Treatment pathways for veterans who access secondary mental health care services in the United Kingdom: A feasibility study

Preliminary Report

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CONTENTS

KING'S CENTRE FOR MILITARY HEALTH RESEARCH

Previously the Gulf War Illness Research Unit, the King's Centre for Military Health Research (KCMHR) was launched in 2004 as a joint initiative between the Institute of Psychiatry, Psychology and Neuroscience (IoPPN) and the Department of War Studies at King's College London. KCMHR draws upon the experience of a multi-disciplinary team and is led by Professor Sir Simon Wessely and Professor Nicola Fear. It undertakes research investigating military life using quantitative and qualitative methods. Its flagship study is a longitudinal investigation of the health and well-being of the United Kingdom's (UK) armed forces personnel. The study, funded by the UK Ministry of Defence (MoD), has been running since 2003 and completed its third phase of data collection in 2017. Data from our studies has been used to analyse various military issues and papers have been published in peer reviewed, scientific journals. Our findings are regularly reported in the press and have also been used to inform military policies.

Authors:

Dr Katharine Mark

Dr Dominic Murphy

Mr David Pernet

Dr Sharon Stevelink

Professor Nicola Fear

EXECUTIVE SUMMARY

Introduction

A considerable number of military veterans suffering with mental health problems fail to seek professional help for their difficulties. Previous research focusing on United Kingdom (UK) veterans who do engage in treatment tells us mainly about those accessing primary care services. Although it is useful to investigate the profile of ex-serving[*] personnel who initiate their mental health treatment through primary care, there is a relative lack of quantitative evidence concerning those who access secondary care services – that is, more specialist mental health care, frequently delivered in higher intensity therapeutic clinics or hospitals.

Research objectives

This research used two electronic health record (EHR) case registers to explore the utility and feasibility of identifying veterans accessing secondary mental health care services within the UK. In addition, the report compared the socio-demographic profiles, the types of mental health disorders and the treatment pathways of veterans who engage in secondary mental health care services within the UK, across two different settings.

Method

Two EHR databases were used to identify veterans who had accessed secondary mental health care services within the UK: 1) The South London and Maudsley (SLaM) Biomedical Research Centre (BRC) case register; and 2) The Combat Stress case register. The SLaM BRC case register provided data on veterans who had accessed secondary mental health care services through the SLaM National Health Service (NHS) Trust. The Combat Stress case register provided data on veterans who had accessed secondary mental health care services through the military mental health charity Combat Stress. The study procedure involved: 1) identifying veterans from the SLaM BRC case register; 2) matching veterans from the Combat Stress case register to veterans from the SLaM BRC case register on age and gender; 3) extracting data on socio-demographic characteristics, types of mental health disorders and treatment pathways through care; and 4) describing the utility and feasibility of these processes and analysing the similarities and differences between the two groups of veterans.

Utility and feasibility results

This study showed that it is feasible to identify veterans using the SLaM BRC case register. However, the procedure was impractical and time consuming. Accessing the two case registers and associated data was lengthy and involved various administrative hurdles and data security issues. Identifying veterans from the SLaM BRC case register was particularly labour intensive. It involved systematically searching the database, using military-related phrases and exclusion criteria, and scrutinising 1,600 individual records one-by-one.

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[*] The terms 'veteran' and 'ex-serving personnel' are used interchangeably in this report and refer to the same group of individuals.

The percentage of true veterans identified in the SLaM BRC case register, versus the percentage of non-veterans[†] identified, was 43% overall . While this percentage reflects a positive first step in creating a methodology to identify veterans from large clinical databases, it is still relatively low compared to automated identification processes that make use of natural language processing (NLP). We were careful in our decision regarding who to classify as a veteran – we read through all clinical notes at least twice and only confirmed veteran status when an explicit statement about the patient serving was reported by the clinician. The term 'Royal Air Force' correctly identified veterans most often during the searches.

After identification of 6,039 veterans who had accessed secondary mental health care through the SLaM NHS Trust and 1,136 veterans who had accessed secondary mental health care through Combat Stress, we were able to successfully generate two comparable groups, matched on age and gender. The sample consisted of 189 SLaM veterans and 189 Combat Stress veterans. These numbers are more than sufficient for the current feasibility study and are in line with the numbers expected for this report.

Extracting, cleaning and analysing data from the SLaM BRC case register and, to a lesser extent the Combat Stress register, revealed large amounts of missing data. A limited amount of this – records for 71 SLaM veterans and 110 Combat Stress veterans – was manually backfilled, using free-text clinical notes and patients' scores on mental health questionnaires. However, this issue was not systematically tackled due to time and resource constraints.

Veteran group comparison results

The majority of the age and gender matched veterans who accessed secondary mental health care through both the SLaM NHS Trust and through Combat Stress were male. SLaM veterans and Combat Stress veterans had a median age of approximately 40.0 years (interquartile ranges were 31.0 – 49.0 for SLaM veterans and 31.4 – 50.5 for Combat Stress veterans).

In terms of socio-demographic variables, SLaM veterans were significantly more likely to live alone and to be single/other in relationship status than Combat Stress veterans, whereas Combat Stress veterans were significantly more likely to live with their partner/children and to be in a relationship than SLaM veterans. Combat Stress veterans were also significantly more likely to have British ethnicity than SLaM veterans.

In terms of mental health variables, SLaM veterans were significantly more likely to be given a drug misuse or an 'other' disorder diagnosis or to be assigned a 'no diagnosis given'[‡] category, whereas Combat Stress veterans were significantly more likely to be given a depressive, anxiety or stress disorder diagnosis. Combat Stress veterans were significantly more likely to be given more than one mental health disorder diagnoses than SLaM veterans.

In terms of treatment pathway variables, SLaM veterans booked significantly fewer outpatient secondary mental health care appointments than Combat Stress veterans. SLaM veterans went on to

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[†] The term 'non-veteran' refers to the general public – that is, to civilians who have never served in the UK armed forces.
[‡] The 'no diagnosis given' category represents those veterans who were seen within secondary mental health care services, but who were not given a mental health disorder diagnosis.

attend significantly fewer outpatient secondary mental health care appointments than Combat Stress veterans.

Discussion

We found that it is possible to identify veterans using the SLaM BRC case register. While this feasibility project exceeded our expectations, it also faced significant procedural challenges. Specifically, it did not allow us to optimise the process of veteran identification or to extract and analyse additional data, due to time and budget constraints. FiMT have approved our research group to carry out a follow-on project. This will improve the methodology for extracting veteran data by developing an NLP tool to help us identify ex-military personnel in a more efficient way. The combined findings from both the current and future report will be used to share the NLP identification tool and to inform the possibility of rolling out a nationwide study. The combined findings will provide further insight into veterans' secondary mental health treatment pathways, on a larger and more representative scale.

This initial report helps to unpick similarities and differences in socio-demographic, mental health and treatment outcomes between veterans accessing secondary mental health care services through the SLaM NHS Trust and veterans accessing secondary mental health care services through the charity Combat Stress. The follow-on project will allow us to improve the potential and impact of the extracted data and carry out similar comparisons between veterans accessing secondary mental health care services through the SLaM NHS Trust and a matched group of non-veterans accessing services through the SLaM Trust. Specifically, this further research will: (1) increase the pool of veterans derived from the SLaM BRC case register, to increase statistical power; (2) analyse additional variables available within the SLaM BRC case register, such as medication usage for mental health difficulties and types of clinicians seen; (3) focus on specific veteran subgroups of interest within the SLaM BRC case register, such as women, ethnic minorities and those with a diagnosis of PTSD; and (4) systematically backfill missing data within the SLaM BRC case register, to improve reliability and robustness.

