ROYAL BRITISH LEGION

Understanding the Impact of Hearing Impairment on Working Age United Kingdom Armed Forces Veterans

Westminster Centre for Research in Veterans | University of Chester

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Foreword

Hearing impairment, including hearing loss and tinnitus, is one of the most common long-term and progressive health issues faced by the Armed Forces community, often caused by harmful levels of noise during Service. Despite this, there has been limited evidence on how it affects working-age veterans in the UK and whether current support is meeting their needs.

The Royal British Legion has long recognised the challenge that Service-related hearing impairment presents for veterans and their families. In 2014, we published *Lost Voices,* which provided evidence to suggest that hearing impairment was having a significant impact on veterans' lives, highlighting barriers to care and calling for better provision. In 2015, we also administered the Veterans Hearing Fund, directly helping thousands of veterans to access specialist equipment and services.

Building on these foundations, as well as earlier UK and international research, this new study provides the most detailed evidence to date of how hearing impairment affects working-age veterans. Drawing on primary healthcare data that compares veterans with the general population, alongside a large-scale survey of over 650 veterans, in-depth interviews, and focus groups, we show that hearing loss and tinnitus are more common in veterans than in non-veterans and can have lasting consequences for health, wellbeing, family life, and social connection.

Many veterans describe the challenges they faced in seeking help, and the stigma that still surrounds hearing loss. Others speak of the positive difference made when the right support was in place, showing how much of an impact timely help can make for those living with hearing impairment.

At the Royal British Legion, we will use these insights to continue advocating for improvements across government, the statutory and voluntary sector to better support the Armed Forces community. The report sets out ten recommendations to guide that change, directed at government, the Armed Forces, health services, and the charity sector. We hope the findings and recommendations will help shape policy and practice, ensuring that prevention, awareness, and support are strengthened for those who need them.

This work also sits within a wider context as the Ministry of Defence has formally recognised hearing loss as a Service-related condition, and agreements are in place to allow veterans to bring compensation claims. It is vitally important to ensure that every veteran affected by hearing impairment receives the recognition and support they deserve.

I would like to thank the veterans who took part in this study. Their willingness to share their experiences ensures this report reflects the realities of life with hearing impairment. Their voices remain at the heart of all that we do.

We hope this report will not only deepen understanding but also influence meaningful change. Our ambition is simple: that every veteran affected by hearing loss or tinnitus can access the support they need, when they need it, and live well after Service.

Mark Atkinson
Director General

Executive Summary

Loud and harmful levels of sound are a significant occupational hazard for those Serving or who have Served in the United Kingdom (UK) Armed Forces (MOD, 2010). Hearing loss and tinnitus are widely recognised as having a substantial impact on quality of life, affecting physical health, mental wellbeing, and social relationships (Henderson, 2024; NHS, 2015; 2019). Despite this, there is limited evidence on how hearing impairment specifically affects UK Armed Forces veterans, many of whom may have been exposed to harmful noise during their Service.

This research addresses this evidence gap by exploring how hearing impairment affects working-age UK Armed Forces veterans (18 to 67 years old), whether resulting directly from their Service or acquired while Serving. It examines whether current support adequately meets their needs and provides evidence-based recommendations to improve services, ensuring that those affected receive appropriate and timely support.

A mixed-methods approach was adopted to build a comprehensive understanding of the issue. This included a matched comparison study using primary healthcare (PHC) data to compare veterans and non-veterans. In addition, 658 participants completed surveys and 34 participated in one-to-one interviews.

To validate these findings and ensure they reflect the lived experiences of those with Service-related hearing impairment, two focus groups were conducted with participants from across the UK. The first brought together members of the Expert Reference Group (ERG), while the second involved veterans who had participated in the interview stage of this study. Input from the ERG was particularly valuable, and participants across both groups welcomed the opportunity to share their perspectives.

By drawing on these combined methods, the findings presented below bring together new evidence on the prevalence of hearing impairment among working-age veterans and highlight the key challenges it creates for their health, wellbeing, and access to support.

Survey findings offer insight into veterans' experiences of hearing impairment during and after Service, particularly their attitudes towards wearing hearing protection. In some groups, there was evidence of short-term decision-making, with limited focus on long-term health consequences. The data suggests that hearing impairment was not a major concern during Service. Although hearing protection was available, it was often considered incompatible with operational effectiveness, and at times uncomfortable. Participants reported balancing the need for hearing protection against any negative impact of not hearing instructions or warnings from colleagues. This balancing of priorities may help explain why only 14% of survey respondents reported always wearing hearing protection. These findings highlight the need to review how information on hearing impairment is communicated during Service and to develop strategies that better prepare individuals for transition to civilian life.

Survey findings also indicated that 55% of respondents noticed hearing loss during their time in Service. For some individuals, hearing loss was identified during annual audiometry

testing while Serving. For others, it did not become noticeable until several years after leaving the Armed Forces. Some expressed concerns about how acknowledging hearing difficulties might harm their career, which discouraged help-seeking. These findings reinforce earlier research suggesting that Service personnel and veterans are less likely to seek help than the wider population, compounded by stigmatised beliefs associated with hearing loss (Wallhagen, 2009).

There were also high levels of self-reported Post Traumatic Stress Disorder (PTSD), alcohol misuse, feelings of isolation and loneliness, reinforcing previous research showing that wider mental health and wellbeing challenges are linked to hearing impairment. The findings indicate that Service-related tinnitus and hearing loss can negatively affect long-term mental and physical health. This underscores the need for effective prevention and rehabilitation strategies for Armed Forces personnel and veterans, which could in turn, enhance their daily functioning and overall wellbeing.

Findings also suggested that many veterans in this study had been willing to seek help from multiple sources. Despite this, they perceived the support they received from health services to be inadequate, although those who received hearing aids cited the positive impact on their lives. This dissatisfaction extended to how compensation claims were managed. Veterans felt frustrated with the difficulties associated with proving their hearing impairment was Service-related, often resulting in their compensation claims for hearing impairment being refused.

Survey data also showed that veterans who had deployed on operational tours were **1.98 times more likely to experience hearing loss** than veterans who had not deployed, with longer Service length further increasing this likelihood. As hearing impairment can be degenerative, prevalence is expected to be higher in older veteran cohorts.

To support these findings, an analysis of primary healthcare medical records, compared veterans with a matched sample of non-veterans, providing further evidence of the extent of hearing impairment in the veteran population. The results showed **veterans were 2.33 times more likely than non-veterans** to experience hearing loss **and were 1.6 times more likely than non-veterans to experience tinnitus.**

Together, these findings show that Service-related hearing impairment is common among working-age veterans in this study, with wide-ranging effects on health, wellbeing, family life, and for some, a reluctance to seek help. There is a need to improve education, prevention, and rehabilitation, alongside support that addresses both the direct and indirect impacts of hearing loss and tinnitus.

This report offers important evidence that can help shape future policy and practice. The findings may support veterans with hearing impairment by informing national and international approaches to care and support. They can also provide useful insights for recruitment and retention strategies within the UK Armed Forces, with implications for policy development, education, and clinical guidance.

Key findings are presented in Image 1.

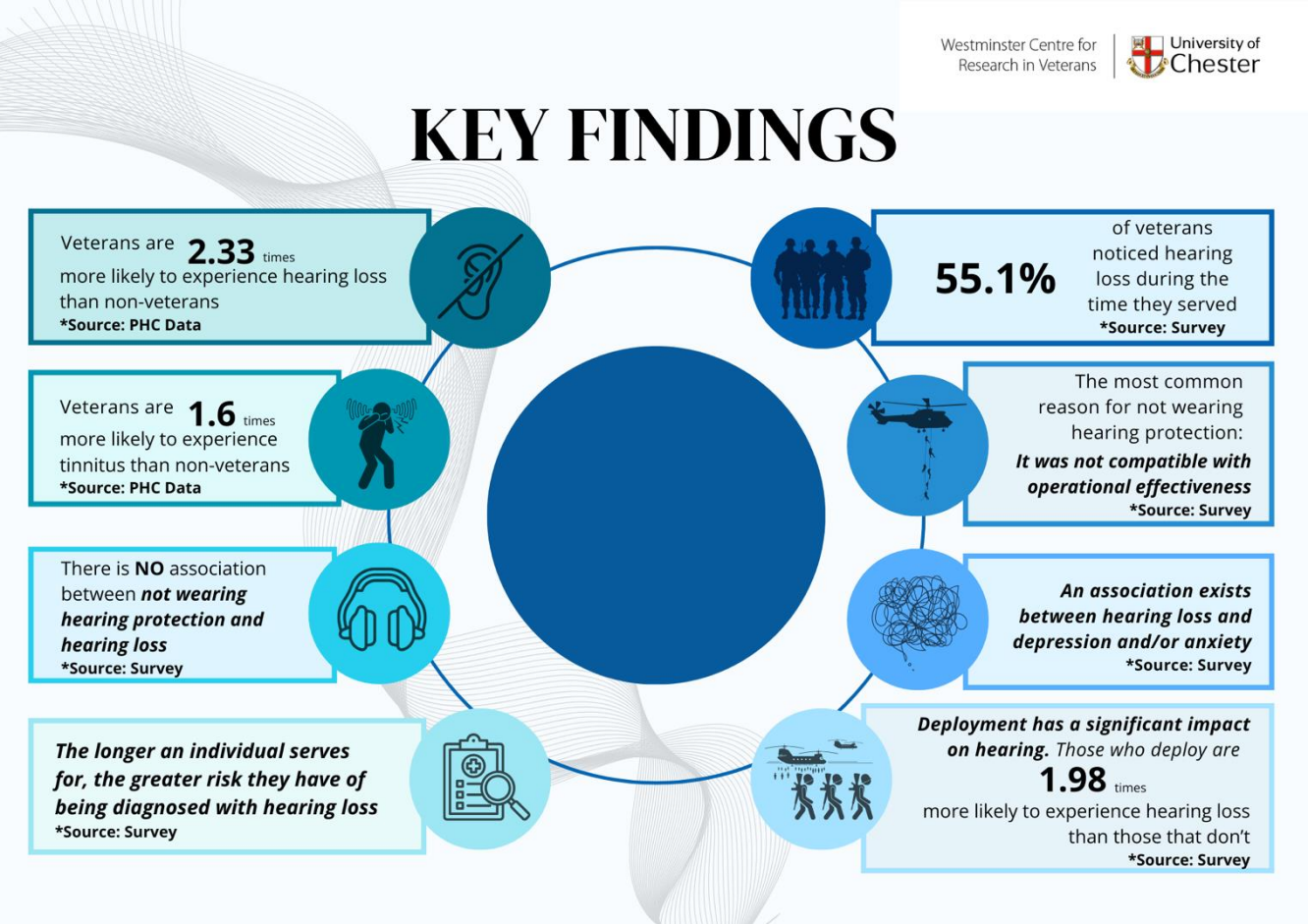


Image 1. Key findings from different components of this research project[1]

[1]Relating to the finding: "there is no association between not wearing hearing protection and hearing loss", this might be a result of multiple factors: hearing protection may not have been consistently or correctly used, it may have been insufficient to mitigate high-impact military noise exposure, or other variables (e.g., cumulative exposure, individual susceptibility, or non-service noise exposure) may play a greater role. In addition, retrospective self-reporting data introduces uncertainty around the accuracy of reported use. These findings highlight the complexity of noise-related hearing loss in military populations and suggest that prevention strategies must go beyond simply issuing protective equipment.

