Drinking risk varies within and between Australian Aboriginal and Torres Strait Islander samples: A meta-analysis to identify sources of heterogeneity

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Author Note

Declaration of interests This work was supported by the National Health and Medical Research Council (NHMRC) through a Project Grant (#1087192 #1105339), the Centre of Research Excellence in Indigenous Health and Alcohol (#1117198) and a Practitioner Fellowship for K Conigrave (#1117582). Chikritzhs is supported by funding from the Australian Government under the Substance Misuse Prevention and Service Improvement Grants Fund. Room and Callinan are supported by funding from the Foundation for Alcohol Research and Education (FARE) and the Australian Research Council (for Callinan, DE180100016). **Published manuscript** This work is the submitted manuscript for an article published in Addiction. The DOI for the published work is https://doi.org/10.1111/add.15015

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Abstract

Background and Aims To reduce health and social inequities, it is important to understand how drinking patterns vary within and between Indigenous peoples. We aimed to determine how varied estimates of Indigenous drinking patterns are. We sought to identify factors (demographic and methodological) linked to variability in drinking estimates. **Design** A three-level meta-analysis of Australian Aboriginal and Torres Strait Islander ("Indigenous") drinking patterns (PROSPERO #CRD42018103209). A systematic review of the literature revealed 44 eligible studies. **Setting** Australia. **Participants** Indigenous Australians. **Measurements** The primary outcomes extracted were drinking status, single-occasion risk and lifetime risk. Moderation analysis was performed to identify potential sources of heterogeneity. Moderators included gender, age, socioeconomic status, local alcohol restrictions, sample population, remoteness, Australian state or territory, publication year, Indigenous involvement in survey design or delivery, and cultural adaptations. **Findings** For all primary outcomes, considerable heterogeneity was identified within ($I^2_{(2)}$ = 51.39 - 68.80%) and between ($I^2_{(3)}$ = 29.27 - 47.36%) samples. The pooled proportions (p) of current drinkers (p = 0.59, 95% CI 0.53 - 0.65), single-occasion (p = 0.34, 95% CI 0.24 - 0.44) and lifetime (p = 0.21, 95% CI 0.15 - 0.29) risk were all moderated by gender, age, remoteness and measurement tool. Reference period moderated proportions of participants at single-occasion risk. **Conclusions** Estimates of Indigenous Australian drinking patterns vary within and between communities. Responses to reduce drinking risk should be developed with local communities as key partners.

Keywords: Indigenous; alcohol; drinking patterns; drinking risk; meta-analysis; systematic review

Word count: 3,773

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Introduction

Alcohol is a major cause of mortality and disease [1–3], and is especially damaging to Indigenous peoples who have been colonised [4–7]. Colonisation has resulted in inter-generational trauma, threats to culture, and loss of self-determination [8,9]. Indigenous peoples worldwide face discrimination and reduced socioeconomic opportunity [8–11]. These conditions provide fertile ground for unhealthy alcohol use and addictions [8]. This is the case for Australia's Aboriginal and Torres Strait Islander peoples (Indigenous Australians) [12]. Three times as many alcohol-attributable hospitalisations occur to young Indigenous Australians relative to their non-Indigenous counterparts [13].

Reducing harms from alcohol is a priority for Indigenous Australian communities, service providers and for Australian governments [5,14,15]. Individuals at risk from drinking can be hard to engage [16]. National surveys include prevalence estimates of Indigenous drinking risk and these may assist in resource allocation for prevention and treatment efforts [17,18]. However, the variability (heterogeneity) in Indigenous drinking between and within communities requires clarification.

Relative to non-Indigenous Australians, Indigenous Australians are nearly twice as likely to drink to intoxication. In contrast, they are also more likely to abstain from drinking [19]. And yet, alcohol use among Indigenous Australians is often socially, and politically stereotyped [15]. Governments have at times employed broad-stroke interventions to address Indigenous drinking risk across multiple communities [20]. In addition to reducing autonomy, these programs ignore local contexts and potential variation in drinking patterns within and between communities. Assessing drinking pattern variability is challenging as many factors can affect estimates. Such factors include regional variability, sampling error, and study methods.

Drinking levels and patterns may vary substantially between communities [21]. There are differences in culture, geography and history. Some communities also have restrictions on the sale and consumption of alcohol ("dry" communities) [15]. Such restrictions may result in irregular drinking patterns where no alcohol is consumed for most of the year, apart from intermittent periods when alcohol is smuggled into communities, or when individuals leave their community to visit larger towns or cities [15,22]. Demographic factors such as age, gender, socioeconomic status and remoteness may all predict hazardous drinking [23,24]. Additionally, differing research methods may drive variability in estimates of drinking risk.

Alcohol consumption is difficult to measure from self-report [25]. For Indigenous peoples, direct questioning about drinking may be considered invasive [15,22]. Perceptions of privacy and confidentiality may be especially important for Indigenous respondents so that drinking patterns are not under-reported [26]. Cultural adaptation of instruments may help address differences in worldviews, literacy and language [27–31].

We performed a meta-analysis to better describe and explain sources of heterogeneity in Indigenous drinking patterns. We tested a range of demographic moderators including sample demographics, remoteness, and region. Method moderators included: cultural adaptations, survey instrument, Indigenous involvement and study quality.

Method

The protocol for this meta-analysis was registered with PROSPERO (CRD42018103209). This study was performed in accordance with the PRISMA statement [32]. Analytic code and the data extraction table, including references, are available in supplementary materials. Project design and interpretation of results were guided by an Indigenous Advisory group. Three study authors themselves identify as Indigenous Australian.

Inclusion criteria

Reports were included if they presented quantitative results on drinking patterns among Indigenous Australians. Drinking patterns were defined as whether or not an individual drinks, if they drink at risky levels (either a risky amount on a single-occasion, or an amount which places them at cumulative risk over a lifetime), and average amount of alcohol consumed per day. Records were excluded if they did not contain original data, if Indigenous results were not reported separately from other populations, if participants were recruited on the basis of displaying specific drinking patterns, or if the record was published more than 30 years prior to the start of the project (before 1988).

