Associations of common mental disorder with alcohol use in the adult general population: a systematic review and meta-analysis

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Running head: Common mental disorder with alcohol use

Word count: 4448

ABSTRACT

Background and Aims: Research has shown that alcohol use and common mental disorders (CMDs) co-occur; however, little is known about how the global prevalence of alcohol use compares across different CMDs. We aimed to i) report global associations of alcohol use (alcohol use disorder (AUD), binge-drinking and consumption) comparing those with and without a CMD, ii) examine how this differed among those with and without specific types of CMDs, and iii) examine how results may differ by study characteristics. **Methods**: A systematic review and meta-analysis. Cross-sectional, cohort, prospective, longitudinal and case-control studies reporting the prevalence of alcohol use among those with and without a CMD in the general population were identified using PsycINFO, MEDLINE, PsyARTICLES, PubMed, Scopus and Web of Science until March 2020. Depression, anxiety and phobia were included as a CMD. Studies were included if they used a standardised measure of alcohol use. A random effects meta-analysis was conducted to generate pooled prevalence and associations of AUD with CMD with 95% confidence intervals (CI). A narrative review is provided for binge-drinking and alcohol consumption. **Results**: 512 full-texts were reviewed, 51 included in our final review and 17 in our meta-analyses (*N*=382,201). Individuals with a CMD had a two-fold increase in the odds of reporting an AUD (odds ratio (OR)=2.02, 95% CI=1.72-2.36). The odds of having an AUD were similar when stratified by the type of CMD (mood disorder: OR=2.00, 95%CI=1.62-2.47; anxiety/phobic disorder: OR=1.94, 95%CI=1.35-2.78). An analysis of study characteristics did not reveal any clear explanations for between-study heterogeneity (I^2 >80%). There were no clear patterns for associations between having a CMD and binge-drinking, or alcohol consumption, respectively. **Conclusions**: People with common mental disorders (depression, anxiety, phobia) are twice as likely to report an alcohol use disorder than people without common mental disorders.

Keywords: alcohol, mood disorders, anxiety disorders, comorbidity, associations

INTRODUCTION

It is estimated that 32.5% of the global population consume alcohol (1). While there are differences between countries (2), approximately 18.4% of adults report binge-drinking (3) and 5.1% have an alcohol use disorder (AUD)(2), including harmful and dependent drinking. Despite differences between countries, alcohol use was ranked the seventh leading risk factor for premature death and disability. Alcohol use has also led to 1.6% and 6% of disability adjusted life years for females and males, respectively (1). Meanwhile depressive and anxiety disorders (known as common mental disorders; CMD) are also prevalent in the general population globally, with 4.4% and 3.6% reporting a depressive or anxiety disorder, respectively (4).

Drinking alcohol can be harmful to an individual's mental health particularly if they meet criteria for an AUD (symptoms include an impaired ability to control alcohol use (5)), binge-drinking (generally consuming more than five units alcohol in a certain period (6)), or drinking excessively (drinking excessive amounts of alcohol on most days or weeks (7)). Among the general population, research has found associations between CMD with binge-drinking (8-10) and AUD (11). Research has also shown that those with co-occurring panic disorder and AUD, or depression and AUD, are at an increased risk of mortality compared to those without such disorders (12, 13). Elsewhere, a narrative review found evidence to suggest that anxiety and depressive episodes are related to binge-drinking which can subsequently lead to injury (14). Other research also found college students with co-occurring anxiety and depressive symptoms reported increased weekly alcohol use, more hazardous use and negative alcohol consequences, compared to those without symptoms (15). Nineteen percent of all alcohol-related hospital admissions have been attributed to mental health problems resulted from alcohol use (16) and those with co-occurring alcohol and mental health problems may have difficulties accessing treatment compared to those with only one of these problems (17).

These findings indicate that having a CMD is associated with a range of alcohol outcomes, which have negative health implications on health, however, previous research has focussed specifically on associations with AUD.

There is evidence for an association between worsening mental health and increased alcohol use (18). Motivational models argue that individuals may be motivated to use alcohol to cope with stress (19), where benefits outweigh the cost (20). Such models suggest alcohol may be used to cope with symptoms of poor mental health, and alcohol may be used specifically due to its rapid onset of action (21). This might be the case among those with a CMD as drinking alcohol may be perceived to alleviate symptoms of a disorder (21).

Genome-wide studies have shown a causal relationship between CMDs, such as major depression, and alcohol dependence while the reverse association has not been found (22). However, associations between alcohol use and mental health comorbidity may be more complex and vary based upon the specific type of CMD (23, 24). Among the general population, research has shown that those with major depressive disorder (MDD) were more likely to report lifetime moderate/severe AUD compared to those without MDD (25). Whereas those with generalized anxiety disorder (GAD) were more likely to report mild or severe AUD, compared to those without GAD (25). Elsewhere, a significant association with alcohol dependence among those meeting criteria for alcohol abuse was reported among those with dysthymia but not MDD, compared to those without the respective disorder (26). While a review across observational studies showed differences in associations with AUD with specific types of anxiety disorders, such as panic disorder (27). Differences in associations have also been found for other patterns of alcohol use. For example, a positive association of binge-drinking with anxiety disorder was found among individuals attending primary care in Portugal while a negative association with binge-drinking was found for major depression, compared to those without the respective disorders (10).

Previous systematic reviews have explored alcohol misuse and CMD in both directions, for example, the prevalence of CMD among those misusing alcohol (28) and the prevalence of alcohol misuse among those with a CMD (11). The latter was most recently reported by Lai and colleagues (2015) where those with an anxiety disorder or major depression were around one-and-a-half times more likely to report alcohol abuse, and two-and-a-half and three times more likely to report dependence, respectively (11). This indicates that those with a CMD are more likely to use alcohol at harmful levels, and that there may be differences based upon the type of CMD. However, this review included bipolar disorder in their definition of CMD, which United Kingdom health guidelines on CMD exclude along with other psychotic and related disorders (29-31). This review also did not include post-traumatic stress disorder (PTSD) despite its inclusion as a CMD in United Kingdom health guidelines (32).

To date, there has not been a systematic review or meta-analysis reporting the prevalence of other types of alcohol use, such as binge-drinking, among those with and without a CMD in the adult general population, and by specific CMD diagnoses. The current systematic review and meta-analysis aimed to i) estimate the pooled prevalence of alcohol use (AUD, binge-drinking and alcohol consumption) in those with and without a CMD, ii) evaluate associations between CMD and patterns of alcohol use, iii) examine how prevalence and associations differed across specific types of CMDs and iv) examine how results may differ by study characteristics.

METHOD

This study is pre-registered on PROSPERO (ref. CRD42019126770) and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (33) (see PRISMA diagram in Figure 1 and checklist in supplementary material), and in line with the Condition, Context, Population (CoCoPop) framework (34). The CoCoPop framework is a quality appraisal tool suitable for systematic reviews and meta-analyses which

aim to examine the prevalence of a condition, and therefore, require specific information about groups that may not be required using other frameworks (35).

Inclusion and exclusion criteria

We included peer-reviewed observational studies, comprising cross-sectional, national surveys, cohort, prospective, longitudinal and case control studies published in English. Where the same dataset was used by multiple studies and reported the same outcome, we used the study which reported information on more CMDs. If two or more studies reported the same information, the more recent study was chosen. Reviews and intervention studies were excluded.

Studies which measured the prevalence of lifetime or 12-month AUD, binge-drinking or alcohol use, comparing those with and without a CMD, and used a standardised measure of alcohol use, alcohol use disorder and CMD, for example the Diagnostic and Statistical Manual diagnostic instruments were included. The authors note that definitions of binge-drinking may vary across countries and details of standardised measures of alcohol use and CMD are reported in table 1. CMDs were defined in this review as MDD, dysthymia, GAD, panic disorder, phobias, PTSD, obsessive-compulsive disorder (OCD), or social anxiety disorder (SAD)(36). Studies were excluded if they did not report the prevalence of alcohol use in those with and without a CMD.

As this review aimed to report the global prevalence of alcohol use among those with and without a CMD within the adult general population, studies that focused on treatment-seeking individuals were excluded. Studies which examined the prevalence of alcohol use in those with and without a CMD within a population who experienced a specific traumatic event (e.g. military) or with a specific health condition, such as epilepsy, were also excluded (see table S1 for a full list of criteria).

Search strategy

PsycINFO, MEDLINE, PsycARTICLES, PubMed, Scopus and Web of Science were searched using Boolean methods. Key terms were chosen using databases' own "MeSH" terms or subject headings and broad enough to cover possible synonyms for alcohol use (e.g. alcohol*), CMDs (e.g. depression), comorbidity (e.g. comorbid*) and prevalence (e.g. prevalence) (see table S2 for full search terms). Titles, abstracts and keywords were searched. A manual search of reference lists of studies which met the inclusion criteria was also conducted. The search was conducted from inception until March 2020.

A second researcher (PI) reviewed a random sample of 10% of titles, abstracts and full-texts and checked against the first author's screening to establish reliability for inclusion. A kappa score of 0.62 was confirmed between researchers, indicating moderate agreement in study inclusion (37).

Assessment of methodological quality

The Joanna Briggs Critical Appraisal Checklist for Studies Reporting Prevalence Data was used to assess the methodological quality of each study (34). This checklist consists of nine items (scored 0 if no or unclear evidence or 1 if evidence was present) which covers different methodological aspects, such as the sampling frame, appropriateness of the analysis conducted, and response rate. The maximum possible score was nine.

Data extraction

In accordance with the Joanna Briggs Institute Data Extraction Form for Prevalence Studies, the following study characteristics were extracted: name and date of study, author, titles, journal, year survey was conducted, sample size, use of methods for establishing the diagnosis of CMD and AUD, use of methods to measure SES, study population, country, description of

main results and reviewer comments. We contacted authors for additional information if any key information was missing.

Synthesis of data

Statistical analyses

Our meta-analysis focuses on the prevalence and associations of AUD among those with and without a CMD, other alcohol outcomes were not included due to variance in the measures and cut-offs used. In light of changes to the diagnostic criteria of AUD, we categorised AUD as mild, moderate or severe (5). Studies that used earlier definitions of AUD, such as DSM-IV abuse and dependence, were re-categorised whereby abuse was considered mild and dependence as moderate or severe given previous research indicates that there may be differences in those meeting criteria for alcohol abuse and moderate AUD (38). Due to the small number of studies examining the prevalence among those with and without a specific CMD (e.g. GAD), we grouped CMDs into two broad categories: mood disorder (dysthymia and MDD), anxiety/phobic disorder (GAD, OCD, PTSD, panic disorder, social phobia, simple phobia, and specific phobia). The comparison group was not meeting criteria for any CMD.