The finding that "55.1% of veterans noticed hearing loss during Service" refers only to veterans who reported hearing loss and reflects when they first became aware of it. It does not represent all veterans.

Broadly, findings should not be interpreted as representative of all veterans. Survey results reflect the views and experiences of participants who self-identified as having Service-related hearing impairment and chose to take part in research about this issue.

Recommendations

The recommendations from this research have been grouped under three overarching themes: **Inform, Support, and Minimise**, to reflect their focus on improving awareness and access to information, strengthening the availability and quality of services, and reducing future risk of hearing impairment among Serving personnel and veterans. These recommendations are intended to complement the significant work already undertaken across health services, the voluntary sector and government to improve support for hearing impairment and the Armed Forces community. RBL will use these insights to continue championing further improvements ensuring this momentum is sustained and strengthened. In these recommendations, the term hearing impairment refers to both hearing loss and tinnitus, unless stated otherwise.

Inform

Recommendation 1: The Ministry of Defence must strengthen guidance issued to all Service personnel, and their families, transitioning out of the Armed Forces. Guidance must provide clear and consistent information regarding support for hearing impairment regardless of how long after transition this condition may present, or their reasons for leaving Service. This should include clear and practical information about the circumstances under which compensation is available, and how to pursue this. Information and communication methods must be appropriate for, and accessible to, Serving personnel, veterans and their families, and informed by those with experience of Service-attributable hearing impairment. It ought to be provided in multiple formats and accessible to personnel after they have left Service.

Recommendation 2: Statutory and charity services providing support for the Armed Forces community affected by Service-attributable hearing impairment and/or tinnitus should undergo robust systematic monitoring and evaluation. This will ensure that services are evidence-based, and experiences of those accessing support are captured, to continually improve tailored hearing impairment services.

Recommendation 3: This project has identified research priorities which could broaden understanding and inform more tailored support for specific groups within the Armed Forces community in relation to hearing impairment and tinnitus. Further research is recommended to examine additional health conditions and population needs, including:

- Needs and effective support for veterans aged 65 and older
- Effective support for veterans with tinnitus
- Needs and experiences of female veterans
- Employment experiences and outcomes among veterans with hearing impairment
- Needs and effective support for families of those with hearing impairment
- Differences in barriers to help-seeking across different demographic groups, additional needs, e.g. mental health, other disabilities; and testing approaches to increasing help-seeking

Support

Recommendation 4: The Ministry of Defence and Veterans UK must do more to understand and address barriers veterans experience to accessing appropriate and timely compensation for Service-attributable hearing impairment, including exploring whether the impact and progressive nature of hearing impairment is adequately recognised within compensation policies, tariffs, and frameworks for assessing eligibility.

Recommendation 5: NICE (England & Wales), SIGN (Scotland), and Department of Health Northern Ireland (DoH NI) must produce an evidence-based review on the most effective treatments and support for veterans experiencing Service-attributable hearing impairment and/or tinnitus. This must be informed by large-scale trials and further high-quality research that enables full cost-benefit analysis and identification of the most effective interventions for addressing these conditions and related impacts, including wellbeing and mental health.

Recommendation 6: The Ministry of Defence must reinstate dedicated funding for veterans' hearing support, financed by HM Treasury. The Veterans Hearing Fund should function to provide hearing aids and related support for needs not met through statutory services and mitigate potential disadvantage owing to the unique experiences of military Service.

Recommendation 7: The NHS across all UK nations must implement regularly updated training modules, and supplementary guidance, on Service-attributable hearing impairment. Training must reflect the unique experience of the Armed Forces community and address the wider impact that hearing impairment can have on wellbeing. This must be delivered within professional development frameworks, such as the Veteran Friendly GP Practice programme and Devolved equivalents, as well as being embedded in staff guidance and accessible patient information materials.

Minimise

Recommendation 8: The Ministry of Defence must implement standard timelines for reviewing policies in relation to hearing protection and impairment. These policies must reflect the implications of hearing impairment, as well as lived experience through co-production with affected Serving and ex-Serving personnel and families. This could include exploring ways to ensure that hearing tests during Service are as accurate as possible, and that barriers to help-seeking are minimised where possible.

Recommendation 9: NICE (England & Wales), SIGN (Scotland), and Department of Health Northern Ireland (DoH NI) must recommend, and the NHS must ensure that audiology assessments are embedded as a routine element of treatment and care pathways for veterans experiencing Traumatic Brain Injury(s) (TBI) and any mental health conditions. This would facilitate early intervention and treatment to minimise the impact of Service-attributable hearing loss.

Recommendation 10: The NHS must strengthen clinical coding guidelines to ensure the regular and accurate recording of specific hearing impairments (including tinnitus), and veteran status, across primary healthcare practices. This coding must be applied by

practices, with support from external providers, to facilitate the timely transfer of relevant medical information, to inform appropriate and coordinated support pathways.

Introduction

Globally, it is estimated that 430 million people have disabling hearing loss, which, if left untreated, correlates with poorer health outcomes (World Health Organisation, 2020). Those who have served in the Armed Forces are at greater risk of experiencing hearing impairment due to their regular exposure to excessive noise (Orru et al., 2020). Indeed, hearing damage is one of the less visible but most common injuries sustained as a result of military Service (Gordon et al., 2017; Saunders & Griest, 2009; Swan et al., 2017).

Members of the Armed Forces are highly likely to be exposed to noise levels ranging from approximately 145 dB from small arms fire to over 200 dB from explosive blast events (Okpala, 2007). The legal framework governing occupational noise exposure in the UK is primarily established under the Health and Safety at Work etc. Act 1974, with specific requirements for noise managed through the Control of Noise at Work Regulations 2005, alongside relevant personal protective equipment (PPE) regulations.

The Environmental Protection Act 1990 sets out legislation relating to environmental noise, although the Ministry of Defence is exempt from clause 79(1)(g) in relation to noise emitted from premises for operational and training activities. We have clarified these distinctions to ensure the legislative context is accurately represented.

More recently, Moore (2021) reported significantly higher levels of progressive hearing loss in a military noise-exposed group than a non-exposed group, consistent with the idea that the noise exposure during military Service accelerates the subsequent progression of hearing loss.[2] Exposure to noise above the legal peak limit of 140 dB (Legislation.gov.uk, 2005) can have a profound capacity to damage the auditory system and result in an increased incidence of noise induced hearing loss (NIHL) (MacGregor et al., 2020). At these levels, even the best hearing protection may not reduce exposure down to safe levels (Health & Safety Executive, 2024) and NIHL is recognised as a significant source of hearing loss morbidity for UK Armed Forces Service personnel (Patil & Breeze, 2011).

In 2023, the University of Chester's Westminster Centre for Research in Veterans (The Centre) was awarded funding from the Royal British Legion (RBL) to conduct research into Service acquired hearing impairment in working age UK Armed Forces veterans. The research aimed to understand the impact of hearing loss resulting from military Service, evaluate whether current support provision meets veterans' needs, and inform recommendations for policy and practice.

[2] Moore (2021) reported higher levels of progressive hearing loss in a military noise-exposed cohort, suggesting that Service-related noise may accelerate later deterioration. This interpretation is debated; some wider evidence indicates that noise-related and age-related hearing loss are additive rather than progressive once exposure ceases. Both interpretations are relevant when considering long-term outcomes for veterans exposed to high-intensity acoustic trauma.

Background

Auditory Assessment

Hearing is vital to the safety and operational effectiveness of Armed Forces personnel. All Service members undergo audiometric testing at enlistment, and hearing may be monitored throughout their careers through annual (or routine) audiometry as part of health surveillance programmes. The results of these assessments inform the PULHHEEMS medical grading system (Physique, Upper Limbs, Locomotion, Hearing (right), Hearing (left), Eyesight (right), Eyesight (left), Mental Function and Stability), which is used to determine fitness to enlist, deploy and undertake specific military roles (British Army, 2010; Gov.UK, 2022). From an MOD perspective, hearing loss "*specifically refers to any instance where a member of the Armed Forces has undertaken an audiometer test and has found to have decreased in hearing capacity from when they joined, including those who have lost hearing but are still above the threshold to be considered able for duty*." (MOD, 2024b).

Early identification through annual/routine audiometry can enable risk-mitigation, including reducing further noise exposure. However, hearing loss may also result in a person being deemed unfit to deploy on operational tours and, in some cases, medically discharged from Service (MOD, 2023), which can cause significant mental health distress. Despite efforts to improve hearing protection, noise-related hearing damage remains a widespread outcome of military Service (Patil & Breeze, 2011; Swan et al., 2017).

Types of Hearing Loss & Levels within the Armed Forces Community

Consistent and often unexpected loud noise can be experienced by military personnel in both peacetime and operational environments, leading to NIHL whereby the complex structures within the inner ear are damaged (National Institute on Deafness and Other Communication Disorders, 2024). This can lead to significant hearing impairment within the military and can affect combat performance, with NIHL and tinnitus cited as the second most prevalent Service-connected disabilities (Yong & Wang, 2015). United States (US) research has identified a negative impact of tinnitus upon daily functioning (Rademaker et al., 2022), with tinnitus affecting up to 54% of US veterans (Theodoroff et al., 2015).

There are many different types of hearing loss and impairment; sensorineural hearing loss can affect all ranges of hearing with some people struggling to hear both low-pitched and high-pitched sounds, while others may only struggle with one range (Tanna, Lin & De Jesus, 2023). One of the more common types of sensorineural hearing loss is high frequency hearing loss where certain consonants cannot be heard (Tanna, Lin & De Jesus, 2023). Similar to high-frequency hearing loss, noise-notch hearing loss restricted hearing of certain high-pitched sounds such as children's voices. Unlike high-frequency hearing loss, those affected may still hear very high-pitched sounds such as birds or beeps. This type of hearing loss is associated with loud and sudden NIHL (Phatak, 2009).

There are over two million veterans residing in the UK (MOD, 2019). Previous research conducted by the RBL in 2014 suggested hearing impairment was found more frequently among veterans aged under 75, than non-veterans in this age group, and could potentially affect tens, or even hundreds of thousands of veterans (RBL, 2014). However, contemporary

and reliable estimates of the prevalence of hearing impairment in the veteran population is lacking. This report aims to address that gap and generate further understanding of how the needs of those veterans with hearing impairment can be better met.

Tinnitus

Tinnitus is the perception of sound that does not have an external source, so other people cannot hear it. Tinnitus is commonly described as a ringing sound, but some people hear other types of sounds, such as roaring or buzzing. There is no known cure for tinnitus and no commonly accepted framework to manage and treat the symptoms pharmacologically (National Institute on Deafness and Other Communication Disorders, 2024).

