

A systematic review of the comorbidity between PTSD and alcohol misuse

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Received: 28 September 2013 / Accepted: 27 February 2014
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Abstract

Purpose This systematic review aimed to assess (1) the level of comorbidity of post-traumatic stress disorder (PTSD) and alcohol misuse reported in research studies since 2007 and (2) any associations found between specific PTSD symptom clusters and alcohol misuse.

Methods A literature search was carried out to capture any papers published from 2007 to the end of July 2012. Six hundred and twenty abstracts were identified and reviewed, and 42 papers were included in the final review after applying inclusion and exclusion criteria.

Results The prevalence of comorbid alcohol misuse in those with PTSD ranged from 9.8 to 61.3 %. The prevalence of comorbid PTSD in those with alcohol misuse ranged from 2.0 to 63.0 %, and the majority of prevalence rates were over 10.0 %. Almost all of the odds ratios representing the strength of association between the conditions across a variety of populations were significant, and those ranged from 1.1 to 4.87. Of the different PTSD symptom clusters, this review found most evidence for

associations between alcohol misuse and both avoidance/numbing symptoms and hyperarousal symptoms.

Conclusions Given that comorbidity appears to be common, the evidence from this systematic review supports the use of routine screening for comorbidity in populations who are known to have PTSD or alcohol misuse.

Keywords Post-traumatic stress disorder · Alcohol misuse · Alcohol use disorder · Comorbidity

Introduction

In England, the Adult Psychiatric Morbidity Survey (APMS) in 2007 found that 3.8 % of the general population were engaged in “harmful” drinking [Alcohol Use Disorders Identification Test (AUDIT) score ≥ 16] and a prevalence of post-traumatic stress disorder (PTSD) of 3.0 % [1]. This survey found that PTSD and alcohol dependence were moderately correlated (tetrachoric correlation = 0.32) [1]. In the US general population, the National Comorbidity Survey (1990–1992) reported a prevalence of comorbid PTSD in those with alcohol dependence of 10.3 % (men) and 26.2 % (women) [2].

Although individual English prevalence rates for PTSD and alcohol misuse appear low compared to some common mental disorders, e.g. mixed anxiety and depressive disorder with a prevalence rate of 9.0 % [1], the combination of PTSD and alcohol misuse results in poorer outcomes. Generally, individuals with comorbid mental health problems have poorer quality of life than those with a single condition [3, 4]. Further, the symptoms of one condition might mask another, and they might also interfere with its management, thus complicating both diagnosis and treatment [1]. More specifically, previous reviews have

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concluded that alcohol abuse may be a predictable consequence of PTSD [5] and that comorbid alcohol dependence and PTSD is a common clinical occurrence associated with poorer outcomes [6]. These previous reviews referenced a range of studies to support the idea of a high level of comorbidity between alcohol misuse and PTSD. However, the research evidence on this comorbidity has not yet been fully assessed or quantified by way of systematic review.

This paper reports on a systematic review, which draws together recent research (since 2007, which was chosen to include publications from the past 5 years) that has measured or examined the comorbidity of PTSD and alcohol misuse in adult populations, an area that has not been previously systematically reviewed. The review then analyses the relationship in more detail: considering whether there are particular symptoms of PTSD which have an association with alcohol misuse.

Methods

Database search

Three databases were searched on 9 August 2012 via the Ovid research tool: PsycINFO (1806–present), MedLine (1946–present) and Embase (1980–present). A summary of the search process is presented in Fig. 1.

Each database was searched using free text keywords. These were chosen to be broad enough to cover all possible synonyms for PTSD and alcohol misuse [broadly defined to include any harmful alcohol use, but particularly aimed at alcohol abuse or dependence as defined in Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV)]. The PTSD aspect of the search used the following keywords: (“posttraumatic stress disorder” OR “post traumatic stress disorder” OR “stress disorder” OR “PTSD” OR “acute stress”). These search terms were combined with any one of the following terms relating to alcohol misuse: AND (“alcohol” OR “drinking” OR “binge”). A further group of keywords were added in order to more precisely target the search towards the *comorbidity* of PTSD and alcohol misuse: AND (“comorbid\$” OR “co-morbid\$” OR “morbidity”). Searches were limited to results published from 2007 onwards, in the English language, and concerning human study subjects only.

Each database (PsycINFO, MedLine and Embase) was searched using its own “MeSH” terms or subject headings. These included: “Posttraumatic stress disorder”, “Stress disorders, traumatic”, “Combat disorders”, “Drinking behaviour”, “Alcoholism”, “Binge drinking”, “Comorbidity” and “Morbidity”.

The results from all of these searches were combined and duplicates removed, which led to an overall total of 620 references that went through to abstract review.

Abstract review

At the abstract review stage, studies not directly relevant to the review were excluded, which reduced the number of studies from 620 to 139. Common themes of studies that were excluded were the following: (1) studies where the sample was chosen for having a particular characteristic other than purely PTSD and/or alcohol abuse, where the aim was to analyse that other primary variable (e.g. personality disorder, bipolar disorder, hepatitis C); (2) studies where PTSD and alcohol abuse were both analysed as consequences of another variable which was the primary focus of the study; (3) studies concerning anxiety/affective disorders generally, where PTSD was not analysed other than as part of that general grouping; and (4) studies about general trauma/stress rather than PTSD specifically.

Inclusion and exclusion criteria

Studies were included according to the following inclusion criteria: (1) more than 100 participants; (2) adult sample; (3) used either standardised/validated measures for PTSD or a clinical diagnosis by a psychiatrist/psychologist; (4) PTSD and alcohol misuse were analysed in their own right (rather than analysing, e.g. a broader “substance abuse” category); and (5) an experimental or observational study design.

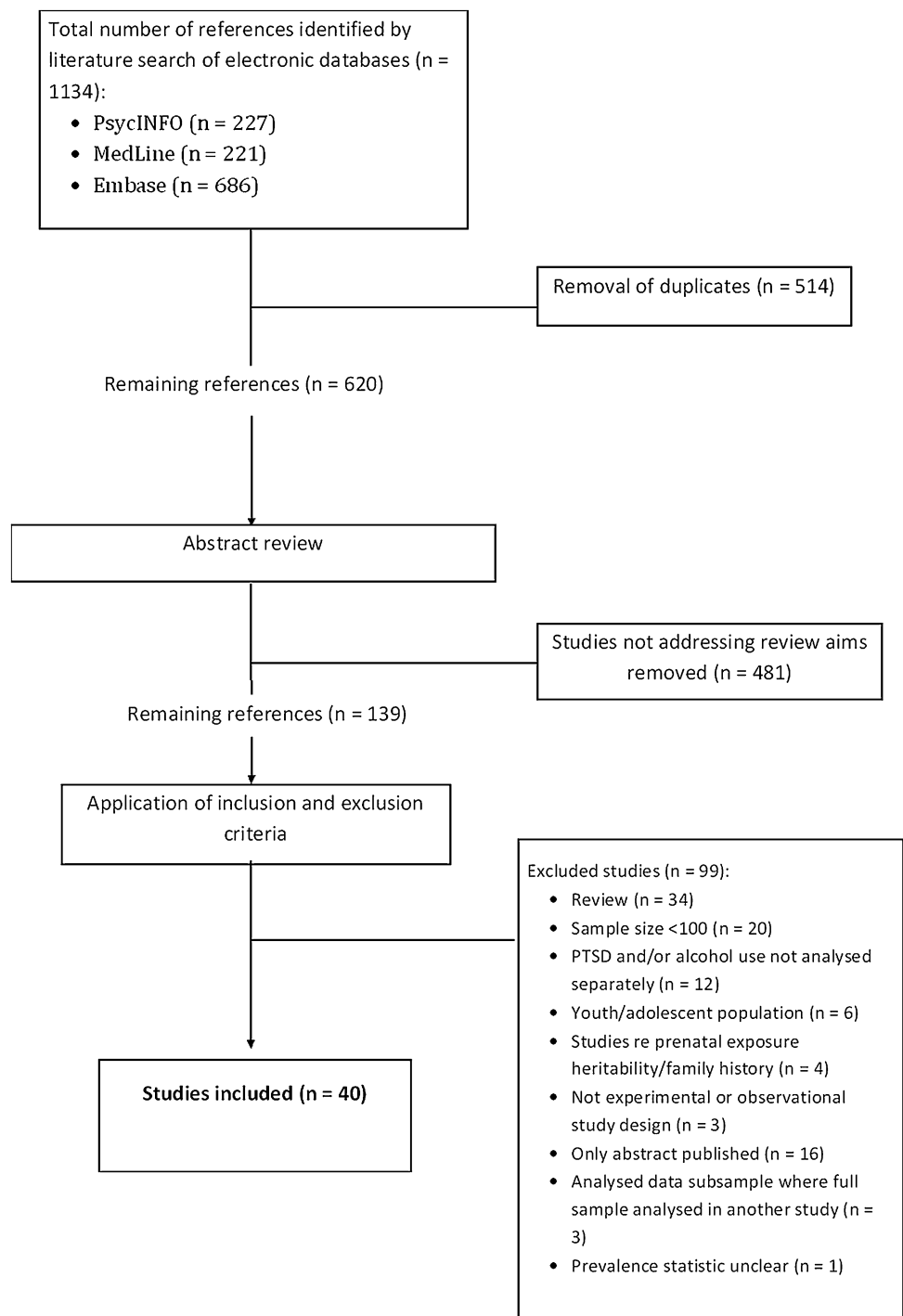
Studies were excluded if: (1) they were reviews or extracts from books; (2) the publication comprised an abstract only; (3) they did not have an experimental or observational study design; (4) they did not analyse PTSD and alcohol misuse in their own right; (5) they analysed a subsample of data already analysed in full in another study; and/or (6) they concerned heritability of or prenatal exposure to PTSD or alcohol misuse, and/or the effect of a family history of PTSD or alcohol misuse, on the basis that they were not focused on the analysis of the relationship between PTSD and alcohol misuse in the same individual. One relevant study was excluded as the comorbidity prevalence statistic it reported was unclear and could not be clarified with the author.

After applying these criteria, 40 studies were included in the review. Two further studies not identified within the search were added when they came to the attention of the authors of this review [7, 8], making a total of 42 studies included in the review.

Authors were contacted where the necessary data were not available in the paper. Additional data were provided by Scherrer et al. [9] and Sullivan and Holt [10].

Data extraction and analysis

The following information was extracted from each study: first author, year of publication, population sampled, how

Fig. 1 Summary of search methodology

sampling/recruitment took place and response rate, the study design (e.g. cross sectional) and the measures used for alcohol misuse and PTSD. Relevant results were extracted, including any comorbidity prevalence rate and any odds ratio describing the strength of association between PTSD and alcohol misuse. Studies were also classified according to whether their sample was treatment-seeking (i.e. recruited from healthcare settings, such as

Department of Veterans Affairs primary care facilities, or recruited into clinical trials to assess treatment for substance misuse or PTSD) or non-treatment-seeking.

For approximately 20 % of the studies, data were extracted by two researchers and then cross-checked for consistency. Once prevalence rates had been extracted Stata 11 (StataCorp [11]) was used to calculate the corresponding 95 % confidence intervals.

Quality scoring methodology

A quality scoring methodology was devised based on guidance for the critical appraisal of research evidence [12], in particular appraisal of cross-sectional studies. The quality score out of 5 was calculated based on the following criteria: (1) clear statement of aims/description of target population: yes (score 1), no (score 0); (2) sample: random sampling (score 1), non-random sampling, e.g. opportunity or self-selected (score 0); (3) sample size >1,000 (score 1), <1,000 (score 0); (4) response rate/follow-up rate >60 % (score 1), <60 % or not stated (score 0); (5) use of standardised/validated measurement of alcohol misuse or diagnostic interview: yes (score 1), no (score 0). Final quality scores, together with the underlying information used in their calculation, are shown in Table 1.