INTRODUCTION

Problem statement

Estimates of the UK's veteran population, defined by the British government as those who have performed military service for at least one day[1], range from 2.5 to five million[2-5]. A minority of veterans may experience mental health problems (estimates range from seven to 22% across psychiatric conditions), some resulting from their experiences in the line of duty[6]. Indeed, when a nationally representative sample of 257 veterans, between the ages of 16 and 64 years of age, was compared to an age and gender matched sample of 504 non-veterans living in the community in England, the former were found to display more violent behaviour and more suicidal thoughts[7]. Interestingly, a large UK cohort study set up to investigate the health of current and former military personnel has also shown that veterans display higher levels of probable PTSD and alcohol misuse than do serving personnel[8]. Recent research suggests that 93% of veterans who report having a mental health difficulty seek some form of help for their problems, including informal support through family and friends[9]. However, when looking purely at formal medical help, another study found that a substantial number (up to 69%) of serving and ex-serving personnel do not seek such support when needed[10]. Factors influencing individuals' choice not to access formal treatment include lacking recognition of their mental health disorder symptoms or believing that their symptoms are not severe enough; a propensity to favour informal over formal sources of help; preferring to deal with problems oneself; fearing adverse occupational outcomes; problems accessing services; and concern about the stigma associated with mental ill health[8, 11-14]. Recent research suggests that the latter is only a major issue at treatment initiation, when first accessing mental health services[12].

Of the veterans who do seek treatment, around 20% receive medication or counselling[10], typically by entering the health care system at the primary care[§] level within the NHS. The limited existing literature in this field tells us that most ex-serving personnel who present to such primary care settings are white males who served in the Army at lower ranks[15-17].

While it is important to know the profile of those who take the first step to tackling their problem through primary care, we know relatively little about veterans who access secondary mental health care[**] services. There is a lack of quantitative information concerning the profile of veterans receiving secondary mental health care and the treatment they receive, as the work that has been done has been qualitative in nature and has not included any additional participant groups as means of a comparison[18]. This is true both for NHS-based services and for military specific services offering treatment, such as the veteran charity Combat Stress. Combat Stress was established to provide both inpatient and outpatient clinical mental health services to veterans experiencing mental health difficulties. The interventions offered are classed as secondary mental health care services and veterans can refer themselves or can be referred by a primary care practitioner (usually a GP) to the charity. Those who access secondary mental health services or who are referred to these services

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[§] Primary mental health care refers to settings like general practitioner (GP) surgeries or low-level therapeutic clinics.
[**] Secondary mental health care refers to more specialist care, often delivered in higher intensity therapeutic clinics or hospitals.

from primary care will, in general, have more complex levels of need compared to those who remain in primary care.

Electronic health records

EHR-based case registers function as single, complete and integrated electronic versions of traditional paper health records, typically held by hospitals and other care services within the UK[19]. These registers have been positioned as a possible 'new generation' for mental health research[19] and their use, particularly within the NHS, has increased in recent years[20]. The methodological advantages of case registers – including their ability to follow up, in detail, large groups of individuals over time – make them an important research asset, providing large numbers of participants and measurement points[21]. EHRs in mental health care provide extremely rich material – because, in theory, they contain every piece of information recorded in a clinical service about a person's presentation, symptoms and relevant background history, as well as the interventions they have received and their response to treatments[22]. Exploration of data within such case registers can reveal patterns in health care provisions, patient profiles and mental and physical health problems.

Important limitations of EHR systems include the large amounts of missing data often present[23]; non-standardised and error-filled clinical free-text notes[24]; and a lack of information regarding undiagnosed mentally ill individuals within the community[25]. However, despite these, and other, potential problems with such case registers, they are hugely advantageous for investigating vulnerable subgroups within the wider population. Specifically, for this project, EHR databases provide us with the opportunity to examine treatment pathways for veterans accessing mental health care services within the UK, on a large scale.

Research objectives

There were two main research objectives for this study report.

1. To assess the utility and feasibility of identifying veterans accessing secondary mental health care, by using two EHR-based case registers.
2. To explore the socio-demographic profiles, the types of mental health disorders and the treatment pathways of veterans who engage in secondary mental health care services within the UK.

It is worth noting that this report is part of a larger on-going study. The results from the on-going study will be reported to FiMT in the Summer of 2019.

METHOD

Study materials

Two EHR databases, described below, were used to identify veterans who had accessed secondary mental health care services within the UK[††].

1. The South London and Maudsley Biomedical Research Centre case register

The SLaM BRC case register was set up in 2006 as a novel data resource, derived directly from the routine EHRs of the SLaM NHS Trust network[26]. SLaM is one of Europe's largest mental health providers, serving over 1.2 million residents in four South London boroughs (Croydon, Lambeth, Lewisham and Southwark)[23]. Specifically, the database holds records for secondary mental health care provisions within SLaM, which include all specialist care (i.e., apart from that provided by GPs) for hospitalisations, outpatient care, community care, psychiatric liaison services to general hospitals and forensic mental health services. It is linked to the SLaM Patient Journal System (PJS), which is a bespoke electronic clinical record, used across all Trust services within the SLaM network. The BRC case register includes patients' demographic details, mental health symptoms, mental health disorder diagnoses, psychometric test scores, medications prescribed and clinical events records (referrals, admissions and discharges). It currently holds over 320,000 cases and sees approximately 50,000 new patient referrals each year[22]. Patient records are updated every 24 hours[26].

In order to facilitate research, a de-identified version of the SLaM BRC case register, called the CRIS system, was developed[23]. The CRIS application comprises of a sequence of data processing pipelines, which both structure and de-identify PJS fields filled in by clinicians and stored in the SLaM BRC case register. This results in the availability of pseudo-anonymised data from the full clinical record. Researchers can systematically search CRIS for any combination of different fields available within the records, including date of birth, scores on psychological tests and clinical notes relating to particular outpatient psychiatric appointments.

2. The Combat Stress case register

The Combat Stress electronic case register was set up in 2013, from the charity's paper records[27]. Combat Stress was established in 1919, after the end of the First World War, to support veterans experiencing mental health difficulties. Today it is the UK's largest military charity in terms of the number of individual's treated, providing both inpatient and outpatient secondary mental health services to veterans and specialising in PTSD[28]. Indeed, since 2011, Combat Stress has been funded by the NHS to provide a national specialist PTSD clinical service for ex-serving personnel[27]. Approximately 2,000 new veteran patients present to the charity's services each year and they treat individuals from across the UK[28]. Similarly to the CRIS database, the Combat Stress case register holds records for veterans who have accessed secondary mental health care services through the charity. The database includes patients' demographic details, mental health symptoms, mental health disorder diagnoses, scores on mental health questionnaire measures, medications prescribed

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[††] While outside the scope of the current report, the first case register described was used to identify non-veterans who had accessed similar secondary mental health care services, through the SLaM network. All methods and results relating to this third population group will be covered in the follow-on study report, delivered to FiMT in 2019, and are therefore not mentioned here.

and clinical events records. While the data held is broadly similar across the SLaM BRC and Combat Stress databases, the EHR systems and their associated outputs are completely distinct, in terms of both the search process and the structure used.

Study population

The current report consists of two groups.

1. <u>Veterans in the South London and Maudsley Biomedical Research Centre case register</u>

The first population group were veterans who had accessed secondary NHS mental health care services through the SLaM NHS Trust. They were identified using a detailed search strategy (see the utility and feasibility results chapter, pages 14 to 16).

Inclusion criteria

- Veterans who had accessed these mental health care services within a ten-year window – between 1st January 2007 and 31st December 2016[‡‡]. The CRIS register was implemented in 2007, so this was the earliest that digital records could be accessed from. This project began in 2017, so 2016 was the last full year digital records were available for.
- Veterans who had served in the UK armed forces – we retained records for those whose country of birth was noted as the UK or was left as blank (as we noticed that this field was often left blank if the individual was a UK national).

Exclusion criteria

- Veterans aged under 18 years of age, as our focus was on adults.
- Veterans aged over 64 years of age (or born before 1943) – this ensured that those who carried out national service were not included, because this subgroup does not reflect those who voluntarily enter the forces and biases the sample towards older veterans.

2. <u>Veterans in the Combat Stress case register</u>

The second population group were UK veterans who had accessed secondary mental health care services through the charity Combat Stress.

Inclusion criteria

- Veterans who had accessed these mental health care services within a four-year window – between 1st January 2013 and 31st December 2016. The Combat Stress database was implemented in 2013, so this was the earliest that digital records could be accessed from. This project began in 2017, so 2016 was the last full year digital records were available for.

