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Prevalence of PTSD and common mental disorders amongst ambulance personnel: a systematic review and meta-analysis

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Abstract

Purpose There is increasing concern regarding the mental health impact of first responder work, with some reports suggesting ambulance personnel may be at particularly high risk. Through this systematic review and meta-analysis we aimed to determine the prevalence of mental health conditions among ambulance personnel worldwide.

Methods A systematic search and screening process was conducted to identify studies for inclusion in the review. To be eligible, studies had to report original quantitative data on the prevalence of at least one of the following mental health outcome(s) of interest (PTSD, depression, anxiety, general psychological distress) for ambulance personnel samples. Quality of the studies was assessed using a validated methodological rating tool. Random effects modelling was used to estimate pooled prevalence, as well as subgroup analyses and meta-regressions for five variables implicated in heterogeneity.

Results In total, 941 articles were identified across all sources, with 95 full-text articles screened to confirm eligibility. Of these, 27 studies were included in the systematic review, reporting on a total of 30,878 ambulance personnel. A total of 18 studies provided necessary quantitative information and were retained for entry in the meta-analysis. The results demonstrated estimated prevalence rates of 11% for PTSD, 15% for depression, 15% for anxiety, and 27% for general psychological distress amongst ambulance personnel, with date of data collection a significant influence upon observed heterogeneity.

Conclusion Ambulance personnel worldwide have a prevalence of PTSD considerably higher than rates seen in the general population, although there is some evidence that rates of PTSD may have decreased over recent decades.

Introduction

Emergency service work can have significant emotional costs, with personnel exhibiting elevated psychiatric symptoms and distress as a result of their job [1, 2]. There are a range of organisation-specific and individual factors identified as potential contributors to this elevated risk [1], such as repeated exposure to suffering and trauma [3],

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organisational stress [4], working conditions (shift work, lack of control/unpredictability), low social support and fatigue [4, 5]. Given that frequent exposure to traumatic and life-threatening events is a key feature of many emergency service jobs, it is not surprising that the majority of research on the mental health of this population has, to date, focused upon post-traumatic stress disorder (PTSD). Whilst 12-month prevalence rates for PTSD in the general population are estimated at 3.5% in the United States of America [6] and 1.1% in a cross-national sample spanning 27 countries [7, 8], PTSD prevalence rates as high as 10% have been reported amongst emergency service workers [9]. Ambulance personnel appear to be particularly at high risk, with a recent meta-analysis finding this group reported significantly higher rates of PTSD compared to other emergency services such as police and firefighters [9].

However, PTSD represents only one of the possible mental health consequences of regular trauma and stress in emergency service work. Whilst there have been recent reviews of rates of PTSD amongst emergency service workers [9], there is limited research examining other common mental health outcomes such as depression and anxiety within this profession. This lack of research risks leading to the true extent of the psychiatric burden experienced by emergency services being underestimated. The few studies published to date have demonstrated rates of depression and anxiety in ambulance personnel are in excess of population estimates [4, 10, 11] with higher rates of depression and anxiety as the burden of cumulative trauma increases [12].

Another issue making interpretation of the literature difficult is that there is a wide variation in prevalence rates of various mental health disorders reported amongst emergency service workers to date [9]. For example, PTSD rates of between 5 and 29% [9] have been reported amongst rescue workers and disaster responders. Whilst a number of potential reasons for such variation in estimates have been proposed, such as differences in scale type, diagnostic classifications, trauma status and inconsistent sampling size and methods, to date there has been very little systemic examination of these issues. A commonly cited contributor to such variation in reported rates is the use of mixed samples combining a range of different services (firefighters, police, disaster rescuers) and international variations in terminology and occupational roles within emergency medical situations (first responders, disaster workers, body handlers). Changes and improvements in methodological rigor over time may also be a factor. A further possibility is that rates of mental health problems amongst emergency service personnel may be changing over time, with changes in frequency and reporting of certain critical incidents and traumatic events such as mass natural disasters and acts of terrorism. Systematic examination of these factors is necessary to better investigate this heterogeneity in the literature on mental health prevalence amongst emergency service workers.

In summary, we propose that there are two key gaps in the published literature that need to be addressed. First, while there is evidence that ambulance personnel appear to be a particularly high-risk group, there is an urgent need to understand the broader mental health issues amongst ambulance personnel beyond the previous focus on PTSD. Second, there is substantial heterogeneity in the literature on mental ill-health among emergency services, and little by way of systematic examination of the causes of these differences.

This review aims to provide updated estimates of the prevalence of post-traumatic stress disorder (PTSD) and common mental health disorders (depression, anxiety and general psychological distress) amongst ambulance personnel. We also sought to examine heterogeneity within existing data to investigate whether methodological issues or changing patterns over time could explain the wide variation within previous published prevalence estimates for mental health conditions within this occupation.

Method

Population of interest

Due to variation in terminology and meaning of ambulance and paramedic personnel worldwide, we adopted an inclusive definition of such workers. We defined "ambulance personnel" as including paramedics, emergency medical technicians (EMTs), ambulance workers and other individuals who provide pre-hospital emergency medical care and transport as part of their daily on-road duties during accident and emergency medical situations. Administrative ambulance staff (call-takers, dispatchers), retired or volunteer ambulance personnel, and student paramedics who were not undertaking on-the-job training of more than a month were excluded. Where studies reported on multiple occupational groups (e.g. a mixed sample including firefighters and ambulance personnel), we reported data pertaining only to the ambulance subgroup.