Tinnitus is strongly predictive of hearing loss (Rademaker et al., 2023); and has been the leading disability amongst US Veterans over the past 15 years (Department of Veterans Affairs, 2019). US military data show a prevalence of tinnitus of 6.33 per 1,000 Service personnel in 2015 (Moore et al., 2019), with much higher rates (up to 31.3%) in those who had sustained a battle injury (MacGregor et al., 2020). In non-veterans, tinnitus may be comorbid with cognitive dysfunction and depression (Armstrong et al., 2020) including risk of suicide, sleep disorders, and/or anxiety (Crönlein et al., 2016; Maes et al., 2013; McCormack et al., 2014; Stockdale et al., 2017). Hearing loss and tinnitus can therefore have profound effects on quality of life.

Operational Tours and Hearing Loss

During the international coalition conflicts in Afghanistan (2001-2021) and Iraq (2003-2011), factors such as the comprehensive healthcare provision at Camp Bastion (Care Quality Commission, 2012) combined with superior body armour, resulted in lives saved where casualties would previously have died (Ford et al., 2017; Hodgetts, 2012). The signature serious injuries of these conflicts were poly-trauma, primarily associated with orthopaedic injuries and burn related injury (Jansen et al., 2012), and notable increases in traumatic brain injuries (TBI) (Taylor et al., 2012; Institute of Medicine 2014; Brain Trauma Foundation, 2015). Head injuries were strongly associated with tinnitus and hearing loss and were the primary disabilities amongst US Service personnel (Clifford et al., 2022).

The impact was revealed in audiological data from infantry personnel returning from Afghanistan in 2007/08, indicating that up to 14% had suffered from hearing loss (Brown, 2010). Similarly, a systematic review investigating the prevalence of hearing impairment and tinnitus in US Service members and veterans deployed to the Iraq and Afghanistan conflicts estimated that 16.4% - 26.6% of Servicemen and women were subsequently diagnosed with hearing damage (Theodoroff et al., 2015).

Traumatic Brain Injury

TBI is associated with hearing loss in military personnel (Institute of Medicine, 2014) and is largely attributed to explosive blasts (Belmont et al., 2012; Owens et al., 2008). These blasts have led to auditory and sometimes cognitive deficits, which may be associated with speaking recognition difficulties in patients who have normal hearing. These auditory problems have been correlated with poor functioning and MH problems such as depression, anxiety and PTSD (Ahmed et al., 2025).

The US Defense and Veterans Brain Injury Center reports that nearly 414,000 TBIs occurred among US Service members between 2000 and late 2019, and more than 185,000 US veterans have been diagnosed with at least one TBI (Whiteneck et al., 2015). Mild TBI has been linked to high rates of tinnitus and, in some studies, increased risk of hearing loss, with tinnitus prevalence reported at up to 75.7% in certain cohorts (Clifford et al., 2019; Karch et al., 2016; Theodoroff et al., 2015).

Hearing Protection

To prevent intensive noise exposure, hearing protection devices have been widely used by workers (Kwak & Han, 2021) and are mandated by legislation in UK work environments (Health & Safety Executive, 2024). Within a military context, quality and effectiveness of these devices has improved, but Service personnel must balance the effectiveness of wearing them against an innate and essential requirement to hear military commands and localise sounds (Fink et al., 2019). User acceptability is an important factor, leading to reports that as few as 4% were routinely wearing Personal Interface Hearing Protection (personally moulded hearing protection) on patrol in Afghanistan, although this was also attributed to a reluctance to wear a new system that was issued immediately prior to this deployment (Patil & Breeze, 2011).

Quality of Life and Social Isolation

Being able to hear and communicate is crucial to living a healthy and productive life, yet veterans who leave the Armed Forces due to a physical complaint can face particular challenges (Sharp et al., 2019) and remain at greater risk of experiencing MH distress than those who do not leave with a physical complaint (Dyball et al., 2022). Hearing loss and tinnitus may have profound impact on an individual's quality of life (Van Hoof et al., 2022) potentially resulting in a barrier to effective communication with family, friends, colleagues and health professionals. This can lead to loneliness and frustration, often resulting in social isolation (Gopinath et al., 2012; Kramer 2002; Monzani et al., 2008; Arlinger, 2003). Hearing loss also doubles the risk of developing depression and increases the risk of anxiety and other MH problems (Li, 2014; Saito et al., 2010). There is also additional evidence that hearing loss increases the risk of developing cognitive decline (Lin et al., 2013) and dementia (Livingston et al., 2020).

Economic impact

Economically, hearing loss impacts personal earning capacity and the wider economy, with historic calculations reported in 2013 suggesting that the UK economy lost £24.8 billion in potential economic output (UK Parliament, 2013). It has been found that, on average, people with hearing loss were more likely to be unemployed (Jung et al., 2012) and when they do work, they are paid significantly less than the general population (The Ear Foundation, 2014). Veterans who are diagnosed with a hearing impairment are entitled to claim for financial compensation from the MOD if their hearing loss is a direct result of Serving in the Armed Forces (MOD, 2024).

However, accessing compensation can be challenging. The current AFCS compensation threshold for noise induced hearing loss is an averaged 50 dB across 1, 2 and 3 kHz. In its seventh report, the Independent Medical Expert Group (July 2024) concluded that no robust evidence exists to justify lowering this threshold, meaning that many veterans with hearing difficulties may still fall below the eligibility criteria. Establishing a clear link between Service and hearing impairment is also difficult as hearing loss is often progressive and may not become evident until after an individual has left the Armed Forces

This challenge is reflected in MOD AFCS data successful claims. Since 2005, there have been 4,235 awards for senses related injuries and illness, of which 205 Lump Sum and Guaranteed Income Payments, and 2890 Lump Sum (only) awards were for noise induced hearing loss (Ministry of Defence, 2025, Table 12). At the same time, data on common law compensation claims (Ministry of Defence, WPS/AFCS), highlight new claims for noise induced hearing loss rose dramatically in 2023/24 to 13,748, up from 4,571 in 2022/23, 3,269 in 2021/22, and 1,522 in 2020/21.

Stigma

Within the veteran population, the accurate estimation of the levels of hearing impairment may be affected by the known poor help-seeking behaviour in this population (Finnegan & Randles, 2023; Randles & Finnegan, 2022). Male Service personnel may feel unable to ask for help due to feelings of shame, stigma and fear for their career (Finnegan et al., 2014), with military culture and identity cited as reasons why veterans view any form of ill health as a sign of weakness (Wray et al., 2016). Therefore, a sense of pride may stop veterans from seeking help for any form of ill health (Randles & Finnegan, 2022). Female veterans have also adopted the same attitudes in not wanting to appear weak (Graham et al., 2022).

The Royal College of General Practitioners Veteran Friendly Practice initiative intends to improve the recording of veterans in PHC, as the number of correctly registered veterans remains unknown (Finnegan et al., 2022).

UK research indicates that veterans had mixed views on social support for tinnitus and many did not want to talk about tinnitus with others and/or did not want to burden their family (Burns-O'Connell et al., 2019).

Despite these findings, there is limited literature exploring the impact of hearing loss among Serving personnel and veterans. Further, much of the literature which does exist emanates

from the US and given the differences in health services support and provision for military veterans between the US and the UK (Desai et al., 2010), it is important to explicitly understand the experiences of UK veterans. Therefore, this research aims to understand the impact that hearing impairment might have on working age veterans in the UK and establish their support needs. Further, the research seeks to address a gap in knowledge and understanding in relation to hearing loss in the Armed Forces Community, to practical recommendations that improve outcomes for veterans with hearing impairment.

Aims and Objectives

The aim of this research was to understand and determine the impact of hearing impairment on working age UK Armed Forces veterans (18 to 67 years old) as a direct result of Service or acquired whilst in Service, and to use this information to establish whether their support needs were being met by current provision.

The research objectives were organised into four key areas:

Understanding the Problem

a) Complete a comprehensive systematic review including UK and international literature that is aligned to the aim of the study.
b) Determine how the impact and presentation of hearing loss amongst working-age veterans differ from the non-veteran working-age population.
c) Distinguish UK trends and risk factors including gender, age, relationship status, ethnicity, and socioeconomic status.

Impact on Veterans and their Families

d) Highlight how hearing loss has impacted on working-age veterans seeking to live fulfilling lives post-Service. This will include an evaluation of the primary health and social care issues that the population have experienced since leaving the Armed Forces due to hearing problems. This encompasses the impact on social status due to experiencing financial, housing and employment issues.
e) Describe the barriers to care veterans with hearing loss experienced in accessing support. This is determined by the MH and social detriments and by establishing whether employment status, the support of the local medical Services, stigma and help-seeking behaviours were significant contributing factors in influencing and motivating access to health and social care facilities. Thereby, this research will establish the life-course experiences after leaving the Armed Forces and the coping mechanisms to help resolve these issues.
f) Examine the potential for “ripple effects” where the participants’ experiences are reflected in mental health challenges or benefits for other family members.

Evaluating Current Support Provision

g) Identify if the current statutory and charitable support provision for working-age veterans with hearing loss meets the needs of the cohort.
h) Evaluate the provision offered to veterans by the National Health Service and military charity sector.
i) Explore the financial compensation and support offered by the MOD and the State in terms of entitlement or eligibility, accessing financial support, and gaps in terms of what people are entitled to and what is claimed.

Future Solutions

j) To construct a theoretical (predictive) model that can be used by veterans and those involved in their welfare (statutory and charitable organisations) to assist veterans with hearing problems. This will indicate the utilisation and transferability of this programme at national and international levels.

Methodology

This research applied a mixed-methods approach with data collected via a cross-sectional survey, interviews and validatory focus groups. In addition, a PHC comparison of demographically matched veteran and non-veteran samples was designed to identify any differences in the hearing loss and tinnitus morbidity between veterans and demographically matched non-veterans.

Data collection commenced in June 2023 and ended in June 2024; interviews were conducted between September and November 2023; the survey launched in August 2023 and closed in February 2024, and the two focus groups were held in May and June 2024. Interviews built on the survey data and explored topics which had arisen in the survey in greater depth whilst focus groups permitted triangulation of the data. Data triangulation enhances the credibility and validity of research findings by cross-verifying information from multiple sources (Carter et al., 2014).

Systematic Review

A systematic review of international literature was also conducted to examine the experiences and health impacts of hearing impairment and tinnitus among veterans. Keyword searches were conducted in PsycINFO, PubMed, Medline, and CINAHL following PRISMA guidelines.

Twelve studies published between 1990 and 2023 were included in this systematic review. Of these, eleven originated from the United States and one from the United Kingdom. The majority of studies employed quantitative methodologies, primarily using self-report surveys and analysis of clinical databases. One study utilised a mixed-methods approach. Three studies included comparisons with demographically matched non-veteran populations. The studies covered a range of themes, which were synthesised into three overarching categories: Mental Health, Physical Health, and Lived Experience and Functioning, with a fourth emergent category of Support identified in one study.

The findings of the review showed that hearing loss and tinnitus in veterans are frequently linked with mental health issues such as depression, anxiety, PTSD, and cognitive decline. These conditions are also associated with physical comorbidities including traumatic brain injury (TBI), blast injuries, and type 2 diabetes. When resulting from blast or TBI, hearing-related symptoms may include more complex auditory and cognitive difficulties.
The review concludes that hearing impairment and tinnitus significantly affect veterans' mental and cognitive health. It highlights the need for more research, particularly comparative studies with civilian populations and UK-based research, to better understand and address the health consequences of noise-induced hearing loss (NIHL) in this population.

