reflect a clinical population in which younger and TGD people may need treatment for both substances.

We also found that co-users of alcohol and cannabis are more likely to report loneliness. A similar result was found in the literature during and after the pandemic [22,57], suggesting that alcohol and cannabis may be used together to cope following a traumatic event, such as the COVID-19 restrictions on vulnerable individuals [58]. These associations are concerning because loneliness has increased among the general population during the pandemic, and evidence suggests that loneliness is associated with poor physical and mental health outcomes, including lower quality of life, increased suicidality, and increased substance use severity [57,59]. This shows that interventions to reduce loneliness may help improve population health and well-being and prevent or reduce alcohol and cannabis co-use.

Our findings indicate that alcohol–cannabis co-use is associated with higher self-reported anxiety and depression. This conclusion aligns with findings in the literature, where many individuals turned to these substances to cope with the overwhelming stress caused by social distancing measures during the COVID-19 pandemic [58]. The measures began in Canada with the declaration of a state of emergency at the start of the first wave of the pandemic in March 2020. This was followed by social distancing measures that included prohibiting large gatherings, implementing stay-at-home orders, closing schools, and restricting restaurants and bars until December 2021 in most provinces. Public health restriction policies varied across Canadian provinces and territories, depending on the daily counts of new COVID-19 cases. Between November and December 2020, several provinces introduced stricter public health restrictions, which included limiting retail capacity, closing non-essential businesses, and suspending sports and recreational programs. Alberta and Ontario implemented lockdowns in December 2020, while Quebec enforced curfews (between 8 p.m. and 5 a.m.) throughout 2021 in regions experiencing significant outbreaks. However, the survey was not designed to allow provincial-level analysis, which prevented us from accounting for these variations across provinces in our analysis. These restrictions have contributed to an increase in mental health problems among the population. It is crucial to recognize the risks associated with the co-use of alcohol and cannabis during a crisis, as well as the urgent need for practical support strategies during difficult times.

4.3. Limitations

There are limitations to this study. First, the use of a survey panel and reliance on participants from the English-speaking population (thus excluding French-speaking Canadians) may lead to participation and selection biases [60], impacting prevalence estimates. Second, the non-probability sampling method, combined with the web-based survey format, may introduce selection bias, as it only reaches literate individuals who have internet access and are sufficiently interested in the topic to complete the survey. As a result, the findings may not be applicable to the entire Canadian population. Third, the way gender identity was measured in this survey might have influenced the number of respondents identifying as TGD. The options provided for the gender identity question may not include all possible identities. Experts suggest adding a second question regarding sex assigned at birth, offering choices of "male" or "female" [61,62] to correctly identify and classify TGD individuals, which was not done in this study. This may result in misclassification regarding gender identity. Misclassification may also occur when participants who selected: "Questioning/Not sure of my gender identity" and "Identity not listed" were included in the TGD group. Additionally, we had to group various gender identities into TGD due to small sample sizes; thus, potential differences in co-use among various TGD groups could not be examined. Fourth, the study is cross-sectional. As a result, we cannot draw causal inferences or address issues of temporality. Additionally, we were unable to study the same individuals over time to see if their behaviour changed. Fifth, the survey did not include questions on participants' clinical histories or whether they had undergone pharmacological treatments; these factors could affect the study outcomes and introduce bias. Finally, all data in this study are based on self-reported responses, which may suffer from recall bias [63,64].

5. Conclusions

Around 10% of participants co-used alcohol and cannabis, with individuals who were TGD and young adults being significantly more likely to co-use alcohol and cannabis. Additionally, co-using cannabis and alcohol increased the likelihood of self-reported HED,

anxiety, depression and loneliness, which may lead to mental health and/or alcohol use disorders [16]. These findings support the need for programs to prevent and treat both alcohol and cannabis use problems, rather than focusing on a single behaviour, particularly in vulnerable populations identified, i.e., TGD, and young adult populations.

