

RESEARCH ARTICLE

Patterns and predictors of alcohol use during the early stages of the COVID-19 pandemic in Australia: Longitudinal cohort study

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Abstract

Background: The COVID-19 pandemic has resulted in disruptions across many life domains. The distress associated with the pandemic itself, and with public health efforts to manage the outbreak, could result in increased alcohol use. This study aimed to quantify changes in alcohol use during the early stages of the pandemic and factors associated with different patterns of use.

Methods: Data were obtained from a longitudinal survey of a representative Australian adult sample ($N = 1296$, 50% female, $M_{\text{age}} = 46.0$) conducted from March to June 2020, during the first wave of the COVID-19 outbreak in Australia. Change in alcohol consumption was examined using Alcohol Use Disorders Identification Test-Consumption (AUDIT-C) scores from waves one, three, five, and seven of the study, each 4 weeks apart. Factors associated with alcohol consumption were examined, including depression (PHQ-9) and anxiety (GAD-7) symptoms, health risk tolerance, stress and coping, work and social impairment (WSAS), COVID impacts, and sociodemographic variables. We tested changes in alcohol use across the full sample using a mixed effects repeated measure ANOVA model and a multinomial logistic regression to identify factors assessed at wave 1 that were independently associated with alcohol use.

Results: There was no significant change in AUDIT-C scores across the study. For most participants, alcohol use did not increase during the early phase of the COVID-19 pandemic in Australia. COVID-19 exposure, higher perceived coping, depression symptoms, and male gender were associated with greater odds of increasing or elevated levels of alcohol use. Social changes, which included working from home, had mixed effects on alcohol consumption.

Conclusions: Although no evidence was found for increased alcohol use overall during the early months of the pandemic, several factors were associated with alcohol consumption at risky levels. Greater understanding of motivations for drinking across public and private contexts, along with targeted support for high-risk groups, could assist in reducing harm associated with alcohol consumption.

KEYWORDS

alcohol use, COVID-19 pandemic, lockdowns, representative national sample

INTRODUCTION

The COVID-19 pandemic has had a disruptive effect on social interactions, work, and health behaviors. Reviews and commentaries early in the pandemic raised alarms about the need for action to limit alcohol use and related problems (Clay & Parker, 2020; Ramalho, 2020). Many studies have reported increases in mental ill health and distress associated with public health measures early in the pandemic (Dawel et al., 2020; O'Connor et al., 2020; Pierce et al., 2020a; Schmits & Glowacz, 2021), which may lead to increased alcohol use (Turner et al., 2018). In addition, the boredom of the lockdown routine, along with reduced social contact, may have led to increased alcohol use (Schmits & Glowacz, 2021). Home delivery and spending on alcohol increased during the early stages of the pandemic in Australia (AIHW, 2021; Colbert et al., 2020). Nevertheless, it is also possible that reduced access to social settings where alcohol consumption typically occurs, such as bars and restaurants (Halim et al., 2012), may have decreased alcohol use.

There is a limited evidence base to quantify changes in alcohol use during the early stages of the pandemic. In particular, very few longitudinal studies have examined alcohol use in representative national samples (e.g., Nordeck et al., 2022; Pollard et al., 2020), with few studies using validated measures of alcohol consumption to adequately and objectively assess changes in drinking during the pandemic. Self-selected cross-sectional samples are likely to provide very little evidence for the prevalence of alcohol use, and are inadequate for assessing changes in alcohol use and other potential negative outcomes related to the pandemic, even in large samples (Pierce et al., 2020b).

Existing findings have been mixed, possibly due to reliance on convenience samples, limited use of validated measures and reliance on retrospective or cross-sectional data. Longitudinal data from a US nationally representative probability sample conducted by Pollard et al. (2020) compared alcohol use in mid-2019 to mid-2020 and found increased frequency of alcohol use, particularly among women, younger, and non-Hispanic White participants. Other longitudinal studies from the United States and the United Kingdom have similarly found increases in alcohol use, particularly for males, those with less education and those reporting financial distress (Irizar et al., 2021; Lechner et al., 2021; Nordeck et al., 2022). However, other studies in the early stages of the pandemic have reported that decreases in alcohol consumption have been as common as increases in consumption (Chodkiewicz et al., 2020; Evans et al., 2021; Schmits & Glowacz, 2021). Studies have identified a range of lifestyle, demographic and health factors associated with higher levels of alcohol use during the early stages

of the pandemic and lockdown (Neill et al., 2020; Tran et al., 2020), such as job loss, middle age, male gender, mental and physical illness, economic concerns, and working from home. A US study (Avery et al., 2020) found higher self-reported levels of stress and anxiety were associated with increased alcohol use during the pandemic. However, none of these studies used prospective measurement of consumption over time.