Results

Study characteristics

Table 1 presents details of the 42 studies included in the review [7–10, 13–50]. The majority of studies included within this systematic review were carried out in the USA ($n = 29$). Only two studies were carried out in the UK [7, 39], and the rest were from a range of other countries. Most were cross sectional in design ($n = 34$); the remainder were longitudinal cohort ($n = 7$) or case–control studies ($n = 1$). However, one of the longitudinal studies was effectively cross sectional in relation to the data of interest in this review [36]. Some studies were gender-specific (female $n = 5$, male $n = 8$). Military populations (veterans or serving personnel) featured in almost half of the studies ($n = 18$). A small minority used data from large studies of general populations ($n = 6$), including the National Epidemiologic Survey on Alcohol and Related Conditions [33], the US National Comorbidity Survey-Replication 2007 [21], the Korean Epidemiologic Catchment Area study replication [46] or other general population screening [32, 45, 48]. Some studies were carried out in substance-using populations ($n = 9$). More studies were in treatment-seeking populations ($n = 24$) than non-treatment-seeking populations ($n = 18$).

The majority of studies ($n = 30$) reported a prevalence rate of comorbid PTSD and alcohol misuse and/or an odds ratio for the strength of the association between PTSD and alcohol misuse. These were framed in one or more of the following ways: (1) the prevalence rate of comorbid PTSD and alcohol misuse; (2) the prevalence/odds of alcohol misuse in a sample defined as having PTSD; and (3) the prevalence/odds of PTSD in a sample defined as having alcohol misuse.

Three of the studies that reported a prevalence rate/odds ratio went on to analyse the association between alcohol misuse and specific symptom clusters. A further six studies reported findings regarding symptom cluster associations, therefore nine studies in total considered symptom cluster associations.

The remaining seven studies either presented a statistic representing the correlation between PTSD and alcohol misuse ($n = 3$) or analysed the relationship between PTSD and alcohol misuse ($n = 3$), e.g. whether the severity of each condition was interlinked.

The vast majority of studies ($n = 31$) scored 3 or more for quality.

Prevalence of comorbid PTSD and alcohol misuse

Two studies reported the comorbidity of PTSD and alcohol misuse in a population not already defined as having PTSD or alcohol misuse. The prevalence rates found were 15.9 % [29] and 25.0 % [31].

Comorbid alcohol misuse in those with PTSD

Fifteen studies reported a prevalence rate for alcohol misuse in those with PTSD and/or an odds ratio describing the association between PTSD and alcohol misuse (Fig. 2) [9, 17, 21, 23, 27, 32–34, 36, 37, 40, 41, 45, 49, 50].

The prevalence of alcohol misuse in those with PTSD ranged from 9.8 to 61.3 %. The highest prevalence rate was found by Scherrer et al. [9], in a study with a quality rating of 3, and this was the rate of alcohol dependence in those with PTSD. One of the lowest prevalence rates was found in a large, representative national survey, in a study scoring 3 for quality [45]. One study scored below 3 for quality, which reported a prevalence of 45.0 % [50].

Comorbid PTSD in those with alcohol misuse

Fourteen studies reported a prevalence rate for PTSD in those with alcohol misuse and/or an odds ratio describing the association between alcohol misuse and PTSD (Fig. 3) [7, 10, 14, 18, 24, 26, 37, 39, 42–46, 48].

The prevalence of PTSD among those misusing alcohol ranged from 2.0 to 63.0 %, with most falling within the ~15–30 % range. The highest was from a large (>456,000 person) study of US veterans from operations in Iraq/Afghanistan [37]. The next highest (53.6 %) was from a small UK military population study [7], with a quality score of 2. The lowest prevalence rates for current and lifetime PTSD were from a small sample of women with alcohol use disorders ($n = 260$) recruited to two randomised controlled trials comparing manual-based cognitive behavioural treatments for alcohol use disorders [18].

Table 1 A summary of the design and main results for each study included in the systematic review ($n = 42$)

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
<i>US studies</i>							
1 Blume et al. [14]	Mexican-Americans reporting heavy alcohol use	100 Mexican American volunteers aged 15–80 years with one positive response to CAGE questionnaire. No response rate stated	Cross-sectional study (measures administered to participants by researchers)	Structured Clinical Interview for DSM-IV; PTSD Symptom Severity-Self report (PSS-SR)	CAGE (screening), Structured Clinical Interview for DSM-IV	83.0 % met criteria for DSM-IV alcohol use disorders, and 19.0 % met DSM-IV criteria for PTSD A significant association was found between PTSD and alcohol use diagnosis, where total PTSD scores were significantly associated with the absence of a DSM-IV alcohol use diagnosis [OR 0.90 (0.83–0.97), $p < 0.05$ in the “no alcohol abuse” group]. However, in a model which also included anxiety and hopelessness measures, PSS-SR was not found to be significantly associated with DSM-IV alcohol use diagnosis: OR 0.99, (0.90–1.08) i.e. non-significant in the “alcohol abuse” group	2
2 Chiu et al. [14]	US retired fire fighters exposed to 9/11 or during the 2 weeks after	1,915 retired, male fire fighters who completed a WTC Medical Monitoring and Treatment Program visit. Response rate = 47.0 %	Cross-sectional study	PTSD Checklist-17 modified to fit context of 9/11	Alcohol Use Disorders Identification Test	“Elevated PTSD risk” (score >38) in 22.0 % of participants. Unadjusted alcohol use disorder (score >7) was associated with PTSD risk [OR 2.0 (1.5–2.5), $p < 0.01$]; when adjusted for elevated depression risk, the association was no longer observed [OR 1.1 (0.8–1.5), $p < 0.65$]	3
3 Coffey et al. [15]	US adults in substance abuse programmes	162 patients recruited from local substance abuse programmes meeting criteria for cocaine and/or alcohol dependence. 97.6 % of the samples originally recruited were included in the analysis	Cohort study (longitudinal analysis)	Modified PTSD Symptom Scale Self-Report; National Women’s Study PTSD module; Clinician administered PTSD Scale	Structured Clinical Interview for DSM-III-R; Addiction Severity Index; Time Line Follow Back	PTSD and non-PTSD groups did not differ significantly on alcohol addiction severity scores (PTSD group mean score 0.38, SD 0.28; non-PTSD group mean score 0.29, SD 0.28)	3
4 Drapkin et al. [16]	US adults seeking treatment for PTSD, alcohol dependence or both	167 individuals with comorbid PTSD/alcohol dependence (AD); 105 individuals with PTSD and 240 individuals with AD. Recruited to RCTs by referrals and newspaper advertisements. Response rate/follow-up rate for the RCTs not stated	Cross-sectional study (compared baseline functioning of samples from 3 RCTs)	PTSD Symptom Severity-Interview; Structured Interview for PTSD	Structured Clinical Interview for DSM-IV; Time Line Follow Back; Drinker Inventory of Consequences (DrinC); Penn Alcohol Cravings Scale (PACS)	The PTSD/AD group had significantly higher levels of cravings to drink (on the PACS scale) than the AD-only group ($F = 7.00, p = 0.005$). However, the PTSD/AD sample did not differ from the AD-only sample on reported alcohol consumption, and reported similar amounts of negative consequences for drinking on the DrInC scale The PTSD-only and PTSD/AD samples did not differ on reported PTSD symptoms. The one area of significant difference was related to depression (based on BDI score): the PTSD/AD sample reported significantly higher levels of depression than both the AD-only sample and the PTSD-only sample ($F = 13.27, p = 0.000$)	2

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
5 Durai et al. [17]	US male veterans >65 years old attending primary care at VA sites	17,205 eligible veterans >65 years old recruited from 6 Department of Veterans Affairs primary care sites. Response rate = 89.1 %	Cross-sectional study (screening phase of multisite trial)	Short instrument published in the Veterans Health Administration Clinical Guidelines for Major Depressive Disorder including Co-morbidities of Substance Use and PTSD (1997) (including 1 question on trauma from the Quick Diagnostic Interview Schedule, and 3 questions on symptom clusters from the PTSD Checklist)	"At risk drinking" = 14 or more drinks/week for men (dietary guidelines) or >2 binges/3 months	Of the participants who had experienced qualifying traumatic events ($n = 5,585$), 37.0 % endorsed PTSD symptoms from any cluster (11.9 % of total sample). Of those with symptoms, 89.0 % had "partial PTSD" (symptoms from 1 or 2 clusters), and 11.0 % ($n = 228$) had PTSD (all clusters). "At-risk drinking" was significantly associated with both partial PTSD [OR 1.3 (1.1–1.5)] and PTSD-all clusters [OR 1.4 (1.0–2.1)]. The Cochran-Armitage Trend Test (3.631, $p < 0.001$) supported the hypothesis that the prevalence of at-risk drinking correlated with increasing levels of PTSD symptoms (no trauma, trauma-no PTSD, partial PTSD, PTSD-all clusters). The prevalence of at-risk drinking in the "PTSD-all clusters" group was 14.8 % (compared to 10.9 % for "no trauma", 12.2 % for "trauma but no current PTSD", and 13.3 % for "partial PTSD").	3
6 Farris et al. [18]	US women with alcohol use disorders	260 women with alcohol use disorders actively recruited to and participating in two randomised clinical trials comparing manual-based cognitive behavioural treatments for alcohol use disorders. 87.3 % of women completed the immediate post-treatment assessment, and 81.2 % provided data 6 months post-treatment	Cross-sectional data (within a longitudinal, experimental study)	Structured Clinical Interview for DSM Disorders; PTSD section of the Psychiatric Research Interview for Substance and Medical Disorders	Structured Clinical Interview for DSM Disorders; Timeline Follow-Back Interview	The prevalence of lifetime PTSD was 5.8 %, and the prevalence of current PTSD was 2.7 %. The presence of a lifetime PTSD diagnosis did not significantly predict variance in percent days drinking post-treatment or during follow-up	3
7 Gahm and Lucento [19]	US Army soldiers	2,882 active duty Army soldiers recruited as they entered an outpatient behavioural health clinic as new cases between June 2003 and July 2005 (i.e. all new cases). Response rate not stated	Cross-sectional study (data from clinical records plus a questionnaire)	Primary Care PTSD Screen	Alcohol Use Disorders Identification Test	44.0 % of the sample screened positive for PTSD, and 23.0 % of the sample screened positive for alcohol use (AUDIT ≥ 8). 62.6 % of the sample screened positive for ≥ 2 of depression, anxiety, panic, PTSD and alcohol use. The inter-correlation between the PTSD clinical scale and the alcohol clinical scale was calculated to be 0.135 (significant at the 0.01 level)	3