[‡‡] Note, however, that, after matching, the final sample from the SLaM BRC case register consisted of veterans who had accessed mental health care services through the SLaM NHS Trust within a four-year window, in line with the inclusion criteria for the Combat Stress case register (see the utility and feasibility results chapter, page 18).

Exclusion criteria

- Veterans aged under 18 years of age.
- Veterans aged over 64 years of age (or born before 1943).

Study procedure

We used four steps for this study's research procedure – these are described below and in Figure 1 (see the utility and feasibility results chapter for more details, pages 13 to 18).

Figure 1. The four steps for the study's research procedure.

1. Identifying

The South London and Maudsley Biomedical Research Centre case register

As there is no structured field for flagging veterans within the CRIS system, our objective was to identify veterans by applying key word searches to the unstructured free-text notes filled in for each patient by clinicians. We aimed to identify a sample of veterans that had accessed secondary mental health services through the SLaM NHS Trust and who, therefore, had a record in the CRIS database.

The Combat Stress case register

Unlike within the SLaM BRC database, individuals within the Combat Stress case register are all self-reported veterans. Therefore, no specific search system was needed to identify this group of individuals.

2. Matching

Once the veterans accessing secondary mental health care services through the SLaM NHS Trust had been identified, the team matched the veterans who had accessed secondary mental health care services through Combat Stress to this first group of veterans. The veteran group who sought help through Combat Stress were frequency matched by age (in age bands) and gender to the veteran group who sought help through the SLaM NHS Trust. This ensured that the two samples were comparable. A random stratified sampling method[§§] was used for matching. Randomised matching meant that the overall sample was representative of both veterans accessing SLaM services and veterans accessing Combat Stress services. Stratified matching meant that the age and gender subgroups matched on were also represented properly within the sample.

[§§] Random stratified sampling is a method of sampling that involves the division of a population into smaller groups, known as strata. The strata are formed based on members' shared attributes or characteristics. In this case, the strata were broken down by age bands and gender, across the two groups.

3. Extracting

Once we identified veterans in the SLaM BRC system and matched them to a similar sample of veterans from the Combat Stress system, relevant data was extracted from both case registers. Data fields were exported from the registers and imported into a Microsoft Excel file. Structured fields relating to the veterans' socio-demographic characteristics, mental health disorder diagnoses and treatment pathways through care were extracted. The details were transferred to a bespoke study database. The 12 specific variables extracted from both case registers are shown in Table 1.

Table 1. The 12 variables extracted from both the SLaM BRC and the Combat Stress case registers.

Variables extracted	
1. Age (in years)[***]	7. Types of mental health disorder diagnoses
2. Gender[†††]	8. Number of mental health disorder diagnoses
3. Who the veteran lives with (i.e. alone; with friends/family/other; or with partner/children)	9. Number of outpatient secondary mental health care appointments booked
4. Ethnicity	10. Number of outpatient secondary mental health care appointments attended
5. Marital status	11. Number of inpatient secondary mental health care stays
6. Service branch	12. Duration of inpatient secondary mental health care stays (in days)

4. Analysing

The analyses for this report were split into two sections, in line with our research objectives.

Utility and feasibility of identifying veterans who access secondary mental health care

The utility and feasibility of extracting data on veterans presenting to secondary mental health care, using two EHR-based registers, was assessed by examining the practicality of accessing the required veteran data, of identifying veterans, of matching our samples and of extracting, cleaning and analysing veteran data. For example, we considered firewall constraints surrounding the CRIS system; time and manpower requirements when detecting veteran records; limitations in matching the samples; and amounts of missing data present.

[***] Age was already extracted at step 2 (matching).
[†††] Gender was already extracted at step 2 (matching).

Socio-demographic profiles, types of mental health disorders and treatment pathways of veterans who access secondary mental health care

Quantitative analyses for this part of the report were carried out using the statistical software STATA (version 15). To address this research objective, a variety of statistics were calculated, such as prevalence rates and chi-square tests, to determine whether statistically significant differences existed in socio-demographic profiles, types of mental health disorders and treatment pathways, between the SLaM BRC veteran group and the Combat Stress veteran group.

<u>SUMMARY</u>

- Two EHR databases were used to identify veterans who had accessed secondary mental health care services within the UK:
    1. The **SLaM BRC** case register
    2. The **Combat Stress** case register

- These case registers provided data on two population groups:
    1. Veterans who accessed secondary mental health care services through the **SLaM NHS Trust**
    2. Veterans who accessed secondary mental health care services through the military charity **Combat Stress**

- The study procedure included:
    1. **Identifying** veterans from the SLaM BRC case register
    2. **Matching** veterans from the Combat Stress case register to veterans from the SLaM BRC case register
    3. **Extracting** data on socio-demographic characteristics, types of mental health disorders and treatment pathways through care for veterans
    4. **Analysing** the utility and feasibility of these processes and similarities and differences between the two groups of veterans

UTILITY AND FEASIBILITY RESULTS

This chapter discusses the utility and feasibility of identifying veterans accessing secondary mental health care services within the UK and subsequently extracting their data. Feasibility is defined as 'capable of being done, effected, or accomplished'[29], and utility is defined as 'the state of being useful, profitable, or beneficial'[29]. More specifically, feasibility studies, such as this one, are pieces of research that tend to be carried out before a further project, in order to answer the question, 'Can this study be done?'[30]. They are used to estimate parameters needed to design relevant future studies[30]. We discuss utility and feasibility in relation to: 1) accessing the required veteran data; 2) identifying veterans; 3) matching our samples; and 4) extracting, cleaning and analysing veteran data.

1. *Accessing*

The South London and Maudsley Biomedical Research Centre case register

There were a number of steps involved in gaining full access to the SLaM BRC and CRIS system databases, which are documented below. In total, these processes took approximately four months to complete and this time was factored into the study timeline.

Project approval

The team submitted an application to the BRC to request approval of the research project. This detailed a summary of the research, objectives, rationale, the types of variables required and the expected outputs. The application was discussed at one of the monthly BRC committee meetings and was fully approved two months later. NHS Research Ethics Committee approval was not needed, because the BRC has previously been granted ethical approval for linking its anonymised data.

Research passports

Following project approval, the team requested research passports to access the CRIS system. Research passports are the equivalent of an honorary contract with the SLaM NHS Trust and ensure that researchers are contractually obliged to adhere to relevant Trust policies regarding confidentiality and data protection. The applications were processed by the BRC over a two-month period and, subsequently, we were given log in details for the SLaM network and the CRIS system.

Firewall constraints

CRIS data could only be accessed using the SLaM firewall. This meant that the team had to source computers at the BRC (located at the King's College London Denmark Hill campus) to access CRIS. However, we were also able to apply for access for a remote connection to the SLaM network, allowing us to carry out data cleaning and analyses from our own King's College London computers.

The Combat Stress case register

We submitted an application to request access to the Combat Stress database, summarising the research and how we would keep the data secure. Following this being reviewed and filed at Combat Stress, a pseudo-anonymised dataset with our specified variables was shared with the team. One of our team members (DM) is the research lead at the charity.

2. *Identifying*

The South London and Maudsley Biomedical Research Centre case register

Despite their being no military service flag for patients within the SLaM BRC case register, it was feasible to identify veterans using the database. The identification process was iterative in nature and took place in two broad steps. Firstly, key words were derived during an initial search of veteran medical records within the SLaM BRC case register, by noting down frequently used military-related terms that appeared in veterans' records. Secondly, the team compiled their own list of military terms, using their expertise in the field. Together, these two methodologies resulted in a large list of military-related words, of which 17, including 'Royal Navy', 'Army', 'Royal Air Force' and 'armed forces' (see Appendix 1 for the full list, pages 29 and 30) proved to be useful. Using the same processes, we also created a list of over 30 exclusion limits, such as 'navy blue' and 'Salvation Army' (see Appendix 1 for the full list, pages 29 and 30), to prevent a substantial number of non-veterans being identified as veterans (false positives). The key words and exclusions were then combined into a joint search strategy, to systematically search the SLaM BRC case register through the use of CRIS. All medical records that were identified as potential veteran records, because they contained certain key words, were scrutinised individually to ensure that the patient had actually served in the military. Each patient's notes were read in detail, to determine whether we could confidently determine that the patient was a veteran – we read through all clinical notes at least twice and only confirmed veteran status when an explicit statement about the patient serving was reported.