There are several potentially interconnected psychosocial and health-related factors that may influence alcohol use, based on evidence from studies conducted before the pandemic. For example, alcohol use may be associated with poorer mental health potentially as a maladaptive coping mechanism (Peirce et al., 1994; Turner et al., 2018), or due to common associations with trauma (Pitman et al., 2020). Attitudes towards health risks (i.e., the possibility of behaviors having harms on physical health) may also shape these associations. The established positive connection between sensation seeking and increased alcohol use suggests that individuals are driven by the perceived benefit in terms of acquiring intense feelings and experiences from alcohol intake (Hittner & Swickert, 2006). Individuals are more likely to engage in alcohol consumption when the needs for sensational rewards are higher than the perceived health risks, such that they can tolerate these risks. In addition, alcohol use is often influenced by social behavior. While peer affiliation and selection in social networks can influence the development of alcohol use (Leung et al., 2014), greater social capital and reduced isolation also have demonstrated protective effects against risky alcohol use (Bryden et al., 2013). Stressful life events commonly observed in the COVID-19 pandemic, such as job loss, relationship breakdown and financial distress may also contribute to increased levels of alcohol use (Keyes et al., 2011). Further evidence is needed to identify the social, psychological, health and demographic factors that have influenced alcohol consumption during the pandemic, and whether initial levels of alcohol use varied over time in response to these factors.

The current study aimed to (1) assess the prevalence of increased and decreased alcohol consumption during the first 3 months of the COVID pandemic in Australia (March to June 2020), and (2) identify factors associated with increased or decreased alcohol consumption. We used four waves of data from a nationally representative longitudinal adult sample ($N = 1296$). Participants were classified at each time point on the basis of alcohol consumption being at either low risk or elevated risk. We hypothesized that there would be increases in alcohol use after the initial assessment as the pandemic developed and that people most affected by social and psychological changes associated with the pandemic would have the greatest increases in alcohol use.

METHOD

Participants and procedure

The data for the current study were drawn from the Australian National COVID-19 Mental Health, Behavior and Risk Communication (COVID-MHBRC) survey, which aimed to longitudinally measure the impact of the COVID-19 pandemic in a representative sample of Australian adults (Dawel et al., 2020). The study consisted of eight waves of online data collection, with the first seven waves completed fortnightly between March and June 2020. Surveys were administered to market research panels through Qualtrics Research Services. Participants were emailed an invitation to complete each study wave, with a 1-week window for completion and up to five email reminders. Quota sampling was used to obtain a sample of the Australian population that was representative on the bases of age group, gender and State/Territory of residence. The mean age of participants was 46.0 years and 50% were female. Written informed consent was obtained from all participants prior to participation in the study. The study was approved by The Australian National University Human Research Ethics Committee (protocol 2020/152) and the full study protocol is available online (https://psychology.anu.edu.au/files/COVID_MHBRC_protocol.pdf).

The first wave of data collection commenced on the March 28, 2020 ($N = 1296$). Data on alcohol consumption was collected at every second wave. Thus, data for the current study were drawn from waves one (28 to 31 March 2020), three (25 to 30 April), five (23 to 28 May), and seven (20 to 25 June). Retention of the wave 1 sample was 73% at wave 3 ($N = 952$), 67% at wave 5 ($N = 874$), and 59% at wave 7 ($N = 762$), with 51% completing all four assessments. The timeframe of the study coincided with public health measures being introduced to minimize viral transmission including travel restrictions, shutting down non-essential services, stay-at-home orders or “lockdowns,” and the cancelation of social gatherings and events. These restrictions were gradually introduced in Australia between the 22 and 30 March 2020, then eased through May to June 2020 before a second outbreak in late-June 2020 (after the end of data collection) led to further restrictions.

Measures

Alcohol consumption was classified over the four assessments, with all independent variables assessed at wave 1.