A random effects meta-analysis was conducted to examine the global associations of AUD (e.g. mild, moderate or severe AUD) and any CMD. To consider both within and between study variability (39), we then conducted an a-priori random effects meta-analyses to examine the global prevalence and associations of any AUD stratified by type of CMD (e.g. mood disorder), then two post-hoc random effects meta-analyses by i) severity of AUD (e.g. mild AUD vs no AUD excluding moderate/severe AUD, and moderate/severe AUD vs no AUD excluding mild AUD)), and ii) severity of AUD by type of CMD.

For all analyses, studies which reported the total number of participants meeting criteria for a mood, anxiety/phobic disorder, or no disorder were included. Studies which tested

multiple CMDs within the same sample, over multiple time-frames in the same sample (e.g. 12-month AUD and lifetime AUD), or did not state the cut-off used to determine AUD severity were excluded. Stratified analyses, such as severity of AUD by type of CMD, were not conducted where there were less than three sources of data within a group.

The *metaprop* command with Freeman-Tukey transformation was used to pool proportions of those with and without a CMD who reported AUD (40) using the numbers of those with a CMD who reported having an AUD and those with a CMD who did not report having an AUD, and this was repeated among those without a CMD for each study. The pooled proportions were then converted to an odds ratio using the *metan* command with the DerSimonian and Laird mode in STATA 16 (39). Forest plots and tables were generated to present the pooled prevalence, odds ratios and 95% confidence intervals. We conducted a sensitivity analysis by removing studies with the largest and smallest odds ratio to test the effect on the overall odds of having any AUD among those with a CMD and publication bias was assessed using the Egger's test (41) and funnel plot. A planned a priori sub-group analysis by decade of data collected and continent was conducted. It was not possible to conduct other sub-group analyses due to a lack of reporting of demographic characteristics stratified by those with and without a CMD. Heterogeneity was assessed using I^2 and funnel plots using the *metafunnel* command (42).

Narrative synthesis

Due to a small number of studies reporting the prevalence of binge-drinking of which one study had a much larger sample size than others, it was not appropriate to conduct a meta-analysis. Further, due to variances in the measures and cut-offs used to measure alcohol consumption, we were unable to conduct a meta-analysis of alcohol consumption. Instead, a narrative synthesis is provided for these alcohol outcomes.

The current systematic review and meta-analysis had planned to examine the prevalence of alcohol use among those with and without a CMD from different SES backgrounds, however, studies included in this review did not report adequate information. Instead, studies generally reported the overall SES characteristics of the total sample and did not provide the required data stratified by SES.

RESULTS

Study selection

Our initial search yielded 2,862 results after removing duplications with 512 full-texts reviewed after screening titles and abstracts. 51 studies were included in our final review and 17 in our meta-analyses (N=382,201, see PRISMA diagram in Figure 1). Of the 51 studies included, 33 reported the prevalence of mild, moderate or severe AUD (including earlier diagnostic classifications), five of binge-drinking, and 12 of alcohol consumption. Studies were conducted in 24 countries, with the majority in the United States of America (N=10) and used data from 33 surveys. Bias scores ranged from 3-9 with a median of 7 indicating medium to low bias (see table 1).

Study characteristics

Of the 51 studies identified in the systematic review, 34 examined the prevalence of alcohol use among those meeting criteria for an anxiety/phobic disorder and 31 for mood disorder. The type of CMD most commonly studied was MDD (39%). None of the included studies examined alcohol use among those with and without SAD. Of the 33 studies reporting the prevalence of AUD among those with and without a CMD, 16 were not included in the meta-analysis (see reasons in Figure 1).

Insert Table 1 and Figure 1

Primary analysis

Prevalence and associations of any AUD among those with and without a CMD

The pooled prevalence of having any AUD among those with a CMD was higher than those without (K=17, 15% vs 8%, see table 2), with those with a CMD being twice as likely to report any AUD (OR=2.02, 95% CI=1.72-2.36, I^2=90.70%, see table 2). When stratified by 12-month and lifetime AUD, the prevalence remained higher for lifetime AUD among those with a CMD (12-month: K=9, 10%, lifetime: K=8, 21%, see table 2) compared to those without (12-month: 5%, lifetime: 12%, see table 2). Our meta-analysis found associations for both 12-month and lifetime AUD were approximately two-fold among those with a CMD compared to those without (12-month: OR=2.14, 95% CI=1.75-2.62, I^2=78.90%; lifetime: OR=1.91, 95% CI=1.45-2.52, I^2=94.70%, see table 2 and figure 2).

The pooled prevalence and associations of any AUD by the type of CMD, regardless of duration, among those with an anxiety/phobic disorder was 17% (K=9, compared to 10% for those without, see table 3) and 11% for mood disorder (K=6, compared to 5% for those without). Associations of having any AUD were similar for those with a mood or anxiety/phobic disorder (mood: OR=2.00, 95% CI=1.62-2.47, I^2=90.00%; anxiety/phobic: OR=1.94, 95% CI=1.35-2.78, I^2=91.40%, see table 3 and figure 3).

A sensitivity analysis removing studies with the largest (43) and smallest (44) odds ratio resulted in only a small change in the total and lifetime effect size (see figures S5 and S6). In light of changes to the categorisation of mental disorders whereby PTSD and OCD are now two distinct diagnosis classifications ("trauma- and stressor-related disorders" and "obsessive-compulsive and related disorders" (5)), a sensitivity analysis examining differences in associations of any AUD among those with PTSD compared to other anxiety/phobic disorder (without OCD) was conducted and showed a two-fold increase in associations among those with PTSD while associations with other anxiety/phobic disorders were non-significant (see

table S4). We were unable to conduct a sensitivity analysis of OCD due to an insufficient number of studies.

*** *Insert figures 1 and 2*** *

*** *Insert tables 2 and 3*** *

Exploratory analysis

When stratified by the decade (e.g. 1990's) and continent (e.g. Europe) in which the study was conducted respectively, we found similar strengths of associations (see tables S5 and S6).

Heterogeneity

There was substantial heterogeneity between studies when conducting each meta-analysis as illustrated in the forest plots (see figures 1-4), where I^2 percentages were over 80% which was further confirmed by our overall funnel plot (see figure S1). An Egger's test was non-significant (p=0.86) and a funnel plot showed studies remained close to the overall effect size, indicating limited evidence of bias (see figure S7). We also explored sources of heterogeneity by conducting a sub-group analysis according to the decade during which data was collected, continent in which the studies were conducted in, and bias score (see figures S2-S4) but these did not substantially reduce heterogeneity estimates. We were unable to explore heterogeneity according to group characteristics due to a lack of reporting among those with and without a CMD, however, there were differences in the diagnostic criteria used to assess both AUD and CMD which may explain some of the heterogeneity.

Secondary analyses

Prevalence and associations of mild and moderate/severe AUD among those with and without a CMD

The pooled prevalence of mild AUD was higher among those with a CMD compared to those without (K=6, 7% vs 5%, see table 4). Those with a CMD were more likely to report mild AUD

compared to those without a CMD (OR=1.71, 95% CI=1.31-2.23, I^2=75.20%, see table 4 and figure 4). We found 12% of those with a CMD reported moderate/severe AUD compared to 6% of those without a CMD (K=17, see table 4), and those with a CMD were twice as likely to report moderate/severe AUD (OR=2.19, 95% CI=1.82-2.63, I^2=91.30%, see table 4 and figure 4).

Due to the small number of studies examining the prevalence of mild AUD (N=6), it was not possible to conduct a sub-group analysis of mild AUD by the type of CMD, though this was possible for moderate/severe AUD. We found those with a mood or anxiety/phobic disorder were approximately twice as likely to report moderate/severe AUD (mood: K=6, OR=2.02, 95% CI=1.60-2.57, I^2=89.60%; anxiety/phobic: K=9, OR=2.12, 95% CI=1.43-3.14, I^2=92.20%, see table S3).

*** *Insert figures 3 and 4* ***

Narrative synthesis

Binge-drinking among those with and without a CMD

Five studies reported the prevalence of binge-drinking among those with and without a CMD, though there was variation in the cut-offs used to assess this and the duration of binge-drinking (see table 5). Of the five studies, four examined the prevalence of binge-drinking among those with and without depression, one with anxiety and one with PTSD. Four of the five studies reported a higher prevalence of binge-drinking among those with a CMD (3.70%-35.03%, see table 5) compared to those without (1.01%-31.62%). One reported a lower prevalence (12.60% vs 15.10%, see table 5), this may have been due to the study measuring depressive episode or having any anxiety whereas other studies examined specific types of CMDs or depressive symptoms.

Alcohol consumption among those with and without a CMD

Twelve studies reported the prevalence of alcohol consumption among those with and without a CMD, although there was variation in the type of alcohol consumption and CMD assessed and cut-off scores used (see table 6). Three studies reported a higher prevalence of alcohol consumption among those with a CMD (1.66%-24.29%), compared to those without (0.92%-7.94%), six reported a lower prevalence among those with a CMD (0.00%-42.00%) and three reported both higher and lower prevalence depending on the type of CMD and alcohol consumption outcome (0.00%-14.81%, see table 6).

DISCUSSION

Key findings

Our systematic review and meta-analysis aimed to examine the prevalence and associations of AUD, binge-drinking and alcohol consumption among those with and without a CMD, respectively. We found that those with a CMD were twice as likely to report an AUD compared to those without and these associations were similar across types of CMD across decades and continents. Based on the odds ratio, associations between CMD and AUD were stronger for moderate/severe AUD compared to mild AUD. In addition, our narrative review identified both positive and negative associations for CMD with binge-drinking and alcohol consumption indicating that more research using similar methods is required.

Our findings identified that those with a CMD were more likely to report severe levels of AUD and that most studies focussed on associations with a specific type of CMD, such as MDD. We were unable to identify any studies examining associations with SAD. In addition, much of the research has focussed on AUD as opposed to other problematic drinking patterns, such as binge-drinking, despite the high prevalence in the general population (3) and the known negative health impacts (6, 14).

Models of comorbidity and comparisons to previous research

Models of comorbidity have debated whether alcohol worsens mental health or vice versa (18) and previous longitudinal research assessing both pathways indicate stronger support for the notion that poor mental health increases alcohol use (45), however, there is likely to be a bi-directional association. Psychological models, such as the stress-coping model and incentive-motivation model, hypothesise that individuals may be motivated to use alcohol to cope with stress and enhance positive affect (19) and that benefits of drinking outweigh the consequences of not (20). Considering that symptoms of a CMD include low mood and irritability (32), alcohol may be used to cope with symptoms initially, increasing alcohol use (46). The self-medication model argues further that alcohol may be used specifically because of its rapid onset of action and differ according to the individuals' symptoms (21). Our findings are based on cross-sectional research, therefore we cannot infer causality. We found associations between AUD and CMD regardless of the type of CMD and severity of AUD. It may be that individuals with a CMD may use alcohol to enhance positive affect and cope with symptoms of poor mental health. Further qualitative and longitudinal research is required to understand the reasons why those with a CMD use alcohol.