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
8 Hien et al. [20]	US women in community-based drug and alcohol treatment programmes	353 women recruited by 7 substance abuse treatment programmes, with full or sub-threshold PTSD and current drug or alcohol abuse/dependence. Follow-up rate not stated	Secondary (longitudinal) analysis of a RCT of two 12-session group interventions (substance use and PTSD) were assessed during and after treatment at certain points)	PTSD Symptom Severity-Self Report	Addiction Severity Index-Lite (alcohol use in last 30 days)	At baseline, mean PSS-SR severity score (total) in the alcohol misuse group was 48.41 (SD 14.78), compared to 44.19 (15.34) in the no alcohol misuse group ($p = 0.016$) At baseline, mean cluster C (avoidance/numbing) scores were significantly higher in the alcohol misuse group: 19.35 (SD 7.13) compared to the no alcohol misuse group: 17.24 (SD 6.93); $p = 0.009$. Mean cluster D (hyperarousal) scores were also significantly higher in the alcohol misuse group: 18.07 (SD 5.75) compared to the no alcohol misuse group: 16.50 (SD 6.01); $p = 0.022$. However, there were no significant differences between the two groups by cluster B (re-experiencing) scores Among participants with alcohol misuse at baseline, there were no significant differences in PSS-SR scores during the first week of treatment between the two treatment groups ($p = 0.92$). However, the PSS-SR scores were significantly lower for those in Seeking Safety during the remainder of treatment ($p < 0.05$) and follow-up ($p < 0.05$) compared to the Health Education group	2
9 Hofmann et al. [21]	US adults	Data were drawn from the public release of the National Comorbidity Survey-Replication (NCS-R). Interviews were conducted with 9,282 respondents, and sampling was based on a multi-stage clustered area probability design. 70.9 % response rate	Cross-sectional study (face-to-face interview comprising a core diagnostic assessment of all respondents, and further interview of a sub-sample)	World Mental Health Survey Initiative Version of Composite International Diagnostic Interview	World Mental Health Survey Initiative Version of Composite International Diagnostic Interview	The study compared lifetime ORs for alcohol abuse/dependence among those with PTSD plus externalising problems, those with PTSD alone, and those with externalising problems only (e.g. conduct disorder and ADHD). PTSD alone was the anxiety disorder most consistently associated with the highest odds of alcohol use disorder (OR 3.8, CI 2.8–5.0 for alcohol dependence, OR 4.6, CI 3.1–6.9 for alcohol abuse). When externalising problems were comorbid, the odds ratios decreased [1.1 for alcohol dependence (ns), 1.7 for alcohol abuse ($p < 0.05$)]	5
10 Hruska et al. [22]	US motor vehicle accident victims	238 non-amnesic motor vehicle accident victims admitted to a level-1 trauma centre were recruited during their hospital stay. Of those initially recruited ($n = 356$), complete data were available for 238 participants at 6 weeks (66.9 %)	Longitudinal study (recruited during hospital stay then follow-up assessments at 6 weeks and 6 months)	Impact of Event Scale—Revised; Clinician Administered PTSD Scale; Brief COPE inventory	Structured Clinical Interview for DSM-IV	The bivariate correlation between IES-R PTSD scores and alcohol use disorder history was found to be 0.07 (ns) at 6 weeks post-accident	3

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
11 Jakupcak et al. [23]	US veterans (OEF/OIF)	287 OEF (Afghanistan)/ OIF (Iraq) veterans were consecutively assessed at intake to a health clinic from 3 May 2004–1 January 2007. Final sample was 85.4 % of those assessed (due to removal of cases with missing variables)	Cross-sectional study (self-report questionnaires)	PTSD Checklist Military version	Patient Health Questionnaire	28.0 % of veterans screened positive for alcohol misuse, and 37.3 % for PTSD. A logistic regression analysis found that PTSD status was a significant, unique predictor of alcohol misuse (OR 2.10, 95 % CI 1.02–4.32). A second logistic regression analysis found that emotional numbing symptoms (part of cluster C) were significantly associated with alcohol misuse status (OR 1.35, 95 % CI 1.04–1.75). There was also a trend towards a significant association between hyperarousal symptoms (cluster D) and alcohol misuse status (OR 1.28, 95 % CI 0.98–1.69; $p = 0.08$). In contrast, there was no significant association between intrusion symptoms (cluster B) (OR 0.90, CI 0.71–1.15) or effortful avoidance symptoms (part of cluster C) (OR 0.68, CI 0.39–1.18) and alcohol misuse status	4
12 Johnson et al. [24]	US female adults with problem drinking or drug use	791 18–67-year-old women were recruited into an HIV prevention study through street outreach via non-probability sampling and had either problem drinking as identified using AUDIT or tested positive for cocaine, amphetamine or heroin in the urine in the last 30 days. 32.0 % of women eligible ($n = 858$) completed baseline assessments; data for 791 were included in the final analysis (i.e. those reporting a history of a DSM qualifying traumatic event)	Cross-sectional study	Computerised Diagnostic Interview Schedule for DSM-IV	AUDIT (screening); Composite International Diagnostic Interview Substance Abuse Module for DSM-IV diagnoses	22.0 % of sample with only alcohol dependence (AD) currently had PTSD (OR 1.71, $p = 0.04$) and 28.0 % at some point in their lifetime (OR 1.74, $p = 0.02$), compared to 19.0 and 14.0 %, respectively, in the non-dependence group. Of those with AD, 60.0 % met PTSD Criterion B over lifetime (OR 1.92, $p = 0.001$), 50.0 % met Criterion C (OR 1.96, $p = 0.001$), 54.0 % met Criterion D (OR 1.83, $p = 0.002$) and 27.0 % reported lifetime PTSD-related impairment (OR 2.30, $p = 0.001$)	2

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
13 Khoury et al. [25]	US adults attending hospital clinics in Atlanta and participating in a molecular genetics project	587 adults who were subjects in a molecular genetics project, and were recruited from a hospital waiting room. All who met eligibility criteria completed a battery of assessments	Retrospective cross-sectional study (battery of clinician-administered self-report assessments, plus interviews)	Modified PTSD Symptom Scale Self-Report	Kreek-McHugh-Schliger-Kellogg Scale quantifying substance use self-exposure	Lifetime alcohol dependence was found to be associated with higher PSS total scores ($F = 6.48$; $p < 0.05$) Lifetime alcohol dependence was found to be associated with higher avoidance/numbing (cluster C) symptom scores ($F = 6.92$; $p < 0.01$) and higher hyperarousal (cluster D) symptom scores ($F = 4.46$; $p < 0.05$). There was no significant group difference in intrusive (cluster B) symptom level found between those with lifetime alcohol dependence and those without. However, alcohol dependence group differences were no longer significant after depressive symptoms were taken into account	2
14 Liebschutz et al. [26]	US adults visiting a primary care clinician	509 patients with a primary care appointment were consecutively approached and deemed eligible after interviewer screening (February 2003–September 2004) based on if they had one of the 7 selected conditions (including heavy drinking, $n = 48$). Of those eligible, 81.0 % were enrolled in the consecutive sample. Additional eligible participants ($n = 98$) were subsequently enrolled	Cross-sectional study (a 30-min interview before or just after clinician visit)	Composite International Diagnostic Interview version 2.1	Composite International Diagnostic Interview—Short Form	Of the heavy drinkers ($n = 73$), 32.0 % had current PTSD compared to those who were not heavy drinkers ($n = 524$) with a prevalence of 21.0 % (unadjusted, $p = 0.05$). Prevalence (adjusted for age, gender, race, income, employment and marital status) were as follows: 26.0 % (CI 16.0–38.0 %) of heavy drinkers had current PTSD, compared to 19.0 % (15.0–23.0 %) of those who were not heavy drinkers ($p = 0.174$). For lifetime PTSD, 53.0 % of heavy drinkers had lifetime PTSD, compared to 33.0 % of those who were not heavy drinkers (unadjusted, $p = 0.0005$). Adjusted prevalence: 49.0 % (CI 37.0–62.0 %) of heavy drinkers had lifetime PTSD, compared to 31.0 % (CI 27.0–36.0 %) of those who were not heavy drinkers ($p = 0.007$)	3
15 Maguen et al. [27]	US veterans (OEF/OIF) with PTSD	159,705 OEF/OIF veterans identified using a VA veterans database, with at least one clinical visit to a VA facility from October 2001 to the end of 2010 and with a PTSD diagnosis. Response rate not stated	Cross-sectional study	Clinical diagnosis of PTSD (ICD-9-CM diagnosis 309.81)	Clinical diagnosis of alcohol use disorder (ICD-9-CM diagnoses from 305.00 to 305.03)	Comorbid PTSD and AUD diagnoses were present in 16.1 % of women ($n = 2,461$) and 28.5 % of men ($n = 41,121$). Combining men and women, comorbid PTSD and AUD diagnoses were present in 27.3 % of the whole sample ($n = 43,582$)	3

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
16 McDevitt-Murphy et al. [28]	US trauma-exposed college students	136 trauma-exposed college students who were invited to participate after screening (if they met criteria for PTSD, depression, social phobia or well-adjusted groups). 30.2 % of those screened were included in the final sample	Cross-sectional study (self-report questionnaire screening, then audiotaped structured clinical interviews by doctoral students in clinical psychology/ a licensed clinical psychologist)	Clinician Administered PTSD Scale; PTSD Checklist	Questions on quantity and frequency of alcohol use, and usual level of intoxication; Rutgers Alcohol Problem Index	The PTSD group experienced significantly more alcohol problems compared to the social phobia/well-adjusted groups ($F = 3.83, p < 0.05$). There was a significant difference in typical level of alcohol intoxication between the PTSD and depression groups: PTSD (mean = 1.67) > D (0.91) [$F = 3.59, p < 0.05$]. Group differences in number of drinks per occasion were also significant for PTSD (mean 5.04) and D (3.20), with PTSD > D. PTSD severity score was significantly correlated with alcohol symptoms (cluster B) were significantly correlated with alcohol-related problems: 0.20 ($p < 0.05$), avoidance/numbing symptoms (cluster C) were too: 0.35 ($p < 0.01$), but hyperarousal symptoms (cluster D) were not significantly correlated with any of the substance use measures (0.16, ns). When cluster C symptoms were disaggregated, stronger relationships were found for numbing symptoms than for avoidance symptoms: 0.34 ($p < 0.01$) versus 0.21 ($p < 0.05$)	2
17 McDevitt-Murphy et al. [29]	US veterans (OEF/OIF) seeking primary healthcare	151 participants aged 21–62 recruited from Memphis VAMC (a clinic for OEF/OIF veterans); the data were obtained from a screening procedure for a larger study. Response rate = 74.0 %	Cross-sectional study	PTSD Checklist Military version	Alcohol Use Disorders Identification Test	15.9 % screened positive for both PTSD (score >49) and hazardous drinking (score >7). PCL-M score was significantly correlated with AUDIT total score (0.29, $p < 0.01$). Hazardous drinking significantly mediated the correlation between PTSD symptoms and global ratings of mental health (Sobel test Z score 2.00, $p < 0.05$) but not physical health	3
18 Miller et al. [30]	US male veterans (Vietnam)	1,325 male veterans who served in Vietnam (August 1964–May 1975) using health services at 15 VA medical centres at the time of the study (recruited between 1989 and 1992). Response rate not stated	Cross-sectional data (secondary analysis of data)	Structured Clinical Interview for DSM-III-R	Structured Clinical Interview for DSM-III-R	58.5 and 71.9 % met criteria for current or lifetime military-related PTSD, respectively. 76.2 % met criteria for lifetime alcohol dependence. PTSD and alcohol abuse/dependence had a tetrachoric correlation of 0.42	3
19 Norman et al. [31]	US male veterans	120 male veterans receiving medical and/ or psychiatric treatment, with a documented history of DSM-IV PTSD and/or alcohol dependence. Response rate (of those eligible) was 80.0 %	Cross-sectional study (interview plus self-report measures, aimed at developing and testing a new PTSD-Alcohol Expectancy Questionnaire).	Structured Clinical Interview for DSM-IV; Impact of Event Scale – Revised	Structured Clinical Interview for DSM-IV; Alcohol Expectancy Questionnaire; Time Line Follow Back	25.0 % ($n = 30$) of the sample had both alcohol use disorder and PTSD	3

