

Ageing and Alcohol: Drinking Typologies among Older Adults

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Abstract

Objectives: Alcohol consumption and harms among older people are increasing. We examined different demographic characteristics and drinking patterns among an older population. **Methods:** Secondary analyses of nationally representative Australian data; subjects aged 50+ years ($N = 10,856$). Two-step cluster analysis was performed to identify demographic groups and alcohol consumption behaviours. **Results:** Three groups were identified: Group 1 (older, unmarried, and lived alone): >65 years, moderate drinkers, poorest health, psychological distress, social disadvantage, smokers, illicit drug users, and more frequent previous alcohol treatment. Group 3 (older married): >65 years, good health, low psychological distress, less likely to drink at risky levels, and one in five drank daily. Group 2 (younger married): 50–64 years, mostly employed, highest proportion of risky drinkers and of 5+ standard drinks per session, and liberal drinking attitudes with most concern from others about their drinking. **Discussion:** These demographic typologies can inform targeted prevention efforts for an estimated 1.3 million adults older than 50 years drinking at risky levels.

Keywords

alcohol consumption, harm reduction, Australians, older adults, cluster analysis

Introduction

Alcohol is a leading contributor to the global burden of disease (Centers for Disease Control and Prevention, 2016; Griswold et al., 2018). While alcohol consumption over the life course has generally decreased with age (Holton et al., 2019), contemporary evidence indicates that older adults are drinking more than previous generations (Breslow et al., 2017; Han et al., 2017; Han et al., 2019; Kim et al., 2012; Rao & Roche, 2017; Roche & Kostadinov, 2019; World Health Organization, 2014), with associated increases in alcohol use disorders among older adults (Grant et al., 2017; Han et al., 2019; Slade et al., 2016). The proportion of older adults drinking alcohol at risky levels has increased significantly in Australia (Roche & Kostadinov, 2019) and overseas (Han et al., 2017). In contrast, younger people are drinking at less risky levels than previously (Pape et al., 2018). To date, however, little is known about specific differences in patterns of alcohol use among the older age groups, despite recognition of the diversity among older people (Wilkinson, 2018).

Alcohol consumption can cause greater harm among older than younger adults. Contributory factors include slower metabolism of alcohol (Meier & Seitz, 2008), decreased water-to-body weight ratio (Cederbaum, 2012), increases in

contraindicated medications (Han & Moore, 2018), and increases in falls and injuries (Lehmann & Fingerhood, 2018). With greater longevity and increases in the overall proportion of older age groups, the majority of alcohol-related deaths will occur in older adults (Rehm et al., 2009; Rehm & Poznyak, 2015).

Typically, drinking patterns are established early in life (Merline et al., 2008) and usually fluctuate and ultimately decrease over the life course. However, potential drivers of change that can alter the trajectory of typical alcohol consumption patterns include changes in physical health (Han et al., 2017); mental health, including loneliness and social isolation (Canham et al., 2016); economic and social status (Kalousova & Burgard, 2014); and alcohol-related policies (Anderson et al., 2009). These factors have particular salience in relation to older people.

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General population consumption patterns may not be appropriate indicators for potential harm among older people (Lehmann & Fingerhood, 2018; Rehm et al., 2009; Rehm & Poznyak, 2015). In addition, there is likely to be wide variation in the patterns of alcohol use among older adults suggesting that blunt universal prevention messages to just drink less may have limited utility. Effective interventions that are specifically designed and tailored for older age groups are required to avert the emergence or continuation of potentially harmful patterns of use (Kelly et al., 2018).

Identifying drinking typologies among older adults may inform the development of proactive, targeted age-appropriate policies and interventions to promote healthy ageing (Fried, 2016) and support healthy decision-making regarding drinking. Cluster analysis can be used in the identification of typologies (Han et al., 2012), has been used to identify lifestyle clusters on the basis of health behaviours in older people (Griffin et al., 2014), and allows consideration of multiple, often co-occurring variables relevant to alcohol consumption. The current study, therefore, aimed to identify demographic and health-related cluster groups within a large, nationally representative, cross-sectional sample of older Australians and explore associations between group membership and a range of alcohol-related characteristics.

Methods

Data Source

A secondary analysis was undertaken using data from the 2016 National Drug Strategy Household Survey (NDSHS). The NDSHS uses a multistage stratified random sample design to collect data on alcohol and other drug use and attitudes and is conducted triennially. The survey cooperation and response rates in 2016 were 51.1% and 34.7%, respectively. Detailed survey methodology has been published elsewhere (AIHW, 2017).

The prevalence of alcohol consumption by Australian adults aged 50–59 years is high (Australian Institute of Health and Welfare, 2017), and despite recent declines in self-report of social drinking in the population, this trend has not been observed in adults older than 50 (Callinan et al., 2017). Such findings highlight the need to investigate the broad spectrum of older adults. Alcohol-related survey data typically do not specifically focus on older age groups to account for likely differences in physiology, metabolism, and medication intake (Cederbaum, 2012; Griswold et al., 2018; Han & Moore, 2018). Definitions of “older age” are not standardised: for example, terms such as “elderly” are often used to refer to a person older than 65 years (Orimo et al., 2006) but are inconsistently applied (Singh & Bajorek, 2014). Studies addressing the effects of alcohol on people as they age increasingly use 50 years of age as the lower cut-off point (e.g., Clausen et al., 2016; Roche & Kostadinov, 2019), allowing for comparison of age groups such as those aged 50–64 years

with those aged 65 and older. Consistent with a purposefully broad definition of older age (Chapman et al., 2020), we included all respondents aged 50+ years in the 2016 NDSHS ($N = 11,886$) for this study.

Measures

Demographic and health-related variables. Twelve demographic and health-related categorical variables were entered into the cluster analysis: sex, age, marital status, education level, employment status (in the workforce (i.e., any current labour force participation)/not in the workforce (including retired, on a pension, or looking for work)), number of people in household, and socioeconomic status (Index of Relative Socioeconomic Advantage and Disadvantage; ABS, 2018) (as in Table 1). Health-related variables were current smoking status, illicit drug use in the last 12 months, physical health condition diagnosed and/or treated in the last 12 months, and self-reported general health. Psychological distress was measured using the Kessler Psychological Distress Scale (Kessler et al., 2002) as low (10–15), moderate (16–21), or high/very high (22–50) (ABS, 2012).

Alcohol-related variables. Risky drinking was defined as an average daily consumption of >2 standard drinks (long-term risky drinking) or a single-occasion consumption of >4 standard drinks at least monthly (short-term risky drinking), based on Australian guidelines (National Health and Medical Research Council, 2009). A “standard drink” in Australia contains 10 g of alcohol. Two questions were used to indicate support of alcohol use and related policy. Personal approval or disapproval of regular alcohol use by an adult (single item “For each of the drugs listed below [Alcohol], do you personally approve or disapprove of their regular use by an adult?”) was measured on a 5-point scale and collapsed to approve/strongly approve, neither approve nor disapprove, and disapprove/strongly disapprove. Extent of personal support or opposition of increasing alcohol price to reduce problems associated with excessive alcohol use (...to reduce the problems associated with excessive alcohol use, to what extent would you support or oppose...? [Increasing the price of alcohol]) was measured on a 5-point scale and collapsed to support/strongly support, neither support nor oppose, and oppose/strongly oppose.