An equitable and inclusive approach is essential for designing and implementing measures to reduce disease propagation during major public health crises, such as limiting access to non-essential health services (e.g., gender-affirming treatments). While these measures are necessary, the needs of minority and more vulnerable groups must be considered through an approach that can help anticipate and mitigate potential negative impacts that may drive vulnerable individuals towards unhealthy behaviours, exacerbating their already precarious situations. A continuous evaluation of the effects of lockdown rules and social distancing (related to the pandemic) on unhealthy behaviours among at-risk populations may help inform targeted health promotion strategies for future public health crises. We recommend that future studies utilize a longitudinal approach to assess the causal effects of alcohol-cannabis co-use on mental health and HED. This approach will help us understand how it affects individuals over time, providing better information for policy development. Additionally, we suggest including a two-step gender identity question to more accurately identify individuals' gender, as well as incorporating questions about participants' clinical histories to ensure more robust findings.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/psychoactives4030027/s1, Table S1: Survey interview information and response rate calculations; Table S2: Average marginal effects of covariates on the probability of alcohol-cannabis co-use during the pandemic; Table S3: Associations of sociodemographic factors with the alcohol–cannabis co-use with survey wave and age group interactions terms and temporal trend testing; Table S4: Average marginal effects of covariates on the probability of experiencing a mental health problem during the pandemic; Table S5: Testing interaction effects of Alcohol-cannabis co-use with gender and age on heavy episodic drinking and mental health symptoms.

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Data Availability Statement: All data generated or analyzed during this study are publicly available for download at: http://www.delvinia.com/coronavirus (accessed on 5 May 2025).