Search strategy and record screening

Reports were extracted from four databases: “CINAHL”, “PsycInfo”, “Scopus” and “Web of Science”. Records were screened by combining keywords from four groups: Indigenous Australians, alcohol, drinking patterns and Australia. Terms within each group were combined with “or” statements. Each group was combined with other groups with “and” statements. The keywords used for Indigenous Australians were: “Aboriginal”, “Aborigine”, Indigenous’, “First Nations” and “First Peoples”. For the “alcohol” group the following terms were used: “alcohol”, “grog”, “ethanol”, “drink*”, “wine”, “beer”, “spirit*” and “liquor”. Drinking patterns were represented with “consumption”, “pattern*”, “frequency”, “epidemiology”, “AUDIT”, “prevalence”, “intake” and “screen*”. We did not use synonyms for “Australia”. Reports were extracted on April 17 2018, and subsequently on April 10 2019 to find new publications. Two authors completed title and abstract, and full-text screening in duplicate (JC, CZ). A third author helped settle disagreements (KL).

Data extraction

Data was extracted by one author (JC), and verified by another (CZ). If multiple estimates were reported, they were entered as unique observations on separate rows. Estimates from the same study were linked with a study identifier "study ID". Study quality was independently rated by two authors (JC, CZ) using the Joanna Briggs Institute's Critical Appraisal Checklist for Studies Reporting Prevalence Data [33]. Average study quality was calculated by dividing the number of times "yes" was recorded by the number of applicable items.

Primary outcomes. The primary outcomes were the proportions of: participants who identify as current drinkers, people at single-occasion and lifetime risk, and average Australian standard drinks consumed per day. Single-occasion risk was defined as consumption of more than four standard drinks during a drinking occasion; lifetime risk as mean consumption of more than two standard drinks per day [34].

Study features

Several cohort and methodological features were extracted. These included the percentage of females, mean age, cohort type, remoteness, Australian state or territory, whether there was Indigenous involvement in the research, the instrument used to measure drinking patterns, if the questionnaire was modified to be more culturally appropriate, and how the questionnaire was administered (pen-and-paper or interview). Two moderators were added during data extraction: community-level alcohol restrictions reported by authors, and socioeconomic status of the sample. Categorical variables were coded as follows.

Cohort type and demographics. For each estimate, samples were categorised by the age and gender of participants. For age, samples were coded as containing the following age groups based on the mean age, plus or minus the standard deviation: 15-24, 25-34,

35-49, and 50+ years. Studies with broad age distributions could be coded as containing multiple age groups. For gender, samples were categorised as "mostly male", "mixed gender", and "mostly female" based on the proportion of female participants (respectively, $< 1/3$, $1/3$ to $2/3$ and $> 2/3$). Sample type was coded based on the source population; for example, from communities, clinics, hospitals, or health centres.

Australian state or territory. The state or territory of samples was recorded per estimate.

Alcohol restrictions. Restrictions on the sale or supply of alcohol in each study were recorded and categorised into three levels: no restrictions ("none"); communities where alcohol could be consumed only in licensed premises ("restricted to club"); and communities where alcohol was not available for sale ("dry").

Remoteness. Three levels were used to classify the remoteness of samples ("urban", "regional","remote"). If the authors reported the name of sample regions or communities, remoteness was defined by standard national criteria [35]. In other cases, estimates were classified based on authors' explicit descriptions.

Socioeconomic status. Where sample socioeconomic status (SES) was provided by study authors it was coded ("low", "moderate", "high"). Reports did not provide sufficient details for sample SES to be independently determined.

Indigenous involvement. Indigenous involvement in studies was recorded as a binary variable. Studies where authors explicitly mentioned Indigenous involvement in any stage of the research were coded "yes". Where authors made it clear Indigenous people were not involved, those records were coded with "no".

Cultural adaptations. If study authors commented that instruments used to measure alcohol consumption had been adapted for an Indigenous context, that record was marked with "yes"; all other records were coded "no". Changes included modified language, visual elements, or administration.

Instrument. The instrument used to measure drinking patterns was recorded and sorted into four categories: "not described", Alcohol Use Disorders Identification Test variants ("AUDIT"), other quantity-frequency measures ("quantity-frequency"), "retrospective diary", and "other".

Missing data

For papers published in the last seven years, we requested additional data from authors who did not report on all extracted variables. For example, if a study reported on the proportion of drinkers at single-occasion risk, but not on the proportion at lifetime risk, we requested the latter information. Two authors provided missing data. Studies which did not report estimates required for a given outcome were excluded from that analysis (complete case analysis).

Analysis

All analyses were performed using R version 3.6.3 (2020-02-29) [36]. To prevent transcription errors, this paper was prepared using the software packages "rmarkdown" [37] and "papaja" [38].

The principal summary measures were the proportions of: current drinkers, people at single-occasion risk, people at lifetime risk. Additionally, the average number of standard drinks per day was pooled. Proportions were transformed to log-odds for analysis. The function "escalc" from the "metafor" package was used to calculate effect sizes [39]. Log-odds were back-transformed to proportions in tables and figures for ease of interpretation.

In this meta-analysis, multiple estimates were reported by some authors. For example, proportions of current drinkers were often reported separately for males and females. To account for estimate dependencies, we conducted three-level meta-analyses

using the R package "metaSEM" [40,41]. Estimates (level 1) were pooled while modelling within-, and between-study heterogeneity (levels 2, and 3 respectively) [42]. Study identification number was used as the clustering variable. Pooled estimates and 95% confidence intervals are presented for each analysis. Heterogeneity indices were calculated ("I^2") [43]. $I^2_{(2)}$ and $I^2_{(3)}$ indicates heterogeneity within and between studies, respectively [42]. An R package "msemtools" was developed for this paper which can be used to reproduce all analyses, tables, and figures [44].