Additional variables, used in subsequent analyses only for respondents who had consumed alcohol in the past 12 months, included daily alcohol consumption based on standard quantity–frequency measures. Subjects’ daily drinking status was classified as not daily, low-risk, moderate, or heavy drinker. Drinking categories were based on average daily and occasional consumption thresholds in Australian guidelines (National Health and Medical Research Council, 2009): low-risk (no more than two drinks daily on average) to reduce lifetime risk of alcohol-related harm in an average day of drinking; moderate drinking (3–4 daily standard drinks on

Table 1. Importance and Distribution of Categorical Variables (%) Included in Cluster Solution. Data Source: 2016 National Drug Strategy Household Survey.

	Group 1: "Older, Unmarried, and Lived Alone"	Group 2: "Younger and Married"	Group 3: "Older and Married"
	<i>n</i> = 3963 (36.5%)	<i>n</i> = 3865 (35.6%)	<i>n</i> = 3028 (27.9%)
Demographic variables			
Sex (.20)			
Male	37.3	47.7	57.5
Female	62.7	52.3	42.5
Age, years (1.00)			
50–64	43.8	95.8	.6
65+	56.2	4.2	99.4
Marital status (1.00)			
Not married/de facto	98.9	3.1	.0
Married/de facto	1.1	96.9	100.0
Education level (.17)			
High school or less	46.1	32.1	46.3
Certificate/diploma	34.9	38.1	35.1
Bachelor's degree or higher	19.0	29.8	18.6
Employment status (1.00)			
Not in the workforce	69.6	28.7	87.9
In the workforce	30.4	71.3	12.1
Number of people in household (1.00)			
1 (lives alone)	74.3	.7	.0
2	18.5	52.6	83.7
3+	7.2	46.7	16.3
IRSAD (.24)			
1 (lowest quintile)	27.5	14.3	20.9
2	23.4	19.2	21.4
3	17.9	19.7	19.0
4	18.5	21.2	17.2
5 (highest quintile)	12.8	25.5	21.5
Health-related variables			
Smoking status (.17)			
Current smoker	18.2	12.0	6.0
Not a current smoker	81.8	88.0	94.0
Illicit drug use ^a (.12)			
Yes	7.6	5.8	.8
No	92.4	94.2	99.2
Physical health condition ^b (.49)			
Yes	67.3	43.9	72.1
No	32.7	56.1	27.9
General health (.31)			
Excellent/very good	37.4	58.1	42.0
Good	38.5	31.7	38.6
Fair/poor	24.0	10.2	19.4
Psychological distress (.15)			
Low	69.2	76.2	82.5
Moderate	18.4	16.6	13.3
High/very high	12.5	7.2	4.2

Note. Variable values in parentheses describe the importance of the variable in overall cluster formation; range .0–1.0, with higher values indicating greater importance. IRSAD = index of relative socio-economic advantage and disadvantage, with higher quintiles indicating higher relative socioeconomic status.

^aIllicit drug use = non-medical use of any one of steroids, meth/amphetamine or amphetamines, cannabis, heroin, methadone, cocaine, hallucinogens, ecstasy, inhalants, ketamine, GHB, any non-prescribed injected drugs, synthetic cannabis, or novel psychoactives in the last 12 months.

^bPhysical health condition = any of diabetes, heart disease, hypertension, low iron, asthma, cancer, chronic pain, or "other" illness including sexually transmitted infections and hepatitis B/C diagnosed and/or treated in the last 12 months.

average) to reduce single-occasion risk, and; heavy drinking (5+ daily standard drinks on average) exceeds the single-occasion risk guideline. Concern from others about drinking (“*Has a relative, friend, doctor or other health care worker been concerned about your drinking or suggested you cut down?*”) was categorised as ‘no’ or ‘yes, but not in last 12 months’, or ‘yes, in last 12 months’. Attempts to reduce alcohol consumption in past 12 months were measured using three separate items: “*Have you...reduced the amount of alcohol you drink at any one time?*”, “*reduced the number of times you drink?*”, and “*switched to drinking more low-alcoholic drinks than you used to?*”. Lifetime participation in an alcohol or drug treatment program (excluding “medications to help quit smoking”) was recorded as yes or no. The use of personal harm reduction strategies when drinking alcohol were measured on a 5-point scale (always/most of the time/sometimes/rarely/never) for seven items (e.g., “*count the number of drinks you have?*”). Subjects who used at least one strategy were classified as positive, with a single dichotomous summary variable for analysis: yes (always/most of the time on at least one of the seven items) versus no.

Analyses

All analyses were conducted in IBM SPSS Statistics version 25. A TwoStep cluster analysis procedure was used with the demographic and health-related variables, which involved (1) the formation of preclustered cases, based on a log-likelihood distance measure and the cluster feature tree algorithm, and (2) agglomerative hierarchical clustering to merge preclusters (IBM, 2017). Associations between alcohol-related variables and the distinct demographic/lifestyle groups were subsequently examined. This approach offers superior statistical power compared to using an individual predictor variable approach (McLernon et al., 2012).

Cases were randomly ordered to minimise order effects in clustering, and Schwarz’s Bayesian information criterion (BIC) was used as the model fit index to inform the optimum number of clusters in the automatic selection procedure. Unweighted data were used in the cluster analysis procedure (Conry et al., 2011). The TwoStep cluster analysis procedure uses list-wise deletion of missing data. Complete case data were available on the 12 demographic and health-related input variables from $N = 10,856$ respondents ($n = 1030$ missing cases from the total $N = 11,886$ survey sample aged 50+).

The cluster structure was validated using the Tkaczynski (2017) procedure. Firstly, the BIC and silhouette measure of cluster cohesion and separation were assessed for overall goodness of fit. A silhouette measure coefficient $>.0$ indicates within- and between-cluster distance validity (Norusis, 2011). Bonferroni-corrected chi-squared tests (Rebar et al., 2014) were used to confirm that groups differed significantly across each input variable and to confirm validity in the final model. The input importance index was used to confirm

the predictive importance of each input variable in the model, with values $>.02$ considered acceptable for inclusion (Tkaczynski, 2017). Similarity of the cluster model in each of two random half samples was compared to assess the stability of the model. The within-cluster importance and distribution of categorical levels for each input variable were used to aid in the interpretation of each group. Labels were applied to each group to describe the overall characteristics of each group and were largely based on those input variables with an importance index of 1 (range = $.0-1.00$), that is, having the highest discrimination between groups.