When considering the individual word searches used to identify veterans, the term 'Army' returned the highest number of potential veteran records, followed by 'Royal Navy' and then 'Royal Air Force'. However, sheer numbers returned are not reflective of the hit rate of each term. We tested a random batch of 457 of these potential veteran records, to determine the individual identification rates for each of the three key military terms used. These were calculated as the percentage of true veterans identified versus the percentage of non-veterans identified, from the overall number of potential veteran records returned. As shown in Figure 2, 'Royal Air Force' had the highest sensitivity rate, out of all 17 military-related words, for correctly identifying veterans, followed by 'Royal Navy' and then 'Army'. 'Royal Air Force' arguably returned the cleanest veteran records when the case register was searched – that is, we had to implement the fewest exclusion criteria for records returned using this term (see Appendix 1, pages 29 and 30).
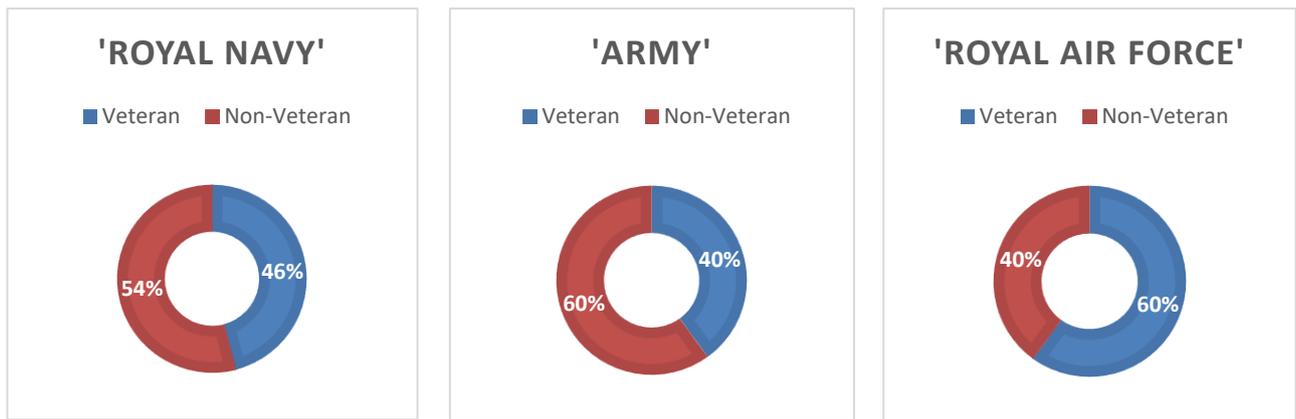
Figure 2. Hit rates for the three primary military search terms used in the CRIS system – 'Royal Navy', 'Army' and 'Royal Air Force'.

The key word searches, combined with the exclusion limits, of the CRIS system's free-text notes returned 6,039 potential veterans who fitted these criteria. These records were randomly sorted into an ordered list, which was then used for selecting a smaller sample of potential veterans for checking. The team selected 1,600 records to scrutinise in more detail, to ensure that we could meet the proposed sample size, while also taking into account time and manpower restrictions. Of these 1,600 possible veterans, 693 were identified as being true veterans by the research team. Following implementation of our inclusion and exclusion criteria (see the method section, pages 9 and 10), 306 of the identified veterans were included in the final sample[‡‡‡]. Figure 3 shows a flow chart of the SLaM BRC veteran numbers.
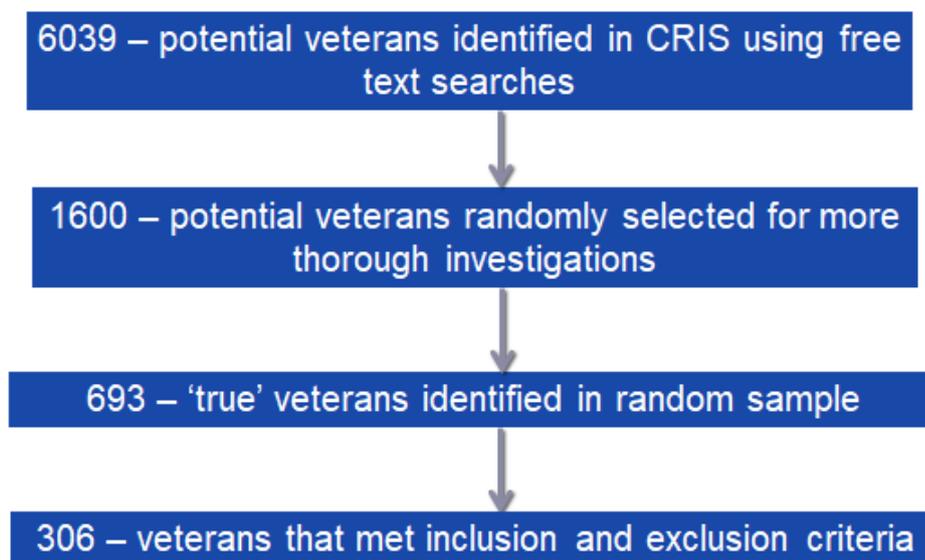
Figure 3. Flow chart to show the numbers of veterans identified through the CRIS system.

Identifying veterans through the CRIS system in this way was labour intensive and time consuming. Manually verifying each potential veteran record involved reading through, often, a vast amount of free-text notes, written by the clinician who had seen the patient. We found that reading through

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[‡‡‡] Note, however, that this final sample size was condensed following the matching process (see page 18).

each patient's notes took, on average, 15 minutes. We manually worked through 1,600 potential veteran records for this project, which equated to 400 hours of reading time or approximately 11 weeks' worth of work. This time frame did not include creating the search strategies for identifying potential veterans, extracting their data, matching the SLaM BRC and Combat Stress samples or carrying out data analyses.

Of the 1,600 possible veteran records checked, 693 were identified as being true veterans by the research team, representing an overall identification rate of 43.3%. While this percentage reflects a positive first step in creating a methodology to identify veterans from large clinical databases, it is still relatively low compared to automated identification processes that make use of natural language processing (NLP)[31]. The team had to read through a large number of patient notes to validate a considerably smaller number of actual veterans.

It must be noted that there was no way to confirm our identified SLaM veterans, verified by the research team using clinical notes, were actual veterans. We were careful and deliberate in our decisions regarding who to classify as a veteran – we read through all clinical notes at least twice and only confirmed veteran status when an explicit statement about the patient serving was reported. If in doubt, we were conservative, categorising the patient as a non-veteran. Even so, the process used relied on patients' self-reporting having previously served in the military, which may have been inaccurate or false, particularly considering this population of individuals were suffering from fairly severe and complex mental health problems.

Along the same lines, there was no way to confirm that our verified non-veterans had not served in the armed forces. Some veterans may not have volunteered the fact that they had belonged to the military to their health care provider. In this case, there would be no mention of these individuals' veteran statuses in their clinical notes, and the team would subsequently have classified them as non-veterans. It is worth noting, however, that it is protocol for clinicians to talk through a patient's history/background, including their previous occupations, when they first enter services.

The Combat Stress case register

Unlike within the SLaM BRC database, individuals within the Combat Stress case register are all veterans. Therefore, no specific process was needed to identify this group of individuals.