Our narrative review of associations between binge-drinking and CMDs and consumption respectively, showed mixed evidence. Studies included in this review suggest that alcohol use and CMD comorbidity may be more complex as some studies reported increases in binge-drinking or consumption while others did not. This may have been due to the range of CMDs measured or the measures used to assess alcohol use and CMDs. However, previous research suggests that this may also be explained by additional factors, such as gender (10, 15), age (14, 47), and specific CMD diagnoses (9). Future research should consider such characteristics when examining associations between alcohol use and CMD. In addition, further research is required on associations of CMDs with other alcohol outcomes given that

they are more prevalent in the general population compared to AUD (3) and are known to have implications on health (6).

A previous systematic review reported a two-fold increase in the odds of reporting any AUD among those with an anxiety disorder and two-and-a-half-fold increase for those with major depression, in addition to a two-and-a-half-fold and three-fold increase in the odds of reporting alcohol dependence for any anxiety disorder and major depression, respectively. We found slightly weaker associations, with a two-fold increase in the odds of any AUD (and the same for moderate/severe AUD) for any anxiety or mood disorder, respectively. This difference could be explained by the types of CMDs included in our review in which we included MDD, dysthymia, GAD, panic disorder, phobias, PTSD, OCD, or SAD. Whereas Lai and colleagues (11) included agoraphobia, GAD, panic disorder, social phobia, bipolar disorder, dysthymia and MDD. Our sensitivity analysis also showed a two-fold increase in the odds of having any AUD among those with PTSD while a non-significant association was found among those with any other anxiety disorder, excluding OCD.

Other psychological models suggest that comorbid alcohol and mental health problems are due to shared vulnerabilities, such as SES factors (23, 48-50). We attempted to explore this by reviewing evidence examining the prevalence of alcohol use among those with and without a CMD based on SES characteristics, however, studies included in this review did not report this and thus cannot support or reject these suggestions.

Strengths and Limitations

With regards to the studies included in this review, the majority of studies used large sample sizes representative of the general population and standardised criteria to assess alcohol use and CMD, particularly those reporting the prevalence of AUD. There are some limitations to note. Firstly, the majority of studies focussed on the prevalence of alcohol use among those

with and without types of CMDs, namely MDD, rather than other disorders such as SAD. Therefore, we were unable to explore associations beyond broad mood and anxiety/phobic disorders, including more specific disorders. Secondly, we were unable to conduct a meta-analysis on the prevalence and association of binge-drinking or alcohol consumption due to variations in the measures and cut-offs used, therefore, we cannot conclude whether those with a CMD are more likely to report different patterns of alcohol use compared to those without beyond AUD.

With regards to our review, we conducted an extensive search of the literature across multiple databases and included a range of CMDs and types of alcohol use, with large sample sizes. There are also some limitations to note. Firstly, there was substantial heterogeneity between studies. While the majority of studies used diagnostic criteria to establish the presence of CMD and AUD, different versions of criteria were used between studies. There were also limited reporting of group characteristics among those with and without a CMD which may explain some of the heterogeneity. We overcame this by exploring differences in associations between the severity of AUD, type of CMD, as well as the continent and decade in which the study was conducted in. Secondly, we included published research, therefore, we may have missed some grey literature. However, given multiple databases and references were searched, we believe our review was inclusive. Thirdly, some of the associations may have been driven by specific types of CMD, as found in previous research (25), we conducted a sensitivity analysis with PTSD but were unable to do further analyses to due to insufficient numbers. Fourthly, the stratified prevalence by AUD severity would equal the overall any AUD prevalence for studies that provided this stratified data, however, some studies reported moderate/severe AUD only. For those studies which reported the stratified prevalence by AUD severity, then the sum of the mild and moderate/severe prevalence would equal the overall prevalence. But some studies only reported the prevalence for moderate/severe AUD and, in

these cases, this was the same as the numbers included in the overall meta-analysis. Finally, while studies included in this review generally included individuals aged 18 and over, in some cases studies had a minimum age in adolescence (e.g. 15 years and over). Due to the way in which data was presented in these studies, it was not possible to exclude these participants and restrict the prevalence estimates to those aged 18 and over. However, in large population studies the numbers aged under 18 would be in the minority and this should not impact on the prevalence reported.

Conclusions

Our review and meta-analysis show that having a CMD is associated with increased odds of having an AUD, particularly moderate/severe AUD. There was little difference in associations based on the type of CMD. There is a need to ensure alcohol and mental health problems are treated in parallel while more research is required to investigate group characteristics and differences beyond broad CMD classifications. Additional research examining associations between having a CMD with other alcohol outcomes is required to provide a more holistic understanding of drinking patterns among individuals with a CMD.

Funding

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FIGURES AND TABLES

Figure 1: PRISMA flow diagram
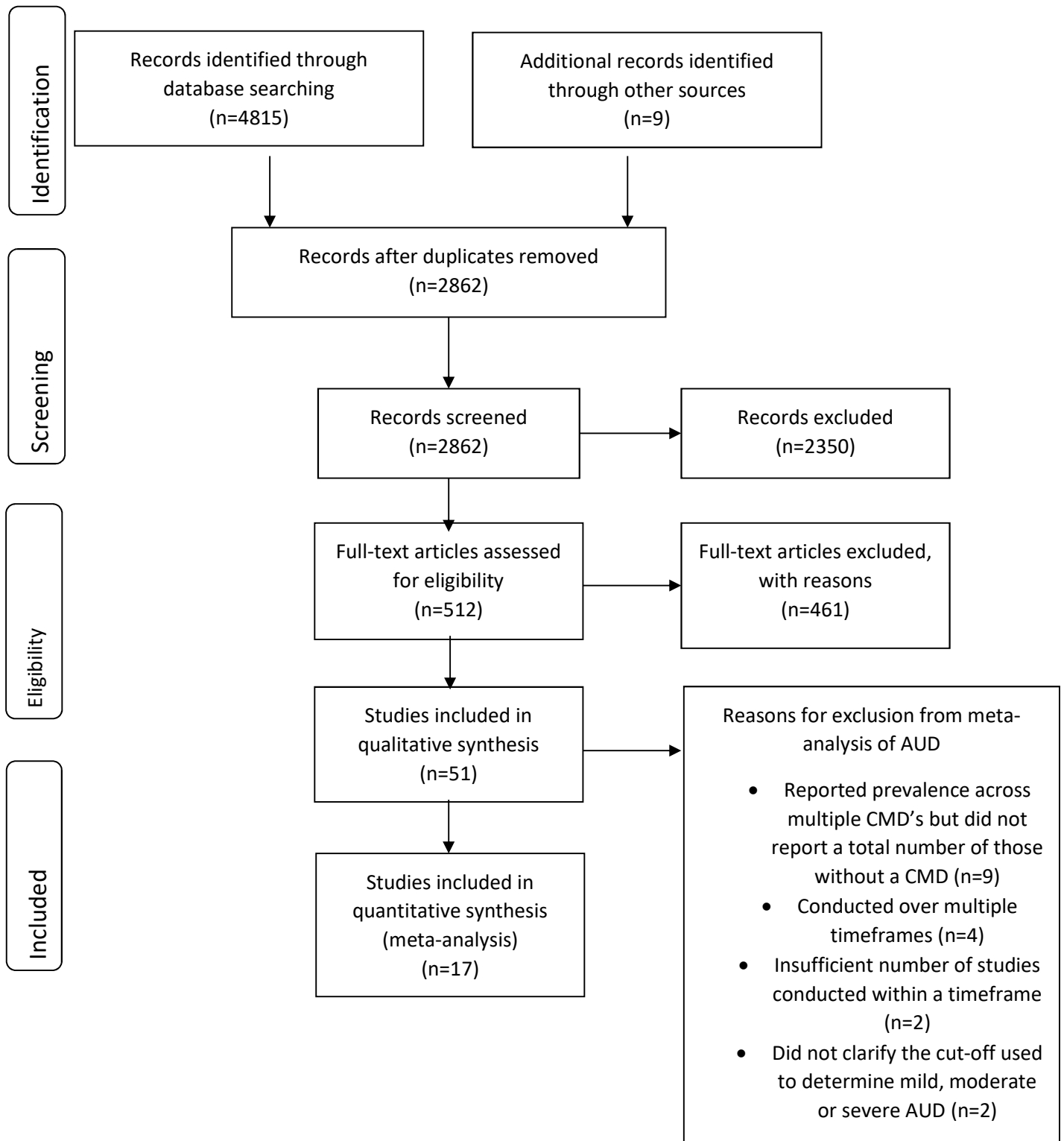
Table 1: Study Characteristics

Study	Year(s) conducted	Country	Dataset	Waves used	Sample size (response rate)	Gender and age	Type of CMD studied (and measure and criteria used to assess presence of CMD)	Type of alcohol use studied (and measure and criteria used)	Duration of AUD	Risk of bias score (max score of 9)
1. Archie et al 2012	2005	Canada	Canadian Community Health Survey	Cycle 3.1	17,524 (response rate not stated)	Gender Female=8587 (49.0%) Male=8937 (51.0%) Age range 15-24	Depressive symptoms (Derived Depression Scale, cut off score of 5 or more)	Binge-drinking (item on alcohol use, 5 or more drinks once a month or more)	12-month	7
2. Batelaan et al 2012	Baseline = 1996, time 1 = 1997. Time 2 = 1999	Netherlands	Netherlands Mental Health Survey and Incidence Study (NEMESIS)	Baseline	5571 (no overall response rate)	Gender Female=2896 (51.9%) Male=2675 (48.1%) Age range Not clear	Panic disorder (Composite International Diagnostic Interview, DSM-III-R)	Alcohol dependence (Composite International Diagnostic Interview, DSM-III-R)	12-month	6
3. Blanco et al 2010	2001-2002	United States of America	National Epidemiologic Survey on Alcohol and Related Conditions (NESARC)	Wave 1	43,093 (81%)	Gender Female=21,662 (51.43%) Male=19,598 (48.57%) Age range 18+	Chronic MDD Dysthymic disorder (Alcohol Use Disorder and Associated Disabilities Interview Schedule, DSM-IV)	Alcohol abuse Alcohol dependence (Alcohol Use Disorder and Associated Disabilities Interview Schedule, DSM-IV)	12-month Lifetime	9
4. Burns & Teesson 2002	1997	Australia	National Survey of Mental Health and Well Being (NSMH&WB)	Wave 1	10,641 (78%)	Gender Female=5452 (51.2%) Male=5189 (48.8%) Age range Age range=18+	Depression Dysthymia Bipolar disorder Panic disorder Social phobia OCD PTSD GAD Agoraphobia (Composite International Diagnostic Interview, DSM-IV)	Alcohol abuse Alcohol dependence Alcohol use disorder (Composite International Diagnostic Interview, DSM-IV)	12-month	7