Chi-squared tests were used to assess the association between group membership and each of the alcohol-related variables. The complex survey procedure was used to account for the complex survey design, and inverse probability of sampling weights was used to enable results to be nationally representative. In all weighted analyses, the sampling variability was assessed, and the data were considered sufficiently reliable (relative SE $< 25\%$; AIHW, 2017). A two-sided type 1 error rate of $\alpha = .05$ was used for significance testing.

Results

Respondents

Of the total respondents in the weighted sample with complete case data available for cluster analysis ($N = 10,856$), 48.4% were male, 55% were aged 50–64 years (45.0% aged 65+ years), 17.6% reported average daily long-term risky drinking, 17.7% reported single-occasion risky drinking (1 month), and 20.9% reported abstaining from alcohol for at least 12 months.

Cluster Analysis

The cluster analysis produced a three-cluster model containing all 10,856 respondents. The model had a high log-likelihood distance measure ratio (1.71), which was lower than for a two-cluster model but higher than for other cluster models. The average silhouette coefficient for the three-cluster model of $.2$ indicated that the three groups had a separation distance acceptable for subsequent analyses ($>.2$; Tkaczynski, 2017).

Two- and four-cluster solutions did not improve overall goodness of fit, as indicated by the silhouette measure. A four-cluster model had a lower BIC (165,960.71); however, the three-cluster model (BIC = 172,403.54) was considered most suitable on the basis of both parsimony and interpretability.

The three groups differed significantly across each input variable ($p < .001$), and each input variable contributed to acceptable predictive importance in the formation of the three-cluster solution (range $.12-1.00$). In each of two random half samples, a three-cluster model was also automatically selected and was similar in cluster characteristics, silhouette measure of cohesion and separation, and predictor importance. Therefore, the three-cluster model was used in

Table 2. Distribution of Alcohol-Related Categorical Variables (%) for All Respondents, by Group Membership. Data Source: 2016 National Drug Strategy Household Survey.

	Group 1: "Older, Unmarried, and Lived alone" (25.1%)	Group 2: "Younger and Married" (45.2%)	Group 3: "Older and Married" (29.6%)	<i>p</i> value ^a
Long-term risky drinking ^b				<.001
Abstainer	26.5	15.9	23.9	
Low risk	58.4	63.6	61.0	
High risk	15.1	20.5	15.1	
Short-term risky drinking ^c				<.001
Abstainer	26.6	15.9	23.9	
Low risk	58.6	60.6	65.0	
High risk	14.9	23.5	11.1	
Approval of alcohol use				<.001
Disapprove/strongly disapprove	30.5	20.1	27.4	
Neither approve nor disapprove	37.2	34.3	37.5	
Approve/strongly approve	32.3	45.6	35.2	
Support for raising price of alcohol				<.001
Oppose/strongly oppose	33.6	40.4	30.2	
Neither support nor oppose	30.7	29.2	32.4	
Support/strongly support	35.8	30.4	37.4	

Note. All proportions weighted to be representative of total Australian population.

^aUsing chi-squared tests for each analysis.

^bLong-term risky drinking = average daily consumption of >2 standard drinks.

^cShort-term risky drinking = single-occasion consumption of >4 standard drinks, at least monthly.

subsequent analyses. Model fit indices for automatic selection in the full sample and random half samples are presented in [Supplementary Table 1](#).

The first, second, and third groups contained 3963 (36.5%), 3865 (35.6%), and 3028 (27.9%) respondents, respectively. Employment status, marital status, the number of people in household, and age had the highest relative importance for distinguishing between groups (importance for inclusion = 1.0 each) ([Table 1](#)).

Group 1 (older, unmarried, and lived alone) comprised respondents who were typically older than 65 years, unmarried, not employed, and living alone. They were more likely to be socioeconomically disadvantaged, in poor physical and mental health, to smoke, and use illicit drugs. Those in Group 2 (younger and married) were younger, married, and living with one person or more. They were typically employed and had the highest levels of education and socioeconomic advantage and were generally in good health but contained more smokers and were more psychologically distressed than Group 3. Group 3 (older and married) comprised slightly more males who were generally older (>65 years) not employed, married, and living with one other person. This group had the lowest proportion of smokers and illicit drug users. While many of this group had a physical

health problem, they also recorded low levels of psychological distress.

Group Associations with Alcohol-Related Variables

Long-term and short-term risky drinking differed significantly across groups (each $p < .001$) ([Table 2](#)). Respondents in Group 2 (younger and married) were more likely to engage in high-risk alcohol in both the long-term (20.5%) and on a single occasion (23.5%) than respondents in the other two clusters. A higher proportion of those in Group 1 (older, unmarried, and lived alone) engaged in short-term risky drinking (14.9%) than those in Group 3 (older and married; 11.1%).

Support for alcohol-related policy strategies differed significantly across groups ($p < .001$ for each); Group 2 were more likely to approve of regular alcohol use (45.6%, compared to 32.3% in Group 1 and 35.2% in Group 3) and were less likely to support increasing the price of alcohol (30.4%, compared to 35.8% and 37.4% in Groups 1 and 3, respectively).

Respondents in Group 3 were more likely to consume alcohol on a daily basis ([Table 3](#)). A higher proportion of those in Group 3 (8.4%) drank on a daily basis of ≤ 2 drinks

Table 3. Distribution of Alcohol-Related Behaviours (%) for Respondents Drinking Alcohol, by Group Membership. Data source: 2016 National Drug Strategy Household Survey.

	Group 1: "Older, Unmarried, and Lived Alone" (23.5%)	Group 2: "Younger and Married" (48.0%)	Group 3: "Older and Married" (28.6%)	<i>p</i> value ^a
Daily drinking status				<.001
Not a daily drinker	87.1	89.4	82.6	
Low-risk (≤2 daily drinks)	5.6	3.1	8.4	
Moderate (3–4 daily drinks)	3.2	3.1	5.2	
Heavy drinker (5+ daily drinks)	4.2	4.4	3.8	
Concern from others ^b				<.001
No	89.6	88.4	92.2	
Yes, but not in last 12 months	5.3	4.4	3.5	
Yes, in last 12 months	5.0	7.2	4.4	
Attempt to reduce alcohol consumption in past 12 months				.85
No	57.3	58.1	58.1	
Yes	42.7	41.9	41.9	
Use of personal harm reduction strategy ^c				.005
No	6.8	6.3	4.3	
Yes	93.2	93.7	95.7	
Participation in treatment program ^d				<.001
No	90.2	92.9	96.2	
Yes	9.8	7.1	3.8	

Note. All proportions weighted to be representative of the total Australian population.

^aUsing chi-squared tests for each analysis.

^bConcern from others = relative, friend, doctor, or other healthcare worker concerned about respondent's drinking, or suggested they cut down.

^cUse of personal harm reduction strategy = use of at least one strategy (any of seven items) when drinking alcohol, "most of the time" or "always".