Alcohol consumption

The 3-item Alcohol Use Disorders Identification Test – Consumption (AUDIT-C; Bush et al., 1998) was used to assess alcohol consumption over the previous month. Each of the three items on the AUDIT-C

(frequency of consumption, typical level of consumption and frequency of 6 or more drinks) is responded to on a 5-point scale ranging from 0 to 4, with total scale scores ranging from 0 to 12. The internal consistency of the AUDIT-C was satisfactory in the current study (Cronbach's $\alpha = 0.70$). In the current study, AUDIT-C scores >3 were considered to be elevated risk (Bush et al., 1998).

Symptoms of depression and anxiety

The Patient Health Questionnaire-9 (PHQ-9; Spitzer et al., 1999) and Generalized Anxiety Disorder-7 (GAD-7; Spitzer et al., 2006) were used to assess depression and anxiety symptoms respectively, based on the past 2 weeks. The scales align closely with diagnostic criteria for Major Depressive Disorder and Generalized Anxiety Disorder (Kroenke et al., 2010), with good internal consistency in the current study (PHQ-9 $\alpha = 0.92$; GAD-7 $\alpha = 0.94$). PHQ-9 scores range 0 to 27 and GAD-7 scores range 0 to 21, with higher scores indicating greater symptom severity.

Health risk tolerance

The 9-item health risk tolerance scale (Shou & Olney, 2021) was used to assess participants' tolerance of potential negative health consequences in a range of health and medical situations, such as combining medication, using alcohol with medication, not seeing the doctor when sick, or using new skincare products. Items were rated from 1 = extremely unpleasant to 7 = extremely pleasant, with total scale scores ranging 9 to 55. Internal consistency was good ($\alpha = 0.94$) in the current study.

Stress and coping

Two single-item measures were used to assess perceived stress (“Experienced stress in your life”) and coping (“Felt able to cope with the challenges you face”) over the previous two-week period. Participants responded to each of the items on a 6-point scale ranging from 1 (not at all) to 6 (extremely). Responses of ‘Quite a lot’ (4) or greater on the stress item were classified as high perceived stress, and responses of ‘Somewhat’ (3) or lower were classified as low coping.

Work and social impairment

The extent to which work and social activities were impaired by COVID-19 was measured using the 5-item Work and Social Adjustment Scale (WSAS; Mundt et al., 2002). Participants rated the level of impairment COVID-19 had caused for five work and social domains on a 9-point scale from 0 (Not at all impaired) to 8 (Very severely impaired). Total scores ranged 0 to 40, with higher scores indicative of greater

work and social impairment as a result of COVID-19. The WSAS had adequate internal consistency in the current study sample ($\alpha = 0.73$).

COVID impacts

Three separate items were used to examine the direct impacts of COVID-19 on the sample. Exposure to the COVID-19 virus was assessed through a series of yes/no items that enquired whether the respondent or a family member had been diagnosed with COVID-19, had been tested for COVID-19 or had been in direct contact with someone diagnosed with COVID-19. Participants who endorsed any of these items at any of the four waves were classified as having exposure to COVID-19. COVID-related financial distress was assessed with the item: 'Over the past 2 weeks, to what extent have you experienced financial distress related to COVID-19?'. Participants responded to this item on a 6-point scale ranging from 1 (not at all) to 6 (extremely), with responses of 'Quite a lot' or greater at any of the four waves classified as in financial distress. Participants were also asked if they were working from home due to COVID-19 at any of the four waves (yes/no).

Socio-demographic variables

A range of socio-demographic variables were also measured and included participant age, gender (male/female/other), education (years), partner status (yes/no), living alone (yes/no), current diagnosis of a physical, neurological, or mental illness (yes/no).

Analysis

We examined factors associated with attrition using a logistic regression. Participants were classified as having "low risk" alcohol use if they had AUDIT-C scores ≤ 3 at all four time points ($n = 724$). Participants with AUDIT-C scores > 3 at all four time points were classified as "elevated risk". Those with initial scores > 3 who had at least one subsequent score ≤ 3 were classified as "decreased to low risk", and those with initial scores ≤ 3 who had at least one subsequent score > 3 were classified as "increased to elevated risk". Participants who fluctuated between low and elevated risk (i.e., had a change in use but returned to initial levels) were included in a separate category, "fluctuating." Sample characteristics were assessed on the basis of alcohol use category, with bivariate differences between the four categories estimated on the basis of χ^2 tests for categorical variables and F tests for continuous variables. We tested changes in alcohol use across the full sample using a mixed effects repeated measure ANOVA model, which accounts for all available data to assess differences over time, with degrees of freedom estimated using Satterthwaite's correction and post-hoc comparisons used to test wave-on-wave variation.