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
20 Pfefferbaum et al. [32]	US adults	1,963 participants who indicated use of cigarettes or alcohol before or after 9/11 after recruitment via random telephone selection across the USA in 2002. Of those who agreed to participate in the survey ($n = 2,519$), 77.9 % indicated use of cigarettes or alcohol and were included in the analyses. Not stated how many people were approached via random telephone selection	Cross-sectional study	A 7-item scale derived from the NIMH Diagnostic Interview Schedule and Composite International Diagnostic Interview, version 2.1	2 questions on alcohol use, including whether or not this had changed since 9/11	21 out of 1,330 participants screened positive for PTSD. Of those, 27.3 % ($n = 5$) increased their drinking, 40.9 % ($n = 7$) reported no change in drinking, and 31.8 % ($n = 9$) decreased their drinking since 9/11. Ever drinkers who decreased drinking were found more likely to screen positive rather than negative on the PTSD screen (significantly higher than the comparison group at the 0.05 level). Those who reported no change in drinking were significantly more likely to deny rather than endorse having trouble concentrating (part of cluster D) and intrusive remembering (cluster B) in relation to the attacks. Those who decreased drinking were more likely to endorse rather than deny trouble concentrating and intrusive remembering in relation to the attacks	3
21 Pietrzak et al. [33]	US-resident non-institutionalised adults	34,652 participants from NESARC Wave 2. Response rate for Wave 2 was 86.7 %	Cross-sectional study	Alcohol Use Disorder and Associated Disabilities Interview Schedule—IV	Alcohol Use Disorder and Associated Disabilities Interview Schedule—IV	Prevalence of lifetime DSM-IV alcohol abuse/dependence comorbidity by PTSD status: “no PTSD” = 34.9 %, “partial PTSD” = 40.5 %, “full PTSD” = 41.8 %. Adjusted ORs: full PTSD versus no PTSD = 1.7 (95 % CI 1.51–1.88); partial PTSD versus no PTSD = 1.6 (1.38–1.74). OR after further controlling for additional psychiatric comorbidity: full PTSD versus no PTSD = 0.90 (95 % CI 0.82–1.09); partial PTSD versus no PTSD = 1.1 (0.93–1.20)	5
22 Pietrzak et al. [34]	US police	8,466 police recruited through outreach efforts who completed an initial evaluation as part of the World Trade Center-Medical Monitoring and Treatment Program and who worked during the World Trade Center disaster or its aftermath. Response rate not stated	Cross-sectional study	Posttraumatic Stress Disorder Checklist-Specific Version	CAGE questionnaire	18.8 % ($n = 84$) of those with full PTSD also had “probable alcohol use problems”. The odds ratio for probable alcohol use problems for full PTSD vs. trauma controls (i.e. did rescue and recovery work but did not meet PTSD criteria for full or subsyndromal PTSD), adjusted for demographic characteristics, was OR 5.94 (95 % CI 3.97–8.90). When adjusted for both demographic characteristics and additional psychiatric comorbidity, the OR was 3.82 (95 % CI 1.83–7.94)	3

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
23 Read et al. [35]	US college students	997 first-year college students from two universities either screened positive for trauma/PTSD or were randomly selected to be invited to complete a baseline survey. The group's substance use was then followed up longitudinally over the first college year. To obtain the longitudinal sample, college students were sent a survey, and a return rate of 58.0 % was achieved. Of those invited to the longitudinal study (i.e. those who reported trauma and PTSD symptoms on screening), 81.0 % completed the baseline survey, and across cohorts, the retention rate was 91.3 %	Longitudinal study	PTSD Checklist-Civilian Version	Young Adult Alcohol Consequences Questionnaire; items regarding quantity/frequency of alcohol consumption	Students in the full PTSD group ($n = 152$) experienced more alcohol problems in both the fall and spring semesters (mean scores 5.95 and 5.34, respectively) compared to the No Criterion A group (i.e. no trauma or PTSD symptoms) and the Criterion A only group (i.e. trauma but no PTSD symptoms) ($ps < 0.05$). However, there were no reliable differences in number of alcohol problems when comparing the full PTSD and partial PTSD groups ($ps > 0.50$). Modelling to analyse PTSD symptom cluster effects on alcohol consequence trajectories demonstrated that hyperarousal, but not re-experiencing or avoidance/numbing, symptoms were associated with the growth factors and predicted the intercept and linear and quadratic trends (all $ps < 0.05$). High levels of hyperarousal symptoms were associated with high levels of negative drinking consequences in September with a relatively rapid decline in drinking consequences during the fall semester. Negative drinking consequences showed a slight rise at the end of the spring semester for students with high levels of hyperarousal symptoms	3
24 Sartor et al. [36]	US females (twins) born between 1975 and 1985	3,768 participants from the Missouri Adolescent Female Twin Study (a cohort identified from birth records): 964 MZ pairs, 808 DZ pairs, 243 singletons. Data were collected as part of a longitudinal study of alcohol-related problems and related psychopathology. 78.0 % response rate	Cross-sectional data collection—phase 4 of longitudinal study	Semi-Structured Assessment for the Genetics of Alcoholism as modified for telephone administration	Semi-Structured Assessment for the Genetics of Alcoholism as modified for telephone administration	In those with PTSD ($n = 138$), prevalence of alcohol dependence = 33.3 %. Of those with PTSD who experienced non-assaultive trauma ($n = 5$), 40.0 % had AD. Of those with PTSD who experienced assaultive trauma ($n = 133$), 33.1 % had AD. The degree of overlap in genetic and environmental influences between trauma exposure; PTSD and AD were assessed. Genetic factors contributing to trauma exposure/PTSD were correlated at 0.54 with those that contribute to AD (CI 0.31–0.66), thus accounting for just under 30.0 % of the genetic variation in AD	4

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
25 Scherrer et al. [9]	US male twin pair veterans (Vietnam)	5,312 male–male twins born 1939–1957 where both siblings served on active military duty during the Vietnam War era, consisting of: 1,224 MZ pairs, 886 DZ twins and 1,092 singletons recruited from the VET Registry. Response rate to one of two initial studies from which data for this study was drawn was 79.6 %. Overall response rate not stated	Cross-sectional study of existing cohort	Structured clinical interview based on Mental Health Diagnostic Interview Schedule Version III-Revised	Structured clinical interview based on Mental Health Diagnostic Interview Schedule Version III-Revised	Among PTSD subjects ($n = 617$), the prevalence of alcohol dependence (AD) was 61.3 % ($n = 378$) (additional information provided by the study authors). Among subjects with PTSD grouped according to low, medium and high combat exposure, the prevalence of AD was 79.0, 67.0 and 67.0 %, respectively. The prevalence of AD in those without PTSD in low, medium and high combat exposure groups was 30.0, 36.0 and 32.0 %, respectively. PTSD was significantly associated with AD [OR 3.6 (2.8–4.6)] after adjusting for combat level	3
26 Scott et al. [8]	US veterans (OEF/OIF/OND)	634 male and female veteran samples from a larger study (the Women's Veterans Cohort Study). Data collected during Phase 2 of that study. No response rate stated	Cross-sectional data from a larger 2-phase prospective cohort study	PTSD Checklist Military version	Alcohol Use Disorders Identification Test	Both men and women screening positive for hazardous drinking had greater PTSD symptoms (both $p < 0.001$). Multivariate logistic regression analyses showed that in women (but not men), PTSD symptoms were significantly associated with hazardous drinking: OR 1.03 (95 % CI 1.01–1.05). A secondary logistic regression analysis in women using a five-factor symptom cluster model of PTSD (re-experiencing, avoidance, emotional numbing, dysphoric arousal and anxious arousal) indicated that emotional numbing symptoms were independently associated with hazardous drinking ($p = 0.034$)	2
27 Seal et al. [37]	US male and female veterans (OEF/OIF) visiting VA centres after military separation	456,502 OEF/OIF veterans that were first-time users of VA healthcare services between 15 October 2001 and 30 September 2009, identified using the VA OEF/OIF Roster. Response rate not stated	Retrospective cross-sectional study	Clinical interview	Clinical interview	Prevalence of "alcohol dependence" = 5.2 %, "alcohol abuse" = 7.3 %, "alcohol use disorder (AUD)" (including either alcohol abuse, dependence or both) = 9.9 %. PTSD was diagnosed in 26.1 % of the sample. 63.0 % of those with an AUD diagnosis also had a PTSD diagnosis. Having received a PTSD diagnosis increased the odds of an AUD [OR 4.10 (3.79–4.25), $p < 0.001$]	3

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
28 Sullivan and Holt [10]	US women >18 years old exposed to intimate partner violence in the last 6 months	212 women recruited from an urban community in New England who had experienced at least one act of physical victimisation from her male intimate partner in the last 6 months. 240 women were recruited initially, 28 women were ineligible at the time of interview. Final sample = 212 women. Response rate not stated	Cross-sectional study (2-h face-to-face semi-structured interviews by trained female researchers using computer-assisted interviewing)	Posttraumatic Stress Diagnostic Scale	Addiction Severity Index	The prevalence of PTSD among alcohol-only users was 23.9 %. Alcohol users were no more likely to meet full diagnostic criteria for PTSD than non-users, and they were also no more likely to have significantly different scores for any PTSD symptom cluster	2
29 Taft et al. [38]	US male veterans (Vietnam)	1,168 veterans who served in Vietnam, currently using Department of Veterans Affairs inpatient/outpatient services, recruited non-consecutively to a multisite trial over a 42-month period. Of those screened, 69.1 % were eligible. Of those eligible, 79.9 % were included in the analysis	Cross-sectional study (interview and questionnaire)	Structured Clinical Interview for DSM-IV	CAGE	The estimated bivariate associations (correlations) between latent study variables were the following: Alcohol problems/re-experiencing symptoms = 0.12 ($p < 0.05$) Alcohol problems/avoidance and numbing symptoms = 0.19 ($p < 0.05$) Alcohol problems/hyperarousal symptoms = 0.24 ($p < 0.05$)	4
<i>UK studies</i>							
30 Brewin et al. [7]	UK military veterans	132 veterans recruited from the UK Service Personnel and Veterans Agency and receiving a pension for PTSD or physical disability. Of 390 veterans invited, 132 were included in the final sample (33.8 %)	Retrospective record-based study (cross-sectional comorbidity data)	Structured Clinical Interview for DSM-IV	Structured Clinical Interview for DSM-IV	Of those with a retrospective diagnosis at interview of lifetime alcohol abuse ($n = 56$), 53.6 % also received a lifetime PTSD diagnosis ($n = 30$)	2

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
31 Rona et al. [39]	UK military service personnel	3,936 regular Armed Forces personnel deployed on Iraq war phase TELIC 1, and 4,750 military personnel serving at the same time but not on TELIC 1 were surveyed at random (data taken from a cohort study comparing the two sub-samples' health). 61.0 % response rate overall	Cross-sectional survey (self-completion questionnaire during a base visit or by post)	PTSD Checklist Civilian version	Alcohol Use Disorders Identification Test	Percentage of PTSD "cases" in each group: AUDIT score <8 (3.0 %), 8–15 score ("hazardous drinking") (2.0 %), 16–19 score (5.0 %), 20+ score (18.0 %); binge drinking (9.0 %), alcohol-related harm (9.0 %), alcohol dependence (17.0 %). Higher AUDIT scores, alcohol-related harm and alcohol dependence were more common in PTSD-positive cases	5
<i>Other studies</i>							
32 Arbanas [40]	Croatian men diagnosed with PTSD due to combat trauma or war-related trauma	272 patients who attended a psychiatric facility at least twice in 1996 and were diagnosed with PTSD had their past/current medical records reviewed. 29 patients were lost to follow-up as they had no records in 2007–2009. No response rate stated	Retrospective study of medical records from 1996 and 2007–2009 which were reviewed to see outcomes	Non-structured interview with psychiatrist	Non-structured interview with psychiatrist	Of 243 men diagnosed with PTSD in 1996 who had data available in 2007–2009, 74 male patients saw a psychiatrist in 2007–2009 and had a definitive diagnosis in their records at that point. Of these, 73.0 % ($n = 54$) were diagnosed with PTSD, 23.0 % with enduring personality change after a catastrophic experience in 2007–2009, and 17.6 % with alcohol-related disorders instead (i.e. no longer diagnosed with PTSD) Of the 54 patients with PTSD ($n = 54$), 13 (24.1 %) were recorded as seeing a psychiatrist for comorbid alcohol use disorders in 2007–2009	3
33 Caspi et al. [41]	Bedouin men from Northern Israel	317 Bedouin men from Israeli Defence Force-associated households, non-randomly recruited door-to-door via recruiters from five tribal families. 93.5 % of those identified agreed to participate ($n = 348$) and 91.0 % completed the interview ($n = 317$)	Cross-sectional study (a face-to-face interview and administration of self-rating scales by trained graduate psychology students)	Structured Clinical Interview for DSM-IV; Screen for Posttraumatic Stress Symptoms	Structured Clinical Interview for DSM-IV; also apparently asked about consumption of hard liquor; beer and wine (i.e. was this daily/in the last month?)	PTSD was diagnosed in 14.5 % of participants. This composed of "pure" PTSD (5.4 %), PTSD co-morbid with major depression disorder (MDD) (4.0 %), PTSD co-morbid with alcohol abuse (1.6 %) and PTSD co-morbid with both MDD and alcohol abuse (3.5 %). Comorbid alcohol abuse (with or without MDD) was therefore diagnosed in 35.2 % of those with PTSD	3