Search strategy

A computerised literature search of three databases [EMBASE (1980–2016), Medline (Ovid, 1966–2016), PsycINFO (1972–2016)] of publications to March 2018 was conducted to identify relevant academic literature reporting original data on PTSD and common mental health outcomes in ambulance personnel. We performed a search combining terms related to (1) ambulance personnel/paramedic/ emergency medical workers and (2) PTSD, common mental

health disorders and other mental health problems using, abstract, title, text word, subject and exploded MESH headings and thesaurus terms as appropriate for each database. The full search strategies and terminology employed in each database are provided in Online Resource 1. Studies were required to be an original research article, published in a peer-reviewed academic journal in English. No restriction on publication date was set. Dissertations, theses and qualitative studies were excluded, and reviews were retained only for the purposes of reference list searches. An additional reference list search examined three sources: (1) reference lists of 95 articles identified as relevant in the first screen; (2) reference lists of 11 systematic reviews captured in the original search; and (3) reference lists of relevant reviews on this topic known to authors.

Screening and study selection

We followed the MOOSE (Meta-analysis and Systematic Reviews of Observational Studies in Epidemiology) guidelines for study selection and reporting. After the removal of duplicates, all identified studies were independently screened by two authors (JMS and KP). First, an initial screen of titles and abstracts identified potentially relevant articles. The full-text versions of these studies were then scrutinised to determine eligibility for inclusion in the systematic review. Any additional relevant articles identified through reference list searches were also examined in full-text. Any differences or uncertainties were resolved via consensus discussions with a third author (SBH).

Inclusion and exclusion criteria

The inclusion criteria required that studies:

1. Presented original data on at least one of the following mental health outcome(s) of interest using a standardised validated assessment (self-report or interview):

   (a) Post-traumatic stress disorder (PTSD);
   (b) Depression;
   (c) Anxiety; and/or collectively as
   (d) General psychological distress (GPD; defined as elevated symptoms of non-specific emotional distress likely to cause some level of impairment).

In addition to using a validated instrument, included studies were required to state how they used the diagnostic tool in a validated manner, in particular their use of appropriate cut-off scores or validated diagnostic algorithms.

2. Examined a representative population of currently employed ambulance personnel and provided a response rate indicating how many of their sample provided data.

When different articles presented data on the same sample of ambulance personnel, the most recent publication was included. Samples selected on the basis of their exposure to a particular type of trauma (i.e. natural disaster, terrorism), their involvement at a particular site or event (i.e. 2005 London bombings) or who were all exposed to the same critical incident were excluded to ensure a representative sample of ambulance personnel engaged in regular everyday duties were examined.

Quality assessment

One author determined the methodological quality of all studies included in the systematic review ($N = 27$) (KP), with discussion and verification by a second author (JMS) to achieve consensus establish agreement with overall rating scores. Methodological quality was rated using the 14-item National Institute of Health (NIH) Quality Assessment Tool for Observational Cohort and Cross-sectional Studies [13]. This was considered an appropriate tool due to it being designed for the types of studies included within the review, its relevance to epidemiology, and its use in a similar review [14]. Each of the 14 items is rated "yes/no" and following critical appraisal of the ratings across all items and a wider consideration of these factors' collective impact and study methodology as a whole, an overall quality rating of "good", "fair" or "poor" is determined according to validated definitions.

Data extraction

Data were extracted from full-text articles by the first author (KP) and a random selection (one-third of studies; 30%) reviewed for accuracy by two others (JMS and SBH), including quantitative mental health data for meta-analysis. Information was recorded as categorical or continuous variables, into a custom-designed spreadsheet. The same information was extracted for each mental health outcome reported in each article. A range of variables decided a priori were extracted from each study for subgroup analyses: region, date of data collection, response rate and sample size category, and for PTSD studies, type of scale [Impact of Events Scale (IES)/non-Impact of Event Scale (non-IES)]. Region, similarly examined by Berger and colleagues in their 2012 meta-analysis [9], was defined with three groups; namely Europe, America and Asia-Pacific. Year of data collection was defined as the year study data was collected as reported by the authors. If the year of data collection was not reported, we defined it as 1 year prior to the year the article

was accepted for publication. If the acceptance date for publication was not provided, then the date of data collection was defined as occurring 2 years prior to year of publication, to account for time lags in data collection, analysis and publication process. Type of PTSD scale (IES or non-IES) was previously examined as a factor of interest in the latest meta-analysis [9]. However, the wide variation in scale types employed to assess depression, anxiety and general psychological distress precluded analysis of this variable for non-PTSD outcomes. Sample size was defined as the number of ambulance personnel in the sample per study and was classified into three categories (< 100, 100–250, > 250).

Statistical analyses

For those studies included in the meta-analysis, numeric data on prevalence estimates and subgroup variables were extracted and imported into STATA v12 for statistical analysis. Meta-analyses were performed using the *metaprop* command [15]. Given the expected levels of heterogeneity, a random effects model was used to allow for a more conservative approach to calculation of pooled mean prevalence estimates. Pooled prevalence estimates were expressed as mean estimates with 95% confidence intervals. To further evaluate the role of each variable for any observed heterogeneity a series of sub-analyses and meta-regression analyses were undertaken using the *metareg* command. Publication bias was examined by visual inspection of a funnel plot prepared using the STATA *metafunnel* and *metabias* commands.