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References

1. Statistics Canada. Alcohol and Cannabis Use During the Pandemic: Canadian Perspectives Survey Series 6. 2021. Available online: https://www150.statcan.gc.ca/n1/daily-quotidien/210304/dq210304a-eng.pdf (accessed on 16 July 2022).
2. Michelle, R. Canadians who report lower self-perceived mental health during the COVID-19 pandemic more likely to report increased use of cannabis, alcohol and tobacco. In *StatCan COVID-19: Data to Insights for a Better Canada*; Statistics Canada: Ottawa, ON, Canada, 2020.
3. Imtiaz, S.; Shield, K.D.; Roerecke, M.; Cheng, J.; Popova, S.; Kurdyak, P.; Fischer, B.; Rehm, J. The burden of disease attributable to cannabis use in Canada in 2012. *Addiction* **2016**, *111*, 653–662. [CrossRef]
4. Canadian Substance Use Costs and Harms. *Canadian Substance Use Costs and Harms (2015–2017)*; Canadian Substance Use Costs and Harms: Ottawa, ON, Canada, 2020.
5. Bartel, S.J.; Sherry, S.B.; Stewart, S.H. Pandemic-Related Changes in Alcohol and Cannabis Use: Comparing Retrospective Reports and Prospective Data. *Int. J. Ment. Health Addict.* **2023**, *21*, 2077–2083. [CrossRef]
6. Patrick, M.E.; Terry-McElrath, Y.M.; Miech, R.A.; Keyes, K.M.; Jager, J.; Schulenberg, J.E. Alcohol use and the COVID-19 pandemic: Historical trends in drinking, contexts, and reasons for use among U.S. adults. *Soc. Sci. Med.* **2022**, *301*, 114887. [CrossRef]
7. Patrick, M.E.; Kloska, D.D.; Terry-McElrath, Y.M.; Lee, C.M.; O'Malley, P.M.; Johnston, L.D. Patterns of simultaneous and concurrent alcohol and marijuana use among adolescents. *Am. J. Drug Alcohol Abus.* **2018**, *44*, 441–451. [CrossRef] [PubMed]
8. Leatherdale, S.T.; Burkhalter, R. The substance use profile of Canadian youth: Exploring the prevalence of alcohol, drug and tobacco use by gender and grade. *Addict. Behav.* **2012**, *37*, 318–322. [CrossRef]
9. Metrik, J.; Gunn, R.L.; Jackson, K.M.; Sokolovsky, A.W.; Borsari, B. Daily Patterns of Marijuana and Alcohol Co-Use Among Individuals with Alcohol and Cannabis Use Disorders. *Alcohol. Clin. Exp. Res.* **2018**, *42*, 1096–1104. [CrossRef]
10. Subbaraman, M.S.; Kerr, W.C. Simultaneous versus concurrent use of alcohol and cannabis in the National Alcohol Survey. *Alcohol. Clin. Exp. Res.* **2015**, *39*, 872–879. [CrossRef]
11. Abuse, S. *Mental Health Services Administration, Results from the 2013 National Survey on Drug Use and Health: Summary of National Findings, NSDUH Series H-48, HHS Publication No. (SMA) 14-4863*; Substance Abuse and Mental Health Services Administration: Rockville, MD, USA, 2014.
12. Roche, D.J.O.; Bujarski, S.; Green, R.; Hartwell, E.E.; Leventhal, A.M.; Ray, L.A. Alcohol, tobacco, and marijuana consumption is associated with increased odds of same-day substance co- and tri-use. *Drug Alcohol Depend.* **2019**, *200*, 40–49. [CrossRef]
13. Schensul, J.J.; Convey, M.; Burkholder, G. Challenges in measuring concurrency, agency and intentionality in polydrug research. *Addict. Behav.* **2005**, *30*, 571–574. [CrossRef]
14. Chait, L.D.; Perry, J.L. Acute and residual effects of alcohol and marijuana, alone and in combination, on mood and performance. *Psychopharmacology* **1994**, *115*, 340–349. [CrossRef]
15. Ramaekers, J.G.; Robbe, H.W.J.; O'Hanlon, J.F. Marijuana, alcohol and actual driving performance. *Hum. Psychopharmacol. Clin. Exp.* **2000**, *15*, 551–558. [CrossRef]
16. Yurasek, A.M.; Aston, E.R.; Metrik, J. Co-use of Alcohol and Cannabis: A Review. *Curr. Addict. Rep.* **2017**, *4*, 184–193. [CrossRef] [PubMed]
17. Kepner, W.E.; Han, B.H.; Nguyen, D.; Han, S.S.; Lopez, F.A.; Palamar, J.J. Past-month binge drinking and cannabis use among middle-aged and older adults in the United States, 2015–2019. *Alcohol* **2023**, *107*, 32–37. [CrossRef] [PubMed]
18. Center for Behavioral Health Statistics and Quality. *Key Substance Use and Mental Health Indicators in the United States: Results from the 2015 National Survey on Drug Use and Health*; HHS Publication No. SMA 16-4984, NSDUH Series H-51; Center for Behavioral Health Statistics and Quality: Rockville, MD, USA, 2016.
19. Terry-McElrath, Y.M.; O'Malley, P.M.; Johnston, L.D. Alcohol and Marijuana Use Patterns Associated With Unsafe Driving Among U.S. High School Seniors: High Use Frequency, Concurrent Use, and Simultaneous Use. *J. Stud. Alcohol Drugs* **2014**, *75*, 378–389. [CrossRef] [PubMed]
20. Thompson, K.; Holley, M.; Sturgess, C.; Leadbeater, B. Co-Use of Alcohol and Cannabis: Longitudinal Associations with Mental Health Outcomes in Young Adulthood. *Int. J. Environ. Res. Public Health* **2021**, *18*, 3652. [CrossRef]
21. Sokolovsky, A.W.; Gunn, R.L.; Micalizzi, L.; White, H.R.; Jackson, K.M. Alcohol and marijuana co-use: Consequences, subjective intoxication, and the operationalization of simultaneous use. *Drug Alcohol Depend.* **2020**, *212*, 107986. [CrossRef]
22. Gutkind, S.; Gorfinkel, L.R.; Hasin, D.S. Prospective effects of loneliness on frequency of alcohol and marijuana use. *Addict. Behav.* **2022**, *124*, 107115. [CrossRef]
23. Boden, J.M.; Fergusson, D.M. Alcohol and depression. *Addiction* **2011**, *106*, 906–914. [CrossRef]
24. Ontario Agency for Health Protection and Promotion (Public Health Ontario); Meyer, W.; Leece, P. *Evidence Brief: Risk Factors for Simultaneous Use of Alcohol and Cannabis*; Queen's Printer for Ontario: Toronto, ON, Canada, 2018.
25. Brière, F.N.; Fallu, J.S.; Descheneaux, A.; Janosz, M. Predictors and consequences of simultaneous alcohol and cannabis use in adolescents. *Addict. Behav.* **2011**, *36*, 785–788. [CrossRef]