5.	Caraveo-Anduaga et al 2004	1995	Mexico	-	-	1932 (60.4%)	Gender Female=Not stated Male=Not stated Age range 18+	OCD (Composite International Diagnostic Interview, ICD-10)	Alcohol abuse Alcohol dependence (Composite International Diagnostic Interview, ICD-10)	12-month Lifetime	5
6.	De Castro Longo et al 2020	2007-2008	Brazil	-	-	3744 (81 and 95%)	Gender Female=1584 Male=2160 Age range 15-75	PTSD (Composite International Diagnostic Interview 2.1, ICD-10 and DSM-IV)	Hazardous alcohol use Alcohol dependence (Composite International Diagnostic Interview 2.1, ICD-10 and DSM-IV)	12-month	9
7.	Chong et al 2012	2009	Singapore	Singapore Mental Health Study (SMHS)	-	6616 (76%)	Gender Female=3317 (50.1%) Male=3299 (49.9%) Age range 18+	MDD Dysthymia GAD OCD (World Mental Health Composite International Diagnostic Interview, DSM-IV)	Alcohol abuse Alcohol dependence (World Mental Health Composite International Diagnostic Interview, DSM-IV)	Lifetime	8
8.	Chou et al 2012	NESARC- 2001-2002 KECA-2000	Korea and United States of America	NESARC and Korean Epidemiologic Catchment Area (KECA)	NESARC wave 1 KECA wave 1	NESARC=35,336 (81%) KECA=6253 (79.8%)	NESARC: Gender Female=23,227 (65.7%) Male=15,619 (44.2%) Age range 18-65 KECA: Gender Female=3510 (56.1%) Male=2743 (43.9%) Age range 18-65	MDD Dysthymia Panic disorder Social phobia GAD (NESARC: Associated Disabilities Interview Schedule-DSM-IV Version, DSM-IV; KECA: Korean version of Composite International Diagnostic Interview 2.1, DSM-IV)	Alcohol abuse Alcohol dependence (NESARC: Associated Disabilities Interview Schedule-DSM-IV Version, DSM-IV; KECA: Korean version of Composite International Diagnostic Interview 2.1, DSM-IV)	12-month	9

	Author/Year	Years	Country	Study	Wave	N (%)	Sample characteristics	Mental health measure	Alcohol measure	Timeframe	Score
9.	**Cousins et al 2014**	2009-2011	Ireland	The Irish LongituDinal Study on Ageing (TILDA)	Wave 1	8175 (62%)	Gender Female=2041 (53.4%) Male=1774 (46.6%) Age range 60-99	Depression (Center for Epidemiologic Studies Depression Scale, score of 16 or more)	Problem drinker (CAGE, score of 2 or more)	6-month	7
10.	**Crum et al 2005**	1993-1996	United States of America	Baltimore Epidemiologic Catchment Area (ECA) follow-up	Wave 2	2633 (73%)	Gender Female: 1644 (63.2%) Male: 989 (36.8%) Age range 31-99	MDD (Diagnostic Interview Schedule, DSM-III-R)	Alcohol dependence (Diagnostic Interview Schedule, DSM-III-R)	Lifetime	7
11.	**Currie et al 2005**	2002	Canada	Canadian Community Health Survey (CCHS)	Cycle 1.2	36,984 (77%)	Gender Female=Not stated Male=Not stated Age range 15+	MDE (Canadian World Mental Health Composite International Diagnostic Interview, DSM-IV)	Harmful alcohol use (ICD-10) Alcohol dependence (DSM-IV) (Composite International Diagnostic Interview short form)	12-month	7
12.	**Dahl & Dahl 2010**	2000-2001	Norway	Oslo Health Study (HUBRO)	-	2676: 446=SPAS groups and 2230 controls (response rate not stated)	Gender Female=1558 (58%) Male=1118 (42%) Age range 30-45	Social phobia and anxiety symptoms (MINI-Social Phobia Inventory, score of 8 or more)	Alcohol frequency (Self-report item, more than 1 time per week) Alcohol problems (Self-report item on impairment in job due to alcohol')	1 week and 5 years	3
13.	**Davis et al 2020**	2017	United Kingdom	UK Biobank	-	157,366 (46%)	Gender Female=89,101 (56%) Male=68,265 (44%) Age range: 45-82	Depression (Composite International Diagnostic Interview short form) Anxiety disorder (Composite International	Harmful alcohol use (Alcohol Use Disorder Identification Test score of 16 or more)	12-month	4

								Diagnostic Interview short form) PTSD (Post-traumatic Stress Disorder Checklist-6, score of 14 or more)			
14.	**De Sousa et al 2017**	2013-2015	Portugal	EpiDoC 2 (CoReumaPt) study	Wave 2	1680 (response rate not stated)	Gender Female=908 (54%) Male=772 (46%) Age range 65+	Depression and anxiety symptoms (Hospital and Anxiety Disorder Scale, score of 11 or more)	Alcohol intake (self-report of frequency of alcohol intake and categorised as daily, occasionally, never, cut offs not stated)	Not known	5
15.	**Emerson et al 2017**	2012-2013	United States of America	NESARC	Wave 3	36,309 (60.1%)	Gender Female=10,940 (55.5%) Male=8765 (44.5%) Age range 18+	PTSD (Alcohol Use Disorder and Associated Disabilities Interview Schedule-5, DSM-5)	Alcohol use disorder (Alcohol Use Disorder and Associated Disabilities Interview Schedule-5, DSM-5)	12-month	5
16.	**Forlani et al 2014**	2006	Italy	The Faenza Community Aging Study	-	366 (65.8%)	Gender Female=184 (50.3%) Male=182 (49.7%) Age range 70+	Anxiety symptoms (Geriatric Anxiety Inventory short form, cut off of 3 or more)	Alcohol consumption (quantity of alcoholic drink converted to units per day, defined as alcoholic unit as a glass of wine (125 ml), a can of beer (330 ml) and a small glass of hard liquor (40 ml), cut off of more than 2 alcohol units per day)	Per day	5

17.	**Furihata et al 2018**	2008	Japan	Nihon University Sleep and Mental Health Epidemiology Project (NUSMEP)	-	2559 (54%)	<u>Gender</u> Female=1396 (52.53%) Male=1163 (47.47%) <u>Age range</u> 20+	Depressive symptoms (Center for Epidemiologic Studies Depression Scale , score of 16 or more)	Alcohol consumption (self-report item on drinking more than one glass of sake three times per week, defined as A glass of sake is equal to a 500-ml bottle of beer, 80 ml of distilled spirit, 60 ml of whiskey, or two glasses of wine (240 ml), cut off yes)	1 week	5
18.	**Grant & Harford 1995**	1992	United States of America	National Longitudinal Alcohol Epidemiologic Survey (NLAES)	-	42,862 (household response rate=91.9%, sample person=97.4%)	<u>Gender</u> Not stated without depression <u>Age range</u> 18+	MDD (Alcohol Use Disorder and Associated Disabilities Interview Schedule, DSM-IV)	Alcohol abuse Alcohol dependence (Alcohol Use Disorder and Associated Disabilities Interview Schedule, DSM-IV)	12-month Lifetime	7
19.	**Grant et al 2004**	2001-2002	United States of America	NESARC	Wave 1	43,093 (81%)	<u>Gender</u> Female=25,575 (57%) Male=18,518 (43%) <u>Age range</u> 18+	MDD Dysthymia GAD Panic disorder Phobia (Alcohol Use Disorder and Associated Disabilities Interview Schedule, DSM-IV)	Alcohol abuse Alcohol dependence (Alcohol Use Disorder and Associated Disabilities Interview Schedule, DSM-IV)	12-month	8
20.	**Han et al 2017**	2005-2014	United States of America	National Survey on Drug Use and Health (NSDUH)	Ten waves (2005-2014)	61,240 (71.2-76%)	<u>Gender</u> Female=32,825 (53.6%) Male=28,415 (46.4%) <u>Age range</u>	Depressive episode Anxiety (self-report item, cut-off not stated)	Binge-drinking (Self-report idem, five more drinks on same occasion)	Binge-drinking-30 days Alcohol abuse/dependence-12-month	7

No.	Author	Years	Country	Study	Wave	N (%)	Sample	Depression measure	Alcohol measure	Time frame	Quality
							50+		Alcohol Use Disorder (measure not stated, DSM-IV)		
21.	Ho et al 2016	2003-2004	Singapore	Singapore Longitudinal Aging Study (SLAS)	Wave 1	1070 (72.4%)	Gender Female=585 (53.75%) Male=485 (46.25%) Age range 18+	Depressive symptoms (Geriatric Mental State Examination, DSM-IV)	Alcohol consumption (measure not stated, more than one drink per week)	1-week	5
22.	Husky et al 2018	2005	France	-	-	17,237 (62.7%)	Gender Female=10,262 (59.5%) Male=6975 (40.5%) Age range 18-99	MDD GAD Panic disorder PTSD OCD Specific phobia Social phobia (Composite International Diagnostic Interview short form, DSM-IV)	Alcohol abuse Alcohol dependence (Composite International Diagnostic Interview short form, DSM-IV)	12-month	7
23.	Kawakami et al 2004	1997-1999	Japan	-	-	1029 (56.9%)	Gender Female=578 (56.2%) Male=451 (43.8%) Age range 20+	MDD Mania Dysthymia GAD Panic disorder (World Mental Health University of Michigan Composite International Diagnostic Interview, DSM-III-R)	Alcohol use disorder (World Mental Health University of Michigan Composite International Diagnostic Interview, DSM-III-R)	6-month Lifetime	6
24.	Kessler et al 1997	1990-1992	United States of America	National Comorbidity Survey (NCS)	Wave 1	8098 (82.6%)	Gender Female=4263 (49.26%) Male=3835 (50.74%) Age range 15-54	MDD Dysthymia Panic disorder Social phobia Simple phobia GAD (World Mental Health Composite International	Alcohol abuse Alcohol dependence (World Mental Health Composite International	Lifetime	6