A multinomial logistic regression was estimated to identify factors assessed at wave 1 that were independently associated with

alcohol use categories, with "low risk" alcohol use as the reference group. Because there were many candidate independent variables and limited previous research to guide model selection, a stepwise modeling strategy was used to form a parsimonious model, only retaining variables that had significant multivariate associations with alcohol use category ($p < 0.05$). A small minority of participants ($n = 13$, 1%) were excluded from the model on the basis of missing data on one or more independent variables. Finally, because alcohol use category may have been dependent on differential attrition, a sensitivity analysis was conducted, repeating the multinomial logistic regression model among participants who completed all four assessments ($n = 662$).

RESULTS

Based on the mixed effects repeated measures ANOVA, there was no significant change in AUDIT-C scores across the study ($F = 2.03$, $df = 3$, 913.2 , $p = 0.108$). However, post-hoc comparisons between time points indicated that consumption decreased significantly from wave 3 to wave 5 ($t = -2.18$, $df = 877.7$, $p = 0.029$) and from wave 3 and wave 7 ($t = -2.07$, $df = 858.3$, $p = 0.039$).

Sample characteristics are presented in [Table 1](#), categorized by the five alcohol use classifications. The majority of participants ($n = 813$, 63%) had alcohol use at low risk levels. Consistent alcohol use with elevated risk was seen in 23% ($n = 296$) participants. The remainder had a change over time, with 5% ($n = 59$) increasing from low to elevated risk alcohol use, 4% ($n = 53$) decreasing from elevated to low-risk alcohol use, and 6% ($n = 75$) reporting alcohol use that fluctuated across the four waves. As shown in [Table 1](#), total AUDIT-C scores for the full sample remained fairly consistent across the four waves, reflecting the findings from the mixed-effects model.

Attrition was explored using a logistic regression model. Wave 1 factors associated with completion of all four waves (1, 3, 5 and 7) included: higher AUDIT-C scores (OR = 1.11, $p < 0.001$), older age (OR = 1.01, $p < 0.001$), less work and social impairment (OR = 0.97, $p < 0.001$), current neurological condition (OR = 1.84, $p = 0.003$), working from home (OR = 1.55, $p = 0.005$), and low perceived coping (OR = 1.81, $p < 0.001$). Other factors including gender, education, depression/anxiety symptoms, health risk tolerance, living situation, adversity, financial distress, physical health conditions and perceived stress were not significantly associated with completion of all assessments.

The multinomial logistic regression model of alcohol use categories ($n = 1283$) is presented in [Table 2](#), which includes the odds relative to the low-risk group, also known in this context as relative risk ratios. The comparison group for this model was people who had low-risk alcohol use at every time point. People exposed to COVID-19 at any time point had significantly higher odds of reporting a change in their alcohol use (either increase, decrease or fluctuation). Working from home was also associated with changing alcohol use (either increase or decrease). A one-SD increase in depression symptoms was associated with 34% increased odds of fluctuating

TABLE 1 Sample characteristics on the basis of alcohol use categories (N = 1296)