^dParticipation in treatment program = any of telephone support, online support, information and education, peer group/therapeutic community, withdrawal management/residential rehabilitation, or counselling to help reduce or quit alcohol or drug consumption in lifetime.

compared to those in Group 1 (5.6%) and Group 2 (3.1%). However, Group 3 were less likely to report concern from others about their drinking or to have been advised to cut down (92.2% "no", compared to 89.6 and 88.4% in Groups 1 and 2, respectively; $p < .001$). Group 2, which contained the highest proportion of risky drinkers, also reported the highest level of concern from others about their drinking.

Attempts to reduce alcohol consumption in the past 12 months were consistently high across the three groups (42.0% for all respondents), with no significant differences between groups ($p = .85$). Use of personal alcohol harm reduction strategies was reported by over 90% of participants in each group and was significantly greater among Group 3 ($p = .005$). Group 3 were more likely to use alcohol harm reduction strategies (95.7%), compared to those in Groups 1 and 2 (93.2% and 93.7%, respectively), but less likely to report lifetime participation in a treatment program (3.8%), compared to Groups 1 and 2 (9.8% and 7.1%, respectively; $p < .001$).

The findings overall were synthesised to create three typologies of older age drinkers. The typologies are summarised in Table 4.

Discussion

Changing drinking patterns among older people have created an imperative for an improved understanding of the different demographic patterns and social contexts that can pro-actively inform appropriately targeted prevention responses. This study looked for possible relationships between well-defined demographic characteristics and identified three distinct groups among those over 50 years of age, defined by demographic and health characteristics. These findings are the first to establish which demographically defined clusters are associated with different drinking patterns among older adults, providing information that can inform future interventions and preventive strategies. Taking this approach allows for an a priori consideration of which demographic groups may be at greater risk of experiencing alcohol-related harms, and thereby implementing matched or tailored prevention strategies.

Three Typologies of Older Drinkers

Among the three groups identified, individuals in their 50s and early 60s formed one group (younger and married). They were more likely than those older than 65 years to consume

Table 4. Drinking Typologies among Older Adults.

	Group 1: “Older, Unmarried, and Lived Alone” Moderately Risky Drinkers	Group 2: “Younger and Married” Riskiest Drinkers	Group 3: “Older and Married” Moderate Daily Drinkers
Description	A group that comprises typically unmarried, >65 years, not currently in the workforce, and living alone, of whom 14.9% drank at short-term risky levels; most likely (9.8%) to have received past treatment for alcohol. This group is at risk for mental health problems (potentially reflecting isolation, bereavement, and lack of social support; 74.3% live alone, and 62.7% female), and hence, use of alcohol in this vulnerable group warrants close attention	A typically younger (50–64 years), married, and largely employed group with higher levels of education, socioeconomic advantage, and general health, with highest levels of risky short- (23.5%) and long-term (20.5%) alcohol use and more liberal attitudes to alcohol use. Drinking behaviours may reflect long-term, pro-social patterns of use	An older, married group that is not currently in the workforce, with higher levels of physical health problems, and daily alcohol consumption, but who were also more likely to have used a personal harm reduction strategy and less likely to have used a treatment program for alcohol. Daily drinking, while not inherently problematic, represents particular risks that require attention
Treatment, intervention, and policy implications	Specific secondary and tertiary prevention. Need to raise awareness of harm reduction strategies	Need to raise awareness of harm reduction strategies. Primary and secondary prevention to target higher rates of risky drinking. As 71.3% of the group are currently in the workforce, health promotion delivered in workplace settings may be effective in reducing the risks of alcohol-related harms (Martineau et al., 2013; Pidd et al., 2018)	Specific secondary and tertiary prevention

Note. The terms primary, secondary, and tertiary prevention, respectively, refer to interventions designed to prevent the onset of illness/injury, to diagnose/treat early to avert more severe problems developing, and to facilitate rehabilitation/recovery. For example, intervention at the primary prevention level could involve community education in regard to practicing a preventive behaviour, such as minimising alcohol consumption or avoiding it where indicated to offer protection from short-term or long-term harm (Young et al., 2018). Secondary prevention could involve training local healthcare workers to screen for alcohol use to ensure early detection and intervention (Draper et al., 2015). The tertiary level could involve relapse prevention strategies and/or associated mental health supports to help recovery from significant illness or disability (Bhatia et al., 2015).

higher quantities of alcohol and drink at risky levels but less frequently. They were the riskiest group of drinkers in terms of both short- and long-term risk, the group most likely to consume 5+ standard drinks in a session, and they held the most liberal attitudes towards drinking and generated most concern from others about their drinking. The riskier drinking patterns and more liberal drinking norms among the 50- to 64-year-olds, sometimes referred to as “baby boomers”, may be enduring drinking behaviours carried forward from younger years (Holdsworth et al., 2017). It is of concern that such established drinking patterns may continue into older age (i.e., beyond 65 years) among this cohort, given their increased susceptibility to alcohol-related harm, and hence sound preventive advice from healthcare professionals is warranted.

Those older than 65 years largely fell into one of two groups. The first group, “older, unmarried, and lived alone”, had poorest health, highest levels of psychological distress, the most smokers and illicit drug users, and the highest proportion of socially disadvantaged. While this group generally comprised moderate and less frequent drinkers, they were also most likely to have previously received treatment for alcohol

problems; some may fall into what has been described as a “sick quitter” population. The other group also older than 65 years (“older and married”) were in good health with the lowest levels of psychological distress. They were less likely to consume alcohol at risky levels and to have received treatment for alcohol problems, and although they were most likely to use harm reduction strategies, nearly one-in-five drank daily. Daily drinking is considered a flag for potential harm (Hartz et al., 2018; Mäkelä & Montonen, 2018), and long-term risky drinking is a cardiometabolic risk factor for older adults (Ng Fat et al., 2020).

The three typologies identified in this study have highlighted important demographic differences among older adults, their drinking patterns, and the implications for appropriately targeted interventions. They provide a basis for a closer examination of these patterns and their underlying drivers. For example, the emergence of riskier alcohol consumption among those aged 50–64 years may reflect generally better health, ongoing employment, and less use of medications that contraindicate alcohol use (Cederbaum, 2012; Han & Moore, 2018). Conversely, adults aged 65 years and over may have more

time available to drink more frequently and may live in settings where socialising is accompanied or facilitated by use of alcohol (Gauthier & Smeeding, 2003).