Results

Study characteristics

The computerised search yielded a total of 941 articles. Following the removal of duplicates, 643 articles underwent title/abstract screening. A total of 95 potentially relevant full-text articles were screened in detail to determine their eligibility. After application of inclusion criteria, a final set of 27 studies reporting on 26 unique samples were included in the systematic review. Of these, only 18 articles were included for entry in the meta-analysis for at least one mental health outcome [10, 16–32]. Most common reasons for exclusion were failure to report response rate and no mental health outcome of interest. Figure 1 details the full screening process in a flowchart. The articles included in this review were published between 1988 and 2016 with the majority of data collection occurring in the first decade of the 2000s. A total of 32,111 individuals across mixed samples (of which 30,878 were ambulance personnel) were considered across 15 countries, with research conducted mainly in Europe and America. Only one study was longitudinal (for this study,

baseline prevalence data was used), whilst the rest were cross-sectional in design and featured low but acceptable response rates (average 57%). A summary of the characteristics of the included studies is shown in Table 1.

Mental health outcomes

PTSD was the most commonly reported mental health outcome represented in 15 studies (55%) using a variety of scales (IES-R: Impact of Events-Revised, PDS: Posttraumatic Stress Diagnostic Scale, PSS: PTSD Symptom Scale, TSQ: Trauma Screening Scale), 6 of IES and 9 of non-IES derivation. GPD was examined by 9 studies (33%) using General Health Questionnaire scales, whilst depression and anxiety were the least commonly reported mental health outcomes with either HADS (Hospital Anxiety and Depression Scale) or Depression Anxiety Stress Scales (DASS) subscales.

All assessments of mental health were self-report with no studies employing clinical diagnostic interviews. To determine 'caseness' of mental health conditions, around two-thirds of studies employed cut-off scores for symptom severity based on published validation studies whilst the remainder used diagnostic algorithms, most commonly for PTSD.

As demonstrated in Fig. 2, meta-analyses demonstrated ambulance personnel had a pooled estimated prevalence of PTSD of 11% (95% CI 0.07–0.14). The estimated pooled prevalence of depression (15%, 95% CI 0.10–0.20), anxiety (15%, 95% CI 0.08–0.22) and general psychological distress (27%; 95% CI 0.14–0.40) were all slightly higher, as shown in Fig. 3a–c. Furthermore, results confirmed high heterogeneity across all four mental health outcomes.

Subgroup analyses and meta-regression

To examine causes for the relatively high heterogeneity in the estimates of PTSD prevalence a number of additional subgroup analyses and meta-regressions were undertaken [33]. As shown in Table 2, the impact of date of data collection, region, response rate, sample size and type of PTSD scale were examined. Meta-regression showed that of these variables, only the date of data collection explained a significant amount of the heterogeneity in prevalence estimates, although there was also a trend ($p = 0.2$) towards studies with better response rates providing larger prevalence estimates. As shown in the bubble plot in Fig. 4, there has been a significant trend towards lower estimates of PTSD prevalence over the last three decades. The adjusted R-squared statistic from the meta-regression suggested that this effect explained 31% of the between-study variance in PTSD prevalence estimates. Amongst the ten studies undertaken since 2000, the
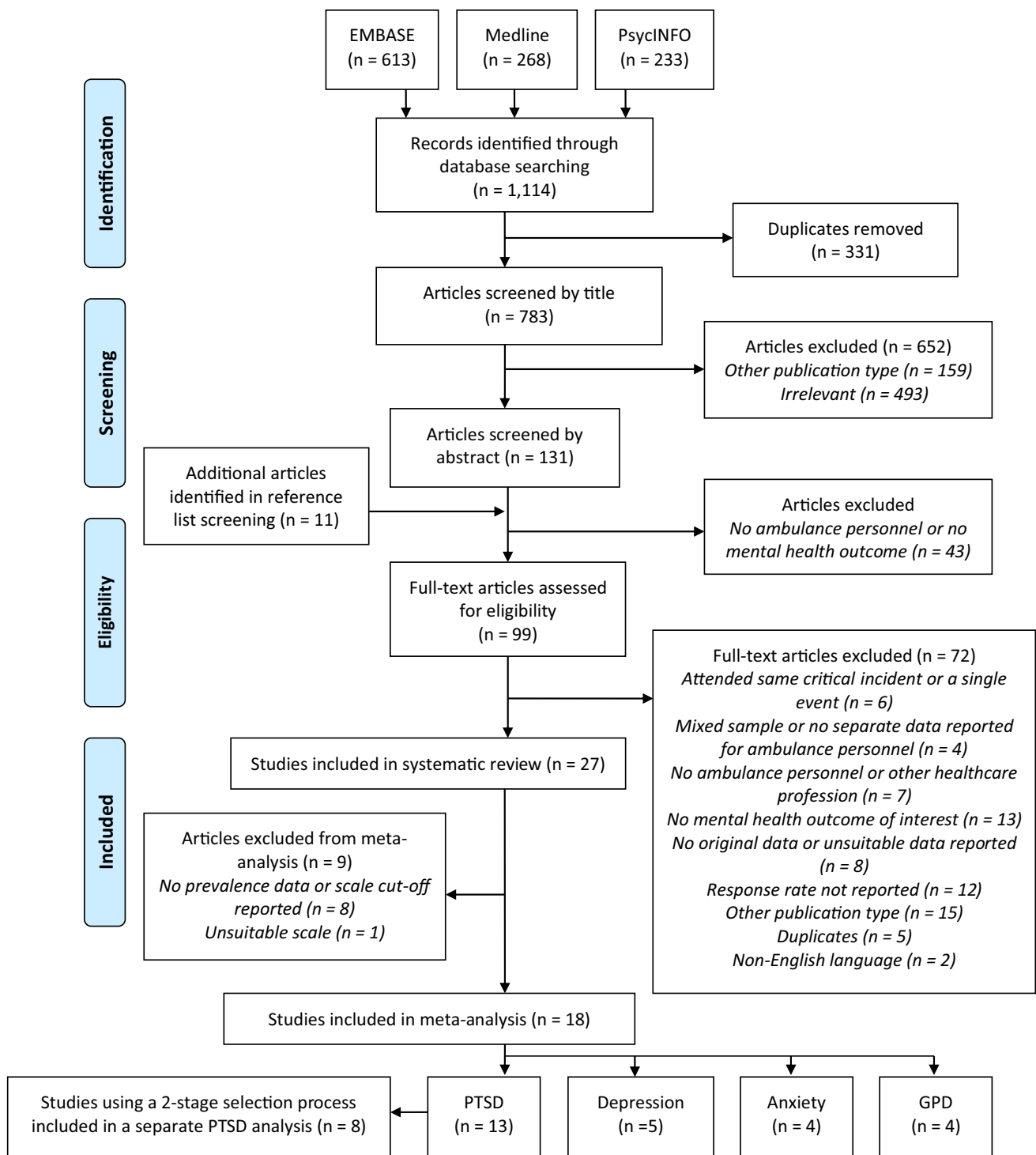
Fig. 1 Flowchart of the screening and study selection process. *GPD* general psychological distress, *PTSD* post-traumatic stress disorder