We gained access to 1,136 anonymised veteran records from the Combat Stress database, all of which fitted our inclusion and exclusion criteria (see the method section, pages 9 and 10). After matching took place, 189 were included in the final sample (see Figure 4).
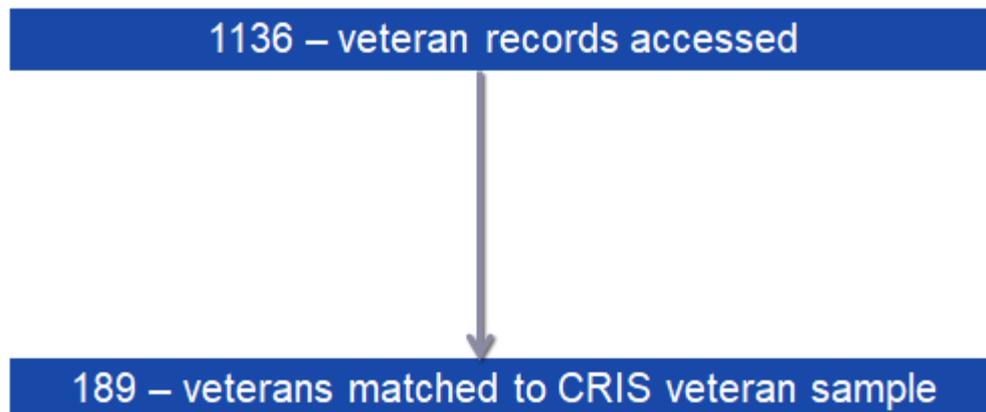
Figure 4. Flow chart to show the numbers of veterans identified through Combat Stress.

   3. *Matching*

In order to match the samples as closely as possible, the SLaM veteran sample was condensed. This was because of the discrepancy in the time window in which the two groups accessed care – the Combat Stress case register was implemented in 2013, whereas the SLaM BRC case register was implemented in 2006. While it was not ideal to have to limit our numbers in the SLaM database, the team included veterans who accessed secondary mental health care services between 2013 and 2016, for both of our two veteran groups, so that they were directly comparable.

Following this, we age and gender matched veterans from the Combat Stress database to veterans from the SLaM BRC database. Gender groupings and age bands in the Combat Stress group were compared to the SLaM group. However, a straightforward match could not be carried out. There were too few eligible veterans accessing Combat Stress services to match to the age band and gender categories of the veterans accessing SLaM services, mainly because the average age of SLaM veterans was higher than that of Combat Stress veterans before matching. 189 veterans from Combat Stress could be successfully matched to the SLaM sample and the remaining veterans from the latter group were removed from the dataset and further analyses. Therefore, a total of 189 veterans who accessed secondary mental health care services through the SLaM NHS Trust and 189 veterans who accessed secondary mental health care services through Combat Stress made up the final sample for this report. These numbers were sufficient for the current feasibility study and in line with our expected sample size estimations for this report.

   4. *Extracting, cleaning and analysing*

Following the identification and matching of veterans, data was transferred to, and subsequently stored in, several bespoke Microsoft Access databases. These allowed us to format the data in an efficient way and to ensure the information was housed securely. From there, data was imported into Microsoft Excel and then into the statistical program STATA (version 15) for cleaning and analysis. For a list of all variables extracted, see Table 1 (in the method section of this report, page 11).

The data available for extraction and analysis within EHR databases such as the SLaM BRC and Combat Stress systems depends upon clinicians having the time to enter the information gathered

from patients who have accessed care[22]. Often, such case registers contain large amounts of missing data – and this was true for some variables within the current project. For example, only 32% of Combat Stress veterans had a mental health disorder diagnosis listed in the structured diagnosis field and only 50% of SLaM veterans had a documented note of who they lived with in the structured 'lives with' field.

While the included data is more than adequate for testing feasibility, such large amounts of missing values decrease reliability and robustness overall. We know, through checking both the SLaM BRC and Combat Stress systems, that a small amount of missing information is available elsewhere within the databases, namely within the free-text clinical/case written notes, even if it is not documented within a specific set field as expected.

Despite dealing with missing data being outside the scope of this feasibility project, we were able to backfill missing data using clinical notes for two of the 12 extracted variables: 1) service branch, within the SLaM BRC case register; and 2) types of mental health disorder diagnoses, within the Combat Stress register. Data on which service branch each veteran belonged to was fairly easy to access within the SLaM BRC database, because these details were often included alongside explicit statements confirming veteran status in the free-text clinical notes. Data on types of mental health disorder diagnoses was also easily accessible within the Combat Stress system, because these details could often be inferred from scores on mental health questionnaires, which tested for common mental health disorders and were generally well reported on. Unfortunately, we did not have the time or resources to backfill missing data for the remaining 10 variables of interest or to systematically tackle the issue of missing data by reading back through all available clinical notes.

Finally, data cleaning and quantitative analysis were relatively uncomplicated to carry out. By this late stage in the project, the challenges faced during the previous methodological steps (and described in detail above) had been dealt with and overcome, leaving us ready to analyse and interpret the results.

SUMMARY

- We were able to successfully identify veterans using the SLaM BRC case register

- **Accessing** the required case registers, and associated data, was lengthy and included requesting project approval, receiving research passports and adhering to firewall constraints
- **Identifying** veterans from the SLaM BRC case register was labour intensive and time consuming. It involved systematically searching the CRIS system, using military-related key words and exclusion limits
- Hit rates were 43% overall but varied across search terms. The phrase 'Royal Air Force' correctly identified veterans most often
- **Matching** SLaM veterans and Combat Stress veterans on age and gender reduced the sample size somewhat, resulting in a final sample of 189 individuals in each group
- **Extracting, cleaning and analysing** data from the SLaM BRC case register revealed large amounts of missing data. To a lesser extent, this was also the case within the Combat Stress case register.

- We backfilled a limited amount of missing data, using free-text clinical notes and mental health questionnaires
- We were unable to systematically tackle the issue of all missing data, because of time and resource constraints

VETERAN GROUP COMPARISON RESULTS

This chapter compares similarities and differences in socio-demographic profiles, types of mental health disorders and treatment pathways, across two groups of veterans – those who access secondary mental health care services through the SLaM NHS Trust and those who access secondary mental health care services through the military charity Combat Stress. We break this section down into the larger factors of: 1) socio-demographics and military variables; 2) mental health variables; and 3) treatment pathway variables.

1. *Socio-demographic and military variables*

SLaM veterans and Combat Stress veterans were matched on age bands and gender. The median age of SLaM veterans was 40.0 (interquartile range (IQR) = 31.0 – 49.0) and the median age of Combat Stress veterans was 40.8 (IQR = 31.4 – 50.5; see Table 2). The majority of veterans in both groups were male (95.8%).

Table 2. Medians, interquartile ranges, numbers and percentage prevalence rates for the socio-demographic and military variables, across SLaM veterans and Combat Stress veterans[§§§].

	SLaM Veterans (*N* = 189)	Combat Stress Veterans (*N* = 189)	Significance[****]
	Median (IQR)	Median (IQR)	*p* value
Age (in years)	40.0 (31.0 – 49.0)	40.8 (31.4 – 50.5)	0.88
	N (%)	*N* (%)	

Gender
    Male
    Female
	
	181 (95.8)
	8 (4.2)
		
		181 (95.8)
		8 (4.2)
			1.00

Who the veteran lives with
    Alone
    Friends/family/other
    Partner/children
	
	46 (48.9)
	22 (23.4)
	26 (27.7)
		
		20 (18.0)
		6 (5.4)
		85 (76.6)
			< 0.001

Ethnicity
    British
    Other
	
	132 (80.5)
	32 (19.5)
		
		158 (98.1)
		3 (1.9)
			< 0.001

[§§§] Note. N = number of veterans; IQR = interquartile range (lower quartile – upper quartile); bold = statistically significant p value differences. For age, the p value refers to differences between means. Missing data for service branch was were backfilled for SLaM veterans where possible, using free-text clinical notes. This allowed us to assign a service branch for 71 SLaM veterans who previously had this field missing. Percentages refer to numbers that had each specific field populated and do not include missing data.

[****] A statistically significant result indicates that a relationship between two or more variables is caused by something other than chance. Statistical hypothesis testing, using *p* values, is used to determine whether the result of a data set is statistically significant or not. If the *p* value falls below 0.05, a statistically significant result has been found. If the *p* value exceeds 0.05, a non-statistically significant result has been found.