26. McCabe, S.E.; Cranford, J.A.; Morales, M.; Young, A. Simultaneous and Concurrent Polydrug Use of Alcohol and Prescription Drugs: Prevalence, Correlates, and Consequences. *J. Stud. Alcohol* **2006**, *67*, 529–537. [CrossRef]
27. Terry-McElrath, Y.M.; O'Malley, P.M.; Johnston, L.D. Simultaneous alcohol and marijuana use among U.S. high school seniors from 1976 to 2011: Trends, reasons, and situations. *Drug Alcohol Depend.* **2013**, *133*, 71–79. [CrossRef] [PubMed]
28. Collins, R.L.; Ellickson, P.L.; Bell, R.M. Simultaneous polydrug use among teens: Prevalence and predictors. *J. Subst. Abus.* **1998**, *10*, 233–253. [CrossRef] [PubMed]
29. Midanik, L.T.; Tam, T.W.; Weisner, C. Concurrent and simultaneous drug and alcohol use: Results of the 2000 National Alcohol Survey. *Drug Alcohol Depend.* **2007**, *90*, 72–80. [CrossRef]
30. Baker, K.E. The Future of Transgender Coverage. *N. Engl. J. Med.* **2017**, *376*, 1801–1804. [CrossRef]
31. Goodwin, S.R.; Moskal, D.; Marks, R.M.; Clark, A.E.; Squeglia, L.M.; Roche, D.J.O. A Scoping Review of Gender, Sex and Sexuality Differences in Polysubstance Use in Adolescents and Adults. *Alcohol Alcohol.* **2022**, *57*, 292–321. [CrossRef]
32. Day, J.K.; Fish, J.N.; Perez-Brumer, A.; Hatzenbuehler, M.L.; Russell, S.T. Transgender Youth Substance Use Disparities: Results From a Population-Based Sample. *J. Adolesc. Health* **2017**, *61*, 729–735. [CrossRef]
33. Callegaro, M.; DiSogra, C. Computing Response Metrics for Online Panels. *Public Opin. Q.* **2008**, *72*, 1008–1032. [CrossRef]
34. Spitzer, R.L.; Kroenke, K.; Williams, J.B.W.; Löwe, B. A Brief Measure for Assessing Generalized Anxiety Disorder: The GAD-7. *Arch. Intern. Med.* **2006**, *166*, 1092–1097. [CrossRef]
35. Roy-Byrne, P.; Veitengruber, J.P.; Bystritsky, A.; Edlund, M.J.; Sullivan, G.; Craske, M.G.; Welch, S.S.; Rose, R.; Stein, M.B. Brief intervention for anxiety in primary care patients. *J. Am. Board Fam. Med.* **2009**, *22*, 175–186. [CrossRef]
36. Ren, Z.; Zhou, Y.; Liu, Y. The psychological burden experienced by Chinese citizens during the COVID-19 outbreak: Prevalence and determinants. *BMC Public Health* **2020**, *20*, 1617. [CrossRef] [PubMed]
37. Kroenke, K.; Spitzer, R.L.; Williams, J.B.W.; Löwe, B. The Patient Health Questionnaire Somatic, Anxiety, and Depressive Symptom Scales: A systematic review. *Gen. Hosp. Psychiatry* **2010**, *32*, 345–359. [CrossRef]
38. Elton-Marshall, T.; Wells, S.; Jankowicz, D.; Nigatu, Y.T.; Wickens, C.M.; Rehm, J.; Hamilton, H.A. Multiple COVID-19 Risk Factors Increase the Likelihood of Experiencing Anxiety Symptoms in Canada. *Can. J. Psychiatry* **2020**, *66*, 56–58. [CrossRef]
39. Radloff, L.S. The CES-D Scale:A Self-Report Depression Scale for Research in the General Population. *Appl. Psychol. Meas.* **1977**, *1*, 385–401. [CrossRef]