#	Author	Years	Country	Survey	Cycle	Sample (response)	Demographics	Mental health measure	Alcohol measure	Timeframe	Score
								Diagnostic Interview, DSM-III-R)	Diagnostic Interview, DSM-III-R)		
25.	**Kinley et al 2009**	2002-2003	Canada	Canadian Community Health Survey – Mental Health and Well-Being	Cycle 1.2	28,541 (77.0%)	Gender Female=15,074 (52.82%) Male=13,467 (47.18%) Age range 15+	Panic disorder (World Mental Health Composite International Diagnostic Interview, DSM-IV)	Alcohol dependence (World Mental Health Composite International Diagnostic Interview short form, DSM-III-R)	12-month	8
26.	**Kleinberg et al 2010**	2006-2008	Estonia	Estonian Health Interview Survey (EHIS)	-	6105 (60.2%)	Gender Female=3177 (52.04%) Male=2928 (47.95%) Age range 18-85	MDD (Mini-International Neuropsychiatric Interview, DSM-IV)	Binge-drinking (Self-report item partly based on the European Health Determinant Module, defined as five bottles of beer, five glasses of wine, or five glasses of vodka at a time, 5 or more)	12-month	7
27.	**Klemenc-Ketis & Kersnik 2015**	2011	Slovenia	-	-	1002 (response rate not reported)	Gender Female=512 (51.1%) Male=490 (48.9%) Age range Not clear	Anxiety/depression (Gothenburg Quality of Life Instrument, answering yes to mood and anxiety items)	"Risky" drinker (Slovenian version of the Alcohol Use Disorder Identification Test-Consumption, score of 6 or more for men or 5 or more for women)	-	6
28.	**Koyanagi et al 2017**	2002-2004	47 countries	World Health Survey (WHS)	-	201,279 (98.5%, range=63%-99%)	Gender Female=102,279 (50.8%) Male=99,058 (49.2%) Age range 18+	Depressive symptoms (Self-report items to four mandatory questions and two additional ones, DSM-IV)	Alcohol consumption (Self report, defined as how many alcoholic drinks they had on each day in the past seven	7 days	7

									days, cut off 4 or 5 drinks on at least three days)		
29.	**Leray et al 2011**	1999-2003	France	Mental Health in General Population (MHGP) survey	French dataset	36,105 (response rate not stated)	<u>Gender</u> Female=19,458 (53.9%) Male=16,647 (46.1%) <u>Age range</u> 18+	GAD Panic disorder Social phobia PTSD (Mini International Neuropsychiatric Interview, ICD-10)	Alcohol abuse (Mini International Neuropsychiatric Interview, ICD 10)	6-month	6
30.	**Levola et al 2011**	2007	Finland	National FINRISK 2007 Study	-	10,000 but used a random subsample (N=2086, 51.9%)	<u>Gender</u> Female=1140 (54.7%) Male=946 (45.3%) <u>Age range</u> 25-74	Depressive symptoms (Modified Beck's Depression Inventory, score of 8 or more)	Heavy drinking occasion (Timeline-Followback reporting frequency and quantity of consumption of standard alcoholic drink, defined as 12 g of absolute alcohol, cut off of seven, or five or more for men and women, respectively)	28-day	6
31.	**Markkula et al 2016**	2000-2001 and 2011	Finland	Health 2000 Survey and Health 2011 Survey	Wave 1 and 2	Wave 1=6005 (75%) Wave 2=4620 (80.6%)	<u>Gender</u> Female=3257 (54.2%) Male=2748 (45.8%) <u>Age range</u> 30+	Depressive symptoms (Munich Composite International Diagnostic Interview, DSM-IV)	Alcohol use disorder (Munich Composite International Diagnostic Interview, DSM-IV)	12-month	7
32.	**Marquenie et al 2007**	Baseline=1996, time 1=1997, time 2=1999	Netherlands	Netherlands Mental Health Survey and Incidence Study (NEMESIS)	All waves	Baseline=7076 (69.7%), time 1=5618 (79.4%) Time 2=4796 (67.8%)	<u>Gender</u> Female=3777 (53.4%) Male=3299 (46.6%) <u>Age range</u> 18-64	GAD Panic disorder Social phobia Agoraphobia OCD (Composite International Diagnostic Interview version 1.1, DSM-III-R)	Alcohol dependence (Composite International Diagnostic Interview version 1.1, DSM-III-R)	Lifetime and one-month	8

No.	Author/Year	Years	Country	Study	Wave	Sample (%)	Demographics	Mental Health Disorder	Alcohol Measure	Time Frame	Score
33.	**Mendoza-Sassi & Beria 2003**	2000	Brazil	-	-	1260 (7%)	Gender Female=679 (53.9%) Male=581 (46.1%) Age range 15+	Minor psychiatric disorder (depression or anxiety; Self Report Questionnaire-20, cut off score of 6 for men and 7 for women)	Probable alcohol use disorder (Alcohol Use Disorder Identification Test, score of 8 or more)	12-month	7
34.	**Meyer et al 2004**	1996-1997	Germany	Transitional in Alcohol Consumption and Smoking (TACOS)	-	4048 (70.2%)	Gender Female=2019 (61.1%) Male=2029 (63.3%) Age range 18-64	MDD Dysthymia Phobia PTSD OCD (Munich Composite International Diagnostic Interview, DSM-IV)	Alcohol abuse Alcohol dependence (Munich Composite International Diagnostic Interview, DSM-IV)	Lifetime and 12-month	6
35.	**Muller et al 2014**	2004-2008	Switzerland	PsyCoLaus	Wave 2	3694 (67.0%)	Gender Female=1958 (53.0%) Male=1736 (47.0%) Age range 35-75	PTSD (French version of Diagnostic Interview for Genetic Studies, DSM-IV)	Alcohol use disorder (French version of Diagnostic Interview for Genetic Studies, DSM-IV)	12-month	7
36.	**Olaya et al 2018**	2011-2012	Spain	COURAGE	-	4569 (69.9%)	Gender Female=2498 (50.6%) Male=2071 (49.4%) Age range 18+	Panic disorder (adapted version of the Composite International Diagnostic Interview, DSM-5)	Alcohol consumption (frequent drinkers – consumed alcohol in either last 30 days and 7 days or 1-2 days per week with 5/4 standard drinks in last 7 days or 3 or more days per week with 5/4 standard drinks in the last 7 days)	30 days	6
37.	**Osland et al 2018**	2012	Canada	Canadian Community Health Survey - Mental Health (CCHS-	Wave 2	25,097 (68.9%)	Gender Female=Not stated Male=Not stated	OCD (self-reported diagnosis)	Alcohol abuse Alcohol dependence (Composite International	12-month Lifetime	3

	Author	Year	Country	Survey	Wave	N (%)	Sample	Mental disorder	Alcohol disorder	Timeframe	Score
				Mental Health)			Age range 15+		Diagnostic Interview short form, DSM-IV)		
38.	**Pacek et al 2013**	2001-2002	United States of America	NESARC	Wave 1	43,093 (81.0%)	Gender Female=25,575 (57%) Male=18,518 (43%) Age range 18+	GAD Panic disorder Social phobia Specific phobia (Alcohol Use Disorders and Associated Disabilities Interview Schedule, DSM-IV)	Alcohol dependence (Alcohol Use Disorders and Associated Disabilities Interview Schedule, DSM-IV)	Lifetime	7
39.	**Park et al 2013**	2001	Korea	Korean Epidemiologic Catchment Area - Replication (KECA-R)	Wave 2	6510 (81.7%)	Gender Female=3229 (49.6%) Male=3281 (50.4%) Age range 18-64	Specific phobia (Korean version of Composite International Diagnostic Interview, DSM-IV)	Alcohol abuse Alcohol dependence (Korean version of Composite International Diagnostic Interview, DSM-IV)	Lifetime	9
40.	**Patel et al 2002**	1994-1995	United Kingdom	Surveys of Psychiatric Morbidity in Great Britain	Wave 1	8564 (67.2%)	Gender Female=Not reported Male=Not reported Age range 16-64	Social phobia (Clinical Interview Schedule-Revised, ICD-10)	Alcohol dependence (Self-completion questionnaire, cut off score of four or more)	12-month	6
41.	**Patten et al 2015**	2015	Canada	Canadian Community Health Survey - Mental Health (CCHS-Mental Health)	Wave 2	25,113 (68.9%)	Gender Female=12,883 (50.7%) Male=12,230 (49.3%) Age range 15+	MDE MDD (World Mental Health Composite International Diagnostic Interview, DSM-IV)	Alcohol abuse Alcohol dependence (World Mental Health Composite International Diagnostic Interview, DSM-IV)	12-month Lifetime	9
42.	**Pirkola et al 2005**	2000-2001	Finland	Health 2000 Survey	Wave 1	6005 (75.0%)	Gender Female=3257 (54.2%) Male=2748 (45.8%) Age range	MDD Dysthymia GAD Panic disorder Social phobia	Alcohol use disorder (Finnish version of Munich Composite International	12-month	9

No.	Author Year	Dates	Country	Survey	Dataset/Wave	Sample size (response rate)	Demographics	Mental disorder (measure)	Alcohol measure	Timeframe	Score
							30+	Agoraphobia (Finnish version of Munich Composite International Diagnostic Interview, DSM-IV)	Diagnostic Interview, DSM-IV)		
43.	Piwonski et al 2010	-	Poland	WOBASZ	-	13,545 (response rate not reported)	Gender Female=7153 (52.8%) Male=6392 (47.2%) Age range 20-74	Depressive symptoms (Becks Depression Inventory, cut off score of 10 or more)	Alcohol consumption (elf-reporting consumption of three times per week)	7-day	6
44.	Tebeka et al 2018	1999-2003	France	Mental Health in General Population (MHGP) survey	French dataset	38,600 (not stated)	Gender Female=20,342 (52.7%) Male=18,258 (47.3%) Age range Age range 18+	MDD Panic disorder Social phobia GAD PTSD (Mini International Neuropsychiatric Interview version 5.0, ICD-10)	Alcohol use disorder (Mini International Neuropsychiatric Interview version 5.0, ICD-10)	Lifetime	7
45.	Torres et al 2006	2000	United Kingdom	British National Psychiatric Morbidity Survey 2000	Wave 2	8580 (69.5%)	Gender Female=4300 (50.1%) Male=4280 (49.9%) Age range Age range=16+	OCD (Clinical Interview Schedule-Revised, ICD-10)	Hazardous use Alcohol dependence Problem drinking (Alcohol Use Disorder Identification Test and Severity of Alcohol Dependence Questionnaire, cut offs not stated)	12-month	7
46.	Tracy 2002	1993-1994	United States of America	Chinese American Psychiatric Epidemiology Study (CAPES)	-	1735 (82%)	Gender Female=876 (50.5%) Male=859 (49.5%) Age range Range=18-65	PTSD (Diagnostic Interview Schedule, DSM-III-R)	Heavy alcohol use (two items from Composite International Diagnostic Interview, frequency-1-3 times per month and quantity-5+ and 4+ per day)	12-month	7