Gender Differences

While typologies were based on seven demographic variables, sex was relatively unimportant (.20) compared to other variables; no group comprised predominantly males or females. Nonetheless, longitudinal clustering research identifies gender-based patterns of consumption (Hsu et al., 2013) with men more likely to drink alcohol, consume more, and be less knowledgeable of low-risk drinking levels; gender convergence trends notwithstanding (Keyes et al., 2011; Slade et al., 2016). Gender differences in alcohol consumption by older populations have been widely reported (Bareham et al., 2019; Holdsworth et al., 2017; Towers et al., 2017). Differences may vary between younger and older age groups, possibly reflecting women's more tenuous social status and other predictive macro-social factors (such as more tenuous housing and less retirement income) (Chapman et al., 2020; Keyes et al., 2010; Seedat et al., 2009). Harmful drinking among older women continues to require attention, given elevated detrimental health consequences (Hanna et al., 1997; Nolen-Hoeksema, 2004), increased propensity to develop alcohol-related chronic disease at lower levels of consumption (Kirpich et al., 2017; Szabo, 2018), higher rates of alcohol-related deaths (White et al., 2020), and likelihood of underdiagnosed/undertreated conditions.

Implications for Prevention and Intervention

Across all three groups, substantial proportions of older adults had attempted to reduce their alcohol consumption in the past 12 months, with use of harm reduction strategies common, consistent with wider societal trends towards more cautious approaches to alcohol (Vashishtha et al., 2019). However, use of harm reduction strategies was notably lower among the group with the highest levels of risky drinking (younger and married), flagging not just the need for greater awareness of harms but also for more sophisticated behaviour change strategies. In relation to further work to motivate and support older people to adopt harm reduction strategies, targeting social norms and overcoming barriers such as embarrassment and stigma are likely to facilitate conversations with health professionals and peers around drinking behaviours (Wilkinson, 2018).

Emerging models of care that focus more strongly on screening, early assessment, and brief intervention specifically for the alcohol-related harms experienced by older people have considerable merit (Butt et al., 2020; Rao, 2019). Population reductions in hazardous drinking are likely to result in improvements in liver function and blood pressure in older adults and confer a reduced risk of stroke with lasting

gains in health and wellbeing further accrued through earlier intervention (Ng Fat et al., 2020).

The characteristics of each demographic group identified in the current study can also inform targeted, as well as universal, intervention approaches. While across the three groups there had been recent attempts to reduce alcohol consumption, this had only occurred in about half of any group; hence, universal strategies and interventions targeting all groups are also warranted. Those older than 65 years in Groups 1 and 3 are potential candidates for specific secondary and tertiary interventions. In particular, those older than 65 years in Group 1, where substantial levels of mental health vulnerability and social disadvantage were noted, are especially flagged for targeted support, given the disproportionate impact of alcohol on such population groups (Roche et al., 2015). Conversely, those older than 65 years in Group 3 were more likely to drink for pro-social reasons, requiring harm reduction approaches that promote the benefits of social interaction, while mitigating risky consumption in these settings.

Those in Group 2 (younger and married) may be appropriate candidates for primary and secondary prevention interventions, respectively designed to prevent the onset of illness/injury and to diagnose/treat early or avert more severe problems developing. As approximately 70% of the group younger than 65 years were employed, untapped opportunities exist for targeted workplace interventions, designed specifically for older adults and those approaching the major lifestyle transition phase of retirement. Workplace alcohol interventions addressing cultural norms as well as personal drivers associated with risky drinking have demonstrated success (Pidd et al., 2018).

Wider Scale Public Health Implications

At a population level, the proportions of older adults drinking at risky levels are substantial. For example, short-term risky drinking was significantly different between groups and highest in Group 2 (23.5%, vs. 14.9% in Group 1 and 11.1% in Group 3). In absolute terms, weighted population estimates of older Australian risky drinkers represented 768,758 individuals in Group 2 (95% CI 710,658–826,858), 265,230 in Group 1 (95% CI 238,745–291,715), and 234,016 in Group 3 (95% CI 206,857–261,175). Similar numbers of older Australians drink at long-term risk levels, with the highest proportion (20.5%) in Group 2 (population estimate $n = 671,985$, 95% CI 619,309–724,662), with fewer (15.1%) in Group 1 (268,764, 95% CI 242,085–295,442) and Group 3 (319,139, 95% CI 286,511–351,767). Taken together, that is a population total of 1.3 million adults older than 50 years who are drinking at risky levels ($N = 1,268,004$ at short-term risk; $N = 1,259,888$ at long-term risk) and who could potentially be targeted according to their group characteristics in public health approaches.

Previous Work Informed by Cluster Analyses

The present findings are consistent with but substantially extend earlier studies that identified two distinct drinking cultures among the general population: one in which individuals drank frequently but in small quantities and another in which individuals drank large quantities but relatively infrequently (Bloomfield et al., 2003). The typologies identified may inform appropriate segmentation in public health approaches such as age-appropriate resources to encourage low-risk drinking, in addition to tailored screening tools in clinical practice (Chapman et al., 2020; Towers et al., 2019). Segmentation approaches are widely used in health promotion and marketing strategies. Subpopulations identified in previous cluster analyses have informed interventions across a range of health behaviours, including tailored education for cardiovascular disease (Vosbergen et al., 2015) and mental health (Chen et al., 2019). The efficacy of public health intervention approaches may also differ across population subgroups identified in cluster analyses, which has been demonstrated in evaluation of adolescent alcohol education programs (Dietrich et al., 2015).

Limitations

Although this study employed a large nationally representative sample, it may nonetheless have underrepresented age groups of interest. For example, insufficient data were available to consider older age groups (e.g., 85+ years), who may face unique alcohol-related challenges. It is also possible that recall bias, where participants systematically do not remember events or experiences accurately, may be stronger in older age groups than that among other survey respondents. However, recall bias in relation to alcohol tends to underestimate the level of use (Stockwell et al., 2004); hence, findings can be considered reliable if conservative. The variables of interest were constrained by relevant items available in the NDSHS database. Future studies may benefit from broadening the range of salient variables, and thereby add depth to the typologies identified here.

The present study applied the current Australian NHMRC guidelines for low-risk drinking in both short and long terms. Questions arise about their suitability for older age groups. Currently, there are no international standards that address the appropriateness of applying the same risk levels across all age groups in the population. There is substantial criticism of the lack of age-differentiated alcohol risk levels (Rao, 2019), and this is flagged as a priority issue for future research. It is also important to note that while these findings are informative and novel, they represent an initial cross-sectional study in the area. Future longitudinal research may also externally validate the drinking typologies of older adults (e.g., with other data sets) and evaluate the effectiveness of targeted interventions for the population clusters identified in this study and address the potential for reverse causation (e.g., risky drinking

may contribute to living alone). These limitations notwithstanding, the present findings provide unique insights into older people's drinking patterns and potential associated harms and can inform interventions in Australia as well as countries with similar demographic and drinking profiles.

Conclusions

The present study identified three distinct drinking typologies among older people empirically derived from demographic and health-related characteristics among a large national sample. The current findings identified significant differences in older adults' drinking patterns and correlates, and suggest that closer examination of older peoples' patterns of alcohol consumption by age group is warranted together with tailored approaches for designated target groups to avert potential alcohol-related harms among older adults. However, it is also clear that a one-size-fits-all approach is ill-advised. The current findings provide a sound empirical basis for the development of sensitive, nuanced, and age-appropriate public health messages and interventions.