40. Somé, N.H.; Shokoohi, M.; Shield, K.D.; Wells, S.; Hamilton, H.A.; Elton-Marshall, T.; Abramovich, A. Alcohol and cannabis use during the COVID-19 pandemic among transgender, gender-diverse, and cisgender adults in Canada. *BMC Public Health* **2022**, *22*, 452. [CrossRef] [PubMed]
41. Flentje, A.; Barger, B.T.; Capriotti, M.R.; Lubensky, M.E.; Tierney, M.; Obedin-Maliver, J.; Lunn, M.R. Screening gender minority people for harmful alcohol use. *PLoS ONE* **2020**, *15*, e0231022. [CrossRef] [PubMed]
42. Benotsch, E.G.; Zimmerman, R.; Cathers, L.; McNulty, S.; Pierce, J.; Heck, T.; Perrin, P.B.; Snipes, D. Non-medical use of prescription drugs, polysubstance use, and mental health in transgender adults. *Drug Alcohol Depend.* **2013**, *132*, 391–394. [CrossRef] [PubMed]
43. Santos, G.M.; Rapues, J.; Wilson, E.C.; Macias, O.; Packer, T.; Colfax, G.; Raymond, H.F. Alcohol and substance use among transgender women in San Francisco: Prevalence and association with human immunodeficiency virus infection. *Drug Alcohol Rev.* **2014**, *33*, 287–295. [CrossRef]
44. Hughto, J.M.W.; Quinn, E.K.; Dunbar, M.S.; Rose, A.J.; Shireman, T.I.; Jasuja, G.K. Prevalence and Co-occurrence of Alcohol, Nicotine, and Other Substance Use Disorder Diagnoses Among US Transgender and Cisgender Adults. *JAMA Netw. Open* **2021**, *4*, e2036512. [CrossRef]
45. Connolly, D.; Gilchrist, G. Prevalence and correlates of substance use among transgender adults: A systematic review. *Addict. Behav.* **2020**, *111*, 106544. [CrossRef]
46. Kidd, J.D.; Jackman, K.B.; Barucco, R.; Dworkin, J.D.; Dolezal, C.; Navalta, T.V.; Belloir, J.; Bockting, W.O. Understanding the Impact of the COVID-19 Pandemic on the Mental Health of Transgender and Gender Nonbinary Individuals Engaged in a Longitudinal Cohort Study. *J. Homosex.* **2021**, *68*, 592–611. [CrossRef]
47. Restar, A.J.; Jin, H.; Jarrett, B.; Adamson, T.; Baral, S.D.; Howell, S.; Beckham, S.W. Characterising the impact of COVID-19 environment on mental health, gender affirming services and socioeconomic loss in a global sample of transgender and non-binary people: A structural equation modelling. *BMJ Glob. Health* **2021**, *6*, e004424. [CrossRef]
48. Tucker, J.S.; Seelam, R.; Green, H.D.; Rodriguez, A.; Pollard, M.S. Alcohol and cannabis co-use in a national sample of U.S. adults ages 30–80. *Addict. Behav.* **2023**, *142*, 107663. [CrossRef]
49. Höhne, B.; Pabst, A.; Hannemann, T.-V.; Kraus, L. Patterns of concurrent alcohol, tobacco, and cannabis use in Germany: Prevalence and correlates. *Drugs Educ. Prev. Policy* **2014**, *21*, 102–109. [CrossRef]
50. O'Grady, K.E.; Arria, A.M.; Fitzelle, D.M.; Wish, E.D. Heavy Drinking and Polydrug Use among College Students. *J. Drug Issues* **2008**, *38*, 445–466. [CrossRef] [PubMed]