#	Author	Year	Country	Study	Wave	Sample (response rate)	Demographics	Mental health measure	Alcohol measure	Timeframe	Score
47.	**Van Ameringen et al 2008**	2002	Canada	-	-	2991 (68.1%)	<u>Gender</u> Female=1811 (51.5%) Male=1180 (48.5%) <u>Age range</u> Age range 18+	PTSD (Revised version of Composite International Diagnostic Interview (CIDI), DSM-IV)	Alcohol use disorder (Mini International Neuropsychiatric Interview)	3-day Lifetime	8
48.	**Van Balkom et al 2000**	Not stated	Netherlands	Longitudinal Aging Study Amsterdam (LASA)	-	3056 (86.0%). Used a subsample (N=659) of this restricted to those aged between 55-84	<u>Gender</u> Female=354 (54.0%) Male=305 (46.0%) <u>Age range</u> Age range=55+	GAD OCD Phobia (Diagnostic Interview Schedule, DSM-III)	Heavy/excessive alcohol intake (Garretsen scale, cut off score of four)	6-month	9
49.	**Van den Berg et al 2009**	2002-2005	Netherlands	Rotterdam study	Wave 3	5019 (85.4%)	<u>Gender</u> Female=2848 (56.7%) Male=2171 (43.3%) <u>Age range</u> Range=58-100	MDD Dysthymia GAD Panic disorder Specific phobia Social phobia (Depression= Schedules for Clinical Assessment in Neuropsychiatry, DSM-IV-TR; Anxiety=Munich version of the Composite International Diagnostic Interview)	Excessive alcohol use (Self-reported question, more than 21 alcoholic drinks per week)	7-day	5
50.	**Van Gool et al 2003**	1992-1993 and 1998-1999	Netherlands	Longitudinal Aging Study Amsterdam (LASA)	Waves 1 and 2	1280 (response rate not reported)	<u>Gender</u> Female=698 (54.5%) Male=582 (45.5%) <u>Age range</u> 55-85	Depressive symptoms (Center of Epidemiologic Studies Depression, cut off score of 16 or more)	Alcohol consumption (Health Interview Questionnaire, three or more drinks per day)	Daily	7
51.	**Yu et al 2018**	2012-2013	China	China National Health and Wellness Survey (NHWS)	Waves 3 and 4	36,806 (response rate not reported)	<u>Gender</u> Female=16,698 (45.4%) Male=20,108 (54.6%) <u>Age range</u> 18+	GAD (Generalized Anxiety Disorder-7, cut off score 10 or more)	Alcohol use (measure not stated, excessive)	Not stated	5

Table 2: Prevalence and Associations of Having Any AUD Among Those With and Without a CMD (*N*=382,201)

Any AUD	Prevalence of those with a CMD (%)	95% CI Lower (%)	95% CI Upper (%)	Weight	Heterogeneity (I²)	p	Prevalence of those without a CMD (%)	95% CI Lower (%)	95% CI Upper (%)	Weight	Heterogeneity (I²)	p	OR	95% CI Lower	95% CI Upper	Weight	Heterogeneity (I²)	p
12-month																		
Batelaan et al 2012	8.00	5.00	14.00	10.79			3.00	2.00	3.00	11.09			2.89	1.53	5.45	6.60		
De Castro Longo et al 2020	8.00	6.00	12.00	11.52			2.00	2.00	3.00	11.06			3.39	2.15	5.34	9.75		
Currie et al 2005	17.00	15.00	19.00	12.00			10.00	10.00	11.00	11.15			1.66	1.44	1.90	17.87		
Davis et al 2020	4.00	4.00	4.00	12.14			2.00	2.00	2.00	11.15			1.70	1.60	1.81	19.16		
Husky et al 2018	7.00	4.00	12.00	10.93			4.00	4.00	4.00	11.14			1.72	0.93	3.18	6.88		
Kinley et al 2009	8.00	6.00	10.00	11.82			2.00	2.00	2.00	11.14			3.63	2.66	4.94	13.36		
Markkula et al 2016	9.00	6.00	12.00	11.64			4.00	3.00	4.00	11.10			2.42	1.67	3.51	11.68		
Muller et al 2014	21.00	15.00	28.00	10.88			11.00	10.00	12.00	11.06			1.90	1.27	2.84	10.97		
Patel et al 2002	14.00	6.00	29.00	8.28			15.00	14.00	15.00	11.12			0.94	0.37	2.41	3.72		
Subtotal	10.00	5.00	16.00	100.00	97.87	0.01	5.00	3.00	8.00	100.00	99.84	0.01	2.14	1.75	2.62	100.00	78.90%	0.01
Lifetime																		
Chong et al 2012	10.00	8.00	13.00	12.51			3.00	3.00	4.00	12.51			3.47	2.61	4.60	11.95		
Crum et al 2005	22.00	19.00	27.00	12.41			11.00	10.00	13.00	12.48			1.98	1.50	2.62	11.99		
Kessler et al 1997	35.00	33.00	37.00	12.62			19.00	18.00	20.00	12.51			1.81	1.64	2.00	13.41		
Marquenie et al 2007	9.00	7.00	11.00	12.57			4.00	4.00	5.00	12.51			2.08	1.64	2.64	12.38		
Pacek et al 2013	40.00	37.00	44.00	12.50			42.00	41.00	43.00	12.52			0.97	0.83	1.13	13.11		

	Prevalence among those with the specific CMD (%)	95% CI Lower (%)	95% CI Upper (%)	Weight	Heterogeneity (I²)	p	Prevalence among those without the specific CMD (%)	95% CI Lower (%)	95% CI Upper (%)	Weight	Heterogeneity (I²)	p	OR	95% CI Lower	95% CI Upper	Weight	Heterogeneity (I²)	p
Park et al 2013	23.00	18.00	28.00	12.26			16.00	15.00	17.00	12.51			1.42	1.05	1.91	11.80		
Tebeka et al 2018	9.00	8.00	10.00	12.63			3.00	3.00	4.00	12.52			2.68	2.38	3.01	13.32		
Van Ameringan et al 2008	28.00	24.00	31.00	12.50			14.00	12.00	17.00	12.42			1.92	1.46	2.53	12.05		
Subtotal	21.00	12.00	32.00	100.00	99.35	0.01	12.00	4.00	24.00	100.00	99.92	0.01	1.91	1.45	2.52	100.00	94.70	0.01
Overall	15.00	9.00	22.00	100.00	99.50	0.01	8.00	5.00	12.00	100.00	99.90	0.01	2.02	1.72	2.36	100.00	90.70	0.01

Table 3: Prevalence and Associations of Any AUD Stratified By Type of CMD (*N*=367,487)

Type of CMD	Prevalence among those with the specific CMD (%)	95% CI Lower (%)	95% CI Upper (%)	Weight	Heterogeneity (I²)	p	Prevalence among those without the specific CMD (%)	95% CI Lower (%)	95% CI Upper (%)	Weight	Heterogeneity (I²)	p	OR	95% CI Lower	95% CI Upper	Weight	Heterogeneity (I²)	p
Anxiety/phobic disorder																		
Batelaan et al 2012	8.00	5.00	14.00	10.95			3.00	2.00	3.00	11.12			2.89	1.53	5.45	9.32		
De Castro Longo et al 2020	8.00	6.00	12.00	11.34			2.00	2.00	3.00	11.11			3.39	2.15	5.34	10.86		
Kinley et al 2009	8.00	6.00	10.00	11.49			2.00	2.00	2.00	11.13			3.63	2.66	4.94	11.99		
Marquenie et al 2007	9.00	7.00	11.00	11.57			4.00	4.00	5.00	11.12			2.08	1.64	2.64	12.43		
Muller et al 2014	21.00	15.00	28.00	11.00			11.00	10.00	12.00	11.11			1.90	1.27	2.84	11.30		
Pacek et al 2013	40.00	37.00	44.00	11.49			42.00	41.00	43.00	11.12			0.97	0.83	1.13	12.85		
Park et al 2013	23.00	18.00	28.00	11.26			16.00	15.00	17.00	11.12			1.42	1.05	1.91	12.07		
Patel et al 2002	14.00	6.00	29.00	9.39			15.00	14.00	15.00	11.12			0.94	0.37	2.41	6.95		
Van Ameringan et al 2008	28.00	24.00	31.00	11.50			14.00	12.00	17.00	11.04			1.92	1.46	2.53	12.23		
Subtotal	17.00	9.00	26.00	100.00	97.86	0.01	10.00	3.00	20.00	100.00	99.92	0.01	1.94	1.35	2.78	100.00	91.40	0.01

	Prevalence among those with a CMD (%)	95% CI Lower (%)	95% CI upper (%)	Weight	Heterogeneity (I²)	p	Prevalence among those without a CMD (%)	95% CI Lower (%)	95% CI Upper (%)	Weight	Heterogeneity (I²)	p	OR	95% CI Lower	95% CI Upper	Weight	Heterogeneity (I²)	p
Mood disorder																		
Crum et al 2005	22.00	19.00	27.00	16.47			11.00	10.00	13.00	16.37			1.98	1.50	2.62	16.05		
Currie et al 2005	17.00	15.00	19.00	17.15			10.00	10.00	11.00	16.75			1.66	1.44	1.90	20.34		
Davis et al 2020	4.00	4.00	4.00	17.41			2.00	2.00	2.00	16.76			1.70	1.60	1.81	21.83		
Husky et al 2018	7.00	4.00	12.00	15.18			4.00	4.00	4.00	16.73			1.72	0.93	3.18	7.74		
Markkula et al 2016	9.00	6.00	12.00	16.47			4.00	3.00	4.00	16.65			2.42	1.67	3.51	13.20		
Tebeka et al 2018	9.00	8.00	10.00	17.34			3.00	3.00	4.00	16.74			2.68	2.38	3.01	20.84		
Subtotal	11.00	6.00	17.00	100.00	99.15	0.01	5.00	3.00	9.00	100.00	99.85	0.01	2.00	1.62	2.47	100.00	90.00	0.01

Table 4: Prevalence and Associations of Mild and Moderate/Severe AUD Among Those With and Without a CMD (*N*=382,201)

AUD severity	Prevalence among those with a CMD (%)	95% CI Lower (%)	95% CI upper (%)	Weight	Heterogeneity (I²)	p	Prevalence among those without a CMD (%)	95% CI Lower (%)	95% CI Upper (%)	Weight	Heterogeneity (I²)	p	OR	95% CI Lower	95% CI Upper	Weight	Heterogeneity (I²)	p
Mild AUD																		
Chong et al 2012	8.00	6.00	10.00	17.31			3.00	2.00	3.00	16.66			3.04	2.21	4.18	20.77		
Currie et al 2005	13.00	11.00	15.00	17.72			8.00	7.00	8.00	16.73			1.72	1.46	2.01	26.75		
Husky et al 2018	1.00	0.00	4.00	14.90			1.00	1.00	2.00	16.71			0.49	0.07	3.50	1.71		
Kessler et al 1997	15.00	14.00	17.00	17.86			10.00	9.00	10.00	16.64			1.61	1.38	1.87	27.03		
Park et al 2013	10.00	7.00	15.00	15.80			10.00	9.00	11.00	16.66			1.00	0.64	1.58	15.79		
De Castro Longo et al 2020	2.00	1.00	5.00	16.41			1.00	1.00	2.00	16.60			1.77	0.79	3.96	7.96		
Subtotal	7.00	4.00	12.00	100.00	95.66	0.01	5.00	2.00	8.00	100.00	99.71	0.01	1.71	1.31	2.23	100.00	75.20	0.01