Variable (baseline unless specified)	Value	Low risk (n = 813)		Increased to elevated (n = 59)		Decreased to low risk (n = 53)		Fluctuating (n = 75)		Elevated risk (n = 296)		Total (N = 1296)		χ^2	p
		n	%	n	%	n	%	n	%	n	%	n	%		
Current physical illness	Yes	295	36.3%	21	35.6%	21	39.6%	25	33.3%	123	41.6%	485	37.4%	3.34	0.503
	No	518	63.7%	38	64.4%	32	60.4%	50	66.7%	173	58.4%	811	62.6%		
Current neurological illness	Yes	111	13.7%	6	10.2%	8	15.1%	6	8.0%	32	10.8%	163	12.6%	3.74	0.442
	No	702	86.3%	53	89.8%	45	84.9%	69	92.0%	264	89.2%	1133	87.4%		
Current mental illness	Yes	187	23.0%	10	16.9%	17	32.1%	17	22.7%	79	26.7%	310	23.9%	5.20	0.267
	No	626	77.0%	49	83.1%	36	67.9%	58	77.3%	217	73.3%	986	76.1%		
Have a partner	Yes	522	64.2%	42	71.2%	33	62.3%	52	69.3%	204	68.9%	853	65.8%	3.67	0.453
	No	291	35.8%	17	28.8%	20	37.7%	23	30.7%	92	31.1%	443	34.2%		
Live alone	Yes	100	12.3%	5	8.5%	8	15.1%	10	13.3%	34	11.5%	157	12.1%	1.42	0.841
	No	713	87.7%	54	91.5%	45	84.9%	65	86.7%	262	88.5%	1139	87.9%		
Sex	Female	454	56.0%	16	27.1%	26	49.1%	32	42.7%	121	40.9%	649	50.2%	35.43	<0.001
	Male	357	44.0%	43	72.9%	27	50.9%	43	57.3%	175	59.1%	645	49.8%		
Exposed to bushfire smoke	Yes	384	47.2%	29	49.2%	27	50.9%	34	45.3%	133	44.9%	607	46.8%	1.04	0.904
	No	429	52.8%	30	50.8%	26	49.1%	41	54.7%	163	55.1%	689	53.2%		
Exposed to bushfire fire	Yes	65	8.0%	4	6.8%	4	7.5%	8	10.7%	30	10.1%	111	8.6%	2.00	0.735
	No	748	92.0%	55	93.2%	49	92.5%	67	89.3%	266	89.9%	1185	91.4%		
Other recent adversity	Yes	155	19.1%	16	27.1%	15	28.3%	32	42.7%	64	21.6%	282	21.8%	25.05	<0.001
	No	658	80.9%	43	72.9%	38	71.7%	43	57.3%	232	78.4%	1014	78.2%		
Financial distress, any time	Yes	300	36.9%	32	54.2%	27	50.9%	37	49.3%	132	44.6%	528	40.7%	15.82	0.003
	No	513	63.1%	27	45.8%	26	49.1%	38	50.7%	164	55.4%	768	59.3%		
Direct COVID-19 exposure, any time	Yes	20	2.5%	8	13.6%	6	11.3%	9	12.0%	17	5.7%	60	4.6%	34.76	<0.001
	No	793	97.5%	51	86.4%	47	88.7%	66	88.0%	279	94.3%	1236	95.4%		
Work from home, any time	Yes	132	16.2%	17	28.8%	15	28.3%	20	26.7%	46	15.5%	230	17.7%	15.34	0.004
	No	681	83.8%	42	71.2%	38	71.7%	55	73.3%	250	84.5%	1066	82.3%		
High perceived stress, any time	Yes	333	41.0%	30	50.8%	32	60.4%	46	61.3%	126	42.6%	567	43.8%	19.33	0.001
	No	480	59.0%	29	49.2%	21	39.6%	29	38.7%	170	57.4%	729	56.3%		
Low perceived coping, any time	Yes	603	74.2%	45	76.3%	45	84.9%	59	78.7%	195	65.9%	947	73.1%	13.55	0.009
	No	210	25.8%	14	23.7%	8	15.1%	16	21.3%	101	34.1%	349	26.9%		
AUDIT-C Wave 1 (N = 1292)		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	F	p
		1.01	1.14	2.20	1.10	5.30	1.39	3.75	2.19	6.32	2.31	2.61	2.75	679.91	<0.001

TABLE 1 (Continued)

	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	F	p
AUDIT-C Wave 3 (N = 942)	0.98	1.17	3.42	1.88	3.63	2.42	3.87	1.67	6.81	2.40	2.70	2.87	474.66	<0.001		
AUDIT-C Wave 5 (N = 862)	0.96	1.15	3.67	1.64	2.91	2.19	3.60	1.69	6.56	2.34	2.58	2.75	422.77	<0.001		
AUDIT-C Wave 7 (N = 754)	0.95	1.14	4.68	1.13	1.91	1.24	3.61	1.88	6.38	2.31	2.61	2.71	393.45	<0.001		
Health risk tolerance	19.70	9.85	22.90	12.47	25.79	11.88	24.88	12.08	22.70	10.90	21.08	10.61	10.95	<0.001		
Years of education	14.61	1.76	14.78	1.72	14.40	1.83	14.65	1.66	14.36	1.86	14.56	1.78	1.45	0.216		
Work/social impairment	14.78	8.89	15.97	9.20	19.00	9.13	19.20	9.84	16.10	9.90	15.56	9.29	6.51	<0.001		
Depression symptoms (PHQ-9)	4.85	5.62	6.00	5.82	7.42	6.33	7.43	6.75	5.80	6.23	5.37	5.92	6.08	<0.001		
Anxiety symptoms (GAD-7)	4.00	5.05	5.17	5.12	5.45	4.92	5.68	5.28	4.84	5.47	4.40	5.18	3.80	0.004		
Age in years	45.69	17.43	46.61	18.03	40.17	15.89	45.71	14.83	48.03	17.25	46.04	17.26	2.63	0.033		

Note: Bold values represent $p < 0.05$.