estimated pooled prevalence of PTSD was reduced to 8% (95% CI 4–12%).

To examine the possibility that over time larger, more accurate studies have been able to occur, a post-hoc analysis was undertaken examining for any association between the year of data collection and the sample size for each study. There was no evidence of increasing sample sizes in studies over time ($p = 0.42$). Similarly, an additional post-hoc meta-regression did not demonstrate any evidence of

Table 1 General characteristics of studies included in systematic review

Study characteristics	Number of studies[a] (%)
Date of data collection (n = 26)	
1985–1999	7 (26.9%)
2000–2005	10 (38.5%)
2006–2017	9 (34.6%)
Year of publication (n = 27)	
1988–1999	6 (22.2%)
2000–2010	12 (44.4%)
2011–2016	9 (33.3%)
Continent (n = 27)	
Africa	1 (3.7%)
America (North and South)	8 (29.6%)
Australia	4 (14.8%)
Europe	14 (51.9%)
Sample composition (n = 26)	
Ambulance only	23 (88.5%)
Mixed[b]	3 (11.5%)
Location of ambulance service (n = 27)	
Metropolitan	8 (29.6%)
Rural/regional	4 (14.8%)
Both	11 (40.7%)
Not reported	4 (14.8%)
Response rate (n = 27)	
	Mean: 57%; 23–100%
0–35%	4 (14.8%)
36–59%	12 (44.4%)
≥ 60%	11 (40.7%)

Sample characteristics	Mean (SD); range
Age (years) (n = 20)	34.9 years (8.8); 18–66 years
Percentage male (n = 23)	78.1% male
Time in service (years) (n = 15)	9.32 years (5.5); 6 months–50 years
Total number of individuals examined in meta-analysis	
Ambulance only	30,878 personnel
Overall (incl. mixed samples)[b]	32,111 individuals; 42–23, 451
Sample size (n = 25)	Number of studies (%)
< 100	5 (20%)
100–250	12 (48%)
> 250	8 (32%)

Outcome characteristics	Number of studies
Number of mental health outcome(s) reported	
Single outcome	17
2 outcomes	9
3 outcomes	1
Representation of each outcome	Review (meta-analysis)
PTSD	15 (14)
GPD	9 (4)
Depression	8 (5)
Anxiety	4 (4)

Table 1 (continued)

Outcome characteristics	Number of studies
Type of outcome(s) reported	
PTSD only	8
PTSD and at least 1 other CMD	7
Multiple CMD outcomes (without PTSD)	3
Single CMD outcome (other than PTSD)	9
Type of PTSD scale (n = 14)	
IES	5 (35.7%)
Non-IES	9 (64.3%)

PTSD post-traumatic stress disorder, *GPD* general psychological distress, *CMD* common mental disorders, *IES* Impact of Events Scale, *Non-IES* PTSD symptom scales that are not derived from the Impact of Events Scale [e.g. Trauma Screening Questionnaire (TSQ), Post-traumatic Diagnostic Scale (PDS)]

[a]Number of studies for each characteristic may not comprise the full set of 27 studies included in the systematic review, as some studies failed to report sufficient data on every characteristic and some characteristics describe a subgroup variable examined in the selected studies included in the meta-analysis

[b]Mixed sample: sample comprised multiple occupational groups, one of which was ambulance personnel; e.g. fire-fighters, other emergency workers, healthcare professionals

an association between study size and estimated prevalence of PTSD ($p = 0.78$).

Publication bias

To evaluate the possibility of publication bias, visual examination of a funnel plot (Fig. 5) was undertaken. There was some suggestion of asymmetry, with a lack of smaller studies with lower prevalence estimates. A sensitivity analysis excluding all studies with samples less than 250 individuals provided an identical estimate of PTSD prevalence (11%; 95% CI 4–18%), suggesting that any publication bias present was unlikely to be having a major impact on the prevalence estimates reported.