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
34 Dom et al. [42]	Belgian alcoholic in-patients	119 participants recruited over 18 months from an in-patient addiction treatment facility. Every second patient hospitalised for alcohol use treatment was invited to participate. Follow-up rate 67.2 % (stayed in the programme and were therefore assessed for PTSD after 2 weeks)	Cross-sectional study (all were assessed for substance abuse, including using self-report questionnaires, 80 pursued treatment and were assessed for PTSD 2 weeks later)	Structured Clinical Interview for DSM-IV; Traumatic Experiences Checklist	Psychiatric interview using DSM criteria; European Addiction Severity Index	Overall 26.3 % of 80 alcoholic patients ($n = 21$) fulfilled criteria for lifetime PTSD diagnosis (32.0 % of the early-onset alcoholic (EOA) patients and 23.0 % of the late onset alcoholic (LOA) patients). More female alcoholic patients had lifetime PTSD (48.0 %) than male alcoholic patients (17.0 %) ($p = 0.006$). 5.0 % of comorbid lifetime PTSD patients were in full remission, so only 21.0 % of the alcohol patients had current comorbid PTSD	4
35 Dragan and Lis-Turlejska [43]	Polish adults in treatment for addiction	458 alcohol-dependent Polish patients aged 18–68 recruited from 17 addiction treatment settings (in-patient and out-patient) in Warsaw and Mazovia district. Response rate not stated	Cross-sectional study (questionnaires were administered by psychologists)	Posttraumatic Stress Diagnostic Scale; Mississippi PTSD Scale-C; Impact of Event Scale – Revised	Retrospective - initial diagnosis made with ICD-10 criteria. Pre-study drinking reassessed during study with Alcohol Use Disorders Identification Test	All patients had a pre-existing ICD-10 diagnosis of alcohol dependence. 25.0 % met criteria for current PTSD on PDS, 20.0 % on IES and 41.0 % on Mississippi PTSD-C Scale. Based on the AUDIT, there were no significant differences between the PTSD/non-PTSD groups in alcohol use history, treatment history, number of relapses and other alcohol-use-related variables	2
36 Driessen et al. [44]	German patients with substance dependence	459 patients aged 15–60 years old were consecutively enrolled from 14 German clinical centres (members in the Northern German Council on Addiction Research) from July 2005–March 2006 (every 3rd, 4th or 5th admitted patient with diagnosed substance dependence was asked to take part). Response rate was 81.4 %	Cross-sectional study (experienced clinicians/social workers administered 60–120-min interviews)	International Diagnostic Checklists for DSM-IV; Posttraumatic Stress Diagnostic Scale	International Diagnostic Checklists for DSM-IVL; European Addiction Severity Index (ASI); questionnaire assessing age of onset of each DSM-IV criterion of substance dependence	39.7 % ($n = 182$) had a pre-existing clinical diagnosis of alcohol dependence (AD) only. Prevalence of PTSD in those with a pre-existing diagnosis of AD was 15.4 %. No differences between the alcohol dependence group and other substance use groups were found to be significant for PDS symptom cluster scores. Addiction severity was much higher in the PTSD subgroup compared to the other 3 subgroups (subsyndromal PTSD, trauma exposure only and no exposure), based on the ASI score ($F = 17.9$, $p < 0.0001$) The highest proportions of subjects with frequent craving for alcohol or drugs during the last month were found in the PTSD subgroup compared to other groups ($\chi^2 = 16.0$, $p = 0.014$). Post hoc analysis revealed a lower mean age of onset of alcohol-related symptoms in the PTSD group compared to the non-exposure group (mean difference of ~ 7 years, $p = 0.001$)	4
37 Leray et al. [45]	French non-institutionalised adults	36,105 adults interviewed in the Mental Health in General Population survey (a WHO study in 1999–2003), recruited in public places using quota sampling. Response rate for original study not stated	Cross-sectional survey (anonymous face-to-face interview administered by trained medical or nursing students)	Mini International Neuropsychiatric Interview	Mini International Neuropsychiatric Interview	Prevalence of alcohol abuse in those with PTSD = 9.8 % ($p = 0.0001$) (the highest among all anxiety diagnoses). In those with no PTSD, the prevalence of alcohol abuse was 2.3 % ($p = 0.0001$). Adjusted ORs indicated that the presence of alcohol abuse more than doubles the likelihood of PTSD (based on multivariate logistic regression analysis): OR 2.1 (95 % CI 1.3–3.3)	3

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
38 Park et al. [46]	Korean adults with alcohol dependence	458 respondents to the Korean Epidemiologic Catchment Area study Replication (KECA-R) who had lifetime diagnoses of alcohol dependence. Subjects were selected for the KECA-R using a stratified multi-stage cluster sample design, and then interviewed face-to-face (response rate 81.7 %)	Cross-sectional study	Korean version of the Composite International Diagnostic Interview	Korean version of the Composite International Diagnostic Interview	Of those treated for alcohol dependence ($n = 403$), 14.3 % had comorbid PTSD. Of those with untreated alcohol dependence ($n = 55$), 2.0 % had comorbid PTSD. When adjusted for sex and age, those with treated alcohol dependence were more likely to have comorbid anxiety disorders than those who were not treated, and in particular PTSD (OR 8.10, $p < 0.001$, 95 % CI 2.81–23.27)	4
39 Richardson et al. [47]	Canadian veterans with military-related PTSD	102 consecutive combat and peacekeeping veterans who met DSM-IV criteria for PTSD and were referred for outpatient psychiatric treatment (sample derived from a retrospective chart review). Follow-up rate at 1 year not stated	Longitudinal study (self-report questionnaires as part of a standardised assessment at intake and follow-up appointments)	Clinician Administered PTSD Scale; PTSD Checklist Military version	Alcohol Use Disorders Identification Test	The study used latent growth curve modelling to examine predictors of treatment outcome in veterans with PTSD. Baseline AUDIT score was found not to be a significant predictor of treatment response (i.e. decrease in PTSD severity) over a 1-year period	3
40 Rodgers et al. [48]	Australian adults	10,641 Australian adult residents, comprising one person randomly selected from each of 13,624 private dwellings. 78.0 % response rate	Cross-sectional (computer-assisted personal interviewing)	Composite International Diagnostic Interview (automated version)	Composite International Diagnostic Interview (automated version)	Individuals were classified into: (1) non-drinkers and occasional drinkers; (2) light drinkers; (3) moderate drinkers; (4) hazardous/harmful drinkers. The ORs for PTSD (DSM-IV) (with light drinkers (2) as the reference category) were as follows: (1) 2.17 (1.22–3.87); (3) 1.31 (0.64–2.67); (4) 4.87 (3.20–7.40) Therefore, based on DSM-IV criteria, both non-/occasional drinkers and hazardous/harmful drinkers had significantly elevated ORs for PTSD. The ORs for PTSD (ICD-10) in each category (with light drinkers (2) as the reference category) were as follows: (1) 1.50 (0.88–2.54); (3) 0.88 (0.51–1.51); (4) 2.41 (1.41–4.14)	5
41 Wang et al. [49]	Chinese soldiers who had been first responders to an earthquake	1,056 soldiers from one battalion randomly selected out of 16 battalions deployed on a rescue mission following the Wen Chuan earthquake. Response rate was 93.9 %.	Cross-sectional study.	Davidson Trauma Scale; clinical interview based on DSM-IV criteria	Positive drinking status defined as having a regular drink at least once a week	6.5 % ($n = 69$) screened positive for PTSD on DTS (score >39), 65 of these also met DSM-IV criteria. 26.0 % had a positive drinking status. Of those with PTSD, 37.7 % had a positive drinking status compared to 25.5 % without PTSD (t test 4.908, $p = 0.027$). There was some evidence that positive drinking status was a predictor of PTSD status in multivariate regression models	4

Table 1 continued

References	Population and location	Recruitment and response rate	Design	Measure of PTSD	Measure of alcohol use	Comorbidity statistics/other relevant findings	Total score
42 Zalhic et al. [50]	Bosnian male war veterans	120 male veterans (60 with PTSD (randomly chosen), 60 without PTSD (matched on age/education level)) attending the Health Care Centre Mostar from September 2005 to June 2006. Response rate not stated	Case-control study (using a questionnaire designed for this study)	Existing PTSD diagnosis	Questions about alcohol abuse (“yes”/“no”) and “social drinking”	45.0 % ($n = 27$) of the veterans with PTSD answered “yes” to the alcohol abuse question (compared to 33.3 % of the “no PTSD” group), 23.3 % ($n = 14$) of the PTSD group answered “no” to the alcohol abuse question, compared to 50.0 % of the “no PTSD” group. 31.7 % ($n = 19$) of the PTSD group reported social drinking, compared to 16.7 % ($n = 10$) of the “no PTSD” group. The group differences were statistically significant: $\chi^2 = 9.6540$; $p = 0.008$	2

The reported odds ratios for the risk of PTSD in individuals with alcohol misuse problems ranged from 1.1 to 4.87. All but one study scored at least 3 for quality. The study scoring 2 found that the risk of current PTSD and the risk of lifetime PTSD were similar in women with alcohol dependence [24]. A study scoring 5 for quality reported odds ratios for PTSD defined according to two different sets of diagnostic criteria (DSM-IV criteria and the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) criteria) [48]. The highest odds ratio reported in Fig. 3 reflects the risk of PTSD as defined according to DSM-IV criteria in that study (the figure based on the ICD-10 definition was more similar to those found in other studies). Chiu et al. [14] reported a significant odds ratio of 2.0 (95 % CI 1.5–2.5) for PTSD risk in those with alcohol use disorder; however, when adjusted for elevated depression risk, this became non-significant (OR 1.1, 95 % CI 0.8–1.5).

PTSD symptom clusters and alcohol misuse

Nine studies examined the relationships between different PTSD symptom clusters and alcohol misuse [8, 10, 20, 23–25, 28, 35, 38]. Of these, eight found significant associations between alcohol misuse and specific symptom clusters [8, 20, 23–25, 28, 35, 38].

There were mixed findings for re-experiencing symptoms (cluster B symptoms), with some studies finding a significant association with alcohol misuse and others finding no significant association [8, 20, 23–25, 28, 35, 38].

Avoidance and/or numbing symptoms (i.e. cluster C symptoms) were significantly associated with alcohol misuse in all but one of the studies which found a significant association [8, 20, 23–25, 28, 38]. The remaining study found that only hyperarousal symptoms, and not re-experiencing or avoidance/numbing, were associated with alcohol consequence trajectories [35].

Three studies disaggregated cluster C into avoidance symptoms and emotional numbing symptoms, which made interpretation of the results more complicated. A study with a quality score of 2 found that both avoidance and numbing symptoms were significantly associated with alcohol misuse, with stronger relationships found for numbing symptoms (correlation 0.34) than avoidance symptoms (correlation 0.21) [28]. Jakupcak et al. [23] (with a quality score of 4) similarly found that numbing symptoms were significantly associated with alcohol misuse status; however, no significant association was found with avoidance symptoms. A study with a quality score of 2 supports this by finding that among all PTSD symptoms, only emotional numbing symptoms were associated with hazardous drinking in female veterans [8].