			< 0.001
Marital status			
In a relationship	40 (25.8)	118 (62.4)	
Separated/divorced/ widowed	31 (20.0)	39 (20.6)	
Single/other	84 (54.2)	32 (16.9)	
Service branch			0.12
Royal Navy	13 (18.3)	16 (8.5)	
Army	52 (73.2)	154 (81.5)	
Royal Air Force	6 (8.5)	19 (10.1)	

The majority of SLaM veterans reported living alone (48.9%), whereas the majority of Combat Stress veterans reported living with their partner/children (76.6%). SLaM veterans were significantly more likely to live alone or with friends/family/other than Combat Stress veterans and were significantly less likely to live with their partner/children ($p < 0.001$).

Most veterans in both groups endorsed having British ethnicity – 80.5% of SLaM veterans and 98.1% of Combat Stress veterans. However, this was significantly higher for Combat Stress veterans than for SLaM veterans ($p < 0.001$).

Over 50% of SLaM veterans reported being single/other, whereas 62.4% of Combat Stress veterans reported being in a relationship ($p < 0.001$).

The majority of veterans reported having served in the Army – 73.2% of SLaM veterans and 81.5% of Combat Stress veterans ($p > 0.05$).

The socio-demographic and military variables with the highest levels of missing data were who the veteran lives with (45.8% missing) and service branch (31.2% missing, after backfilling). Missing data can be noted in Table 2, as the numbers for each variable, across both the SLaM veterans and the Combat Stress veterans, often do not add up to 189.

2. Mental health variables

Across the total sample, the most common mental disorder diagnoses given were stress disorders (43.7%), depressive disorders (41.8%) and anxiety disorders (41.8%; see Figure 5). However, the most common diagnoses given varied when looking at the SLaM veterans and the Combat Stress veterans separately. A greater diversity of diagnoses was given across the SLaM veterans than the Combat Stress veterans.
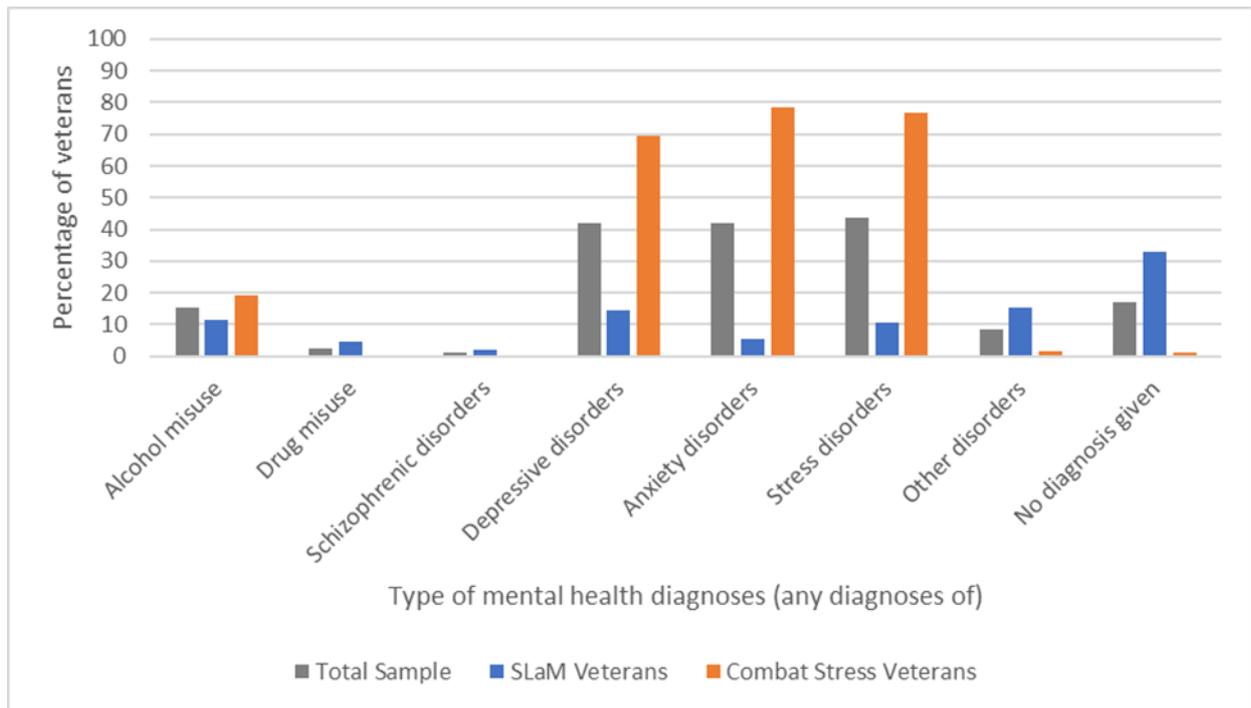
Figure 5. Percentage of veterans diagnosed with differing types of mental health disorder, across the total sample, SLaM veterans and Combat Stress veterans.[††††]

For SLaM veterans, the most common mental health disorder diagnoses given were 'no diagnosis given' (32.8%), 'other' disorders[‡‡‡‡] (15.3%) and depressive disorders (14.3%). For Combat Stress veterans, the most common mental disorder diagnoses given were anxiety disorders (78.3%), stress disorders (76.7%) and depressive disorders (69.3%).

SLaM veterans were significantly more likely to be given a drug misuse (4.8%; $p < 0.01$) or an 'other' disorder diagnosis (15.3%; $p < 0.001$) or to be assigned a 'no diagnosis given' category (32.8%; $p < 0.001$) than Combat Stress veterans (0%, 1.6% and 1.1%, respectively). Combat Stress veterans were significantly more likely to be given a depressive disorder (69.3%; $p < 0.001$), anxiety disorder (78.3%; $p < 0.001$) or stress disorder (76.7%; $p < 0.001$) diagnosis than SLaM veterans (14.3%, 5.3% and 10.6%, respectively).

Across the total sample, the most common number of mental disorder diagnoses given was one (46.0%) and the range was one to six diagnoses. The median number of mental disorder diagnoses

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[††††] Note. The 'no diagnosis given' category represents those veterans who were seen within secondary mental health care services, but who were not given a mental health disorder diagnosis as a result. Percentages do not always add up to 100% (189 patients) in each group, because of missing data and because each veteran can have more than one diagnosis. Missing data for diagnoses was backfilled for Combat Stress veterans where possible, using mental health questionnaires - that is, scores on measures that were completed by veterans on the presence of common mental health disorders. These scores were used to determine whether each individual met the cut off threshold score for a range of diagnoses (including PTSD, depression, generalised anxiety disorder and alcohol misuse). By completing the missing diagnoses in this way, we were able to assign a proxy diagnosis for 110 Combat Stress veterans who previously had this field missing.
[‡‡‡‡] 'Other' disorders include dementia, delirium, dissociative disorders, somatoform disorders, eating disorders, sexual disorders, developmental disorders, hyperkinetic disorders, mood disorders (not including depression), bipolar disorder, personality disorders, neurotic disorders and self-harm and self-poisoning.

given was 1.0 (IQR = 1.0 – 3.0). However, the number of diagnoses given varied when looking at the SLaM veterans and the Combat Stress veterans separately.