Discussion

This systematic review and meta-analysis represents the largest and most comprehensive exploration of the mental health of ambulance personnel published to date. Our findings confirm previous estimates that just over one in ten currently employed ambulance personnel report symptoms consistent with PTSD. In addition to this confirmation, our results make two important new contributions to the literature about first responder mental health. First, we have found
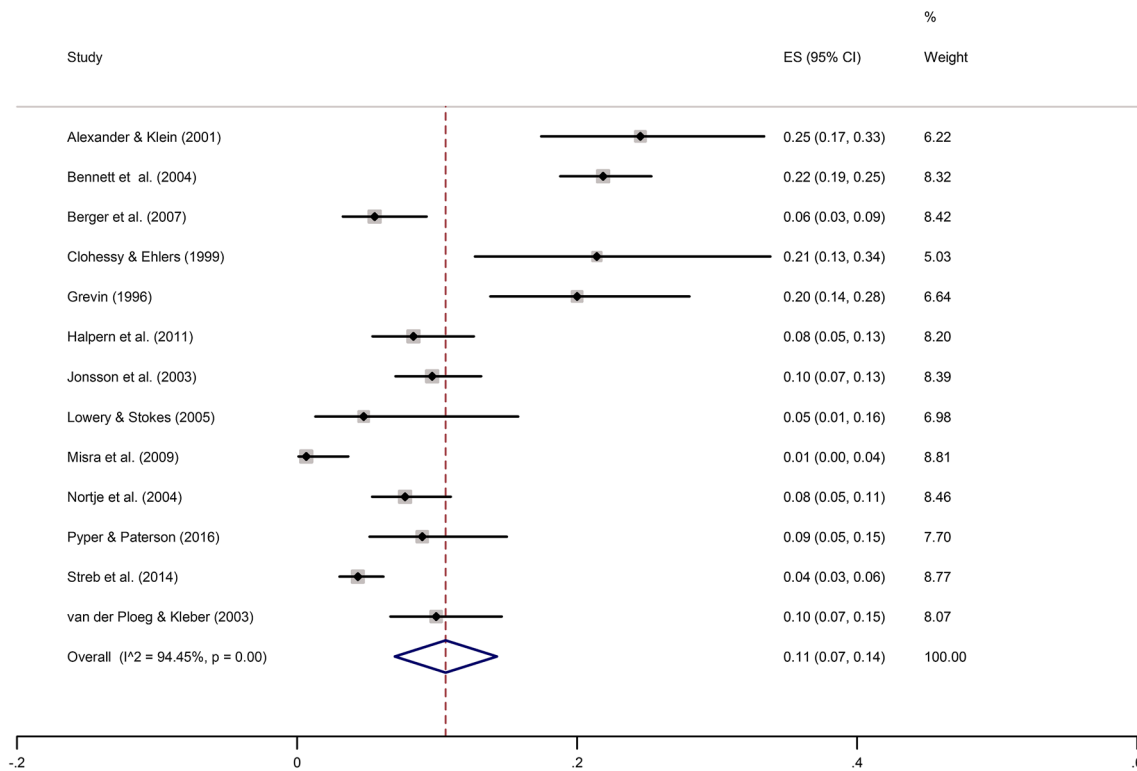
Fig. 2 PTSD prevalence forest plot

evidence that rates of PTSD amongst ambulance personnel may be decreasing over time, with more recent studies tending to find lower prevalence rates. Second, we have shown that other mental health problems, specifically depression and anxiety, are more prevalent than PTSD amongst this particular trauma-exposed occupation, with an estimated 15% of ambulance personnel estimated to be suffering from each of these conditions.

Pooled prevalence rates for some, but not all, mental health outcomes were higher for ambulance personnel in the present study compared to rates seen within the general population. The international pooled prevalence rate of 11% for PTSD found by this review is comparable to figures of 10.2% [9] and 12.4% [34] reported in other systematic reviews of first responders. These figures are higher than point-prevalence rates in the general population, which usually range from 1.3 to 2.9% [6, 35, 36]. While rates of PTSD were very high amongst ambulance personnel, this was not the most common mental health diagnosis amongst this group, with prevalence estimates for depression and anxiety both greater. Depression and anxiety are currently estimated by the World Health Organization to affect 4.4 and 3.6% of the global population, respectively [37]. The results of the meta-analysis presented in this paper suggest rates of depression and anxiety amongst ambulance personnel may be higher, though it is very difficult to compare

prevalence estimates derived from different instruments, particularly self-report compared to diagnostic interviews. A fairer comparison of the level of depression and/or anxiety symptoms can be made using measures of generalised psychological distress, where normative values are well established. Severe psychological distress was estimated to affect 27% ambulance personnel. While this is higher than some of the general population estimates, perhaps the most appropriate comparison group are previous studies of other occupational groups. Counter intuitively, depression and anxiety symptoms are found more commonly amongst occupational studies compared to population studies. A recent systematic review found that the pooled prevalence estimates for case levels of psychological distress (as measured by the GHQ) was 29.6% across all occupational studies, compared to 19.1% amongst population studies [38]. Therefore, on balance, it appears likely that while ambulance personnel have high rates of PTSD compared to the general working population, there is not currently evidence that their levels of general psychological distress symptoms are any higher than rates seen amongst other working populations.