Moderation analysis. To assess whether study features were moderators of heterogeneity, they were included as predictors in mixed-effects meta-analytic models. These models were compared to the baseline model with a likelihood ratio test. The p-value from likelihood-ratio tests was used to assess whether the baseline model fit was significantly improved by inclusion of moderator variables [41]. Estimates for each level of categorical moderators were calculated by constraining model intercepts to zero.

Publication bias. Egger's symmetry tests and funnel plots were used to detect publication bias.

Results

Record search

The literature search returned 1019 records (Figure 1); 14 additional records were identified through hand searching; 186 records were full-text screened. Forty-one met inclusion criteria and were included in the meta-analysis.

Study characteristics

Records were published from 1988 to 2018. Of these, 39.02% of records were published in the last ten years. A range of instruments were used to measure alcohol consumption. Nine studies used variants of the AUDIT, nine used other quantity-frequency

measures, eight used retrospective diaries, and 15 did not describe what instrument was used. Sample sizes ranged from 24 to 9,401 (total $N = 59{,}962$). The socioeconomic status of study participants was rarely described. Four studies reported that their cohorts had low socioeconomic status. None reported that participants had moderate or high socioeconomic status. Due to the lack of variability in this covariate, it is not presented in moderation analyses.

Drinking status

Thirty-seven studies (99 prevalence estimates) presented data on the proportion of current drinkers which could be pooled. The total sample size was 59,023 individuals. Significant heterogeneity was detected ($Q(98) = 5518.62$, $p = < 0.001$). The pooled log-odds and 95% Wald CI was 0.36 (0.10, 0.63). This analysis revealed high levels of heterogeneity within studies ($I^2_{(2)} = 55.59\%$) and moderate heterogeneity between studies ($I^2_{(3)} = 43.36\%$). Within study heterogeneity was largely explained by gender ($R^2_{(2)} = 59.82\%$). Samples with higher proportions of males had higher proportions of drinkers.

A forest plot (Figure 2), revealed a potential effect of time where records published in recent years reported greater proportions of current drinkers. Accordingly, we tested for a moderating effect of publication year (centred prior to analysis). A Likelihood ratio test demonstrated that including publication year as a moderator did not significantly improve the baseline model ($p = 0.059$).

The results from the moderation analyses are presented in Table 1. Besides gender, the covariates which significantly moderated the baseline model were “age”, “remoteness”, “state”, “Indigenous involvement”, “cultural adaptations” and “instrument”.

Publication bias. Potential publication bias was assessed using a funnel plot (Figure 3). An Egger’s symmetry test did not suggest asymmetry ($p = 0.640$).

Single-occasion risk

Nine studies (55 estimates) published the proportion of participants at risk from their drinking on single-occasions as defined by current Australian guidelines (>40g ethanol per occasion) [34]. There was significant heterogeneity (Q(54) = 2635.66, $p = < 0.001$). The pooled log-odds and 95% Wald CI was -0.68 (-1.13, -0.23). The heterogeneity within and between studies was respectively 51.39% and 47.36%.

Reference periods for single-occasion risk varied. Two studies used a reference period of drinking at risk at least once over one week, four used a period of two weeks, three used one month, and one used twelve months. The majority of between-study heterogeneity was explained by this covariate (Table 2; Figure 4; $R^2_{(2)} = 11.65\%$; $R^2_{(3)} = 100.00\%$). Other significant covariates included: “gender”, “age”, “cohort”, “remoteness”, and “instrument”.

Publication bias. A funnel plot did not suggest evidence of publication bias (Figure 5). An Egger’s symmetry test did not suggest the presence of asymmetry ($p = 0.254$)

Lifetime risk

Fourteen studies (60 estimates) presented data on the proportion of participants classified as being at lifetime risk from alcohol based on current Australian guidelines [34]. The Q statistic revealed significant heterogeneity Q(59) = 2041.45; $p = < 0.001$. The pooled log-odds and 95% CI for participants rated as being at lifetime risk was -1.34 (-1.76, -0.92). The heterogeneity within, and between studies was 68.80% and, 29.27%, respectively (Figure 6).

Moderators were used as covariates to see if they improved the baseline model (Table 3).

The predictors which significantly moderated the baseline model were “gender”, “age”, “remoteness”, “indigenous involvement”, “cultural adaptations”, and “instrument”.

Publication bias. The funnel plot for lifetime risk did not reveal obvious bias (Figure 7). However, an Egger's symmetry test suggested asymmetry ($p = 0.005$). While funnel plots may indicate publication bias, asymmetry can also be caused by true heterogeneity [45]. For example, the proportion of individuals at lifetime risk could be different in small and large communities. This could cause estimates to vary with sample size resulting in funnel plot asymmetry.

Average standard drinks consumed per day

Four studies reported the average standard drinks consumed per day by participants. However, only two studies reported an estimate with a corresponding variance. Given the high heterogeneity in drinking patterns and small number of studies, conducting a formal meta-analysis for this variable could be misleading [46]. However, a crude weighted mean was calculated. The pooled average number of drinks consumed per day, weighted by sample size, was 2.28.

Discussion

To our knowledge, this is the first meta-analysis on drinking patterns of any indigenous peoples who have been colonised. Across all identified records, approximately three in five (59%) study participants were current drinkers. Based on Australian guidelines, respectively about one in three (33.7%) and one in five (20.8%) individuals were at high single occasion, and lifetime risk from drinking alcohol. The colonisation of Indigenous peoples has resulted in systemic disadvantage which in some cases results in harmful use of alcohol [8,9]. However, our findings suggest that drinking patterns within and between Indigenous Australian communities vary greatly. Total heterogeneity for all baseline models approached 100%. Accordingly, such pooled estimates of Indigenous drinking patterns are unlikely to be representative of individual Indigenous communities and people. This finding highlights the need to respond to drinking risk experienced by

Indigenous Australians in ways which are mindful of local contexts. To ensure relevance, local community members should be partners in efforts to address Indigenous drinking risk [47]. This meta-analysis identified factors linked to variability in drinking pattern estimates within and between communities.