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References

- ABS. (2012). *Information Paper: Use of the Kessler Psychological Distress Scale in ABS Health Surveys, Australia, 2007-08*. Cat. no. 4817.0.55.001. <https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4817.0.55.001Chapter92007-08>
- ABS. (2018). *Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia, 2016*. Cat. no. 2033.0.55.001. <https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/2033.0.55.001~2016~Main%20Features~IRSAD~20>
- AIHW. (2017). *National Drug Strategy Household Survey 2016: Detailed Findings*. <https://www.aihw.gov.au/getmedia/15db8c15-7062-4cde-bfa4-3c2079f30af3/21028a.pdf.aspx?inline=true>
- Anderson, P., Chisholm, D., & Fuhr, D. C. (2009). Effectiveness and cost-effectiveness of policies and programmes to reduce the harm caused by alcohol. *Lancet*, 373(9682), 2234-2246. doi:10.1016/s0140-6736(09)60744-3
- Australian Institute of Health and Welfare. (2017). *National Drug Strategy Household Survey 2016: Detailed Findings. Drug Statistics series no. 31*. Cat. no. PHE 214.

- Bareham, B. K., Kaner, E., Spencer, L. P., & Hanratty, B. (2019). Drinking in later life: A systematic review and thematic synthesis of qualitative studies exploring older people's perceptions and experiences. *Age and Ageing, 48*(1), 134-146. doi:10.1093/ageing/afy069
- Bhatia, U., Nadkarni, A., Murthy, P., Rao, R., & Crome, I. (2015). Recent advances in treatment for older people with substance use problems: An updated systematic and narrative review. *European Geriatric Medicine, 6*(6), 580-586. doi:10.1016/j.eurger.2015.07.001
- Bloomfield, K., Stockwell, T., Gmel, G., & Rehn, N. (2003). International comparisons of alcohol consumption. *Alcohol Research & Health, 27*(1), 95-109.
- Breslow, R. A., Castle, I.-J. P., Chen, C. M., & Graubard, B. I. (2017). Trends in alcohol consumption among older Americans: National Health Interview Surveys, 1997 to 2014. *Alcoholism: Clinical and Experimental Research, 41*(5), 976-986. doi:10.1111/acer.13365
- Butt, P. R., White-Campbell, M., Canham, S., Dowsett Johnston, A., Indome, E. O., Purcell, B., & Tung, J. (2020). Canadian guidelines on alcohol use disorder among older adults. *Canadian Geriatrics Journal, 23*(1), 143-148. doi:10.5770/cgj.23.425
- Callinan, S., Pennay, A., & Livingston, M. (2017). Decreasing prevalence of social drinkers in Australia. *Addictive Behaviors, 67*, 20-25. doi:10.1016/j.addbeh.2016.12.002
- Canham, S. L., Mauro, P. M., Kaufmann, C. N., & Sixsmith, A. (2016). Association of alcohol use and loneliness frequency among middle-aged and older adult drinkers. *Journal of Aging and Health, 28*(2), 267-284. doi:10.1177/0898264315589579
- Cederbaum, A. I. (2012). Alcohol metabolism. *Clinics in Liver Disease, 16*(4), 667-685. doi:10.1016/j.cld.2012.08.002
- Centers for Disease Control and Prevention. (2016). *Excessive alcohol use: Preventing a leading risk for death, disease, and injury*.
- Chapman, J., Harrison, N., Kostadinov, V., Skinner, N., & Roche, A. (2020). Older Australians' perceptions of alcohol-related harms and low-risk alcohol guidelines. *Drug and Alcohol Review, 39*(1), 44-54. doi:10.1111/dar.13022
- Chen, A. T., Wu, S., Tomasino, K. N., Lattie, E. G., & Mohr, D. C. (2019). A multi-faceted approach to characterizing user behavior and experience in a digital mental health intervention. *Journal of Biomedical Informatics, 94*, 103187. doi:10.1016/j.jbi.2019.103187
- Clausen, T., Martinez, P., Towers, A., Greenfield, T., & Kowal, P. (2016). Alcohol consumption at any level increases risk of injury caused by others: Data from the study on global ageing and adult health. *Substance Abuse: Research and Treatment, 9*(Suppl 2), 125-132. doi:10.4137/SART.S23549
- Conry, M. C., Morgan, K., Curry, P., Mcgee, H., Harrington, J., Ward, M., & Shelley, E. (2011). The clustering of health behaviours in Ireland and their relationship with mental health, self-rated health and quality of life. *BMC Public Health, 11*, 692. <http://www.biomedcentral.com/1471-2458/11/692>
- Dietrich, T., Rundle-Thiele, S., Schuster, L., Drennan, J., Russell-Bennett, R., Leo, C., Gullo, M. J., & Connor J. P. (2015). Differential segmentation responses to an alcohol social marketing program. *Addictive Behaviors, 49*, 68-77. doi:10.1016/j.addbeh.2015.05.010
- Draper, B., Ridley, N., Johnco, C., Withall, A., Sim, W., Freeman, M., Contini, E., & Lintzeris N. (2015). Screening for alcohol and substance use for older people in geriatric hospital and community health settings. *International Psychogeriatrics, 27*(1), 157-166. doi:10.1017/s1041610214002014
- Fried, L. P. (2016). Investing in health to create a third demographic dividend. *The Gerontologist, 56*(Suppl 2), S167-S177. doi:10.1093/geront/gnw035
- Gauthier, A. H., & Smeeding, T. M. (2003). Time use at older ages. *Research on Aging, 25*(3), 247-274. doi:10.1177/0164027503025003003
- Grant, B. F., Chou, S. P., Saha, T. D., Pickering, R. P., Kerridge, B. T., Ruan, W. J., Huang, B., Jung J., Zhang H., Fan A., & Hasin D. S. (2017). Prevalence of 12-month alcohol use, high-risk drinking, and DSM-IV alcohol use disorder in the United States, 2001-2002 to 2012-2013. *JAMA Psychiatry, 74*(9), 911-923. doi:10.1001/jamapsychiatry.2017.2161
- Griffin, B., Sherman, K. A., Jones, M., & Bayl-Smith, P. (2014). The clustering of health behaviours in older Australians and its association with physical and psychological status, and socio-demographic indicators. *Annals of Behavioral Medicine, 48*(2), 205-214. doi:10.1007/s12160-014-9589-8
- Griswold, M. G., Fullman, N., Hawley, C., Arian, N., Zimsen, S. R. M., Tymeson, H. D., & Gakidou, E. (2018). Alcohol use and burden for 195 countries and territories, 1990-2016: A systematic analysis for the global burden of disease study 2016. *Lancet, 392*(10152), 1015-1035. doi:10.1016/S0140-6736(18)31310-2
- Han, B. H., & Moore, A. A. (2018). Prevention and screening of unhealthy substance use by older adults. *Clinics in Geriatric Medicine, 34*(1), 117-129. doi:10.1016/j.cger.2017.08.005
- Han, B. H., Moore, A. A., Ferris, R., & Palamar, J. J. (2019). Binge drinking among older adults in the United States, 2015 to 2017. *Journal of the American Geriatrics Society, 67*, 2139-2144. doi:10.1111/jgs.16071
- Han, B. H., Moore, A. A., Sherman, S., Keyes, K. M., & Palamar, J. J. (2017). Demographic trends of binge alcohol use and alcohol use disorders among older adults in the United States, 2005-2014. *Drug and Alcohol Dependence, 170*, 198-207. doi:10.1016/j.drugalcdep.2016.11.003
- Han, J., Kamber, M., & Pei, J. (2012). Cluster analysis: Basic concepts and methods. In J. Han, M. Kamber, & J. Pei (Eds.), *Data Mining* (3rd ed.) (pp. 443-495). Morgan Kaufmann.
- Hanna, E. Z., Chou, S. P., & Grant, B. F. (1997). The relationship between drinking and heart disease morbidity in the United States. *Alcoholism: Clinical & Experimental Research, 21*(1), 111-118.
- Hartz, S. M., Oehlert, M., Horton, A., Gruzca, R. A., Fisher, S. L., Culverhouse, R. C., Nelson, K. G., Sumerall S. W., Neal P. C., Regnier P., Chen G., Williams A., Bhattarai J., Evanoff B., & Bierut L. J. (2018). Daily drinking is associated with increased mortality. *Alcoholism: Clinical and Experimental Research, 42*(11), 2246-2255. doi:10.1111/acer.13886
- Holdsworth, C., Frisher, M., Mendonça, M., De Oliveira, C., Pikhart, H., & Shelton, N. (2017). Lifecourse transitions, gender and drinking in later life. *Ageing and Society, 37*(3), 462-494. doi:10.1017/S0144686X15001178
- Holton, A., Boland, F., Gallagher, P., Fahey, T., Kenny, R., & Cousins, G. (2019). Life course transitions and changes in alcohol