The finding of a reducing prevalence of PTSD over time was unexpected. We propose three broad hypotheses to explain this observation. First, it may be that study methodology has changed over time, for example, the use of different scales or the ability to access larger more representative
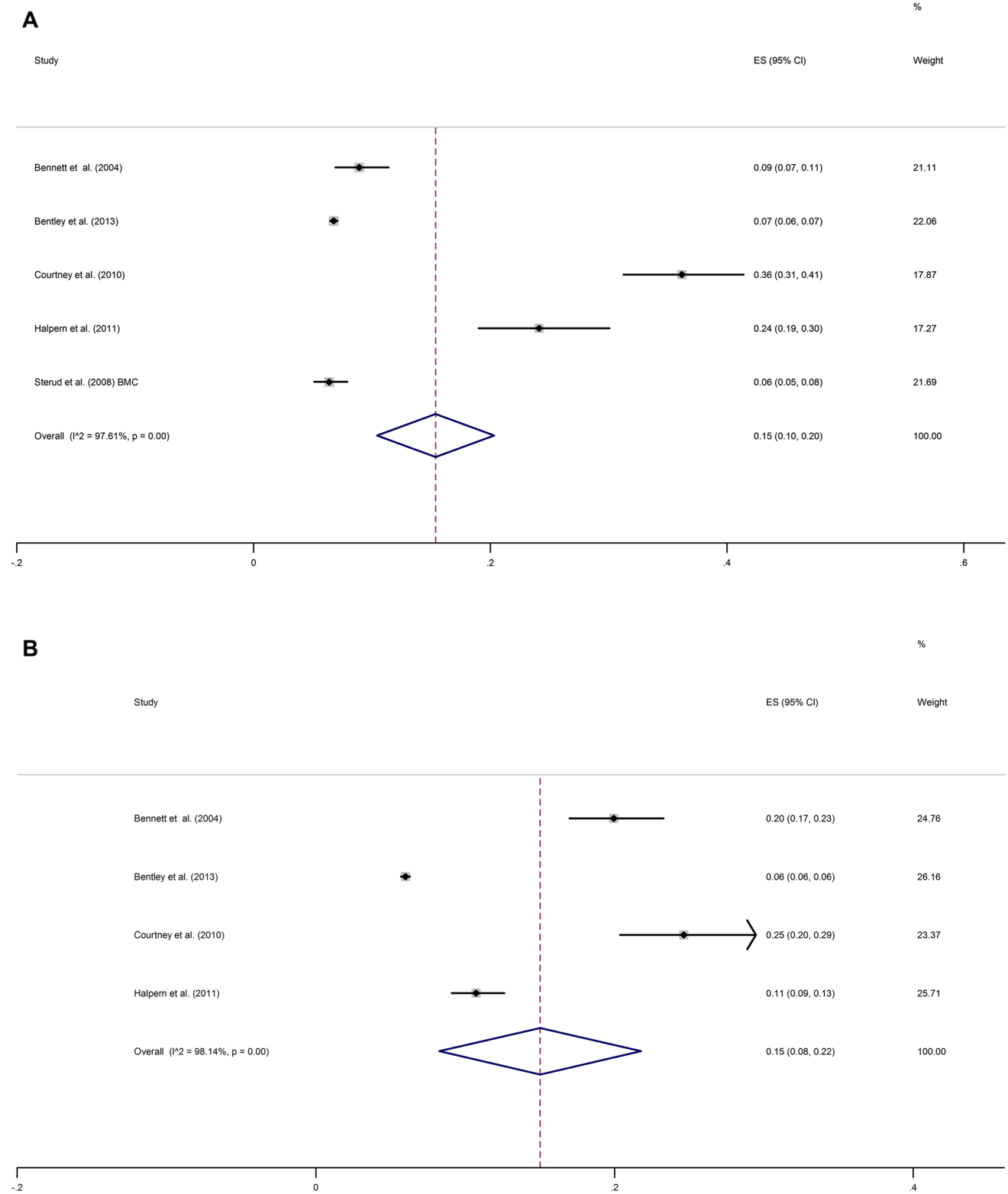
Fig. 3 **a** Depression prevalence forest plot. **b** Anxiety prevalence forest plot. **c** General psychological distress prevalence forest plot

C

%

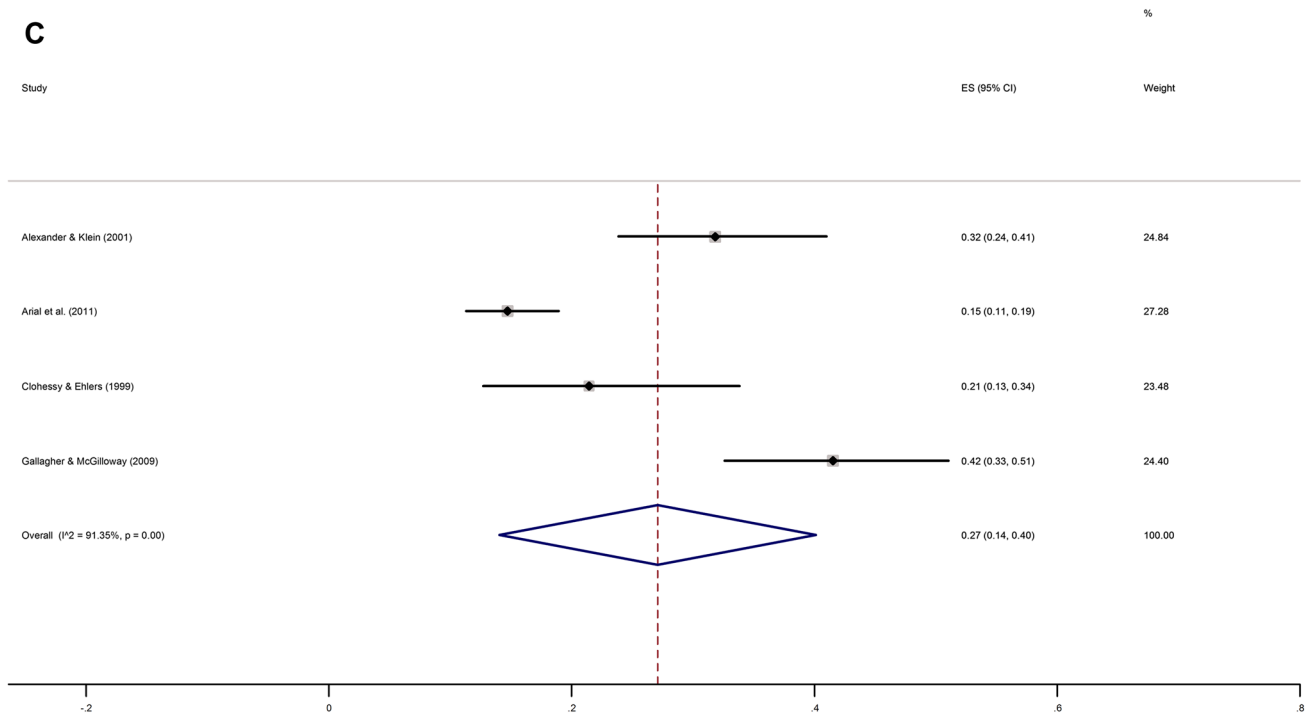| Study	ES (95% CI)	Weight
Alexander & Klein (2001)	0.32 (0.24, 0.41)	24.84
Arial et al. (2011)	0.15 (0.11, 0.19)	27.28
Clohessy & Ehlers (1999)	0.21 (0.13, 0.34)	23.48
Gallagher & McGilloway (2009)	0.42 (0.33, 0.51)	24.40
Overall (I^2 = 91.35%, p = 0.00)	0.27 (0.14, 0.40)	100.00