Demographic differences in drinking patterns

The gender and age compositions of samples were good predictors of drinking patterns. Samples that were comprised of mostly males had 2.5 times as many current drinkers, 2.7 times as many individuals at risk from single drinking occasions, and 3.1 times as many participants at lifetime risk from drinking. This gender gap in drinking is much larger than what has been observed in western populations. In OECD countries, males born in the latter half of the century tend to drink at similar levels to women [48]. It is not clear why Indigenous men are drinking substantially more than Indigenous women. Perhaps Indigenous men are particularly affected by the erosion of traditional societal roles, particularly in communities with higher unemployment. Nonetheless, additional research and support is warranted.

Sample age moderated drinking patterns. Younger samples tended to have higher numbers of participants reporting risky single-occasion use. In contrast, older samples were more likely to have higher prevalence of lifetime risk. This pattern is similar to non-Indigenous samples [49]. Long-term at risk drinking in middle age is of particular concern in Indigenous populations which have a higher prevalence of physical disorders, such as diabetes and cancers [50,51]. Few studies focused on drinking patterns of older Indigenous people ($k = 5$). Further research on how to reduce drinking risk in this cohort may help support the development of targeted programs.

We planned to assess whether drinking patterns were moderated by socioeconomic status, however this was rarely reported by study authors.

Sample setting. Samples drawn from clinical settings were not more likely to be current drinkers or to be at lifetime risk of drinking alcohol. Samples drawn from clinical settings had fewer people at single-occasion risk. However, this finding was based on a small number of studies (k = 2).

Region. Proportions of current drinkers varied based on region. Samples from the Northern Territory reported lower prevalences of current drinkers than other Australian regions. Lifetime and single-occasion risk did not vary by Australian state/territory. Relative to urban samples, Indigenous samples from remote and regional areas tended to have higher proportions of current drinkers and those at high single-occasion risk. Conversely urban samples reported higher rates of individuals at lifetime risk. Drinking estimates from smaller communities may be highly variable over time with consumption influenced by local circumstances like funerals [30].

Cultural adaptations and involvement by Indigenous Australians

Prior authors have argued that Indigenous people under-report their alcohol consumption [52]. This may occur if instruments used to assess drinking lack cultural adaptations, or if there is insufficient trust in confidentiality of data collected [30]. While use of cultural adaptions and use of Indigenous researchers and staff moderated findings, differences were small.

Perhaps reporting that a scale has been culturally adapted may not provide sufficient evidence that a scale is more acceptable and likely to lead to accurate reporting for Indigenous Australian participants. While four in nine (43.9%) studies reported cultural adaptations, these features were generally not described in detail. The nature of cultural adaptations and the degree to which they were made in collaboration with local Indigenous community members may vary greatly. Models which can discriminate between effective and poor cultural adaptions would be useful.

The effect of perceived confidentiality was difficult to assess as records which reported the proportions of participants at single-occasion or lifetime risk all used the same form of administration (pen-and-paper).

Recommendations for reporting drinking patterns

This paper has demonstrated challenges in pooling research on drinking patterns in Indigenous Australians. Generally, authors favoured binary classifications of drinking risk. Such binary classifications are useful as they compare drinking patterns to national standards. However, they cannot describe the degree and the frequency with which recommended drinking limits are exceeded — for example, drinkers who consume one standard drink more than a risk threshold cannot be discerned from those who exceed guidelines by over twenty drinks. Importantly, binary classifications which use different risk thresholds are not easily compared. National guidelines are revised regularly. This has resulted in literature which is fragmented and making comparison between studies over long time-periods is difficult. Researchers should report both continuous and binary estimates of drinking patterns. Reporting medians and interquartile ranges for consumption metrics would be useful.

Additionally, a number of studies used short reference periods (under one month) to determine the proportion of respondents drinking excessively on single occasions. Variance in reporting periods drove much of the between-study heterogeneity for single-occasion risk. Short reference periods do not adequately capture drinking-risk for intermittent drinking patterns which are typical in some Indigenous communities [53]. Accordingly, longer reference periods (spanning months) should be favoured in future study designs.

Limitations

This meta-analysis identified vast heterogeneity. Estimates of drinking risk vary greatly within and between communities. However, these findings rely on non-biased reporting from prior researchers. In many cases authors did not measure, or report data for variables of interest. If data were omitted systematically, estimates could be biased. For example, authors might be less likely to measure drinking risk in communities where alcohol is less of a problem. This would result in inflated estimates of how many Indigenous people are at risk from drinking. Authors tended to only report the presence of methods and not their absence (e.g. they reported the presence of cultural adaptations more than their absence). This also may introduce systematic bias.

Conclusion

Estimates of drinking patterns among Indigenous Australians have varied greatly within and between studies. Pooled estimates of Indigenous drinking patterns are unlikely to be representative of individual Indigenous communities and people. Different drinking patterns may require different responses. Programs devised by, or in partnership with, communities are likely to be better suited to local contexts. Differences between individuals and communities are likely important factors in understanding drinking risk.

Acknowledgements

We would like to acknowledge the help of Summer Loggins from the University of Sydney and Mira Branezac from NSW Health's Drug and Alcohol Health Services Library.

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Table 1

Current drinkers: Meta-analytic results and moderation analysis

Moderator	k	n	Proportion [95% CI]	logOR	SE	$R^2_{(2)}$	$R^2_{(3)}$	p
Baseline ($I^2_{(2;3)}$: 0.56; 0.43)	37	99	0.59 [0.53 - 0.65]	0.36	0.13	-	-	-
Gender	31	93	-	-	-	0.60	0.00	$< .001$*
Mostly male	16	39	0.69 [0.61 - 0.77]	0.80	0.19	-	-	-
Mixed gender	12	12	0.52 [0.40 - 0.64]	0.09	0.25	-	-	-
Mostly female	19	42	0.47 [0.38 - 0.56]	-0.11	0.19	-	-	-
Age	18	41	-	-	-	0.18	0.00	$< .001$*
15-24 years	9	17	0.50 [0.38 - 0.62]	0.00	0.25	-	-	-
25-34 years	11	29	0.39 [0.28 - 0.50]	-0.47	0.24	-	-	-
35-49 years	11	18	0.65 [0.48 - 0.78]	0.61	0.34	-	-	-
50+	4	5	0.49 [0.32 - 0.66]	-0.03	0.36	-	-	-
Alcohol restriction	37	99	-	-	-	0.00	1.00	.151
Cohort	37	99	-	-	-	0.03	0.09	.147
Remoteness	20	33	-	-	-	0.00	0.01	$< .001$*
Urban	4	6	0.54 [0.30 - 0.76]	0.15	0.52	-	-	-
Regional	6	7	0.56 [0.33 - 0.76]	0.22	0.47	-	-	-
Remote	11	20	0.54 [0.40 - 0.68]	0.17	0.30	-	-	-