Sample Size and Eligibility Criteria

Following discussions with the RBL and the study's ERG (See Appendix B), the target sample for the study survey was agreed with the aim of recruiting 200 working age (18- 67 years old) UK Armed Forces veterans (Regular or Reserves) who self-declared a hearing problem or impairment. This target was agreed as achievable and acceptable based on sampling standards (Memon et al., 2020).

In broad terms, data saturation acts as a criterion in qualitative research to discontinue data collection (Glaser & Strauss, 1967), with research in the general population suggesting 9-17 interviews is sufficient to reach saturation (Hennink & Kaiser, 2022). Qualitative research with Armed Forces veterans has identified that a sample of 20 to 30 interviews would be sufficient to reach saturation, wherein no new data patterns are being identified (Finnegan, 2016). Two focus groups were conducted with between 6 and 10 participants, in line with Morgan's (1997) sampling recommendations for effective focus groups. Participants were recruited purposefully from across all UK nations: England, Northern Ireland, Scotland, and Wales, to ensure a broad UK representation. For the PHC component, a total sample of 3100 medical notes of a demographically matched sample of veterans and non-veterans was analysed. The veteran inclusion criteria were any Regular or Reservists (including National Service) who had served for at least one day in the UK Armed Forces.

Survey

Data collection was conducted using an online survey platform, Joint Information Systems Committee (JISC). A recruitment poster (Appendix A) was designed to inform potential participants, and the poster included a Quick Response (QR) code and link to the study to allow access for those with smartphones/computers. An email address was provided for those who preferred to request a paper copy. When clicking the link, participants were guided to a participant information sheet (PIS) which contained detailed information about the study and an email address so that if they had any questions, they were able to ask. Participants were then asked to complete a consent form which once complete, permitted access to the survey.

All data were stored in a password protected shared Drive, accessible only by the research team. The poster was distributed across multiple platforms and third sector organisations (Appendix C), and the Centre's extensive military networks were key in connecting with the research population. To minimise recruitment bias, the survey recruitment poster was disseminated to non-military connected organisations such as Specsavers and Boots. This was to help prevent an overrepresentation of veterans who had sought help from military-specific charities, and to capture veterans who have specifically sought help from civilian Services, allowing greater insight into different help-seeking experiences.

Image 2. Organisations who shared the study flyer

The survey contained 34 questions and was designed by the research team. Survey questions were aligned with the aims of the research and followed a review of the evidence base which highlighted gaps in the literature, thus allowing the research team to accurately investigate veteran's experiences of living with hearing impairment. The survey was piloted within the team and with external lay people. No amendments to the survey were required following piloting. Piloting indicated that the survey would take between 12 and 20 minutes to complete.

There were 658 participants who completed the survey. The survey collected core demographic information (age, gender, sexual orientation, ethnicity, etc) along with specific details relating to Service, including length of Service, rank, operational tour information and reason for discharge. The survey included questions on current hearing problems including tinnitus and hyperacusis (NHS, 2025), a condition that causes people to be overly sensitive to everyday sounds, as well as other ongoing physical or MH needs. Participants were also able to report their satisfaction with the support they have been offered and received. Additional free text boxes were also provided for participants to expand on answers where they felt necessary, for example, help-seeking behaviour.

Four validated psychometric measures were included in the survey. These included the Patient Health Questionnaire-9 (PHQ; Manea et al., 2015), Warwick-Edinburgh Mental Wellbeing Scale (WEMWS; Tennant et al., 2007), Hearing Handicap Inventory for Adults (HHIA; Newman et al., 1990) and the Tinnitus Functional Index (TFI; Meikle et al., 2012). These provided an indication of the health, well-being and perceived severity of hearing impairments of participants. The TFI would only appear as an option if participants indicated they had tinnitus. The Centre obtained copyright permission for these tools. Upon completion of the survey, participants had the option to include any further comments and accept the option to participate in an interview with a member of the research team.

Interviews

The interview schedule aimed to explore in greater depth the experiences of participants and the impact of hearing loss on their lives. Interview questions were developed in line with the survey question set, allowing greater exploration of the topics being discussed in the survey. Interview questions were broadly focused upon veterans' perceptions of the causes of hearing impairment, the impact this might have and their help-seeking for hearing impairment.

Among survey participants, 67% were willing to be interviewed about the level of noise they experienced, their use of hearing protection, and their reasons for different help-seeking behaviours. In this study, participants were recruited through opportunistic sampling, selecting individuals based on their immediate availability and willingness to participate. This method is particularly advantageous in exploratory research within under-investigated areas, as it allows for flexible data collection in less-researched populations without the need for extensive planning or resources (Farrugia, 2019). However, it is important to acknowledge that opportunistic sampling may introduce selection bias, potentially limiting the generalisability of the findings due to the non-random nature of participant selection. To mitigate this concern, efforts were made to include a diverse range

of participants, encompassing various demographic characteristics. This approach aimed to reduce selection bias and enhance the applicability of the results. Nonetheless, the inherent limitations of opportunistic sampling necessitate caution when generalising the study's conclusions to the broader population.

Thirty-four interviews were conducted. Interviews were conducted via Microsoft Teams or Zoom. Interviews aimed to be no longer than one hour and were recorded then transcribed verbatim. Participant demographic information was also captured during the interview.

Focus Groups

Two focus groups were conducted in May and June 2024 to further explore and confirm emerging themes from the interviews. Participants were presented with the preliminary interview themes and discussions were held around whether they agreed that these were a true reflection of veterans' experiences.

Focus group one consisted of seven ERG members and focus group two consisted of six interview participants who had agreed to participate in a focus group. This represented a mix of individuals considered key experts in the field of veterans' health and hearing impairment, and veterans who had themselves experienced hearing loss as a result of their time in Service. These broad perspectives allowed for both professional and lived experience of understanding of the themes identified, facilitating in-depth discussion about the themes and how the experiences identified within the interview and survey data could be improved, and overcome.

The Centre would like to acknowledge all participants who were involved in the study.

Comparison of Hearing Loss and Tinnitus in Veterans and Non-Veterans using PHC Data

Primary Healthcare (PHC) provides 300million consultations to NHS patients in England each year (NHSE, 2024) and is often the first point of contact for veterans and their families. This enables free access to healthcare and support, and to be referred onto other organisations.

PHC patient electronic medical records utilise Systematized Nomenclature of Medicine-Clinical Terms (SNOMED-CT) (NHS Digital, 2021) that contain clinical information related to patient diagnosis, demographics (age, gender, ethnicity), laboratory tests, and medications and provides a consistent vocabulary for recording patient clinical information. SNOMED-CT codes extend to military veterans, and a SNOMED-CT search should reveal the healthcare status of the veteran population.

The authors partnered with 13 Cheshire and Lancashire (England) PHC practices with a population of 137,410 patients. This methodology followed on from two previous research studies conducted by the Centre whereby research had sought to both improve veteran registrations in these practices and identify the prevalence of health issues across veteran and non-veteran patient samples (Finnegan & Randles, 2023a; Finnegan & Randles, 2023b; Finnegan & Salem, 2024). Therefore, the chosen practices had worked with the Centre previously and had been identified as having a strong veteran registration profile and/or

being a large PHC practice (>10,000 patients). Participating practices received financial compensation for their involvement.

PHC staff provided the data from PHC patient medical records. Read/SNOMED codes are utilised to provide a consistent vocabulary for PHC staff to record characteristics, diagnoses and pharmacological treatments on a patient's medical record. For example, if a healthcare professional was required to record hearing loss on a patient's medical record, they will annotate a code on their record related to 'hearing loss'. Practices were asked to include codes related specifically to tinnitus and hearing loss. The research team engaged with the PHC practices to try and ensure consistency as there were numerous codes which could be applied. For example, 'hearing loss' might be coded as 'hearing issues', 'hearing difficulties' or 'hearing impairment'.

Practices were required to complete a search of their SNOMED-CT medical records and identify those with a code for "Military Veteran" (SNOMED code 753651000000107 or Read Code 13Ji) and a code for hearing loss and/or tinnitus. These records were then matched demographically for age and gender with a civilian population. PHC staff anonymised patient records by removing the patients name and individual NHS identification number, before sending to the Centre in an amalgamated format. The searches were submitted to the Centre between October 2023 and January 2024.

Detail from the Census 2021 (Office for National Statistics [ONS], 2023a) indicated that the veteran population across the North-West of England was 3.8%. However, area-specific ONS data from regions within the North-West ranged from 3.9-5.1% and these figures were utilised to provide a more detailed comparison of the data. The figures of those registered in the PHC practices in this study could then be compared to ONS veteran registrations by region.

Analysis

Surveys: All surveys were downloaded from the JISC online surveys portal and entered into Statistics Package for Social Sciences (SPSS) version 28.0. Descriptive statistics were used to summarise demographics, Service history, current illnesses, social networks, employment, living arrangements and psychometric questionnaire results. Inferential analyses, including chi-square tests and t-tests, were conducted to identify statistically significant relationships between sub-groups. Responses to free-text questions were coded using the NVivo software package v.14 and analysed using an inductive Content Analysis (Burnard, 2008). This inductive approach facilitated the generation of new themes and insights, rather than testing pre-existing (Bengtsson, 2016; Burnard, 2008; Zhang & Wildemuth, 2009).

Content Analysis was applied to the open-ended qualitative data within the survey. This analytical method is a practical approach which can be used as a quantitative or qualitative method of data analysis and can be applied to both textual and visual data (Burnard, 1991). The purpose of Content Analysis is to describe the characteristics of the document's content (Bloor & Wood, 2006). Therefore, Content Analysis was considered the best analytic approach for this study as quantifying and analysing the presence of key words and

concepts would permit understanding of the data. Where relevant, infographics and data visualisations are used to present the data.

Interviews: Data were entered into the NVivo software package v.14 and analysed using a modified Grounded Theory approach (Charmaz, 2014; Finnegan, 2014; Glaser & Strauss, 1967). This inductive methodological approach consists of a structured and systematic guideline for gathering, synthesising, analysing, and conceptualising qualitative data to construct a theory grounded in the data from which it was developed whilst enabling the identification of issues from the participant's perspective. Grounded Theory principles facilitate exploration of under-researched social phenomenon and is designed to be flexible, permitting socially constructed concepts and realities to emerge naturally without forcing the data.

Given hearing impairment in veterans is an under-researched area, applying this analytical method was considered the most appropriate approach to further knowledge and understanding of hearing impairment. This approach aligns with the research team's prior experience in analysing qualitative data in both Serving and veteran populations (Finnegan et al., 2016; Finnegan et al 2018; Finnegan et al., 2020a; Finnegan et al., 2020b; Finnegan et al., 2024).

Focus Groups: Focus group discussions were transcribed, coded in NVivo v.14 and analysed using Grounded Theory. This approach enabled a comparison of emergent themes between interview and focus group findings, ensuring consistency and depth.

PHC Data: Submitted matched information was input into an SPSS database for analysis which included descriptive statistics of frequencies and percentages, and inferential chi-square test statistics to indicate statistically significant differences in the prevalence of disorders between the veteran and non-veteran populations.