For SLaM veterans, the most common number of mental disorder diagnoses given was one (92.2%); followed by two (4.8%), three (2.4%) and six (0.6%; see Figure 6). For Combat Stress veterans, the most common number of mental disorder diagnoses given was three (47.4%); followed by two (24.0%), four (17.0%) and one (11.7%). The median number of diagnoses was 1.0 (IQR = 1.0 – 1.0) for SLaM veterans and 3.0 (IQR = 2.0 – 3.0) for Combat Stress veterans.
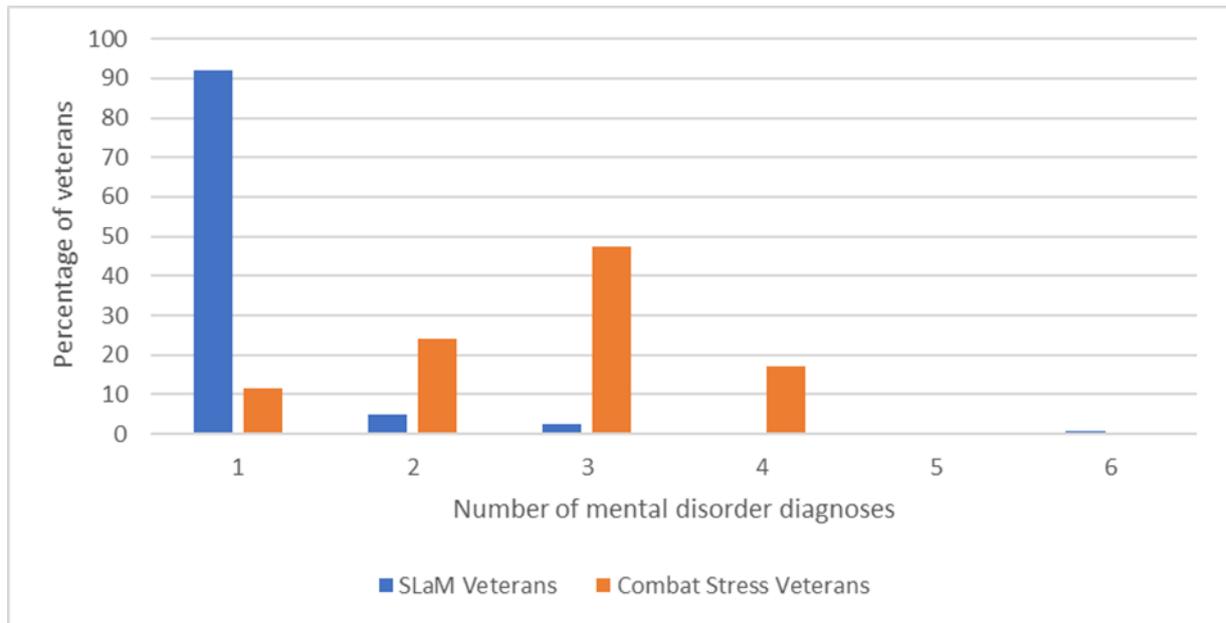
Figure 6. Percentage of veterans diagnosed with 1 to 6 mental disorder diagnoses, across SLaM veterans and Combat Stress veterans.[§§§§]

Combat Stress veterans were significantly more likely to have more than one diagnoses (88.3%) than SLaM veterans (7.8%, $p < 0.001$).

3. *Treatment pathway variables*

Across the full sample, the total number of outpatient secondary mental health care appointments booked was 1,646; the total number of outpatient secondary mental health care appointments attended was 1,463; and the total number of inpatient secondary mental health care stays was 228. The median number of outpatient secondary mental health care appointments booked was 2.0 (IQR = 0.0 – 4.0); the median number of outpatient secondary mental health care appointments attended was 2.0 (IQR = 0.0 – 4.0); and the median number of inpatient secondary mental health care stays was 0.0 (IQR = 0.0 – 1.0). However, these numbers varied when looking at the SLaM veterans and the Combat Stress veterans separately.

[§§§§] Note. The number of mental health disorder diagnoses reported here include the 'no diagnosis given' category. Percentages do not always add up to 100% (189 patients) in each group, because of missing data. This variable was backfilled for missing data for Combat Stress veterans. 22 SLaM veterans and 18 Combat Stress veterans had missing data for this field.

For SLaM veterans, the median number of outpatient secondary mental health care appointments booked was 0.0 (IQR = 0.0 – 0.0); the median number of outpatient secondary mental health care appointments attended was 0.0 (IQR = 0.0 – 0.0); and the median number of inpatient secondary mental health care stays was 0.0 (IQR = 0.0 – 1.0; see Table 3). These median values show that half of the SLaM veteran group had not booked or attended any outpatient secondary mental health care appointments and had not been admitted for any inpatient secondary mental health care stays[*****]. For Combat Stress veterans, the median number of outpatient secondary mental health care appointments booked was 4.0 (IQR = 2.0 – 7.0); the median number of outpatient secondary mental health care appointments attended was 4.0 (IQR = 2.0 – 7.0); and the median number of inpatient secondary mental health care stays was 0.0 (IQR = 0.0 – 1.0). SLaM veterans booked ($p <$ 0.01) and attended ($p <$ 0.001) significantly fewer outpatient secondary mental health care appointments than Combat Stress veterans.

Table 3. Medians and interquartile ranges for the treatment pathway variables, across SLaM veterans and Combat Stress veterans[†††††].

	SLaM Veterans (N = 189)	Combat Stress Veterans (N = 189)	Significance
	Median (IQR)	Median (IQR)	p value
Number of outpatient secondary mental health care appointments booked	0.0 (0.0 – 0.0)	4.0 (2.0 – 7.0)	**< 0.01**
Number of outpatient secondary mental health care appointments attended	0.0 (0.0 – 0.0)	4.0 (2.0 – 7.0)	**< 0.001**
Number of inpatient secondary mental health care stays	0.0 (0.0 – 1.0)	0.0 (0.0 – 1.0)	0.05
Duration of inpatient secondary mental health care stays (in days)	13.0 (5.0 – 26.0)	13.0 (11.0 – 23.0)	0.09

24.9% of SLaM veterans and 29.6% of Combat Stress veterans had an inpatient secondary mental health care stay. Of those who had an inpatient stay, the median duration was 13.0 days (IQR = 5.0 – 26.0) for SLaM veterans and 13.0 days (IQR = 11.0 – 23.0) for Combat Stress veterans ($p >$ 0.05).

[*****] SLaM veterans with 0 booked or attended outpatient secondary mental health care appointments and 0 inpatient secondary mental health care stays will be in the SLaM BRC case register for other reasons – primarily because they had a referral into the SLaM Trust.

[†††††] Note. N = number of veterans; IQR = interquartile range (upper quartile – lower quartile); bold = statistically significant p value differences. For all variables, the p value refers to differences between means. With the exception of duration of inpatient secondary mental health care stays, these numbers include those veterans with 0 booked or attended outpatient appointments and 0 inpatient stays, in order to accurately represent the full sample.

SUMMARY

- 189 SLaM veterans and 189 Combat Stress veterans were included, of which the majority were male (95.8%), with a median age of approximately 40.0 years
- SLaM veterans were most likely to live alone (48.9%), whereas Combat Stress veterans were most likely to live with their partner/children (76.6%)
- SLaM veterans were most likely to be single/other in relationship status (54.2%), whereas Combat Stress veterans were most likely to be in a relationship (62.4%)
- Combat Stress veterans were more likely to have British ethnicity (98.1%) than SLaM veterans (80.5%)

- The most common mental disorder diagnoses for SLaM veterans were 'no diagnosis given' (32.8%), 'other' disorders (15.3%) and depressive disorders (14.3%), whereas for Combat Stress veterans these were anxiety disorders (78.3%), stress disorders (76.7%) and depressive disorders (69.3%). There were significant differences in the types of diagnoses given to SLaM veterans versus Combat Stress veterans
- Combat Stress veterans (3.0) had a higher median number of mental disorder diagnoses than SLaM veterans (1.0)

- Combat Stress veterans (4.0) booked a higher median number of outpatient secondary mental health care appointments than SLaM veterans (0.0)
- Combat Stress veterans (4.0) attended a higher median number of outpatient secondary mental health care appointments than SLaM veterans (0.0)

DISCUSSION

This research used two EHR case registers to explore the utility and feasibility of identifying veterans accessing secondary mental health care services within the UK. These registers were: (1) the SLaM BRC case register, containing data on veterans who accessed services through the SLaM NHS Trust; and (2) the Combat Stress case register, containing data on veterans who accessed services through the military mental health charity Combat Stress. In addition, the report compared the socio-demographic profiles, the types of mental health disorders and the treatment pathways of veterans who engage in secondary mental health care services within the UK, across two different settings.

Key findings

It was feasible to identify veterans using the SLaM BRC case register. We were able to detect 693 veterans accessing secondary mental health services through the SLaM NHS Trust, of which 189 were matched to 189 veterans accessing secondary mental health services through Combat Stress. Despite our success, the identification procedure raised procedural challenges. The difficulties faced are discussed in detail in the 'Recommendations' section below (see pages 27 and 28).