Table 1 continued

Moderator	k	n	Proportion [95% CI]	logOR	SE	$R^2_{(2)}$	$R^2_{(3)}$	p
State or territory	37	99	-	-	-	0.24	0.05	.005*
ACT	13	17	0.60 [0.48 - 0.72]	0.42	0.25	-	-	-
NSW	20	27	0.55 [0.46 - 0.63]	0.19	0.18	-	-	-
NT	17	26	0.33 [0.26 - 0.42]	-0.69	0.19	-	-	-
QLD	19	26	0.53 [0.45 - 0.62]	0.14	0.18	-	-	-
SA	12	16	0.50 [0.39 - 0.61]	0.02	0.23	-	-	-
TAS	12	16	0.58 [0.46 - 0.68]	0.31	0.23	-	-	-
VIC	12	16	0.57 [0.46 - 0.68]	0.30	0.23	-	-	-
WA	17	26	0.55 [0.46 - 0.64]	0.21	0.19	-	-	-
Indigenous involvement	30	90	-	-	-	0.01	0.07	$< .001$*
Yes	22	80	0.59 [0.51 - 0.66]	0.36	0.16	-	-	-
No	8	10	0.70 [0.57 - 0.81]	0.86	0.30	-	-	-
Cultural adaptations	30	84	-	-	-	0.00	0.08	$< .001$*
Yes	19	70	0.58 [0.49 - 0.67]	0.33	0.19	-	-	-
No	11	14	0.68 [0.56 - 0.78]	0.73	0.26	-	-	-
Administration	35	97	-	-	-	0.00	0.06	.087

Table 1 continued

Moderator	k	n	Proportion [95% CI]	logOR	*SE*	$R^2_{(2)}$	$R^2_{(3)}$	*p*
Instrument	37	99	-	-	-	0.00	0.55	.007*
Not described	12	18	0.43 [0.33 - 0.53]	-0.28	0.21	-	-	-
AUDIT	9	13	0.68 [0.57 - 0.77]	0.75	0.25	-	-	-
Quantity-frequency	9	55	0.64 [0.55 - 0.73]	0.59	0.19	-	-	-
Retrospective diary	7	13	0.64 [0.52 - 0.74]	0.56	0.25	-	-	-
Study quality	37	99	-	-	-	0.00	0.05	.516

Note. * $p < 0.05$; $I^2_{(2;3)}$ = Within and between study heterogeneity, respectively; k = number of studies; n = number of estimates; logOR = log-odds (proportion); SE = standard error (log-odds); $R^2_{(2)}$ = the proportion of within-study heterogeneity explained by the covariate; $R^2_{(3)}$ = the proportion of between-study heterogeneity explained by the covariate; p = Likelihood ratio p-value, significant values demonstrate that the addition of the moderator significantly improved model fit; Cohort = sample type; Study quality = Mean response to the Joanna Briggs Institute's Critical Appraisal Checklist for Studies Reporting Prevalence Data

Table 2

Single-occasion risk: meta-analytic results and moderation analysis

Moderator	k	n	Proportion [95% CI]	logOR	SE	$R^2_{(2)}$	$R^2_{(3)}$	p
Baseline ($I^2_{(2;3)}$: 0.51; 0.47)	9	55	0.34 [0.24 - 0.44]	-0.68	0.23	-	-	-
Time period	7	53	-	-	-	0.12	1.00	.001*
1 week	1	2	0.09 [0.04 - 0.19]	-2.26	0.40	-	-	-
2 weeks	3	48	0.34 [0.30 - 0.37]	-0.68	0.08	-	-	-
1 month	2	2	0.36 [0.21 - 0.55]	-0.55	0.38	-	-	-
12 months	1	1	0.70 [0.44 - 0.87]	0.83	0.55	-	-	-
Gender	5	51	-	-	-	0.84	0.41	$< .001$*
Mostly male	4	25	0.37 [0.25 - 0.50]	-0.55	0.29	-	-	-
Mixed gender	1	1	0.70 [0.40 - 0.89]	0.83	0.63	-	-	-
Mostly female	4	25	0.18 [0.11 - 0.28]	-1.53	0.29	-	-	-
Age	2	17	-	-	-	0.34	0.79	$< .001$*
15-24 years	2	5	0.52 [0.30 - 0.73]	0.08	0.47	-	-	-
25-34 years	1	12	0.31 [0.11 - 0.63]	-0.79	0.67	-	-	-
Cohort	9	55	-	-	-	0.00	1.00	.001*
Clinical	1	2	0.09 [0.04 - 0.20]	-2.26	0.43	-	-	-
Community	8	53	0.34 [0.31 - 0.39]	-0.64	0.09	-	-	-

Table 2 continued

Moderator	k	n	Proportion [95% CI]	logOR	SE	$R^2_{(2)}$	$R^2_{(3)}$	p
Remoteness	2	3	-	-	-	0.01	1.00	$< .001$*
Urban	1	2	0.09 [0.07 - 0.12]	-2.29	0.13	-	-	-
Regional	1	1	0.70 [0.63 - 0.75]	0.83	0.15	-	-	-
State or territory	9	55	-	-	-	0.15	0.00	.994
Indigenous involvement	9	55	-	-	-	0.00	0.00	.870
Cultural adaptations	9	55	-	-	-	0.00	0.97	.056
Instrument	9	55	-	-	-	0.00	1.00	.019*
AUDIT	1	1	0.70 [0.41 - 0.88]	0.83	0.61	-	-	-
Quantity-frequency	6	51	0.33 [0.30 - 0.37]	-0.69	0.09	-	-	-
Retrospective diary	2	3	0.20 [0.11 - 0.33]	-1.40	0.36	-	-	-
Study quality	9	55	-	-	-	0.00	0.06	.845