Data Anonymity and Storage

Identifying information (i.e., names, identifiable locations, job roles) were redacted from interview and focus group transcripts. Each interview transcript was assigned a pseudonym (e.g., AA, BB) to maximise participant anonymity. Focus group transcripts followed a similar process, using numbers for participants within the transcripts (e.g., Participant 1, 2, 3). PHC data was anonymised by PHC staff before it was transferred to the Centre.

Names were not requested for survey participation. Respondents who included their email address on the survey were informed on the PIS that this information would be stored securely for future contact to request participation in the interview study. Email addresses were copied into an excel spreadsheet. All research data – including excel files, completed surveys, qualitative recordings, transcripts and SPSS databases were stored in a GDPR compliant, encrypted server. Access was restricted to the research team ensuring participant confidentiality.

Triangulation and Development of Theoretical Model

Triangulation refers to the combining of methods, theories or observations to increase the reliability and validity of findings, providing a more comprehensive understanding of the data (Noble & Heale, 2019). In the case of this research, methodological triangulation occurred between the quantitative survey, PHC data, the qualitative data from the post-project interviews with veterans and finally, the qualitative data from the focus groups. Data from these multiple sources were compared and integrated. Findings were triangulated to create a theoretical model to highlight the experiences and needs of veterans living with Service-related hearing loss. The theoretical model explains and predicts the factors associated with Service-related hearing impairment in veterans.

Project Engagement

Representing experienced voices was a key part of collaborative working along this research journey. The Centre embraced input from ERG members; those considered to have substantial experience working with veterans and an in-depth knowledge of Service-related hearing impairment. ERG members were considered equal partners in designing this research project and were involved in the design of question sets throughout. This ensured the questions being asked were professionally informed and would therefore capture the data required to achieve the research aims.

Results

Survey

A total of 658 valid questionnaires were completed. The study aimed to recruit a sample representative of the UK veteran population. The regional split of survey participants is presented in Table 1 below, followed by participant demographic information presented in Table 2.

Region and Country	Count	% of total
North-West	133	20.31
South-West	114	17.40
South-East	90	13.74
North-East	58	8.85
Scotland	55	8.40
Wales	49	7.48
East of England	49	7.48
West Midlands	34	5.19
East Midlands	30	4.58
Northern Ireland	29	4.43
Greater London	12	1.83
Channel Islands	1	0.15
South Africa	1	0.15
Total	**655**	**100%** [3]

Table 1. Regional split of survey participants

[3] This regional breakdown is based on 655 valid postcodes. Of the 658 survey respondents, three did not provide a usable postcode (two left the field blank and one entered an invalid code).

		%	N
Gender	Male	89.3	584
	Female	9.5	62
	Other	0.9	6
	Prefer not to say (PNTS)	0.3	2
	Missing data	/	4
		Years	
Age	Mean	54	
	Range	27-67	
		%	**N**
Ethnicity	White British	98.6	626
	Other ethnicities	1.4	9
	PNTS	2.3	15
	Missing data	/	8
Religion	None	33.8	221
	Christian	58.5	382
	Jewish	0.2	1
	Sikh	0.2	1
	Muslim	0.3	2
	Other	2.9	19
	PNTS	4.1	27
	Missing data	/	5
Sexual Orientation	Heterosexual	92.8	607
	Bisexual	0.5	3
	Gay/ Lesbian	2.4	16
	Other	0.3	2
	PNTS	4	26
	Missing data	/	4
Region	England	79.4	520
	Scotland	8.4	55
	Wales	7.5	49
	Northern Ireland	4.3	29
	Channel Islands	0.2	1
	South Africa	0.2	1

Table 2. Survey Demographic

SURVEY DEMOGRAPHICS

89.3%	Male
54	Average age (years)
92.8%	Heterosexual
96.3%	White British
58.5%	Christian
50.7%	Employed full-time
68.9%	Home-owners
77.3%	Live with their spouse/partner
65.4%	Served with the British Army
18	Average length of Service (years)
16.3%	Rank of Private or equivalent
90.1%	Experienced at least one operational tour/deployment

Housing and Employment

For veteran housing, 68.9% (n=445) were homeowners, 26.2% (n=169) resided in a rented property, 3.6% (n=23) lived in 'other' accommodation such as living with family members, 0.8% (n=5) were homeless and 0.6% (n=4) lived in residential accommodation. Twelve responses were missing. The 2021 Census (ONS, 2023b) revealed that a higher proportion of veterans owned their house outright or with a mortgage (75%), compared with 64% of the non-veteran population so the results from this study are generally similar. The slightly lower rate may be due to the younger age demographics of participants in this study, compared to the wider veteran population.

Most veterans (77.3%, n=502) indicated that they were living with their spouse/partner, 17.1% (n=111) lived alone, 2% (n=13) lived with their children, 9 responses were missing, 1.2% (n=8) replied 'other', 0 .9% (n=6) lived with grandparents, 0.6% (n=4) lived with other family members, 0.6% (n=4) lived with friends, 0.2% (n=1) in a professional house share.

Most veterans were employed full time (54%, including self-employed), a further 11% employed part time, and 13% unemployed. ONS (2021) data reported 33.6% of veterans in England and Wales were employed compared to 1.6% unemployed, with 46.1% of veterans being retired. Reasons for the higher rates of employment of veterans in this study, compared to the total veteran population is likely explained by the maximum age requirement to participate in this survey (i.e., veterans in this study were not older than 67 and so far, fewer would be expected to be economically inactive due to having retired). In addition, ONS data captures individuals over the age of 16, whereas the lower age bracket in this study was 18. Survey questions within this study also differed to the data collected by ONS, with this survey only offering responses for 'employed full time/ part time', 'unemployed', 'retired' or 'volunteer', whilst ONS data adjusted for long term sick and disability which would account for the higher rates of unemployment reported in this study.

Further, this study differs from US research wherein hearing loss was more prevalent in unemployed civilian participants (Jung et al., 2012). This study did not identify the salaries of those in employment, although studies have shown that when they do work, people with hearing loss are paid significantly less than the UK non-veteran population (The Ear Foundation, 2014). It remains unknown whether this is the case with UK veterans.

Service History

Participants were able to select which branch of the UK Armed Forces they served in and were able to select multiple responses. Most participants served in the British Army (65.4%, n= 430), 13.2% (n=87) in the Royal Navy, 13% (n=86) served in the Royal Air Force (RAF), and 7.8% (n=51) in the Royal Marines. There were also a small number of participants (n=3) who had served in more than one branch of the military. Data were missing for one participant. See Figure 1 for breakdown of military branches. There was no significant association between which section of the Armed Forces an individual had served in, and current hearing loss (X^2 (4, n=476)=.786, p=.940) or tinnitus (X^2 (4, n=649)=3.778, p=.437) which means that all branches of the Armed Forces are vulnerable to hearing impairment.

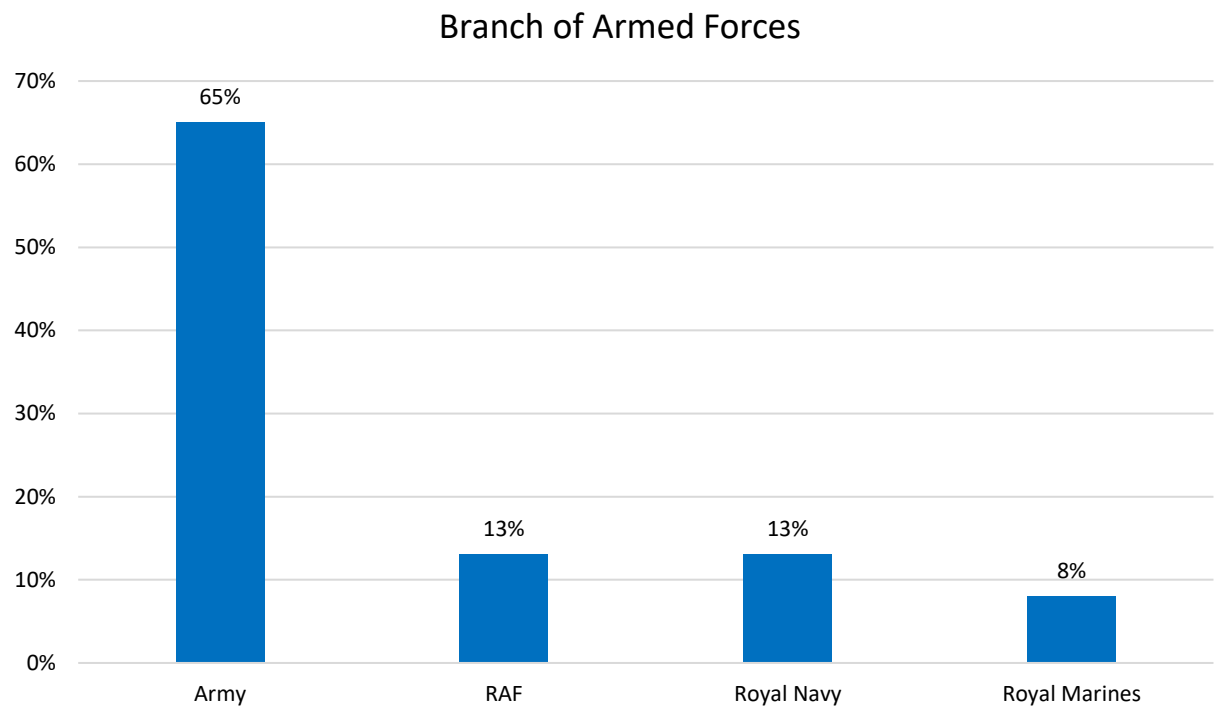


Figure 1. Branch of Armed Forces

Type of Service

Participants were also asked to indicate their type of Service and were also able to select more than one response (e.g., Reserves and Regulars). Most veterans served in the Regular Armed Forces (90.7%, n=595), far less served in the Reserves (4.3%, n=28) and 4.7% (n=31) had served in both the Regulars and Reserves. Data were missing for two participants.

Length of Service

The average time served was 18 years (Range 1-43 years; SD 9.2). The year in which the greatest number of participants had left the Armed Forces was 2013 (n=32). The most historic leave year was 1977, and the most recent was 2023. There were 158 participants who had left in the last ten years (since 2015). There were 211 participants who had left the Armed Forces between 2005-2014, and 283 participants had left prior to 2004. Data were missing for six participants.

Rank

We asked respondents their rank on leaving the Armed Forces (See Figure 2). The most frequent response was a Private soldier, see Figure 2. In ascending rank order, upon leaving the Armed Forces, participants were Privates 16.3% (n=107), Lance Corporals (LCpl) 13.9% (n=91), Corporals (Cpl) 15.6% (n=102), Sergeants (Sgt) 15.3% (n=100), Staff Sergeants (SSgt) 7.8% (n=51), Colour Sergeants (CSgt) 1.8% (n=12), Warrant Officers 15% (n=98), Lieutenant

0.6% (n=4), Captain 3.8% (n=25), Major 6.4% (n=42), Lieutenant Colonel 2.6% (n=17) and Colonel and above 0.9% (n=6). There was no significant association between rank and current hearing loss (X^2 (11, n=474)=8.761, p=.644) or tinnitus (X^2 (11, n=647)=7.587, p=.750). This indicates that all ranks are vulnerable to hearing impairment.