Moderate/severe AUD																	
Batelaan et al 2012	8.00	5.00	14.00	5.66			3.00	2.00	3.00	5.89			2.89	1.53	5.45	4.02		
Chong et al 2012	3.00	2.00	4.00	6.02			0.00	0.00	1.00	5.89			7.32	3.93	13.64	4.11		
Crum et al 2005	22.00	19.00	27.00	5.96			11.00	10.00	13.00	5.84			1.98	1.50	2.62	6.65		
Currie et al 2005	5.00	4.00	7.00	6.08			3.00	3.00	3.00	5.90			1.68	1.31	2.15	6.89		
Davis et al 2020	4.00	4.00	4.00	6.13			2.00	2.00	2.00	5.91			1.70	1.60	1.81	7.82		
Husky et al 2018	4.00	2.00	9.00	5.70			2.00	2.00	3.00	5.90			1.74	0.76	3.96	3.03		
Kessler et al 1997	26.00	24.00	28.00	6.10			12.00	11.00	13.00	5.89			2.23	1.98	2.53	7.61		
Kinley et al 2009	8.00	6.00	10.00	6.02			2.00	2.00	2.00	5.90			3.63	2.66	4.94	6.43		
Markkula et al 2016	9.00	6.00	12.00	5.96			4.00	3.00	4.00	5.88			2.42	1.67	3.51	5.93		
Marquenie et al 2007	9.00	7.00	11.00	6.07			4.00	4.00	5.00	5.89			2.08	1.64	2.64	6.94		
Muller et al 2014	21.00	15.00	28.00	5.69			11.00	10.00	12.00	5.88			1.90	1.27	2.84	5.70		
Pacek et al 2013	40.00	37.00	44.00	6.02			42.00	41.00	43.00	5.90			0.97	0.83	1.13	7.48		
Park et al 2013	15.00	11.00	21.00	5.84			8.00	7.00	8.00	5.89			2.06	1.42	2.98	5.96		
Patel et al 2002	14.00	6.00	29.00	4.68			15.00	14.00	15.00	5.89			0.94	0.37	2.41	2.56		
Tebeka et al 2018	9.00	8.00	10.00	6.12			3.00	3.00	4.00	5.90			2.68	2.38	3.01	7.64		
Van Ameringan et al 2008	28.00	24.00	31.00	6.03			14.00	12.00	17.00	5.76			1.92	1.46	2.53	6.70		
De Castro Longo et al 2020	6.00	4.00	9.00	5.92			1.00	1.00	2.00	5.88			5.45	3.111	9.58	4.52		
Subtotal	12.00	8.00	17.00	100.00	99.26	0.01	6.00	4.00	10.00	100.00	99.88	0.01	2.19	1.82	2.63	100.00	91.30	0.01

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Table 5: Overview of Findings of Studies Examining the Prevalence of Binge-Drinking Among Those With and Without a CMD

Study	Type of CMD assessed	Outcome	Duration	Summary of findings	Demographic characteristics
1. Archie et al 2012	Depression (cut off score >5 or more, derived depression scale)	Binge-drinking (5 or more drinks on one occasion once a month or more)	12-month	**Binge-drinker and depressed:** 420/1199 (35.03%) **Binge-drinker and not depressed:** 5161/16324 (31.62%)	**Gender:** Binge-drinker/depressed: Male: 188/375 (50.00%) Female: 232/824 (28.13%) Binge-drinker/not depressed: Male: 3351/8561 (39.14%) Female: 1310/7763 (23.31%)
2. Han et al 2017	Major depressive episode (yes/no) Anxiety (yes/no)	Binge-drinking (5 or more drinks in last 30 days)	30 days	**With depressive episode:** 2013-2014=169/1339 (12.60%) **Without depressive episode:** 2013-2014=2,142/13,963 (15.10%) **With anxiety:** 2013/2014=123/931 (13.20%) **Without anxiety:** 2206/14371 (15.00%)	
3. Kleinberg et al 2010	MDD (ICD-10)	Binge-drinking (5 or more drinks, never, some times per year, 1-3 times per month, at least once a week*)	12-month	**With MDD:** 26/342 (7.50%) **Without MDD:** 265/5763 (4.60%)	
4. Levola et al 2011	Depressive symptoms (BDI cut off score >8)	Heavy drinking occasion (7 or more drinks for men or 5 or more for women)	28-days	**With depression:** 25/321 (7.79%) **Without depression:** 86/1765 (4.87%)	**Gender and depression** Female=4/198 (2.02%) Male=21/123 (17.07%) **Gender and no depression** Female=36/942 (3.82%) Male=50/823 (6.08%)
5. Tracy 2002	PTSD (DSM-III-R)	Heavy alcohol use (frequency 1-3 times per month and quantity 5+ drinks per day for men and 4+ drinks per day for women, respectively)	12-month	**With PTSD:** 1/27 (3.70%) **Without PTSD:** 17/1691 (1.01%)	

Table 6: Overview of Findings of Studies Examining the Prevalence of Alcohol Consumption Among Those With and Without a CMD

Study	Type of CMD assessed	Outcome	Duration	Summary of findings
1. Dahl & Dahl 2010	Social phobia and anxiety (MINI-SPIN cut off score 8>)	Frequency of alcohol use (>1 times per week) Alcohol problems	Alcohol frequency=1 week Alcohol problems=5 years	**With SPAS:** Weekly drinker=182/446 (40.80%) Alcohol problems=54/446 (11.21%)

			(one or more periods in the last 5 years affected job)		**Without SPAS:** Weekly drinker=1124/2230 (50.40%) Alcohol problems=121/2230 (5.43%)
2.	**de Sousa et al 2017**	Depression (HADS-D cut off score 11>) Anxiety (HAD-A cut off score 11>)	Alcohol frequency (daily*, occasionally, never; cut offs not stated)	Not stated	**With depression:** Daily drinker=58/241 (24.07%) **Without depression:** Daily drinker=553/1439 (38.43%) **With anxiety:** Daily drinker=40/176 (22.73%) **Without anxiety:** Daily drinker=571/1504 (37.97%)
3.	**Forlani et al 2014**	Anxiety symptoms (GAI-SF cut off score of 3>)	Alcohol consumption (<1, 1, 2, 2>* units per day)	Not stated	**With anxiety:** 7/77 (9.09%) **Without anxiety:** 14/289 (4.84%)
4.	**Furihata et al 2018**	Depressive symptoms (CES-D cut off score 16>)	Alcohol frequency (three times per week)	1-week	**With depression:** 32/159 (20.13%) **Without depression:** 533/2175 (24.51%)
5.	**Ho et al 2016**	Depression (GSM, answering yes to questions 1 and 2)	Alcohol frequency (>1 drink per week)	1-week	**With depression:** 0/54 (0.00%) **Without depression:** 14/915 (1.53%)
6.	**Koyanagi et al 2017**	Depressive symptoms (yes to four mandatory questions and 2 additional)	Alcohol consumption (lifetime abstainers, non-heavy drinkers, infrequent heavy drinkers, frequent heavy drinkers* - 4 or 5 drinks for women and men on at least 3 days)	7 days	**With depression:** Frequent heavy drinker=64/12,886 (0.50%) **Without depression:** Frequent heavy drinker=1558/155,835 (1.00%)
7.	**Olaya et al 2018**	Panic disorder (DSM-5)	Alcohol consumption (frequent drinkers – consumed alcohol in either last 30 days and 7 days or 1-2 days per week with 5/4 standard drinks in last 7 days or 3 or more days per week with 5/4 standard drinks in the last 7 days)	12-month	**With panic disorder:** 25/96 (31.30%) **Without panic disorder:** 1680/4176 (42.00%)
8.	**Piwonski et al 2010**	Depressive symptoms (BDI cut off score >10)	Alcohol consumption (>=3 times per week)	Not stated	**With depression:** 63/3800 (1.66%) **Without depression:** 85/9279 (0.92%)
9.	**Van Balkom et al 2000**	GAD OCD Phobia (DSM-III)	Heavy/excessive alcohol intake (cut off score of 4 on Garretsen scale)	6-month	**With phobic disorder:** 1/21 (4.76%) **With panic disorder:** 0/6 (0.00%) **With GAD:** 3/47 (6.38%)

					Without an anxiety disorder: 1/27 (3.70%)
10.	**Van den Berg et al 2009**	MDD Dysthymia GAD Panic disorder Specific phobia Social phobia (DSM-IV-TR)	Excessive alcohol use (more than 21 drinks per week)	Alcohol use=7-day	**With MDD:** 9/96 (9.38%) **With Dysthymia:** 0/19 (0.00%) **With GAD:** 7/103 (6.80%) **With panic disorder:** 4/27 (14.81%) **With specific phobia:** 6/77 (7.79%) **With social phobia:** 5/56 (8.93%) **Without a CMD:** 488/4499 (10.85%)
11.	**Van Gool et al 2003**	Depressive symptoms (CES-D cut off score 16>)	Alcohol consumption (no alcohol intake, moderate, excessive* – 3 or more drinks per day)	Not stated	**With depression:** 7/176 (4.00%) **Without depression:** 45/1104 (4.10%)
12.	**Yu et al 2018**	GAD (GAD-7 cut off score 10>)	Alcohol consumption (do not drink, moderate, excessive*)	Not stated	**With GAD:** 43/177 (24.29%) **Without GAD:** 2769/34,854 (7.94%)

Figure 2: 12-month and lifetime associations of alcohol use disorder (AUD) among those with a common mental disorder (CMD) compared to those without (*N*=382,201)