Table 2 continued

Moderator	k	n	Proportion [95% CI]	logOR	SE	$R^2_{(2)}$	$R^2_{(3)}$	p

Note. * $p < 0.05$; $I^2_{(2;3)}$ = Within and between study heterogeneity, respectively; k = number of studies; n = number of estimates; logOR = log-odds (proportion); SE = standard error (log-odds); $R^2_{(2)}$ = the proportion of within-study heterogeneity explained by the covariate; $R^2_{(3)}$ = the proportion of between-study heterogeneity explained by the covariate; p = Likelihood ratio p-value, significant values demonstrate that the addition of the moderator significantly improved model fit; Cohort = sample type; Study quality = Mean response to the Joanna Briggs Institute's Critical Appraisal Checklist for Studies Reporting Prevalence Data; three moderators were removed due to no variance: socioeconomic status, alcohol restriction, and administration

Table 3

Lifetime risk: Meta-analytic results and moderation analysis

Moderator	k	n	Proportion [95% CI]	logOR	*SE*	$R^2_{(2)}$	$R^2_{(3)}$	*p*
Baseline ($I^2_{(2;3)}$: 0.69; 0.29)	14	60	0.21 [0.15 - 0.29]	-1.34	0.22	-	-	-
Gender	10	56	-	-	-	0.90	0.00	$< .001$*
Mostly male	4	25	0.45 [0.30 - 0.61]	-0.19	0.33	-	-	-
Mostly female	10	31	0.21 [0.12 - 0.33]	-1.34	0.33	-	-	-
Age	5	20	-	-	-	0.17	1.00	$< .001$*
15-24 years	2	5	0.21 [0.13 - 0.30]	-1.34	0.26	-	-	-
25-34 years	5	16	0.12 [0.10 - 0.15]	-1.99	0.12	-	-	-
35-49 years	3	3	0.88 [0.65 - 0.96]	1.95	0.69	-	-	-
50+	2	2	0.55 [0.19 - 0.86]	0.19	0.82	-	-	-
Alcohol restriction	14	60	-	-	-	0.01	0.00	.997
Cohort	14	60	-	-	-	0.00	0.34	.207
Remoteness	4	5	-	-	-	0.00	0.04	$< .001$*
Urban	3	4	0.28 [0.14 - 0.48]	-0.95	0.45	-	-	-
Remote	1	1	0.20 [0.05 - 0.55]	-1.39	0.81	-	-	-
State or territory	14	60	-	-	-	0.09	0.00	1.000
Indigenous involvement	12	58	-	-	-	0.03	1.00	.002*

Table 3 continued

Moderator	k	n	Proportion [95% CI]	logOR	*SE*	$R^2_{(2)}$	$R^2_{(3)}$	*p*
Yes	9	55	0.16 [0.13 - 0.18]	-1.69	0.10	-	-	-
No	3	3	0.24 [0.13 - 0.40]	-1.13	0.38	-	-	-
Cultural adaptations	12	58	-	-	-	0.00	1.00	.005*
Yes	8	53	0.16 [0.13 - 0.19]	-1.68	0.11	-	-	-
No	4	5	0.18 [0.11 - 0.29]	-1.50	0.30	-	-	-
Instrument	14	60	-	-	-	0.04	1.00	.007*
Not described	2	2	0.54 [0.31 - 0.75]	0.14	0.48	-	-	-
AUDIT	1	1	0.20 [0.06 - 0.50]	-1.39	0.71	-	-	-
Quantity-frequency	7	52	0.15 [0.13 - 0.18]	-1.70	0.10	-	-	-
Retrospective diary	4	5	0.22 [0.14 - 0.33]	-1.28	0.29	-	-	-
Study quality	14	60	-	-	-	0.00	0.16	.324

Table 3 continued

Moderator	k	n	Proportion [95% CI]	logOR	SE	$R^2_{(2)}$	$R^2_{(3)}$	p

Note. * $p < 0.05$; $I^2_{(2;3)}$ = Within and between study heterogeneity, respectively; k = number of studies; n = number of estimates; logOR = log-odds (proportion); SE = standard error (log-odds); $R^2_{(2)}$ = the proportion of within-study heterogeneity explained by the covariate; $R^2_{(3)}$ = the proportion of between-study heterogeneity explained by the covariate; p = Likelihood ratio p-value, significant values demonstrate that the addition of the moderator significantly improved model fit; Cohort = sample type; Study quality = Mean response to the Joanna Briggs Institute's Critical Appraisal Checklist for Studies Reporting Prevalence Data; two moderators were removed due to no variance: socioeconomic status, and administration