- consumption among older Irish adults: Results from the Irish longitudinal study on ageing (TILDA). *Journal of Aging and Health*, 31(9), 1568-1588. doi:10.1177/0898264318783080
- Hsu, H.-C., Luh, D.-L., Chang, W.-C., & Pan, L.-Y. (2013). Joint trajectories of multiple health-related behaviors among the elderly. *International Journal of Public Health*, 58(1), 109-120. doi:10.1007/s00038-012-0358-9
- IBM. (2017). *TwoStep cluster analysis*. https://www.ibm.com/support/knowledgecenter/SSLVMB_25.0.0/statistics_casestudies_project_ddita/spss/tutorials/twostepcluster_table.html.
- Kalousova, L., & Burgard, S. A. (2014). Unemployment, measured and perceived decline of economic resources: Contrasting three measures of recessionary hardships and their implications for adopting negative health behaviors. *Social Science & Medicine*, 106, 28-34. doi:10.1016/j.socscimed.2014.01.007
- Kelly, S., Olanrewaju, O., Cowan, A., Brayne, C., & Lafortune, L. (2018). Interventions to prevent and reduce excessive alcohol consumption in older people: A systematic review and meta-analysis. *Age and Ageing*, 47(2), 175-184. doi:10.1093/ageing/afx132
- Kessler, R. C., Andrews, G., Colpe, L. J., Hiripi, E., Mroczek, D. K., Normand, S.-L. T., Walters, E. E., & Zaslavsky, A. M. (2002). Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological Medicine*, 32(6), 959-976. doi:10.1017/s0033291702006074
- Keyes, K. M., Li, G., & Hasin, D. S. (2011). Birth cohort effects and gender differences in alcohol epidemiology: A review and synthesis. *Alcoholism: Clinical and Experimental Research*, 35(12), 2101-2112. doi:10.1111/j.1530-0277.2011.01562.x
- Keyes, K. M., Martins, S. S., Blanco, C., & Hasin, D. S. (2010). Telescoping and gender differences in alcohol dependence: New evidence from two national surveys. *American Journal of Psychiatry*, 167(8), 969-976. doi:10.1176/appi.ajp.2009.09081161
- Kim, J. W., Lee, D. Y., Lee, B. C., Jung, M. H., Kim, H., Choi, Y. S., & Choi, I.-G. (2012). Alcohol and cognition in the elderly: A review. *Psychiatry Investigation*, 9(1), 8-16. doi:10.4306/pi.2012.9.1.8
- Kirpich, I. A., McClain, C. J., Vatsalya, V., Schwandt, M., Phillips, M., Falkner, K. C., Zhang, L., Harwell, C., George D. T., & Umhau J. C. (2017). Liver injury and endotoxemia in male and female alcohol-dependent individuals admitted to an alcohol treatment program. *Alcoholism: Clinical and Experimental Research*, 41(4), 747-757. doi:10.1111/acer.13346
- Lehmann, S. W., & Fingerhood, M. (2018). Substance-use disorders in later life. *New England Journal of Medicine*, 379(24), 2351-2360. doi:10.1056/NEJMr1805981
- Mäkelä, P., & Montonen, M. (2018). Low-risk drinking guidelines to reduce alcohol-related harm: Delphi survey to explore aspects 'beyond epidemiology'. *Addiction Research & Theory*, 26(6), 487-497. doi:10.1080/16066359.2018.1434155
- Martineau, F., Tyner, E., Lorenc, T., Petticrew, M., & Lock, K. (2013). Population-level interventions to reduce alcohol-related harm: An overview of systematic reviews. *Preventive Medicine*, 57(4), 278-296.
- McLernon, D. J., Powell, J. J., Jugdaohsingh, R., & Macdonald, H. M. (2012). Do lifestyle choices explain the effect of alcohol on bone mineral density in women around menopause? *The American Journal of Clinical Nutrition*, 95(5), 1261-1269. doi:10.3945/ajcn.111.021600
- Meier, P., & Seitz, H. K. (2008). Age, alcohol metabolism and liver disease. *Current Opinion in Clinical Nutrition and Metabolic Care*, 11(1), 21-26. doi:10.1097/MCO.0b013e3282f30564
- Merline, A., Jager, J., & Schulenberg, J. E. (2008). Adolescent risk factors for adult alcohol use and abuse: Stability and change of predictive value across early and middle adulthood. *Addiction*, 103 (Suppl 1), 84-99. doi:10.1111/j.1360-0443.2008.02178.x
- National Health and Medical Research Council. (2009). *Alcohol Guidelines*. NHMRC.
- Ng Fat, L., Bell, S., & Britton, A. (2020). A life-time of hazardous drinking and harm to health among older adults: findings from the Whitehall II prospective cohort study. *Addiction*. doi:10.1111/add.15013
- Nolen-Hoeksema, S. (2004). Gender differences in risk factors and consequences for alcohol use and problems. *Clinical Psychology Review*, 24(8), 981-1010. doi:10.1016/j.cpr.2004.08.003
- Norusis, M. J. (2011). *IBM SPSS Statistics 19 procedures companion*. Addison-Wesley.
- Orimo, H., Ito, H., Suzuki, T., Araki, A., Hosoi, T., & Sawabe, M. (2006). Reviewing the definition of "elderly". *Geriatrics and Gerontology International*, 6(3), 149-158. doi:10.1111/j.1447-0594.2006.00341.x
- Pape, H., Rossow, I., & Brunborg, G. S. (2018). Adolescents drink less: How, who and why? A review of the recent research literature. *Drug and Alcohol Review*, 37(S1), S98-S114. doi:10.1111/dar.12695
- Pidd, K., Roche, A., Cameron, J., Lee, N., Jenner, L., & Duraisingam, V. (2018). Workplace alcohol harm reduction intervention in Australia: Cluster non-randomised controlled trial. *Drug and Alcohol Review*, 37(4), 502-513. doi:10.1111/dar.12660
- Rao, R. (2019). New thinking on alcohol related harm in older adults. *British Medical Journal*, 366, 15112. doi:10.1136/bmj.15112
- Rao, R., & Roche, A. (2017). Substance misuse in older people. *British Medical Journal*, 358, j3885. doi:10.1136/bmj.j3885
- Rebar, A. L., Duncan, M. J., Short, C., & Vandelandotte, C. (2014). Differences in health-related quality of life between three clusters of physical activity, sitting time, depression, anxiety, and stress. *BMC Public Health*, 14(1), 1088. doi:10.1186/1471-2458-14-1088
- Rehm, J., Mathers, C., Popova, S., Thavorncharoensap, M., Teerawattananon, Y., & Patra, J. (2009). Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. *Lancet*, 373(9682), 2223-2233. doi:10.1016/s0140-6736(09)60746-7
- Rehm, J., & Poznyak, V. (2015). On monitoring unrecorded alcohol consumption. *Alcoholism and Drug Addiction*, 28(2), 79-89. doi:10.1016/j.alkona.2015.06.003
- Roche, A. M., & Kostadinov, V. (2019). Baby boomers and booze: we should be worried about how older Australians are drinking. *Medical Journal of Australia*, 210(1), 38-39. doi:10.5694/mja2.12025
- Roche, A., Kostadinov, V., Fischer, J., Nicholas, R., O'Rourke, K., Pidd, K., & Trifonoff, A. (2015). Addressing inequities in alcohol consumption and related harms. *Health Promotion International*, 30(Suppl 2), ii20-ii35. doi:10.1093/heapro/dav030
- Seedat, S., Scott, K. M., Angermeyer, M. C., Berglund, P., Bromet, E. J., Brugha, T. S., Demyttenaere, K., de Girolamo G., Haro J. M., Jin