Hyperarousal symptoms (cluster D) were found to be significantly associated with alcohol misuse in the majority

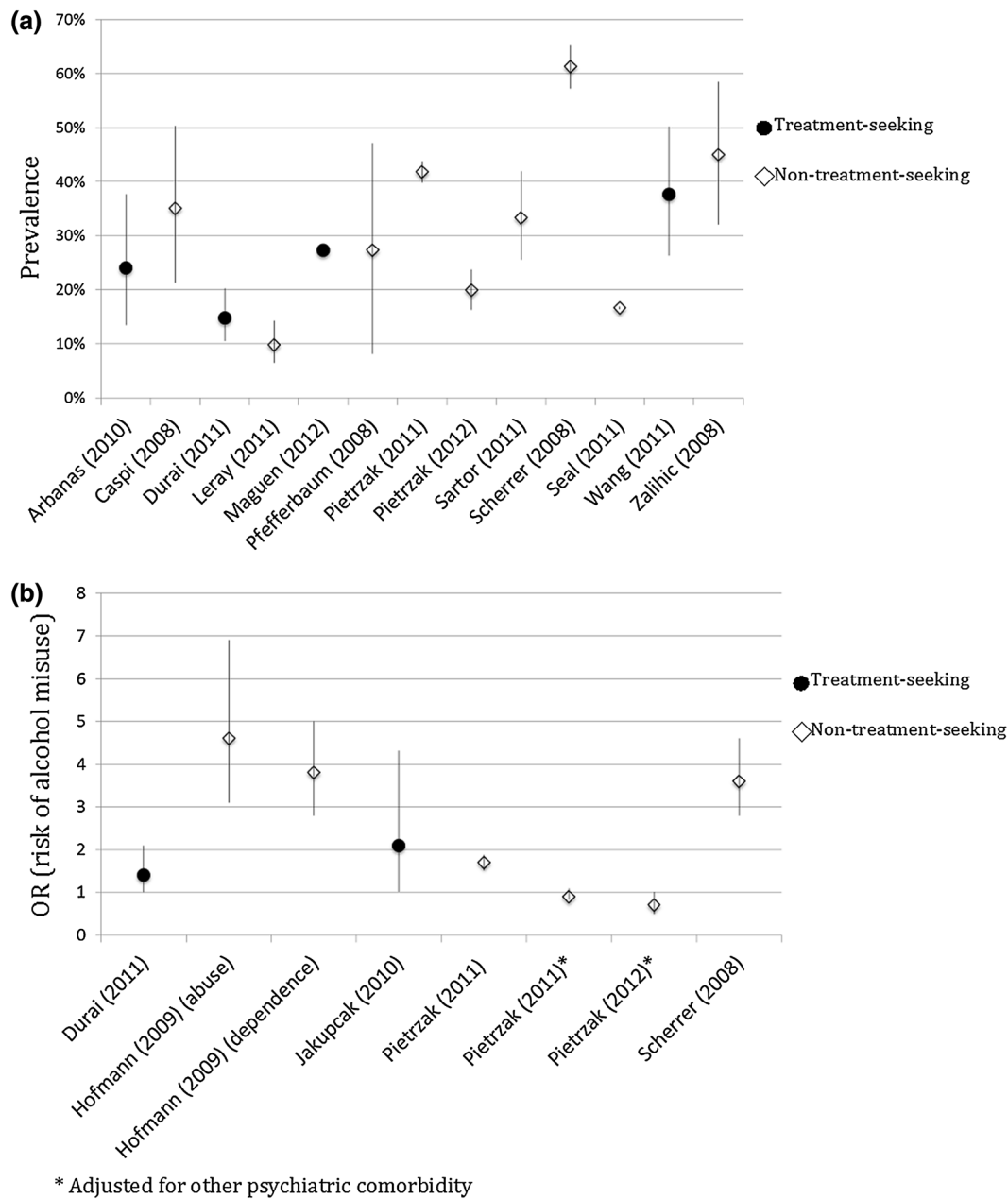


Fig. 2 Prevalence rates/odds ratios of alcohol misuse in individuals with PTSD together with 95 % confidence intervals

of studies [20, 24, 25, 35, 38]. Jakupcak et al. [23] found a trend towards a significant association ($p = 0.08$). However, two relatively small studies with a quality score of 2 found that hyperarousal symptoms were not significantly correlated with alcohol use [8, 28].

Two studies found that all three symptom clusters were associated with alcohol misuse. Johnson et al. [24] found in female substance users that each symptom cluster’s association with alcohol dependence had a similar odds ratios and statistical significance. Taft et al. [38] found in male Vietnam veterans that each symptom cluster had a comparably small but significant association with alcohol problems.

The ninth study, which had a small female sample ($n = 212$), found that alcohol users did not have significantly different scores for any of the PTSD symptom clusters compared with non-substance users [10].

Discussion

Key findings

This review confirms that PTSD and alcohol misuse are frequently associated across a range of populations and study

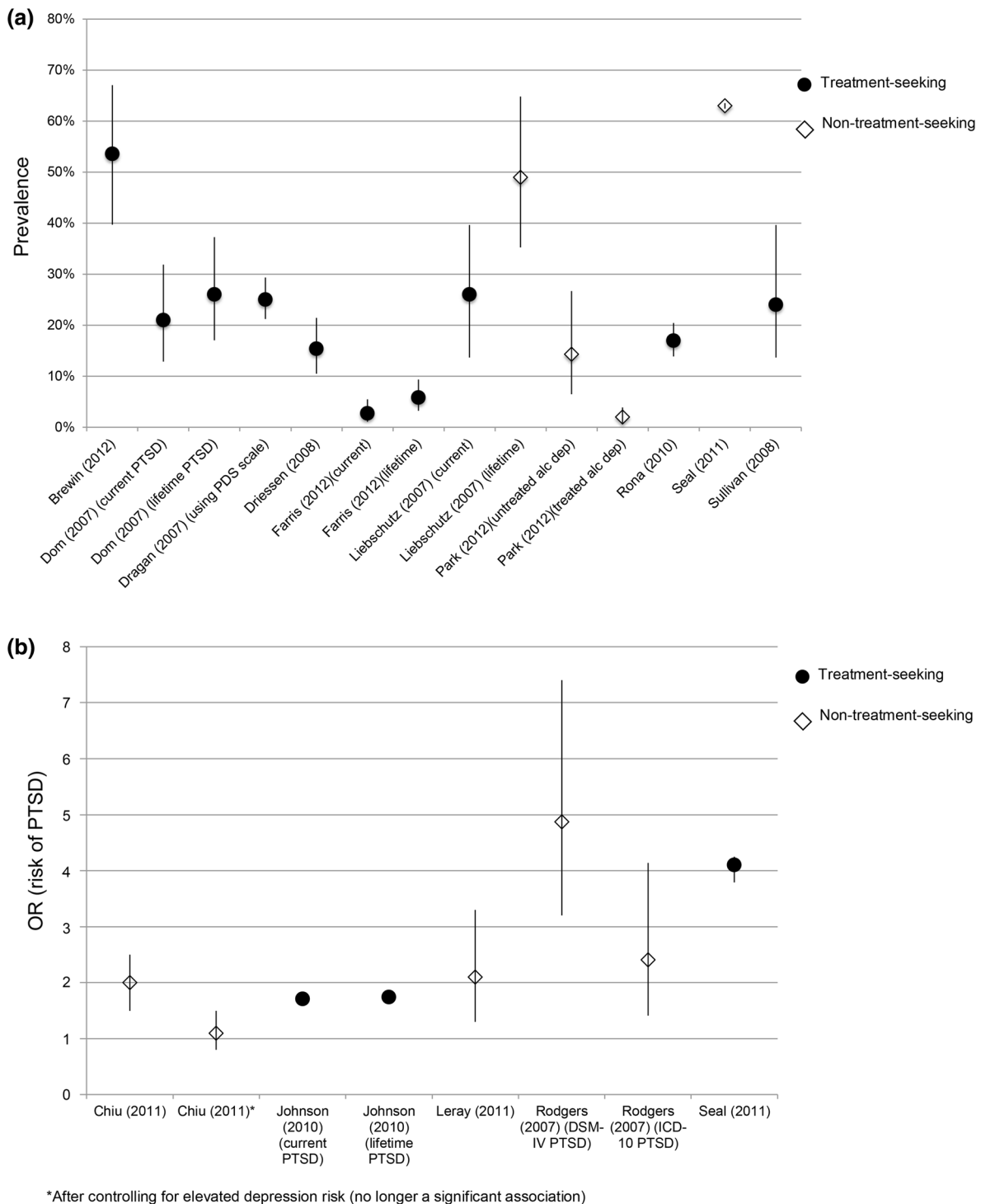


Fig. 3 Prevalence rates/odds ratios of PTSD in individuals with alcohol misuse together with 95 % confidence intervals

designs, and finds that at least 10 % of individuals with PTSD have comorbid alcohol misuse. Other key messages are that of the different PTSD symptom clusters, there is most evidence for associations between alcohol misuse and both avoidance/numbing symptoms and hyperarousal symptoms. Patterns of comorbidity do not appear to be different between treatment-

seeking and non-treatment-seeking samples. Although there is evidence that the severity of PTSD and severity of alcohol misuse may be correlated, there is also some evidence that they are not correlated. These findings are discussed further below.

There is variation between the level and risk of comorbidity in different sample populations, regardless of

whether this is defined as alcohol misuse in those with PTSD or PTSD in those with alcohol misuse. The ranges are broad for both the prevalence/odds of alcohol misuse in PTSD (9.8–61.3 % and OR 1.4–4.6, respectively) and the prevalence/odds of PTSD in alcohol misuse (2.0–63.0 % and OR 1.1–4.87), see Figs. 2 and 3. Where variation does exist in the rate/risk of PTSD or alcohol misuse (in either characterisation of the comorbidity), this review suggests that a number of factors may be implicated. These factors include sample characteristics such as gender and treatment-seeking behaviour, how the conditions are measured/defined (e.g. lifetime vs. current PTSD) and other psychiatric comorbidity. In particular, several studies indicate that controlling for depression or other psychiatric comorbidity can change an odds ratio so it becomes non-significant [14, 33], suggesting a role for other conditions in mediating the association between PTSD and alcohol misuse.

The studies in this review show that avoidance/numbing symptoms and hyperarousal symptoms are the most consistently reported to be associated with alcohol misuse. However, the studies analysing these associations were small compared to many studies in this review. Findings for re-experiencing symptoms were mixed.

When results from studies with treatment-seeking and non-treatment-seeking samples are compared, there is no apparent pattern of difference between them in terms of comorbidity. This is in contrast to findings in other conditions such as fibromyalgia and irritable bowel syndrome, which suggest that treatment-seeking individuals have higher levels of psychiatric morbidity compared with non-treatment-seeking individuals [51, 52]. Of the studies examining the prevalence of PTSD in those with alcohol misuse, only Sullivan and Holt, Rona et al. and Park et al. [10, 39, 46] were conducted in non-treatment-seeking samples. The rest involved samples using or seeking healthcare services (largely individuals in treatment for alcohol addiction). Arguably, the three studies in non-treatment-seeking samples provide more reliable population estimates of comorbidity. Interestingly, though, the prevalence rates they found do not appear markedly different from the treatment-seeking samples. The explanation for why prevalence rates and odds ratios differ appears to be the variation in study design and aims rather than whether the samples are treatment-seeking. It is unclear whether the treatment-seeking characteristic would become important if further research was carried out which eliminated other differences in study design.

A number of studies found that the severity of alcohol misuse correlated with the severity of PTSD (which has implications for treating one condition in the hope of also improving the other), and more studies found that the level of alcohol misuse predicted, or was correlated with, PTSD severity [16, 28, 29, 39, 44] than did not [15, 17, 35, 43].