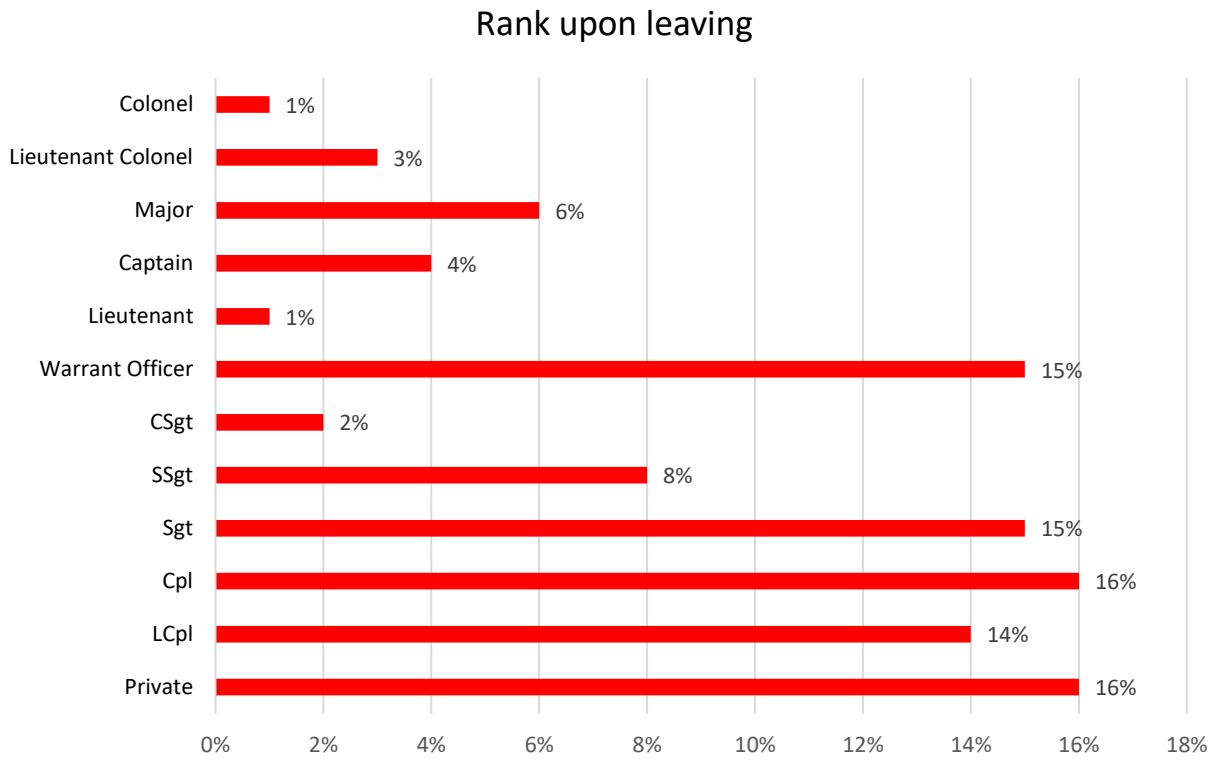


Figure 2. Rank upon leaving

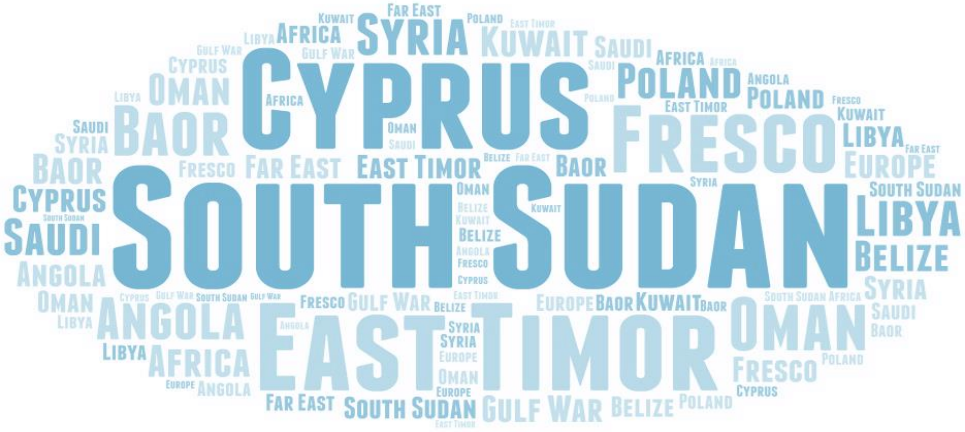
Operational Tours

Regarding operational tours (OT) and deployments, 90.1% (n=592) of veterans stated that they had completed at least one operational tour or deployment. Data were missing for nine participants. Of those who stated they had conducted an OT/deployment, the mean number of tours was 4.66 (SD 3.69, Range 1-12). There was a significant association between deployment and current hearing loss, (X^2 (2, n=476) =7.520, p=.023), meaning **those who had deployed were more likely to experience current hearing loss over those who had not deployed.** However, there was no significant association between having deployed and tinnitus, (X^2 (2, n=649)=1.638, p=.441), meaning there is no greater risk of tinnitus in those who have deployed in this study.

A logistic regression was performed to ascertain the effects of length of Service and deployment on tour on the likelihood that participants have hearing loss. The logistic regression model was statistically significant, (X^2(2)= 8.199, p<0.05). The model explained 3% (Nagelkerke R2) of the variance of hearing loss and correctly classified 84.3% of cases. **Participants who completed an OT were 1.982 times more likely to exhibit hearing loss**

than those who did not. No signification associations were found between just having deployed, regardless of time served, and hearing loss (X^2 (38, n=473) =28.00, p=.883) and tinnitus (X^2 (41, n=644) =45.35, p=.295). Therefore, **increased length of Service and deployments was associated with an increased likelihood of exhibiting hearing loss.**

Participants were asked to specify where they had been on tour and were able to select more than one location. This enabled identification of veterans who have been deployed more than once during their career. Of the 592 veterans who reported having completed an OT, 52.1% (n=343) deployed to Northern Ireland, 43.8% (n=288) to Iraq, 34% (n=224), in the Balkans, 29.6% (n=195) to Afghanistan, 21.6% (n=142) to the Falklands. There were 113 'other' responses including Sierra Leone, Cyprus, and the Gulf, these are shown in the Word Cloud 1 and labelled image 1 below.



Word Cloud 1. Overseas tours

Image 3. Overseas postings

Noise Experienced

Of the 658 responses, 90.9% (n=586) had experienced Small Calibre Weapons, 69.6% (n=449) Large Calibre Weapons, 68.3% (n=450) Rotary Aircraft, 67.4% (n=435) experienced Explosives, 51% (n=329) Electrical Generation Equipment, 47.6% (n=313) Fixed Wing Aircraft, 45.1% (n=297) Tanks, 23.1% (n=149) Aircraft Carrier and 5.1% (n=33) Submarine noise. See Figure 3.

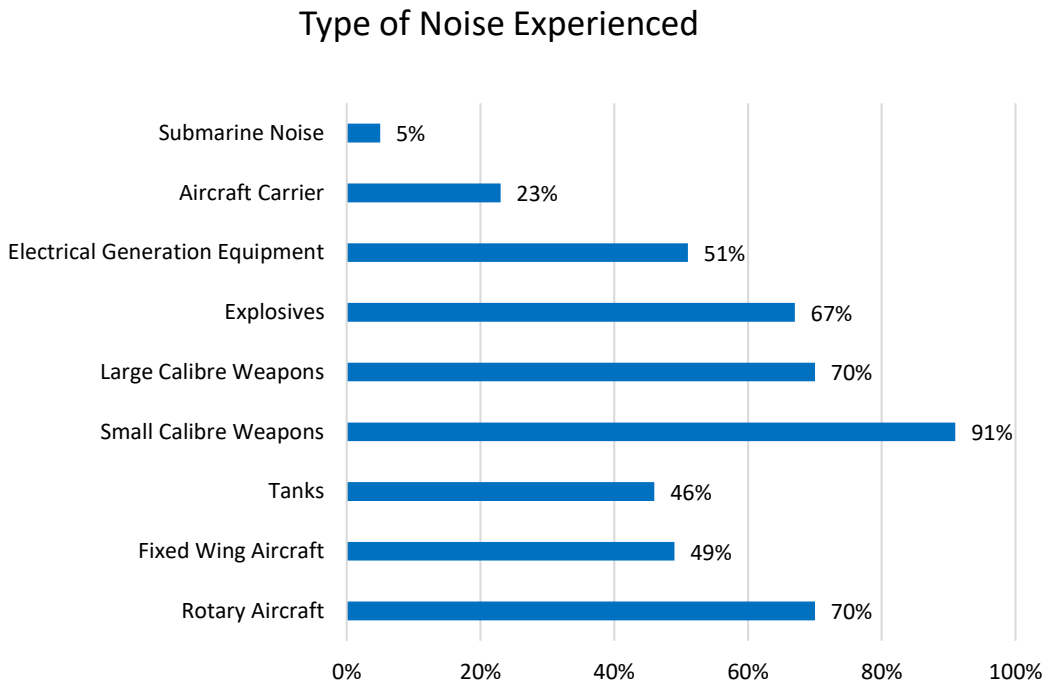
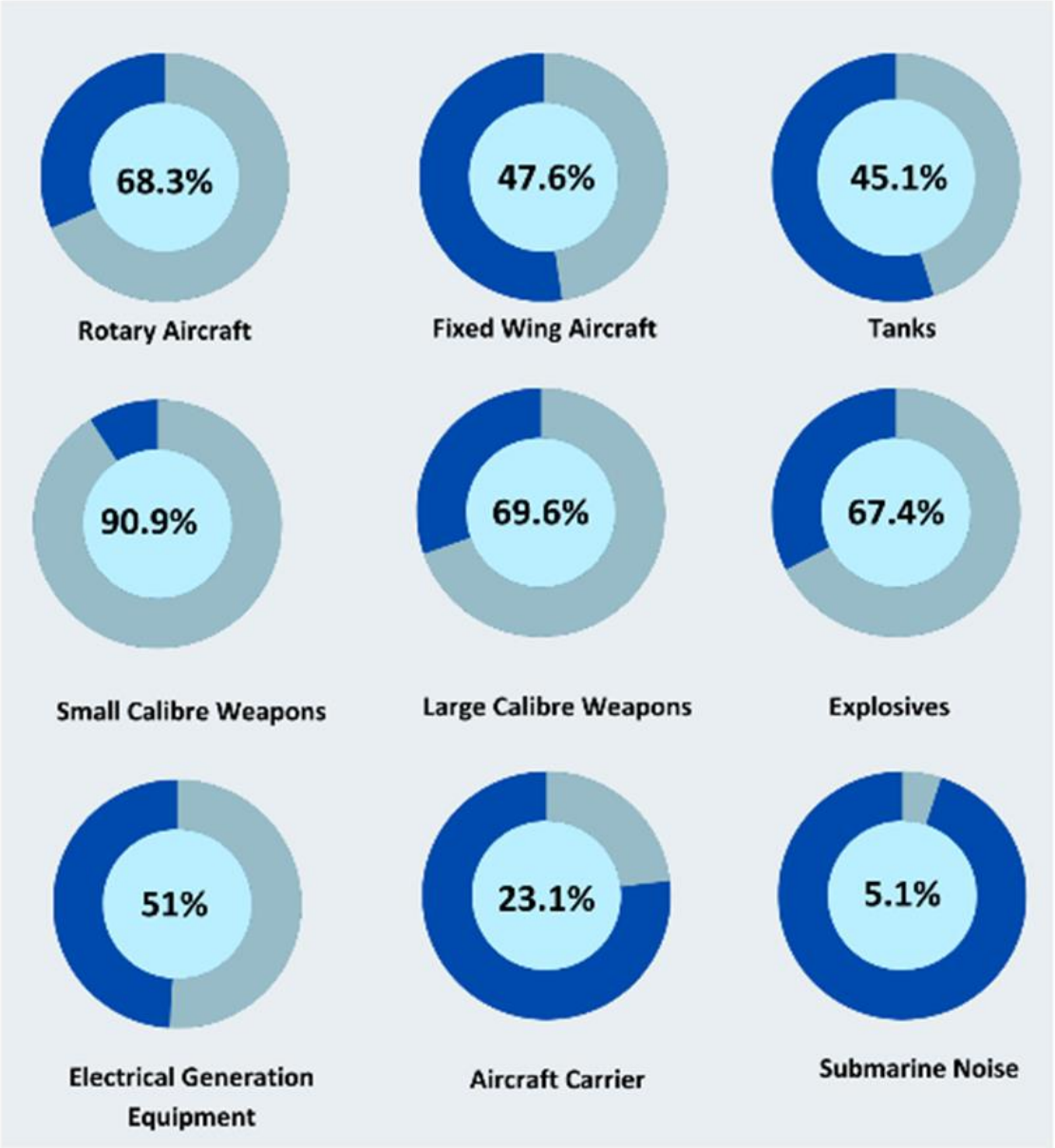