SLaM veterans were more likely to be single and to live alone, whereas Combat Stress veterans were more likely to be in a relationship and to live with their partner and/or children. These socio-demographic differences suggest that SLaM veterans are more socially isolated and perhaps that the clientele of Combat Stress receive more support from their families than veterans accessing other services. Additionally, Combat Stress veterans were more likely to have British ethnicity than SLaM veterans. This highlights that SLaM veterans are a more ethnically diverse group of individuals.

SLaM veterans were assigned a 'no diagnosis given' mental health code more often than Combat Stress veterans. This non-specific diagnosis may represent the fact that the former group have more complex and unrecognised difficulties, which could also explain why they were more socially isolated It suggests that NHS services may struggle to identify specific problems when veterans present to secondary mental health care. Rather than having their difficulties captured by the SLaM Trust, veterans accessing care here may be being referred on to other specialists for diagnosis. Alternatively, it may be that Combat Stress simply do not have an equivalent non-specific diagnosis that they can assign. The more frequent diagnoses of depressive, anxiety and stress disorders and the less frequent diagnoses of 'other' disorders in the Combat Stress sample is unsurprising considering that the charity specialises in treating stress and anxiety disorders including PTSD, which are also highly comorbid with depression[32]. Combat Stress veterans had a higher number and range of mental health disorder diagnoses than SLaM veterans, perhaps because NHS services like SLaM tend to focus purely on the presenting mental health difficulty at the time of contact, while Combat Stress often takes into account the presenting problem as well as any additional difficulties described.

SLaM veterans booked and attended fewer outpatient secondary mental health appointments than Combat Stress veterans. This may be because Combat Stress veterans tend to lose their access to care through the charity if they do not engage in and attend appointments[28]. Such a result could have a bearing on the higher number of diagnoses assigned for Combat Stress veterans. The Combat Stress group may have been diagnosed with more mental health difficulties than the SLaM group

because they had more client-practitioner time, as reflected by their higher number of outpatient appointments.

Finally, there was wider variability in the length of inpatient stays for veterans admitted to the SLaM NHS Trust compared to veterans admitted to Combat Stress. Veterans staying as an inpatient at Combat Stress are, in general, admitted as part of a fixed length (typically six weeks long) residential treatment program[28], while veterans admitted to SLaM tend to be emergency cases who stay for varying amounts of time[22].

Recommendations

- **We recommend trying to improve the accuracy and efficiency of manually identifying veterans from the SLaM BRC case register.**
- We were unable to confirm that our identified SLaM veterans were actual veterans or that our verified non-veterans had not actually served, because we relied on participants' self-reporting their veteran status. There was no way around this problem in the current study.
- The implementation of a military flag in the SLaM BRC case registers and similar NHS databases, perhaps that could be verified with MoD records, would be helpful. This would clearly indicate which patients had previously served in the armed forces.
- Refining the military-related terms employed to search the SLaM BRC case register, by using more specific and detailed phrases, such as individual regiment or operation names, may help improve hit rates for detecting true veterans in large, non-military specific case registers.

- **We recommend accelerating the methodology for identifying veterans from the SLaM BRC case register, through the development of an NLP tool.**
- This would involve us teaching the computer to automatically identify veterans using particular key words and rules.
- While we have shown that the process is feasible, the manual identification of veterans from the SLaM BRC case register was labour and resource intensive, time consuming and impractical.
- The development of NLP would enable future projects using the SLaM BRC, or other, case register(s) and the same data inputs to implement a consistent, reliable and efficient approach to identifying veteran medical records.

- **We recommend increasing the number of veterans identified from the SLaM BRC case register.**
- As a result of the current method for identifying veterans, we were only able to include 189 veterans in each of our two groups. While this sample is more than sufficient for this feasibility study, it is lacking in statistical power for more complex analyses.
- Using our proposed NLP tool, we anticipate that a sample of 2,000 veterans could be identified from the SLaM BRC register alone.
- It would be possible to match this larger veteran group to 2,000 non-veterans accessing similar mental health services through SLaM. Using these data, we could establish whether there are similarities in socio-demographic, mental health and treatment characteristics between the SLaM veterans and non-veterans.

- **We recommend carrying out further statistical tests on extra factors available within the SLaM BRC case register.**

- We have reported on a range of socio-demographic, mental health and treatment variables already. However, there is an abundance of additional data of interest within the case register – for example, details of medication usage, welfare benefit claims and types of clinicians seen.
- We suggest exploring occurrences and similarities and differences across veteran and non-veteran groups.
- Subgroup analyses would also allow us to investigate patterns of outcomes across specific populations within the overall sample, where this was not possible in the smaller current groups. As a starting point, we endorse a focus on three potential subgroups and we estimate the following numbers: (1) 200 women veterans; (2) 300 ethnic minority veterans; and (3) 220 veterans with a diagnosis of PTSD.

- **We recommend the implementation of new techniques, to ensure that missing data within the SLaM BRC and Combat Stress case registers is kept to a minimum.**
- Data within EHRs is not collected primarily for research purposes and, therefore, often has large amounts of missing values[23]. Indeed, this was the case for the current report.
- It would be helpful if data entry for some fields was made mandatory in case registers, to ensure that the most important information was available for all patients.
- While the included data for this report can adequately test feasibility, such large amounts of missing values decrease reliability and robustness (see the utility and feasibility results, pages 17 and 18).
- We endorse backfilling missing data for outcome variables, by using clinical written notes to manually work through patient records one-by-one. Details left out of the database's structured fields are often included within these free-text fields and would allow us to improve data quality.

Conclusions

We have shown that it is possible to identify veterans accessing secondary mental health care in the UK, by using two EHR-based case registers. Despite our success, difficulties with the methodological procedure have identified a need for further work – including development of an automated veteran identification tool, increasing the pool of participants derived from the SLaM BRC case register, implementation of additional analyses and backfilling of missing data. A follow-on project tackling these additional objectives has been funded by FiMT and is beginning shortly. The findings from both the current and future reports will be used to exploit the NLP tool and to inform the possibility of rolling out a nationwide study, in order to gain further insight into veterans' secondary mental health treatment pathways.

APPENDICES

Appendix 1 – Inclusion and exclusion criteria and descriptive notes, for the CRIS system search terms for identifying veterans

Included key words	Exclusion	Notes
Army	"who was/is in (the) army"	Majority of times this refers to someone other than the patient
	"Salvation Army"	
	"army knife"	
	"army gear"	
	"army style"	
	"army cadet"	
	"army cadette"	
	"army themed"	
	"child army"	
	"army family"	
	"rebel army"	
	"refugee army"	
	"army service"	
	"private army"	
	"army green"	
	"army *<item of clothing>*"	Clothing
	"army type"	
	Foreign armies: Eritrea, Sri Lanka	Reference to service in non-UK army, or experiences relating to non-UK army
Navy	"navy blue"	Clothing
	"dark navy"	Clothing
	"navy colour"	Clothing
	"wearing (a) navy"	Clothing
	"dressed in navy"	Clothing
	"navy *<item of clothing>*"	Clothing
	"Merchant Navy"	
	"Army and Navy Store"	
	"worked for Navy, Army, Air Force Institute"	NAAFI
	"*<family member>* was/is in (the) navy"	Family member in Navy
	"due to join the Navy"	(Thinking of) joining Navy
	"accepted into Navy"	(Thinking of) joining Navy
	"potential careers, including Navy"	(Thinking of) joining Navy
	Foreign navies: Italian, US, Israeli, Portuguese, Burmese, Eritrea	Reference to service in non-UK navy, or experiences relating to non-UK navy
RAF / air force	"*<family member>* was/is in (the) RAF"	Family member in RAF
Armed forces		
Afghan		Deployment location

Iraq		Deployment location
Bosnia		Deployment location
Kosovo		Deployment location
Falklands		Deployment location
N Ireland		Deployment location
Cyprus		Deployment location
Germany		Deployment location
Enlisted		
National service		
Combat Stress		Military charity
SSAFA		Military charity
Help for Heroes		Military charity

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