51. Jones, S.E.; Oeltmann, J.; Wilson, T.W.; Brener, N.D.; Hill, C.V. Binge drinking among undergraduate college students in the United States: Implications for other substance use. *J. Am. Coll. Health* **2001**, *50*, 33–38. [CrossRef]
52. Neddermann-Carrillo, S.; Abidi, L.; Gea, A.; Bes-Rastrollo, M.; de la Fuente-Arrillaga, C.; Lahortiga-Ramos, F.; Martínez-González, M.Á.; Pardavila-Belio, M.I.; Ruiz-Canela, M. Tobacco and alcohol co-use: Lifestyle and sociodemographic factors, and personality aspects as potential predictors in the "Seguimiento Universidad de Navarra" cohort. *Res. Nurs. Health* **2024**, *47*, 251–265. [CrossRef]
53. Higgins, S.T.; Budney, A.J.; Bickel, W.K.; Foerg, F.E.; Badger, G.J. Alcohol dependence and simultaneous cocaine and alcohol use in cocaine-dependent patients. *J. Addict. Dis.* **1994**, *13*, 177–189. [CrossRef]
54. Ogborne, A.C.; Kapur, B.M.; Newton-Taylor, B. Characteristics of drug users admitted to alcohol detoxication centers. *Am. J. Drug Alcohol Abus.* **1992**, *18*, 177–186. [CrossRef] [PubMed]
55. Airagnes, G.; Lemogne, C.; Meneton, P.; Plessz, M.; Goldberg, M.; Hoertel, N.; Roquelaure, Y.; Limosin, F.; Zins, M. Alcohol, tobacco and cannabis use are associated with job loss at follow-up: Findings from the CONSTANCES cohort. *PLoS ONE* **2019**, *14*, e0222361. [CrossRef]
56. Linden-Carmichael, A.N.; Mallett, K.A.; Sell, N.; Turrisi, R. Are Co-users of Alcohol and Marijuana More Willing to Experience Consequences From Drinking? A Longitudinal Examination Among First-Year College Students. *Alcohol. Clin. Exp. Res.* **2019**, *43*, 1567–1574. [CrossRef]
57. Ingram, I.; Kelly, P.J.; Deane, F.P.; Baker, A.L.; Goh, M.C.W.; Raftery, D.K.; Dingle, G.A. Loneliness among people with substance use problems: A narrative systematic review. *Drug Alcohol Rev.* **2020**, *39*, 447–483. [CrossRef] [PubMed]
58. 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]
59. Mann, F.; Wang, J.; Pearce, E.; Ma, R.; Schlief, M.; Lloyd-Evans, B.; Ikhtabi, S.; Johnson, S. Loneliness and the onset of new mental health problems in the general population. *Soc. Psychiatry Psychiatr. Epidemiol.* **2022**, *57*, 2161–2178. [CrossRef]
60. Forster, J.J. Sample Surveys: Nonprobability Sampling. In *International Encyclopedia of the Social & Behavioral Sciences*; Smelser, N.J., Baltes, P.B., Eds.; Pergamon: Oxford, UK, 2001; pp. 13467–13470. [CrossRef]
61. Lagos, D.; Compton, D.L. Evaluating the Use of a Two-Step Gender Identity Measure in the 2018 General Social Survey. *Demography* **2021**, *58*, 763–772. [CrossRef]
62. Reisner, S.L.; Biello, K.; Rosenberger, J.G.; Austin, S.B.; Haneuse, S.; Perez-Brumer, A.; Novak, D.S.; Mimiaga, M.J. Using a Two-Step Method to Measure Transgender Identity in Latin America/the Caribbean, Portugal, and Spain. *Arch. Sex. Behav.* **2014**, *43*, 1503–1514. [CrossRef]
63. Gerlich, M.G.; Rehm, J. Recall bias in case-crossover designs studying the potential influence of alcohol consumption. *J. Stud. Alcohol Drugs* **2010**, *71*, 619. [CrossRef]
64. Stockwell, T.; Zhao, J.; Giesbrecht, N.; Macdonald, S.; Thomas, G.; Wettlaufer, A. The raising of minimum alcohol prices in Saskatchewan, Canada: Impacts on consumption and implications for public health. *Am. J. Public Health* **2012**, *102*, e103–e110. [CrossRef]