Figure 3: Type of Noise Experienced

NOISE EXPERIENCED



Taken from Quantitative Survey Data

Hearing Protection

Of the 647 veterans who answered this question, 55% (n=356) wore hearing protection some of the time, 26% (n=168) wore hearing protection most of the time, 13.8% (n=89) always wore hearing protection and 5.3% (n=34) never wore hearing protection. See Figure 4. There was no significant association between wearing of hearing protection and current hearing loss, X^2 (4, n=473)=2.010, p=.734, or tinnitus, X^2 (4, n=645)=6.739, p=.150. This means that **regardless of whether hearing protection was worn all of the time, some of the time or none of the time, this did not directly influence the development of hearing loss**. This might be a result of multiple factors: hearing protection may not have been consistently or correctly used, it may have been insufficient to mitigate high-impact military noise exposure, or other variables (e.g., cumulative exposure, individual susceptibility, or non-Service noise exposure) may play a greater role. In addition, retrospective self-reporting data introduces uncertainty around the accuracy of reported use. These findings highlight the complexity of noise-related hearing loss in military populations and suggest that prevention strategies must go beyond simply issuing protective equipment.

Respondents were asked to specify what type of hearing protection they had used; 60.8% (n=368) used both types of hearing protection described, 18.5% (n=112) used the small in ear defence, 17.9% (n=108) used large over the ear headphone style defenders, and 2.8% (n=17) used other types of hearing protection. There was no significant association between the type of hearing protection worn and hearing loss, X^2 (4, n=463)=2.010, p=.648, which would indicate that **regardless of the type of hearing protection worn, this did not influence development of hearing loss**. There was however a significant association between type of hearing protection worn and tinnitus, X^2 (4, n=632)=12.815, p=.012, with greater prevalence of tinnitus experienced by veterans who had worn both small and large types of protection, than those who just wore one type (See Figure 4).

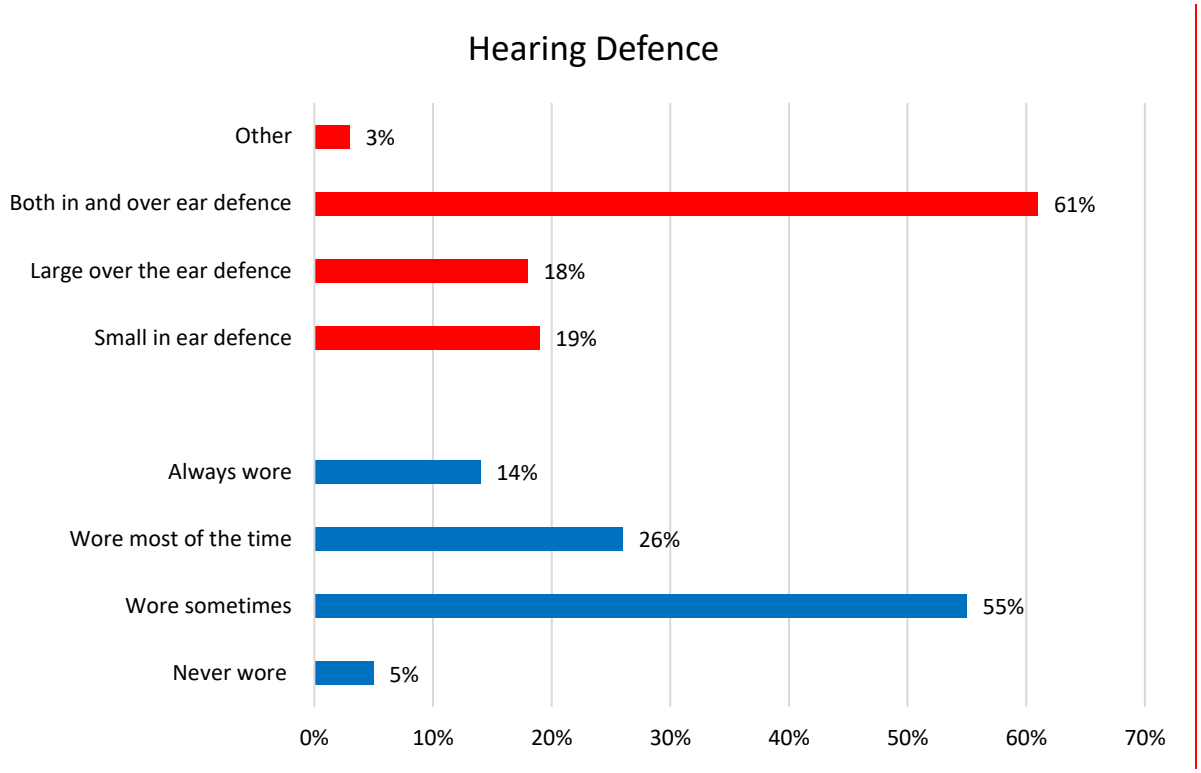


Figure 4. Hearing defence worn

Respondents were also able to specify the reason why they did not wear hearing protection, and these responses were analysed using Content Analysis (Burnard, 1991). This data was grouped into three categories: 1) Practicality, 2) Availability and 3) Personal Beliefs. The most common response was that the protection was not compatible with operational effectiveness (n=282), followed by protection not always being available (n=111). (See Table 3).

Category	Sub-Category	Frequency (n)
Practicality	Not compatible with operational effectiveness	282
	Inadequate	41
	Advised not to use (compatibility)	12
Availability	Not always available	111
	Not enforced	44
	Only worn on military firing ranges	42
Personal Beliefs	Unaware of how damaging the noise could be	9
	Appearance	2

Table 3. Content Analysis detailing reasons for not wearing hearing protection

Discharge

Of the 653 veterans who answered this question, the most common reason for leaving the Armed Forces was end of contract 29.6%, (n=193), followed by medical discharge 25% (n=163), Premature Voluntary Release 16.4% (n=107), retired 12.6% (n=82) redundancy 2.9% (n=19), temperamentally unsuitable 2.1% (n=14), and other reasons 11.3% (n=75). Of those who were medically discharged, 52.1% (n=85) were discharged with a physical problem and 12.9% (n=21) were discharged with a mental health problem, while 33.7% (n=55) were discharged with both. Data were missing for two participants.

Medical Discharge & Physical Problems

Participants who had been medically discharged were able to select from a predefined list of common health problems that led to their discharge and indicate all that applied to them and were able to choose more than one response. Of those who provided an answer, 64.7% (n=90) were musculoskeletal, 37.4% (n=52) had hearing problems and 5.8% (n=8) indicated vision problems, 34.5% (n=48) indicated other and were able to annotate the illness. Other problems included traumatic brain injury, injuries from Improvised Explosive Device (IED) blasts, high blood pressure, cognitive disorders, and Type 1 diabetes.

Of 640 responses, 30.1% (n=196) reported having experienced a head injury, 69.9% (n=444) reported no experience of head injury. Having a head injury was not significantly associated with hearing loss $X^2(2, 137)=1.364$, $p=.506$), suggesting that **even if a veteran with hearing loss has experienced a head injury, there are other factors which contributed to the hearing impairment.**

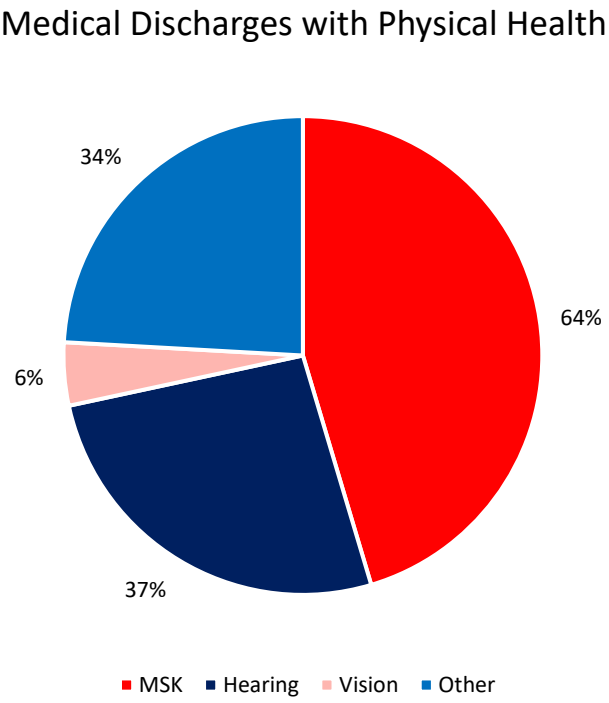


Figure 5. Medical discharges with physical health

Medical Discharge and Mental Health

From 658 respondents, there were 76 (11.6%) veterans who indicated they had been medically discharged due to mental health problems. Of the 76 veterans who reported this, 79.5% (n=66) were discharged due to PTSD, followed by depression 54.2% (n=45), anxiety 43.4% (n=36), and alcohol misuse 7.3% (n=6). (See Figure 6)

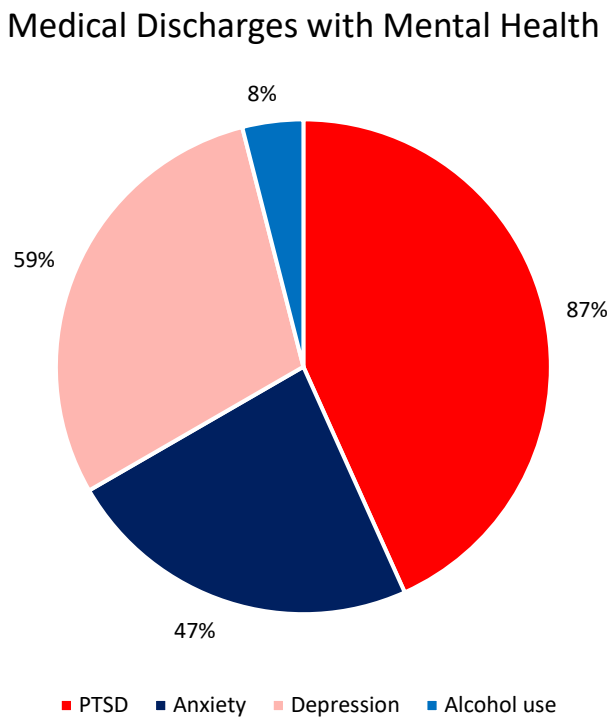


Figure 6. Medical discharges with mental health

Health and Help-Seeking Behaviour

In addition, 73.4% (n=483) of veterans stated that they have a current and long-standing physical or MH problem. Of those with long-standing problems, and where more than one response could be provided, 83.2% (n=401) reported hearing problems, while 67.4% (n=322) reported musculoskeletal problems and 11.7% (n=56) had vision problems. Of these, 51% (n=247) indicated depression, 49.1% (n=238) specified PTSD, 46.5% (n=225) with anxiety, and 18.9% (n=67) misuse alcohol.