Fig. 3 (continued)

sampling. Some of these factors were examined by post-hoc analyses, yet we failed to find evidence for their significance. Second, under-reporting of PTSD may have increased over time, possibly due to stigma or fear of organizational consequences of admitting mental health issues, and this may contribute to lower self-reported rates of PTSD. The third possibility is that there has been a real change in PTSD prevalence rates over time amongst this occupational group. Amongst emergency service organisations such as ambulance services, there has been a rapid increase in the awareness of mental health issues over recent decades, leading to the introduction of a range of new mental health initiatives. These include the introduction of more rigorous pre-employment screening processes, more mental health training and education, more frequent staff wellbeing checks and better post-incident support processes [39]. While the evidence base for any of these interventions remains relatively weak [40–42], it is possible that overall their collective impact is beginning to manifest in reduced rates of PTSD. Unfortunately, there were not enough studies of depression, anxiety or psychological distress amongst ambulance personnel to test if there had been a corresponding reduction in their prevalence over time as well. Such information will be important to gather in the future as it will help determine which of the above proposed hypotheses are most likely, emphasising the need for further long-term larger scale cohort studies.

A substantial amount of heterogeneity was observed in our findings for all mental health outcomes, consistent with

pattern found in previous similar reviews [9]. Although we investigated a number of possible reasons for this variation, the majority of this heterogeneity remained unexplained. Use of different assessment scales for PTSD has been proposed as a potential contributor to between-study variation, however, no significant difference was found between IES and non-IES derived instruments. The possibility of truly different rates between countries remains, but again no significant differences emerged when different geographical regions were compared. Variations in sampling across studies could account for some heterogeneity, with some evidence of a trend towards higher PTSD estimates as response rates increased in the meta-regression. The role of other established correlates of PTSD which are likely to vary between different ambulance services, such as the level of social support [43, 44], the level of exposure to different types of trauma [45] and the type of mental health intervention provided [5] was not examined, but could account for at least part of the observed heterogeneity.

The strengths of this review include its objective quality assessment of the included studies, rigorous study selection and the detailed set of analyses, including meta-regression. Our examination of mental health disorders other than PTSD is another strength that extends upon the literature published to date. There are a number of limitations of both the review itself, and those studies included within the review, that also must also be considered. First, the literature search was limited to peer-review English language publications,

Table 2 Estimated pooled prevalence rates of PTSD by subgroup variables

Subgroup variable and categories	Estimated PTSD Prevalence % ES (95% CI)	p value
Date of data collection		0.03*
1985–1999	0.20 (0.14–0.26)	
2000–2005	0.13 (0.07–0.18)	
2006–2017	0.05 (0.02–0.08)	
Region		0.46
Europe vs. America		0.77
Europe vs. Asia-Pacific		0.40
Europe	0.12 (0.07–0.18)	
America	0.10 (0.04–0.17)	
Asia-Pacific	0.07 (0.04–0.11)	
Response rate		0.23
0–35%	0.06 (0.0–0.11)	
36–59%	0.08 (0.04–0.12)	
60–100%	0.16 (0.08–0.23)	
Sample size[a]		0.90
< 100	0.09 (0.04–0.15)	
100–250	0.10 (0.06–0.14)	
> 250	0.12 (0.02–0.22)	
Type of scale		0.75
IES	0.11 (0.08–0.15)	
Non-IES	0.10 (0.05–0.15)	

ES   0.0 0.05 0.10 0.15 0.20 0.25 0.30

IES Impact of Events Scale, *Non-IES* PTSD symptom scales that are not derived from the Impact of Events Scale