For example, some found higher levels of cravings to drink alcohol in comorbid individuals [16, 44]. However, other studies found that alcohol use profiles were not significantly different in those with or without PTSD, e.g. that PTSD and non-PTSD groups did not differ significantly on alcohol addiction severity scores [15] or alcohol-use-related variables [43].

Contribution to existing literature

The key strength of this systematic review is the breadth of searching and the range of studies included, of which around three-quarters scored at least 3 out of 5 for quality. Based on the range of evidence available, this systematic review supports previous work on the epidemiology of comorbid PTSD and alcohol misuse by emphasising that comorbid PTSD and alcohol misuse is a common occurrence. For example, prevalence rates/odds ratios of PTSD/alcohol misuse comorbidity reported in an article by McCarthy and Petrakis [6] fall within the ranges found in this review.

The systematic nature of this review means that in addition to building a clearer picture of the level of comorbidity of PTSD and alcohol misuse, it is now evident where research has been focused in this area since 2007, and where gaps exist. For example, there is a dearth of longitudinal research in this area. A longitudinal study outside the timeframe of this review found that the 10-year cumulative incidence of alcohol abuse or dependence in those with PTSD at baseline was 15.1 %, but that the risk for alcohol abuse or dependence was not significantly elevated in persons with PTSD compared to people not exposed to trauma. Further, PTSD did not predict the subsequent onset of alcohol abuse or dependence [53]. This is in contrast to most studies in this review, which did find an association between PTSD and alcohol misuse. Carrying out more studies with a longitudinal design may therefore be important for better understanding the causation of this comorbidity and consequently in improving management strategies.

Implications and future research

This review implies that the level of comorbidity of PTSD and alcohol misuse is common enough to consider the use of routine brief screening tests in settings, such as primary care or mental health outpatient clinics, for individuals that have an existing PTSD or alcohol use disorder diagnosis. As a minimum, clinicians who identify the presence of one disorder should take a careful history of the other during their routine consultations.

Current UK clinical guidance on PTSD states that in sufferers with comorbid alcohol dependence or in whom

alcohol use may meaningfully interfere with effective treatment, alcohol misuse should be tackled before addressing PTSD (National Institute for Health and Clinical Excellence (NICE) guideline 2005, paragraph 1.8.2.4 [54]).

The full NICE guideline on alcohol use disorders states that treating an individual's PTSD can improve their substance misuse, but once dependent this must be treated before trauma-focused psychological treatments for PTSD are of benefit (NICE guideline 2011, paragraph 7.17.4 [55]). The guideline mentions the use of integrated treatment for comorbid alcohol dependence and psychiatric disorder, but the difficulties of achieving this in practice are acknowledged, for example a lack of dual diagnosis services (paragraph 7.17.1 [55]).

Not offering PTSD treatment unless alcohol dependence is tackled, and not having clear recommendations for integrated treatment for this comorbidity, means that comorbid individuals are likely to face poorer outcomes than individuals with only one condition. In the main, the results of this review suggest that the severity of PTSD and the severity of alcohol misuse are correlated. The high level of comorbidity justifies further research to more precisely understand the nature of the relationship between the two conditions, and how treating alcohol misuse affects the prognosis of PTSD (and vice versa). This will hopefully shed light on the management of this comorbidity. In the USA, a 2009 Department of Veterans Affairs panel developed a number of recommendations for treating veterans with comorbid substance abuse and PTSD, such as mandating integrated treatment plans with coordinated interventions for both conditions, and the use of Seeking Safety (a programme developed specifically for treating co-existing PTSD and substance use disorder) [56]. Reflecting the lack of research in this area, the panel also recommended systematic treatment response monitoring to continuously evaluate recommended treatments for patients with co-occurring PTSD and substance use disorders.

Potential factors explaining the link between PTSD and alcohol misuse

Several studies suggest that depression may be an additional aspect affecting or mediating the relationship between PTSD and alcohol misuse. In one study where an OR of elevated PTSD risk had been found in those with an AUDIT score ≥ 8 , adjusting for elevated depression risk removed its statistical significance [14]. Similarly, a lifetime alcohol-dependent group was no longer significantly different from other substance-using or non-using groups on PTSD scores once current depressive symptoms was taken into account [25]. In a study comparing baseline functioning of individuals with PTSD only, alcohol

dependence only and comorbidity, the only area of significant difference between the PTSD and comorbid groups was that the comorbid sample reported significantly higher levels of depression [16].

There is an established link between depression and PTSD, for example depression may drive the development of PTSD after a traumatic event [57], and delayed-onset PTSD has been found to be highly associated with having a history of depression [58]. A strong correlation has been found between PTSD and comorbid depressive episode [1], and a 2013 meta-analysis found that 52 % of individuals with current PTSD had co-occurring major depressive disorder [59]. There is also an established but complex relationship between depression and alcohol misuse, for example alcohol use disorder severity has been found to be a significant predictor of first-incident depressive disorders [60]. These findings support evidence from this review that depression may be an important additional factor in the comorbidity of PTSD and alcohol use.

Limitations

The main limitations are that the studies included used a wide range of measures and definitions, and had differing aims and populations, making direct comparison of statistical results difficult. One potentially relevant factor affecting this comorbidity is the level of trauma exposure in the target population; however, it was not possible to draw any conclusions on this issue. The studies were primarily from the USA, and the lack of UK evidence makes it more difficult to directly apply this review's findings to UK (and other non-US) populations. Finally, the dearth of evidence from relevant longitudinal studies precluded an analysis of causation, and how the relationship between PTSD and alcohol misuse changes over time.

Conclusions

In conclusion, we find that there is a clear association between PTSD and alcohol misuse across a range of populations and study designs, with a main finding that at least 10 % of individuals with PTSD also have comorbid alcohol misuse. Given that this is the case, more work would be helpful to try and explain the links between PTSD and alcohol misuse, including longitudinal research and research exploring the associations between different PTSD symptom clusters and alcohol misuse. The key results of this review also support the use of routine screening for comorbidity in individuals with one of the two conditions and highlight the coexistence of these conditions as an issue of importance to professionals in the field.

Acknowledgments This research received no specific grant from any funding agency, commercial or not-for-profit sectors. Dr Laura Goodwin receives salary support from the National Institute for Health Research (NIHR) Mental Health Biomedical Research Centre at South London and Maudsley NHS Foundation Trust and King's College London.

Conflict of interest Professor Simon Wessely is Honorary Civilian Consultant Advisor in Psychiatry to the British Army and a Trustee of Combat Stress, a UK charity that provides services and support for veterans with mental health problems.

References

- McManus S, Meltzer H, Brugha T, Bebbington P, Jenkins R (eds) (2009) Adult psychiatric morbidity in England, 2007: results of a household survey. The NHS Information Centre for Health and Social Care, Leeds
- Kessler RC, Crum RM, Warner LA, Nelson CB, Schulenberg J, Anthony JC (1997) Lifetime co-occurrence of DSM-III-R alcohol abuse and dependence with other psychiatric disorders in the National Comorbidity Survey. *Arch Gen Psychiatry* 54:313–321. doi:10.1001/archpsyc.1997.01830160031005
- Forman-Hoffman VL, Carney CP, Sampson TR, Peloso PM, Woolson RF, Black DW, Doebbeling BN (2005) Mental health comorbidity patterns and impact on quality of life among veterans serving during the first Gulf War. *Qual Life Res* 14:2303–2314. doi:10.1007/s11136-005-6540-2
- Watson HJ, Swan A, Nathan PR (2011) Psychiatric diagnosis and quality of life: the additional burden of psychiatric comorbidity. *Compr Psychiatry* 52:265–272. doi:10.1016/j.comppsy.2010.07.006
- McFarlane AC (1998) Epidemiological evidence about the relationship between PTSD and alcohol abuse: the nature of the association. *Addict Behav* 23:813–825. doi:10.1016/S0306-4603(98)00098-7
- McCarthy E, Petrakis I (2010) Epidemiology and management of alcohol dependence in individuals with post-traumatic stress disorder. *CNS Drugs* 24:997–1007. doi:10.2165/11539710-000000000-00000
- Brewin CR, Andrews B, Hejdenberg J (2012) Recognition and treatment of psychological disorders during military service in the UK armed forces: a study of war pensioners. *Soc Psychiatry Psychiatr Epidemiol* 47:1891–1897. doi:10.1007/s00127-012-0505-x
- Scott JC, Pietrzak RH, Mattocks K, Southwick SM, Brandt C, Haskell S (2013) Gender differences in the correlates of hazardous drinking among Iraq and Afghanistan veterans. *Drug Alcohol Depend* 127:15–22. doi:10.1016/j.drugalcdep.2012.06.003
- Scherrer JF, Xian H, Lyons MJ, Goldberg J, Eisen SA, True WR, Tsuang M, Buchholz KK, Koenen KC (2008) Posttraumatic stress disorder; combat exposure; and nicotine dependence, alcohol dependence, and major depression in male twins. *Compr Psychiatry* 49:297–304. doi:10.1016/j.comppsy.2007.11.001
- Sullivan TP, Holt LJ (2008) PTSD symptom clusters are differentially related to substance use among community women exposed to intimate partner violence. *J Trauma Stress* 21:173–180. doi:10.1002/jts.20318
- StataCorp (2009) Stata statistical software: release 11. Stata Corporation, College Station
- Ajetunmobi O (2002) Making sense of critical appraisal. Arnold, London
- Blume AW, Resor MR, Villanueva MR, Braddy LD (2009) Alcohol use and comorbid anxiety, traumatic stress, and hopelessness among Hispanics. *Addict Behav* 34:709–713. doi:10.1016/j.addbeh.2009.03.039
- Chiu S, Niles JK, Webber MP, Zeig-Owens R, Gustave J, Lee R, Rizzotto L, Kelly KJ, Cohen HW, Prezant DJ (2011) Evaluating risk factors and possible mediation effects in posttraumatic depression and posttraumatic stress disorder comorbidity. *Public Health Rep* 126:201–209
- Coffey SF, Schumacher JA, Brady KT, Cotton BD (2007) Changes in PTSD symptomatology during acute and protracted alcohol and cocaine abstinence. *Drug Alcohol Depend* 87:241–248. doi:10.1016/j.drugalcdep.2006.08.025
- Drapkin ML, Yusco D, Yasinski C, Oslin D, Hembree EA, Foa EB (2011) Baseline functioning among individuals with post-traumatic stress disorder and alcohol dependence. *J Subst Abuse Treat* 41:186–192. doi:10.1016/j.jsat.2011.02.012
- Durai UN, Chopra MP, Coakley E, Llorente MD, Kirchner JE, Cook JM, Levkoff SE (2011) Exposure to trauma and posttraumatic stress disorder symptoms in older veterans attending primary care: comorbid conditions and self-rated health status. *J Am Geriatr Soc* 59:1087–1092. doi:10.1111/j.1532-5415.2011.03407.x
- Farris SG, Epstein EE, McCrady BS, Hunter-Reel D (2012) Do co-morbid anxiety disorders predict drinking outcomes in women with alcohol use disorders? *Alcohol Alcohol* 47:143–148. doi:10.1093/alcalc/agr155
- Gahm GA, Lucenko BA (2008) Screening soldiers in outpatient care for mental health concerns. *Mil Med* 173:17–24
- Hien DA, Campbell ANC, Ruglass LM, Hu MC, Killeen T (2010) The role of alcohol misuse in PTSD outcomes for women in community treatment: a secondary analysis of NIDA's Women and Trauma Study. *Drug Alcohol Depend* 111:114–119. doi:10.1016/j.drugalcdep.2010.04.011
- Hofmann SG, Richey JA, Kashdan TB, McKnight PE (2009) Anxiety disorders moderate the association between externalizing problems and substance use disorders: data from the National Comorbidity Survey-Revised. *J Anxiety Disord* 23:529–534. doi:10.1016/j.janxdis.2008.10.011
- Hruska B, Fallon W, Spoonster E, Sledjeski EM, Delahanty DL (2011) Alcohol use disorder history moderates the relationship between avoidance coping and posttraumatic stress symptoms. *Psychol Addict Behav* 25:405–414. doi:10.1037/a0022439
- Jakupcak M, Tull MT, McDermott MJ, Kaysen D (2010) PTSD symptom clusters in relationship to alcohol misuse among Iraq and Afghanistan war veterans seeking post-deployment VA health care. *Addict Behav* 35:840–843. doi:10.1016/j.addbeh.2010.03.023
- Johnson SD, Cottler LB, Callaghan O'Leary C, Ben Abdallah A (2010) The association of trauma and PTSD with the substance use profiles of alcohol- and cocaine-dependent out-of-treatment women. *Am J Addict* 19:490–495. doi:10.1111/j.1521-0391.2010.00075.x
- Khoury L, Tang YL, Bradley B, Cubells JF, Ressler KJ (2010) Substance use, childhood traumatic experience, and posttraumatic stress disorder in an urban civilian population. *Depress Anxiety* 27:1077–1086. doi:10.1002/da.20751
- Liebschutz J, Saltz R, Brower V, Keane TM, Lloyd-Travaglini C, Averbuch T, Samet JH (2007) PTSD in urban primary care: high prevalence and low physician recognition. *J Gen Intern Med* 22:719–726. doi:10.1007/s11606-007-0161-0
- Maguen S, Cohen B, Cohen G, Madden E, Bertenthal D, Seal K (2012) Gender differences in health service utilization among Iraq and Afghanistan veterans with posttraumatic stress disorder. *J Womens Health (Larchmt)* 21:666–673. doi:10.1089/jwh.2011.3113
- McDevitt-Murphy ME, Murphy JG, Monahan CJ, Flood AM, Weathers FW (2010) Unique patterns of substance misuse associated with PTSD, depression, and social phobia. *J Dual Diagn* 6:94–110. doi:10.1080/15504261003701445