- R., Karam E. G., Kovess-Masfety V., Levinson D., Medina Mora M. E., Ono Y., Ormel J., Pennell B.-E., Posada-Villa J., Sampson N. A., ... Kessler R. C. (2009). Cross-national associations between gender and mental disorders in the World Health Organization World Mental Health Surveys. *Archives of General Psychiatry*, 66(7), 785-795. doi:10.1001/archgenpsychiatry.2009.36
- Singh, S., & Bajorek, B. (2014). Defining 'elderly' in clinical practice guidelines for pharmacotherapy. *Pharmacy Practice*, 12(4), 489. doi:10.4321/s1886-36552014000400007
- Slade, T., Chapman, C., Swift, W., Keyes, K., Tonks, Z., & Teesson, M. (2016). Birth cohort trends in the global epidemiology of alcohol use and alcohol-related harms in men and women: Systematic review and metaregression. *BMJ Open*, 6(10), e011827. doi:10.1136/bmjopen-2016-011827
- Stockwell, T., Donath, S., Cooper-Stanbury, M., Chikritzhs, T., Catalano, P., & Mateo, C. (2004). Under-reporting of alcohol consumption in household surveys: A comparison of quantity-frequency, graduated-frequency and recent recall. *Addiction*, 99(8), 1024-1033. doi:10.1111/j.1360-0443.2004.00815.x
- Szabo, G. (2018). Women and alcoholic liver disease - warning of a silent danger. *Nature Reviews Gastroenterology & Hepatology*, 15(5), 253-254. doi:10.1038/nrgastro.2018.8
- Tkaczynski, A. (2017). Segmentation using two-step cluster analysis. In: T. Dietrich, S. Rundle-Thiele, & K. Kubacki (Eds.), *Segmentation in social marketing: Process, methods and application* (pp. 109-125). Springer.
- Towers, A., Sheridan, J., & Newcombe, D. (2017). *The drinking patterns of older New Zealanders: National and international comparisons*.
- Towers, A., Szabó Á., Newcombe, D. A. L., Sheridan, J., Moore, A. A., Hyde, M., Britton, A., Martinez P., Minicuci N., Kowal P., Clausen T., & Savage C. L. (2019). Hazardous drinking prevalence and correlates in older New Zealanders: A comparison of the AUDIT-C and the CARET. *Journal of Aging and Health*, 31(10), 1770-1789. doi:10.1177/0898264318794108
- Vashishtha, R., Livingston, M., Pennay, A., Dietze, P., MacLean, S., Holmes, J., Herring, R., Caluzzi G., & Lubman D. I. (2019). Why is adolescent drinking declining? A systematic review and narrative synthesis. *Addiction Research & Theory*, 1-14. doi:10.1080/16066359.2019.1663831
- Vosbergen, S., Mulder-Wiggers, J. M. R., Lacroix, J. P., Kemps, H. M. C., Kraaijenhagen, R. A., Jaspers, M. W. M., & Peek, N. (2015). Using personas to tailor educational messages to the preferences of coronary heart disease patients. *Journal of Biomedical Informatics*, 53, 100-112. doi:10.1016/j.jbi.2014.09.004
- White, A. M., Castle, I. J. P., Hingson, R. W., & Powell, P. A. (2020). Using death certificates to explore changes in alcohol-related mortality in the United States, 1999 to 2017. *Alcoholism: Clinical and Experimental Research*, 44(1), 178-187. doi:10.1111/acer.14239
- Wilkinson, C. (2018). *Older Australians: Trends and impacts of alcohol and other drug use*. National Drug Research Institute. <http://ndri.curtin.edu.au/NDRI/media/documents/publications/T281.pdf>
- World Health Organization. (2014). *Global status report on alcohol and health*. https://www.who.int/substance_abuse/publications/alcohol_2014/en/
- Young, B., Lewis, S., Katikireddi, S. V., Bauld, L., Stead, M., Angus, K., Campbell, M., Hilton S., Thomas J., Hinds K., Ashie A., & Langley T. (2018). Effectiveness of mass media campaigns to reduce alcohol consumption and harm: A systematic review. *Alcohol and Alcoholism*, 53(3), 302-316. doi:10.1093/alcalc/agx094