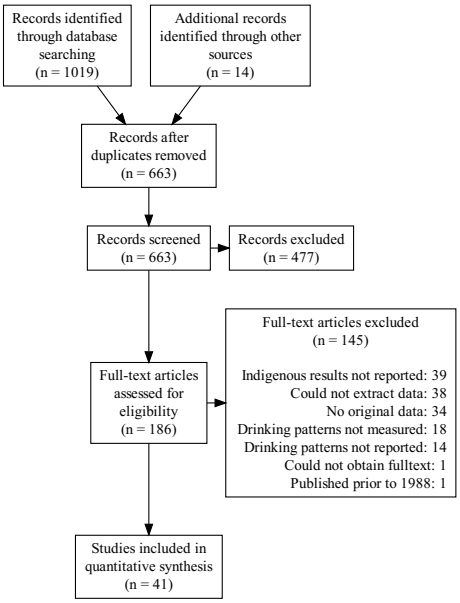

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) inclusion flow diagram

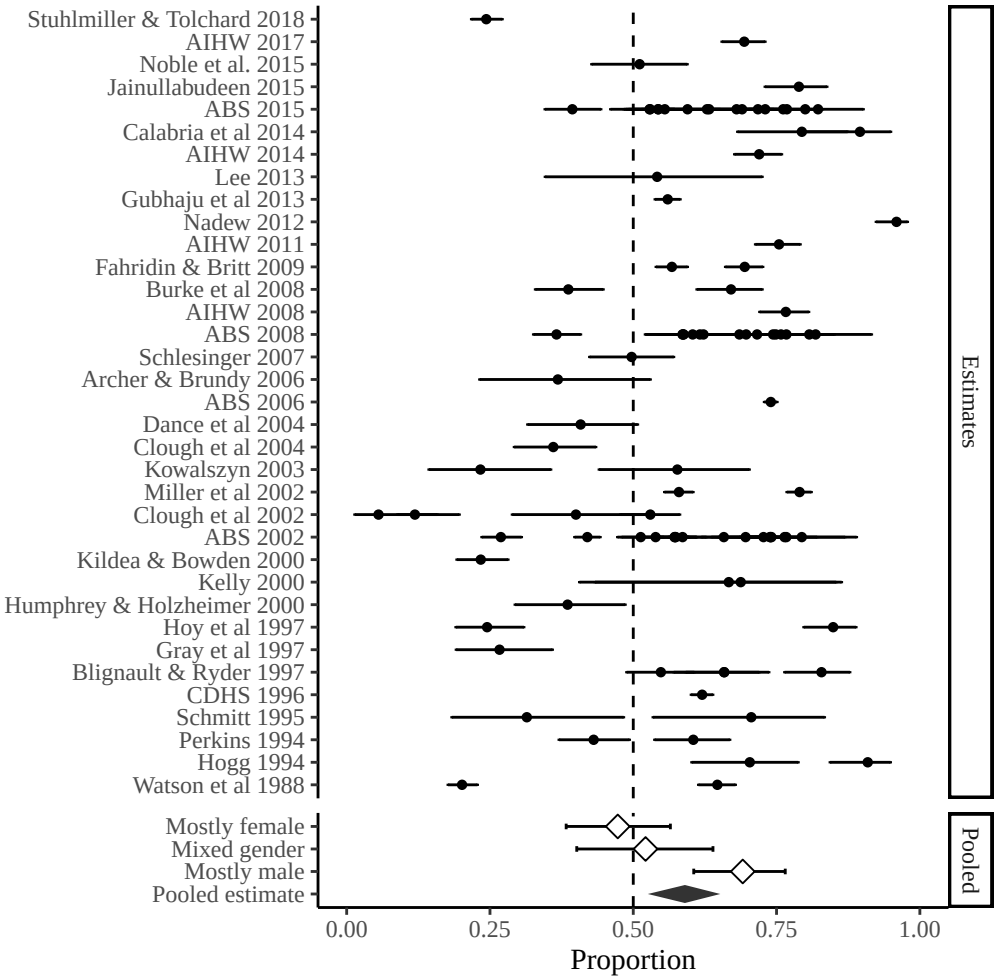

Figure 2. Forest plot for the pooled proportion of current drinkers moderated by gender. Where multiple prevalence estimates were reported by a single study, these are overlaid on the same line (e.g. some studies reported proportions of current drinkers by gender and region). The summary diamonds show pooled estimates according to whether samples were mostly female, mostly male or were of mixed gender.

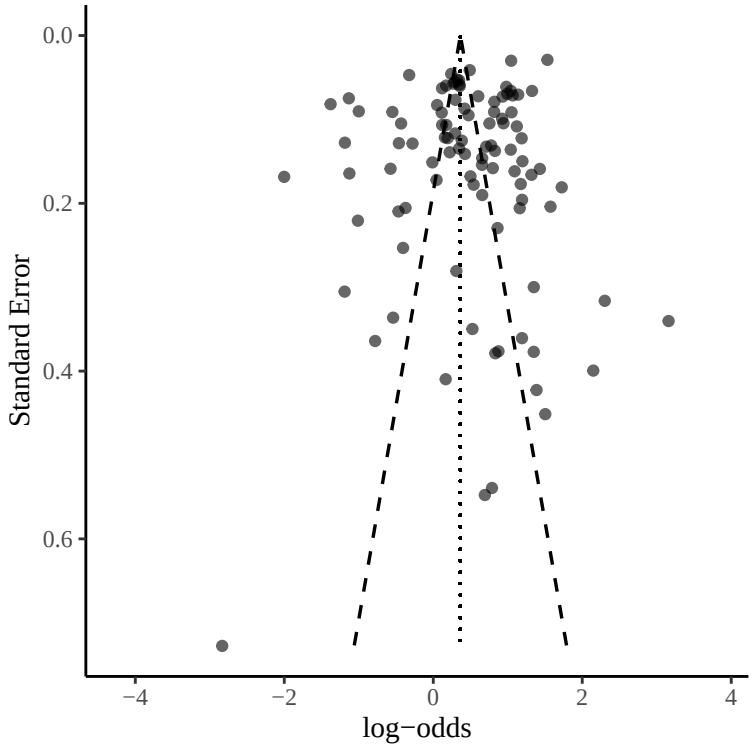

Figure 3. Funnel plot of drinking status (log-odds).