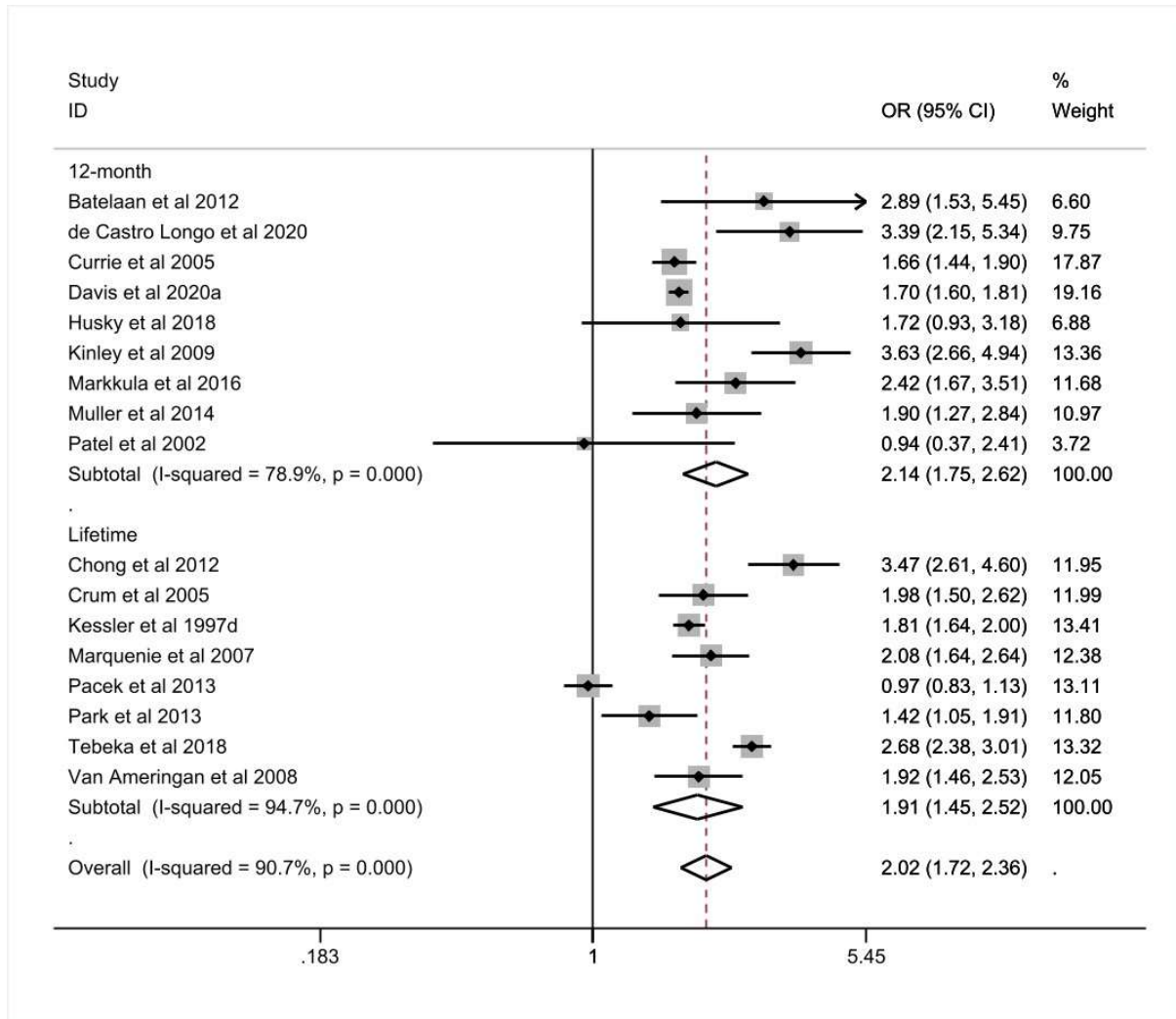| Study ID	OR (95% CI)	% Weight
12-month		
Batelaan et al 2012	2.89 (1.53, 5.45)	6.60
de Castro Longo et al 2020	3.39 (2.15, 5.34)	9.75
Currie et al 2005	1.66 (1.44, 1.90)	17.87
Davis et al 2020a	1.70 (1.60, 1.81)	19.16
Husky et al 2018	1.72 (0.93, 3.18)	6.88
Kinley et al 2009	3.63 (2.66, 4.94)	13.36
Markkula et al 2016	2.42 (1.67, 3.51)	11.68
Muller et al 2014	1.90 (1.27, 2.84)	10.97
Patel et al 2002	0.94 (0.37, 2.41)	3.72
Subtotal (I-squared = 78.9%, p = 0.000)	2.14 (1.75, 2.62)	100.00
.		
Lifetime		
Chong et al 2012	3.47 (2.61, 4.60)	11.95
Crum et al 2005	1.98 (1.50, 2.62)	11.99
Kessler et al 1997d	1.81 (1.64, 2.00)	13.41
Marquenie et al 2007	2.08 (1.64, 2.64)	12.38
Pacek et al 2013	0.97 (0.83, 1.13)	13.11
Park et al 2013	1.42 (1.05, 1.91)	11.80
Tebeka et al 2018	2.68 (2.38, 3.01)	13.32
Van Ameringan et al 2008	1.92 (1.46, 2.53)	12.05
Subtotal (I-squared = 94.7%, p = 0.000)	1.91 (1.45, 2.52)	100.00
.		
Overall (I-squared = 90.7%, p = 0.000)	2.02 (1.72, 2.36)	.

.183   1   5.45

Figure 3: Associations of any alcohol use disorder (AUD) with common mental disorder (CMD), stratified by anxiety/phobic and mood disorders (N=367,483)
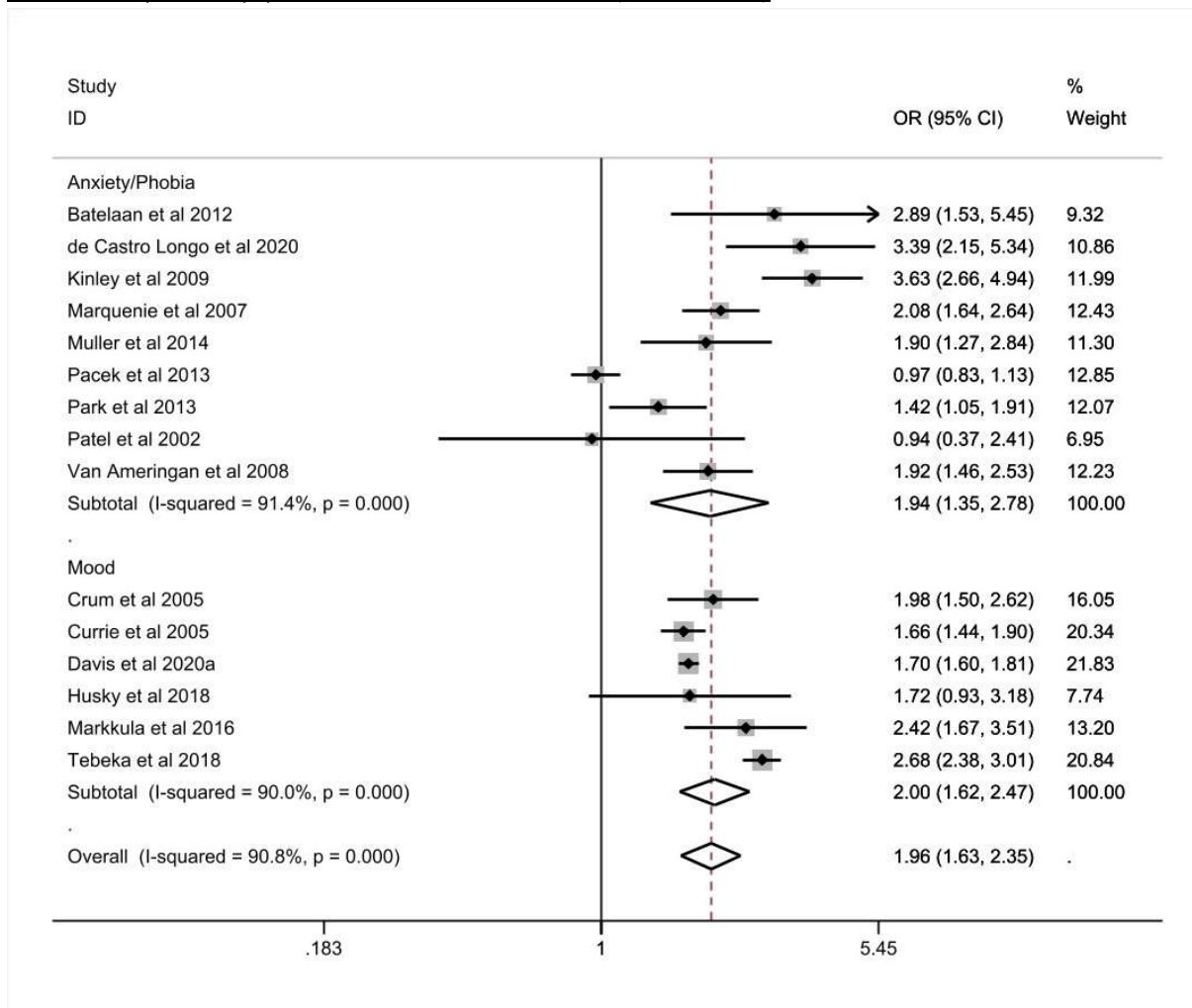
Figure 4: Associations of alcohol use disorder (AUD) among those with a common mental disorder (CMD), stratified by AUD severity (*N*=382,201)

Study ID	OR (95% CI)	% Weight
Mild AUD		
Chong et al 2012a	3.04 (2.21, 4.18)	20.77
Currie et al 2005a	1.72 (1.46, 2.01)	26.75
Husky et al 2018a	0.49 (0.07, 3.50)	1.71
Kessler et al 1997d	1.61 (1.38, 1.87)	27.03
Park et al 2013a	1.00 (0.64, 1.58)	15.79
de Castro Longo et al 2020a	1.77 (0.79, 3.96)	7.96
Subtotal (I-squared = 75.2%, p = 0.001)	1.71 (1.31, 2.23)	100.00
.		
Moderate/severe AUD		
Batelaan et al 2012	2.89 (1.53, 5.45)	4.02
Chong et al 2012b	7.32 (3.93, 13.64)	4.11
Crum et al 2005	1.98 (1.50, 2.62)	6.65
Currie et al 2005b	1.68 (1.31, 2.15)	6.89
Davis et al 2020a	1.70 (1.60, 1.81)	7.82
Husky et al 2018b	1.74 (0.76, 3.96)	3.03
Kessler et al 1997e	2.23 (1.98, 2.53)	7.61
Kinley et al 2009	3.63 (2.66, 4.94)	6.43
Markkula et al 2016	2.42 (1.67, 3.51)	5.93
Marquenie et al 2007	2.08 (1.64, 2.64)	6.94
Muller et al 2014	1.90 (1.27, 2.84)	5.70
Pacek et al 2013	0.97 (0.83, 1.13)	7.48
Park et al 2013b	2.06 (1.42, 2.98)	5.96
Patel et al 2002	0.94 (0.37, 2.41)	2.56
Tebeka et al 2018	2.68 (2.38, 3.01)	7.64
Van Ameringan et al 2008	1.92 (1.46, 2.53)	6.70
de Castro Longo et al 2020b	5.45 (3.11, 9.58)	4.50
Subtotal (I-squared = 91.3%, p = 0.000)	2.19 (1.82, 2.63)	100.00
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Overall (I-squared = 89.4%, p = 0.000)	2.05 (1.77, 2.39)	.

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