Abbreviations: AUDIT-C, alcohol use disorders identification test-consumption; COVID-19, coronavirus disease 2019; GAD-7, generalized anxiety disorder-7; PHQ-9, patient health questionnaire-9.

use and 22% increased odds of elevated alcohol use. Individuals with greater health risk tolerance had higher odds of being in any of the elevated risk groups than in the low-risk alcohol use group, with the exception of increasing use. Males also had higher odds of being in any of the elevated risk groups than in the low-risk alcohol use group, with the exception of decreasing use. Recent adversity was associated with increased odds of fluctuating alcohol use, while low perceived coping and more education were associated with lower odds of consistently elevated alcohol use.

The sensitivity analysis presented in Table 3, restricted to participants who completed all four assessments ($n = 662$), indicated that direct exposure to COVID-19 and higher health risk tolerance were associated with lower odds of being the in low-risk category. In addition, higher work or social impairment was associated with significantly greater odds of fluctuating or decreased alcohol use. Consistent with the original model, males had significantly higher odds of being in any of the elevated risk groups than in the low-risk alcohol use group, with the exception of decreasing use.

DISCUSSION

Alcohol use did not increase overall in a representative adult sample during the early phase of the COVID-19 pandemic and lockdown in Australia. Indeed, there was evidence that alcohol consumption decreased from April to June in this sample. There was a minority of people who had consistently elevated levels of alcohol use (23%), increased their drinking to elevated levels (5%), or had fluctuating levels (6%) across the study period. These rates indicate that consumption of alcohol remains a public health concern during the pandemic. Nonetheless, the majority (63%) had alcohol consumption that was consistently at low-risk levels or decreased their consumption from elevated to low-risk levels (4%) during this period.

Although cross-sectional studies to date have shown mixed findings for changes in drinking during the COVID-19 pandemic, our results contrast with previous longitudinal studies, which have typically shown increases in respondents' alcohol use over time during the pandemic. A US longitudinal study showed an increase in risky drinking in a convenience sample of university students ($N = 1001$) from baseline to post-lockdown of 8.5% to 23.3% (Lechner et al., 2021). Similarly, number of drinking days increased for adults in a US longitudinal representative sample ($N = 4298$), although the increase was primarily seen in males (Nordeck et al., 2022). A UK longitudinal study (Irizar et al., 2021) also showed that AUDIT-C scores increased over time in an adult convenience sample ($N = 539$). Conversely, our data are similar to cross-sectional studies using retrospective baselines, where 16% to 24% of people have reported lower levels of alcohol use post-lockdown (Chodkiewicz et al., 2020; Schmits & Glowacz, 2021). The findings are also consistent with an Australian study of alcohol use in young adults, which found a 17% decrease in alcohol consumption during the pandemic (Clare et al., 2021). It is important to note differences in the samples, settings and measurements

TABLE 2 Multinomial logistic regression on alcohol use category ($n = 1283$)

	Increased to elevated vs. low risk		Decreased to low risk vs. low risk		Fluctuating vs. low risk		Elevated vs. low risk	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Direct exposure to COVID	4.571	1.728, 12.093	2.937	1.016, 8.490	2.835	1.136, 7.079	1.795	0.886, 3.639
Working from home, any time	1.922	1.019, 3.628	2.081	1.070, 4.045	1.616	0.903, 2.892	1.028	0.699, 1.513
Depression symptoms (PHQ-9)	1.040	0.991, 1.091	1.046	0.999, 1.096	1.051	1.010, 1.094	1.034	1.008, 1.061
Health risk tolerance	1.009	0.983, 1.037	1.040	1.012, 1.069	1.025	1.002, 1.049	1.027	1.013, 1.041
Female vs Male	0.266	0.143, 0.494	0.741	0.415, 1.324	0.583	0.354, 0.961	0.540	0.407, 0.715
Current neurological illness	0.578	0.231, 1.446	0.836	0.364, 1.919	0.366	0.148, 0.903	0.614	0.392, 0.962
Recent adversity	1.021	0.519, 2.010	0.994	0.501, 1.971	2.116	1.233, 3.630	0.918	0.640, 1.316
Low perceived coping, any time	1.111	0.580, 2.129	1.535	0.695, 3.386	1.104	0.604, 2.017	0.578	0.425, 0.786
Years of education	1.007	0.854, 1.186	0.886	0.749, 1.050	0.955	0.825, 1.106	0.898	0.830, 0.972