[a]Sample size: refers to overall sample size for ambulance personnel (in the case of mixed samples with other occupational groups, only the number of ambulance personnel was used in analyses)
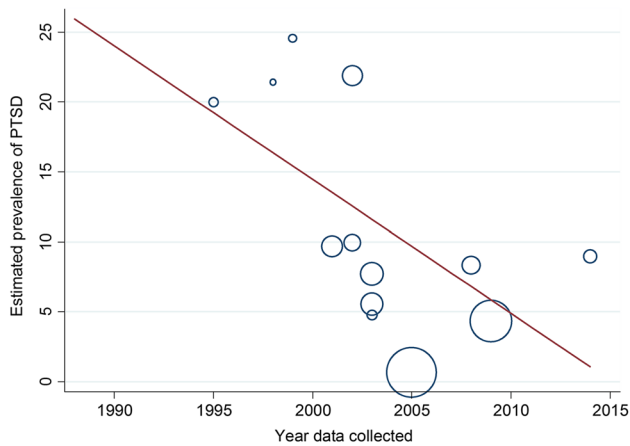
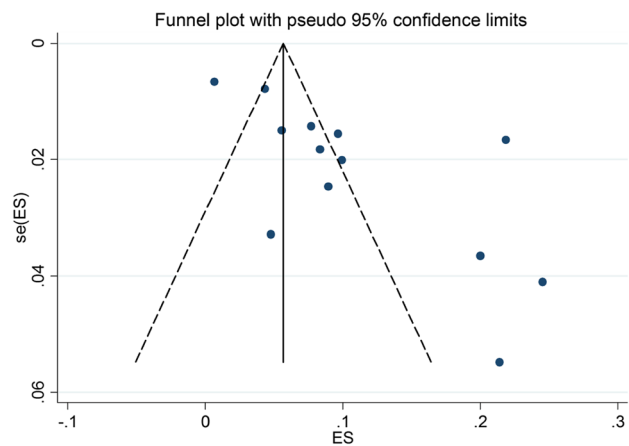**Fig. 4** Bubble plot of meta-regression results for PTSD prevalence by data of data collection

Fig. 5 Funnel plot of publication bias amongst PTSD studies. *ES* effect size, *se(ES)* standard error of effect size

meaning all relevant international studies may not have been captured. Second, there was some evidence of publication bias, with a lack of smaller studies finding lower prevalence estimates, though our reported sensitivity analyses suggest this did not have a significant impact on our overall prevalence estimates. Considerable heterogeneity was observed for all mental health estimates, in line with previous reports, which warrants caution in the interpretation of our overall pooled prevalence estimates in spite of the use of random effects modelling. Finally, these results are limited to currently employed ambulance personnel only, and are not generalizable to other groups of first responders (i.e. police) or retired ambulance workers. In terms of the limitations of the individual studies included in our review, first, all studies were cross-sectional in design and so causal implications regarding the reasons for the high rates of mental health symptoms cannot be drawn. All studies in the review utilised

self-report measures which cannot be considered equivalent to a clinician's diagnostic assessment. The use of such gold-standard assessments in ambulance personnel will be important to enable accurate comparisons with population studies. Comparison between estimates obtained different measures and self-report versus structured interviews raises important issues around methodological context effects, comparability and overestimation within data [38]. We have endeavoured to address this by only comparing to similar self-report community estimates. However, these issues within the literature in general still requires a level of caution when interpreting our findings. It is also important to note that occupational studies tend to produce higher prevalence estimates than community based studies [38], so wherever possible we have used other occupational study norms for comparison. Collectively, studies were of relatively low methodological quality, demonstrated low response rates and relatively small sample sizes that were predominantly male in gender. Whilst typical of studies in similar populations, who are difficult to engage in any mental health survey, these issues may limit the representativeness of our estimates. Notwithstanding these considerations, our meta-analysis was able to include the responses of over 30,000 ambulance personnel worldwide.

The findings from this study provide a number of practical implications for both emergency services and for researchers. Ambulance and other first responder agencies need to be aware of the high level of symptom burden of mental ill-health amongst their personnel, and in particular the importance of depression and anxiety, in addition to PTSD. Services must ensure that programs aimed at assisting identification, training and employee support adequately address depression, anxiety and general psychological distress in addition to the usual focus upon trauma-based approaches and PTSD treatment. The fact that these figures were reported by currently employed ambulance personnel engaged in daily occupational routine, and not by personnel following attendance at a specific critical incident, highlights the importance of ambulance services implementing ongoing preventive and support measures to improve the mental health in their workforce, instead of only focusing such services in the immediate period following a traumatic event. While there is much hope that such support measures may be able to prevent the development of some mental disorders and aid early intervention [46], to date there is relatively limited evidence for the effectiveness of many of the commonly used strategies as preventative interventions [40].

While we did not find evidence of ambulance personnel having greater levels of general psychological distress than other occupational groups, it is important to note that case level symptoms of depression and anxiety were still more common than PTSD. As a result, it may be that

transdiagnostic approaches may be particularly beneficial within the emergency services. The limited amount and low quality of available data identified by our review, particularly for non-PTSD mental health outcomes, indicate ambulance personnel remain an under-researched population. Better quality studies employing larger samples and comprehensive, gold-standard assessments, are required to address this. Large-scale prospective cohort studies would be valuable to establish long-term trends in and consequences of mental ill-health amongst this occupation and the effects of cumulative trauma. More broadly, these studies may also assist in improving our understanding how and why prevalence rates may be changing over time.

Author contributions SBH and KP conceptualized the study, KP and JMS undertook search and screening processes, KP completed data extraction, KP and SBH carried out statistical analysis, and wrote subsequent versions of the manuscript. All other authors reviewed and approved the final submission.

Compliance with ethical standards

Conflict of interest There are no conflicts of interest to report regarding this publication.

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