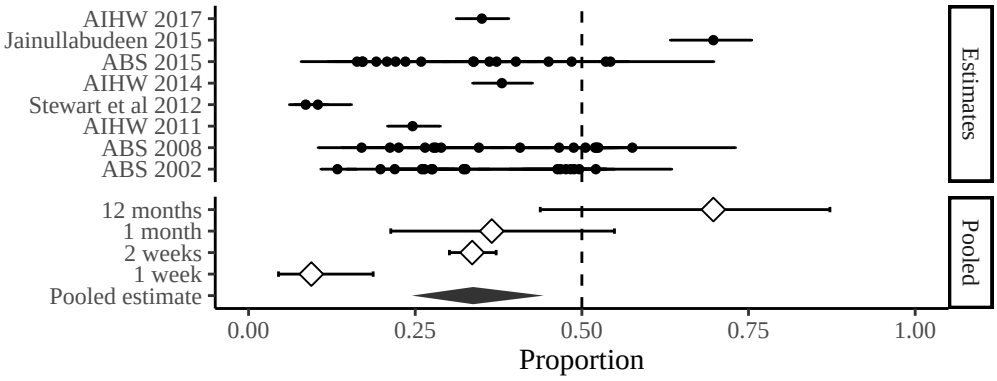

Figure 4. Forest plot showing the proportion of participants at single-occasion risk from alcohol consumption, moderated by reference period

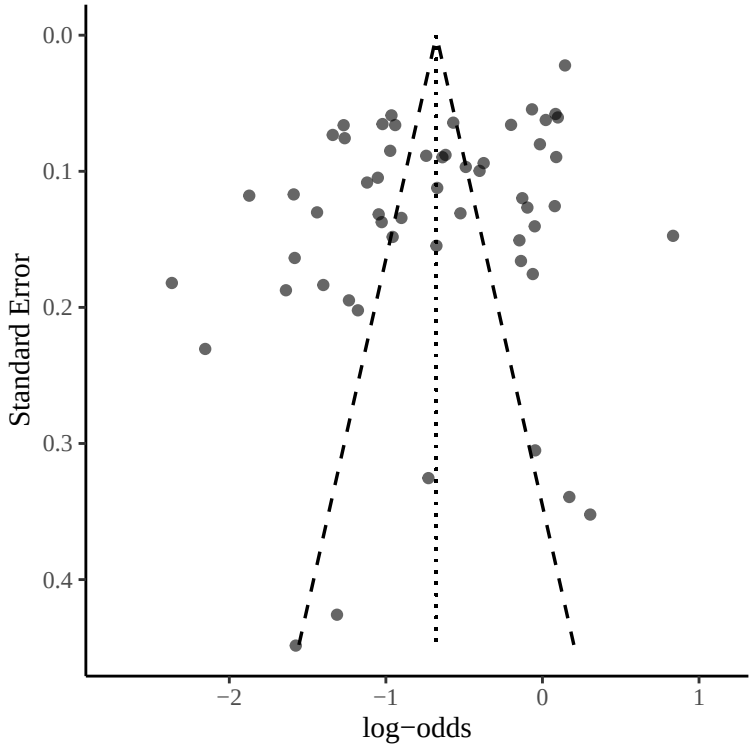

Figure 5. Funnel plot for single-occasion risk (log-odds).

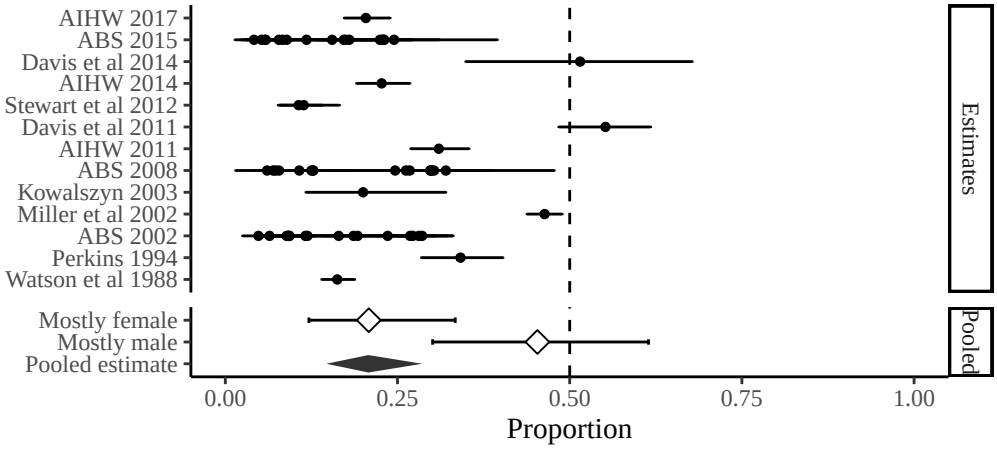

Figure 6. Forest plot showing the proportion of participants found to be at lifetime risk from alcohol consumption, moderated by gender

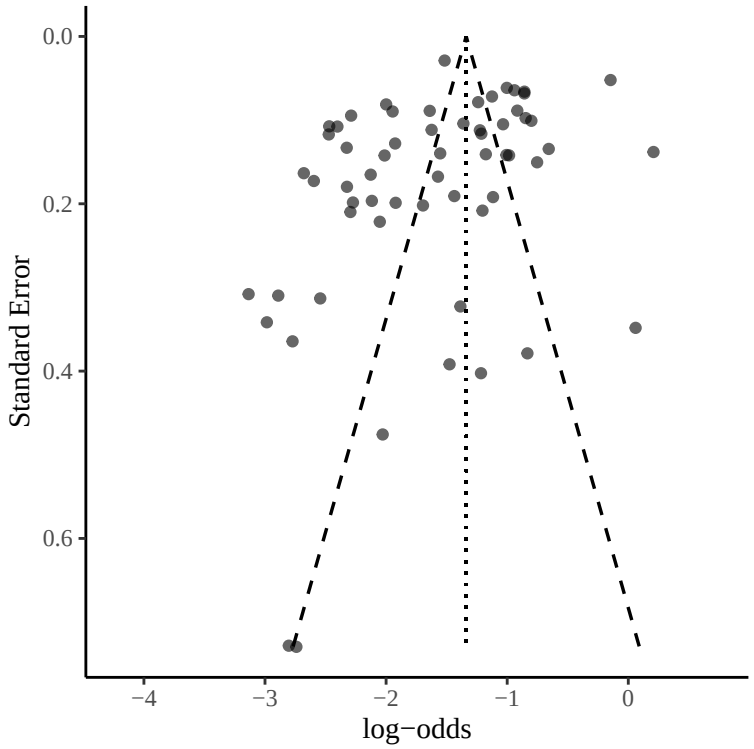

Figure 7. Funnel plot of lifetime risk (log-odds)