Note: Bold values represent $p < 0.05$.

Abbreviations: CI, confidence interval; COVID, coronavirus disease; OR, odds ratio; PHQ-9, patient health questionnaire-9.

TABLE 3 Sensitivity analysis: Multinomial logistic regression on alcohol use category among completers of all four surveys ($n = 662$)

	Increased to elevated vs. low risk		Decreased to low risk vs. low risk		Fluctuating vs. low risk		Elevated vs. low risk	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Direct exposure to COVID	6.064	1.289, 28.535	4.639	1.101, 19.548	3.908	1.076, 14.195	4.950	1.556, 15.740
Work/social impairment (WSAS)	1.013	0.972, 1.056	1.053	1.014, 1.093	1.057	1.026, 1.089	1.002	0.979, 1.026
Health risk tolerance	1.047	1.010, 1.084	1.046	1.013, 1.081	1.034	1.008, 1.061	1.028	1.007, 1.049
Female vs. Male	0.190	0.079, 0.458	0.631	0.313, 1.272	0.522	0.302, 0.903	0.461	0.304, 0.697
Current physical illness	0.545	0.251, 1.185	1.189	0.592, 2.386	0.645	0.366, 1.137	1.327	0.885, 1.989

Note: Bold values represent $p < 0.05$.

Abbreviations: CI, confidence interval; COVID, coronavirus disease; WSAS, Work and Social Adjustment Scale.

mean direct comparisons are difficult to make, with considerable differences between adolescent, university student and general population adult samples (Evans et al., 2021; Lechner et al., 2021). The situation in Australia may have also been different to other countries where the rates of COVID-19 infection and death were substantially higher. For example, a cross-national comparative longitudinal study found that midlife women in the United Kingdom had higher consumption and stockpiling of alcohol than midlife women in Australia (Miller et al., 2021).

Despite the disparities in patterns of use, evidence is emerging that certain key groups may be likely to increase or decrease their alcohol use during lockdown periods and the COVID-19 pandemic. A novel finding was that people directly exposed to COVID-19 were

significantly more likely to report changes in alcohol consumption over time. Although the proportion of the sample who were exposed to COVID-19 was small in this sample (5%), it is likely that the distress associated with being exposed to COVID-19 early in the pandemic may have precipitated changes in alcohol use. Further investigation in larger samples of people who have been diagnosed with COVID-19 may be required. Consistent with our hypothesis, mental health was also associated with alcohol use, with people reporting higher depression symptoms more likely to report elevated risk consumption. However, in contrast with the hypothesis, people reporting low perceived coping were less likely to have elevated alcohol use. It may have been the case that people with awareness of their limitations during a stressful time such as a pandemic may be

less inclined to engage in alcohol use, although further exploration of this finding is needed.

The social disruptions of the pandemic may have had variable effects on alcohol consumption. Specifically, we found that working from home was associated with increased odds of changes in alcohol use. Working from home may have been an inducement to use more alcohol for some people and a protective factor for others, suggesting that the observed changes in drinking are likely to be context-dependent with considerable individual differences. This effect was not maintained in the sensitivity analysis, where instead greater levels of COVID-related work and social impairment were associated with higher odds of reduced consumption. It may be the case that social drinking was more common before lockdowns, with some participants reducing their drinking due to lower exposure to social interactions and social drinking, such as dining out or meeting friends for drinks (Halim et al., 2012). This may present an opportunity to promote healthier levels of alcohol consumption as in-person social interaction increases, although consideration of the variable contexts in which alcohol use occurs is likely to be important. However, it is also of note that alcohol use appeared to decrease from April to May and June, a period in which public health restrictions were reduced in many parts of Australia. This finding may have public health implications for the easing of public health measures, and warrants investigation in other countries.