29. McDevitt-Murphy ME, Williams JL, Bracken KL, Fields JA, Monahan CJ, Murphy JG (2010) PTSD symptoms, hazardous drinking, and health functioning among U.S. OEF and OIF veterans presenting to primary care. *J Trauma Stress* 23:108–111. doi:10.1002/jts.20482
30. Miller MW, Fogler JM, Wolf EJ, Kaloupek DG, Keane TM (2008) The internalizing and externalizing structure of psychiatric comorbidity in combat veterans. *J Trauma Stress* 21:58–65. doi:10.1002/jts.20303
31. Norman SB, Inaba RK, Smith TL, Brown SA (2008) Development of the PTSD-Alcohol Expectancy Questionnaire. *Addict Behav* 33:841–847. doi:10.1016/j.addbeh.2008.01.003
32. Pfefferbaum B, North CS, Pfefferbaum RL, Christiansen EH, Schorr JK, Vincent RD, Boudreaux AS (2008) Change in smoking and drinking after September 11, 2001, in a national sample of ever smokers and ever drinkers. *J Nerv Ment Dis* 196:113–121. doi:10.1097/NMD.0b013e318162aaae
33. Pietrzak RH, Goldstein RB, Southwick SM, Grant BF (2011) Prevalence and axis I comorbidity of full and partial posttraumatic stress disorder in the United States: results from wave 2 of the National Epidemiologic Survey on Alcohol and Related Conditions. *J Anxiety Disord* 25:456–465. doi:10.1016/j.janxdis.2010.11.010
34. Pietrzak RH, Schechter CB, Bromet EJ, Katz CL, Reissman DB, Ozbay F, Sharma V, Crane M, Harrison D, Herbert R, Levin SM, Luft BJ, Moline JM, Stellman JM, Udasin IG, Landrigan PJ, Southwick SM (2012) The burden of full and subsyndromal posttraumatic stress disorder among police involved in the World Trade Center rescue and recovery effort. *J Psychiatr Res* 46:835–842. doi:10.1016/j.jpsychires.2012.03.011
35. Read JP, Colder CR, Merrill JE, Ouimette P, White J, Swartout A (2012) Trauma and posttraumatic stress symptoms predict alcohol and other drug consequence trajectories in the first year of college. *J Consult Clin Psychol* 80:426–439. doi:10.1037/a0028210
36. Sartor CE, McCutcheon VV, Pommer NE, Nelson EC, Grant JD, Duncan AE, Waldron M, Bucholz KK, Madden PAF, Heath AC (2011) Common genetic and environmental contributions to posttraumatic stress disorder and alcohol dependence in young women. *Psychol Med* 41:1497–1505. doi:10.1017/S0033291710002072
37. Seal KH, Cohen G, Waldrop A, Cohen BE, Maguen S, Ren L (2011) Substance use disorders in Iraq and Afghanistan veterans in VA healthcare, 2001–2010: implications for screening, diagnosis and treatment. *Drug Alcohol Depend* 116:93–101. doi:10.1016/j.drugalcdep.2010.11.027
38. Taft CT, Kaloupek DG, Schumm JA, Marshall AD, Panuzio J, King DW, Keane TM (2007) Posttraumatic stress disorder symptoms, physiological reactivity, alcohol problems, and aggression among military veterans. *J Abnorm Psychol* 116:498–507. doi:10.1037/0021-843X.116.3.498
39. Rona RJ, Jones M, Fear NT, Hull L, Hotopf M, Wessely S (2010) Alcohol misuse and functional impairment in the UK armed forces: a population-based study. *Drug Alcohol Depend* 108:37–42. doi:10.1016/j.drugalcdep.2009.11.014
40. Arbanas G (2010) Patients with combat-related and war-related posttraumatic stress disorder 10 years after diagnosis. *Croat Med J* 51:209–214. doi:10.3325/cmj.2010.51.209
41. Caspi Y, Saroff O, Suleimani N, Klein E (2008) Trauma exposure and posttraumatic reactions in a community sample of Bedouin members of the Israel Defense Forces. *Depress Anxiety* 25:700–707. doi:10.1002/da.20449
42. Dom G, De Wilde B, Hulstijn W, Sabbe B (2007) Traumatic experiences and posttraumatic stress disorders: differences between treatment-seeking early- and late-onset alcoholic patients. *Compr Psychiatry* 48:178–185. doi:10.1016/j.comppsy.2006.08.004
43. Dragan M, Lis-Turlejska M (2007) Prevalence of posttraumatic stress disorder in alcohol dependent patients in Poland. *Addict Behav* 32:902–911. doi:10.1016/j.addbeh.2006.06.025
44. Driessen M, Schulte S, Luedecke C, Schaefer I, Sutmann F, Ohlmeier M, Kemper U, Koesters G, Chodzinski C, Schneider U, Broese T, Dete C, Havemann-Reinicke U, TRAUMAB-Study Group (2008) Trauma and PTSD in patients with alcohol, drug, or dual dependence: a multi-center study. *Alcohol Clin Exp Res* 32:481–488. doi:10.1111/j.1530-0277.2007.00591.x
45. Leray E, Camara A, Drapier D, Riou F, Bougeant N, Pelissolo A, Lloyd KR, Bellamy V, Roelandt JL, Millet B (2011) Prevalence, characteristics and comorbidities of anxiety disorders in France: results from the “Mental Health in General Population” Survey (MHGP). *Eur Psychiatry* 26:339–345. doi:10.1016/j.eurpsy.2009.12.001
46. Park S, Cho MJ, Hong JP, Sohn JH, Lee HW, Park JI (2012) Comparison of treated and untreated alcohol dependence in a nationwide sample of Korean adults. *Addict Res Theory* 20:125–132. doi:10.3109/16066359.2011.580066
47. Richardson JD, Elhai JD, Sarreen J (2011) Predictors of treatment response in Canadian combat and peacekeeping veterans with military-related posttraumatic stress disorder. *J Nerv Ment Dis* 199:639–645. doi:10.1097/NMD.0b013e318229ce7b
48. Rodgers B, Parslow R, Degenhardt L (2007) Affective disorders, anxiety disorders and psychological distress in non-drinkers. *J Affect Disord* 99:165–172. doi:10.1016/j.jad.2006.09.006
49. Wang H, Jin H, Nunnink SE, Guo W, Sun J, Shi J, Zhao B, Bi Y, Yan T, Yu H, Wang G, Gao Z, Zhao H, Ou Y, Song Z, Chen F, Lohr JB, Baker DG (2011) Identification of post traumatic stress disorder and risk factors in military first responders 6 months after Wen Chuan earthquake in China. *J Affect Disord* 130:213–219. doi:10.1016/j.jad.2010.09.026
50. Zalihic A, Skobic H, Pejanovic-Skobic N (2008) Case-control study: posttraumatic stress disorder and habits of war veterans. *Psychiatr Danub* 20:75–79
51. Aaron LA, Bradley LA, Alarcón GS, Alexander RW, Triana-Alexander M, Martin MY, Alberts KR (1996) Psychiatric diagnoses in patients with fibromyalgia are related to health care-seeking behavior rather than to illness. *Arthritis Rheum* 39:436–445. doi:10.1002/art.1780390311
52. Koloski NA, Talley NJ, Boyce PM (2001) Predictors of health care seeking for irritable bowel syndrome and nonulcer dyspepsia: a critical review of the literature on symptom and psychosocial factors. *Am J Gastroenterol* 96:1340–1349. doi:10.1111/j.1572-0241.2001.03789.x
53. Breslau N, Davis GC, Schultz LR (2003) Posttraumatic stress disorder and the incidence of nicotine, alcohol, and other drug disorders in persons who have experienced trauma. *Arch Gen Psychiatry* 60:289–294. doi:10.1001/archpsyc.60.3.289
54. National Institute for Health and Clinical Excellence (2005) Posttraumatic stress disorder (PTSD): the management of PTSD in adults and children in primary and secondary care (Clinical Guideline CG26)
55. National Institute for Health and Clinical Excellence (2011) Alcohol-use disorders: diagnosis, assessment and management of harmful drinking and alcohol dependence [National Clinical Practice Guideline 115 (full guideline)]
56. Department of Veterans Affairs (2009) Report of consensus conference: practice recommendations for treatment of veterans with comorbid substance use disorder and PTSD. http://www.ptsd.va.gov/professional/pages/handouts-pdf/SUD_PTSD_Practice_Recommend.pdf. Accessed 9 March 2013
57. Schindel-Allon I, Aderka IM, Shahar G, Stein M, Gilboa-Schechtman E (2010) Longitudinal associations between posttraumatic distress and depressive symptoms following a traumatic event: a test of three models. *Psychol Med* 40:1669–1678. doi:10.1017/S0033291709992248

58. Goodwin L, Jones M, Rona RJ, Sundin J, Wessely S, Fear NT (2012) Prevalence of delayed-onset posttraumatic stress disorder in military personnel: is there evidence for this disorder?: results of a prospective UK cohort study. *J Nerv Ment Dis* 200:429–437. doi:[10.1097/NMD.0b013e31825322fe](https://doi.org/10.1097/NMD.0b013e31825322fe)
59. Rytwinski NK, Scur MD, Feeny NC, Youngstrom EA (2013) The co-occurrence of major depressive disorder among individuals with posttraumatic stress disorder: a meta-analysis. *J Trauma Stress* 26:299–309. doi:[10.1002/jts.21814](https://doi.org/10.1002/jts.21814)
60. Boschloo L, van den Brink W, Penninx BWJH, Wall MM, Hasin DS (2012) Alcohol-use disorder severity predicts first-incidence of depressive disorders. *Psychol Med* 42:695–703. doi:[10.1017/S0033291711001681](https://doi.org/10.1017/S0033291711001681)