There were also specific target groups identified in this study that were more likely to be consuming alcohol at elevated risk levels during the pandemic. In particular, men had significantly greater odds of elevated risk. Similar to a UK longitudinal survey, male gender and lower education predicted higher alcohol use (Irizar et al., 2021). This finding is also consistent with existing evidence suggesting men consume greater quantities of alcohol and report more alcohol-related problems than women (Peng et al., 2012). Furthermore, it reflects findings in the COVID-19 pandemic suggesting specific increases in alcohol consumption related to lockdown among males (Irizar et al., 2021). This finding may have been influenced by the use of a single cut point for AUDIT-C, with some studies using higher cut points when classifying alcohol use in men compared to women (e.g., Jiang et al., 2015), based on evidence that women may be more sensitive to the effects of alcohol than men (Nolen-Hoeksema & Hilt, 2006). However, the cut point we used is the most established and alcohol use guidelines are tending to move away from gendered recommendations for alcohol consumption (e.g., National Health and Medical Research Council et al., 2020). People with lower levels of education were also more likely to use alcohol at elevated levels, a trend reflected in the broader literature (Murakami & Hashimoto, 2019) and within the pandemic (Irizar et al., 2021). These trends are concerning given the widespread health impacts associated with alcohol use (Rehm et al., 2009) and evidence that men and those with less education tend to report higher levels of alcohol-related problems (Peng et al., 2012). As such, vulnerable groups may require additional supports or targeted health promotion messaging.

A lower level of tolerance for health risks was significantly associated with greater odds of low-risk alcohol use. This finding was

consistent with a previous study that reported a positive association between health risk tolerance and alcohol use (Shou & Olney, 2021). It was suggested that such a link could be primarily driven by a greater trade-off between perceived recreational gain (e.g., sensory rewards) and perceived harm on health from alcohol use (Shou & Olney, 2021).

This study is one of very few to longitudinally assess alcohol use in the context of the COVID-19 pandemic in a nationally representative sample. However, there are some limitations to the findings. We used the AUDIT-C rather than the full AUDIT measure, so the findings are indicative of alcohol consumption rather than alcohol harms. The AUDIT-C was only collected at four of the seven assessment points, so variability in scores over time was insufficient for more complex models of change in alcohol use, such as growth curve models. Fluctuating patterns of alcohol use over time and heterogeneous drinking behaviors (e.g., high frequency vs. high quantity) may not have been sufficiently characterized by our method. Furthermore, no assessment of alcohol use was conducted before the pandemic, with the initial assessment conducted at the commencement of public health protections. Although wave-on-wave attrition was relatively low, just more than half of the participants completed all four waves. Although we addressed this issue with a sensitivity analysis, it is possible that systematic differences associated with attrition may have influenced the observed relationships. Specifically, greater attrition was seen among people with lower initial levels of alcohol use, younger people, people not working from home, and people with greater work/social impairment, no neurological condition, or high perceived coping. Although the AUDIT-C has been widely validated and responses were anonymous to the researchers, the possibility of misreporting alcohol use remains. Nevertheless, assessment of alcohol use in this study was more rigorous than using a single item to ask retrospectively about change in alcohol use, an approach adopted by many other related studies. We did not measure other factors that may influence alcohol use, such as medication use, and some of the variables used in the model (e.g., coping, stress, financial distress) did not come from validated scales. A theory-driven approach to model changes in alcohol consumption in the pandemic context may be useful for moving the field forward.

In conclusion, although alcohol use during the pandemic did not appear to increase overall, our findings highlight that alcohol use remained high and identify a number of factors that may be associated with alcohol consumption at elevated risk levels. People experiencing mental health symptoms and those with greater opportunity for social drinking may be key targets for public health measures aimed at reducing harmful drinking. Other potential targets for public mental health messaging include men, people who have been directly exposed to COVID-19 and those with higher levels of health risk tolerance. In the short-term, despite increase in sales of home delivery of alcohol (Colbert et al., 2020), reduced opportunities for social drinking may have reduced alcohol consumption, presenting a potential innovative opportunity to maintain healthier levels of alcohol use. Further investigation of how COVID-19 exposure and infection influences alcohol use is warranted. Future work would also benefit

from characterizing and effectively targeting specific groups with elevated alcohol use during the pandemic, ensuring interventions address the underlying factors driving uncertainty and distress.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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