There was a **significant association between current depression and current hearing loss** ($X^2(1,350)=4.797$, $p<.05$) by contrast the association between current depression and current tinnitus was not significant ($X^2(1,354)=.489$, $p=.489$). There was a **significant association between current anxiety and current hearing loss** ($X^2(1,349)=5.860$, $p<.05$) although the association between current anxiety and current tinnitus was not significant ($X^2(1,353)=1.144$, $p=0.285$). See Figure 7.

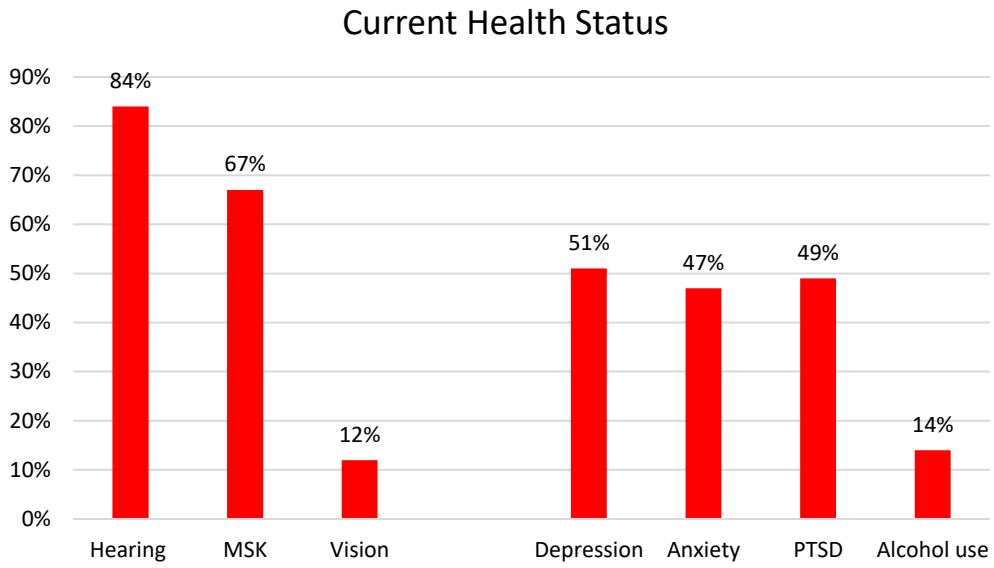


Figure 7. Current health status

Current Hearing

There were 81.8% (n=532) of veterans who self-reported tinnitus and 22.2% (n=140) had hyperacusis. Data analysis indicated no significant association between gender and current hearing loss (X^2 (3, N= 474)=5.727, p=.126), meaning **males and females who completed the survey were equally likely to experience hearing impairment**.

There was a significant association between age and current hearing loss (X^2 (4, N=477)=13.616, *p*=.009), meaning differences across age groups (18-27, 28-35, 36-47, 48-57, 58-67) were explicitly age related. However, these are significantly associated based on current hearing loss and not when veterans first presented with hearing loss. **Hearing loss was most prevalent in the 48-57 age group** (41.5%, n=273). The results reflect the ear protection and circumstances during the participants' time of Service and not necessarily the ear protection currently provided. Although despite this, **increased length of Service was associated with exhibiting hearing loss.**

Data analysis indicated no significant association between gender and tinnitus, X^2 (3, n=646)=1.032, *p*=.597. There was also no significant association between age and tinnitus, X^2 (2, n=650)=6.936, *p*=.139. These results mean that both **males and females were equally likely to experience tinnitus**, and there was no particular age bracket which was more susceptible to developing tinnitus in the survey component of this study despite hearing loss being more prevalent in the 48-57 age group.

Noticing Hearing Loss

Participants were also asked whether they thought they knew the cause of their hearing problems, 58% (n=375) felt they did but the remaining 42% (n=271) could not identify a

cause, with missing data for 12 participants. Participants were also asked to specify when they noticed problems with their hearing with 55.1% (n=360) first noticing during their active Service, 39.5% (n=258) realised after leaving Service, with 1.7% (n=11) noticing before Service and 3.6% (n=24) were unsure about when they first noticed. Data were missing for five participants.

Accessing Support

Fifty two percent (n=330) of veterans stated that they had previously accessed or were currently accessing support for their hearing problems. **Help-seeking was most prevalent in the 58-67 years age group** (59.7%, n=151). The progressive nature of hearing loss might explain why veterans in this age group are more likely to seek help, as symptoms may become more severe. Further, older individuals may be more likely to have regular engagement with PHC than younger individuals, meaning identifying hearing loss might be easier for those who have greater engagement with health services. (See Table 4).

Help-seeking by age		
Age group	**%**	**N**
18-27	100	1
28-37	37	10
38-47	38.2	34
48-57	49.4	134
58-67	59.7	151

Table 4. Help-seeking by age

Services from which Support was Accessed

Of those 330 veterans who had sought support, the most common place they sought support was NHS services at 69.1% (n=228), GPs 39.2% (n=129), private services 26.4% (n=87), RBL 17.6% (n=58), Veterans' Hubs 10% (n=33) and charities other than the RBL 4% (n=13). (See Figure 8).

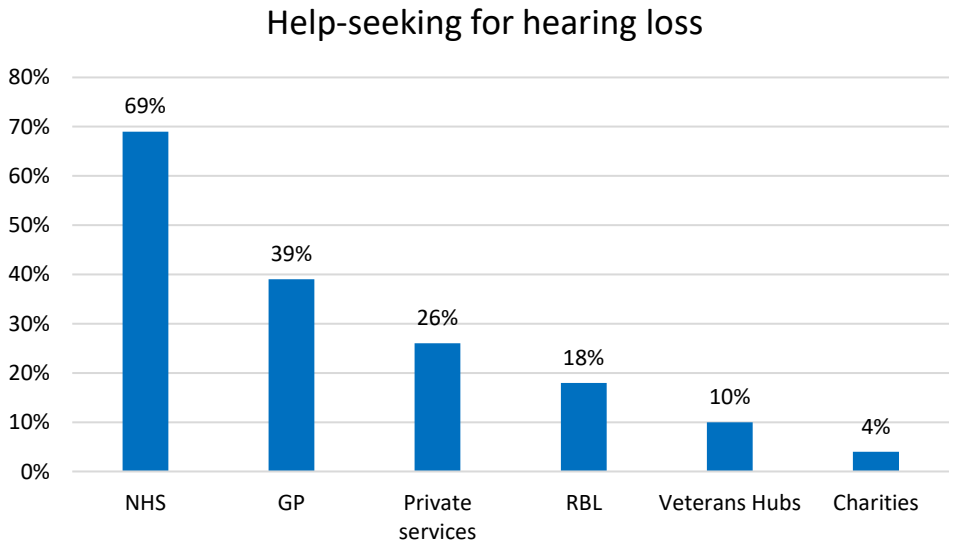


Figure 8. Help-seeking for hearing loss

After accessing support, 62.3% (n=202) had hearing aids provided, 4% (n=13) had surgery, and 25.6% (n=83) had nothing provided to them. Eleven per cent (n=37) of veterans received Tinnitus Retraining Therapy (TRT) and 3.4% (n=11) received masker therapy as distraction techniques to help 'mask' the sound of their tinnitus (Hobson, Chisholm & El Refaie, 2012; Phillips & McFerran, 2010). (See Figure 9).

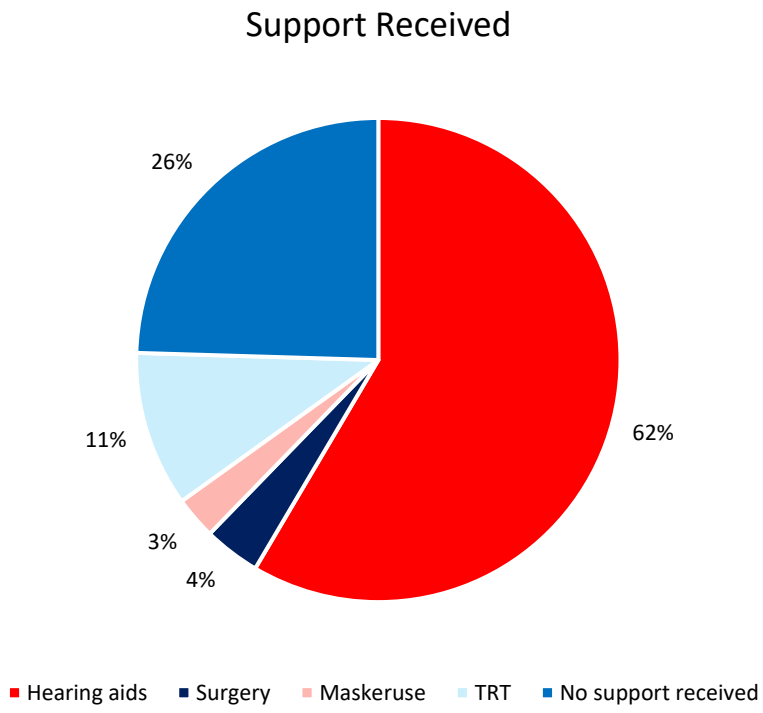


Figure 9: support received

Were participants happy with the support they received?					
Support accessed	**Yes**		**No**		**Total**
	%	**Total**	**%**	**Total**	
NHS	37	85	63	143	228
Private Services	37	32	63	55	87
GP	29	37	71	92	129

RBL	48	28	52	30	58
Veteran organisation	15	5	85	28	33
Charities other than RBL	0	0	100	13	13

Table 5. Satisfaction with support received

There were 298 participants who answered the question regarding whether they were happy with the help they received. Findings presented in Table 5 below show 39.6% (n=118) were satisfied with the support, while 60.4% (n=180) were not satisfied with the support they received.

People to Rely on

There were 58.6% (n=384) respondents who had people to rely on, a further 15.1% (n=99) who had some people to rely on and 26.3% (n=172) had no one to rely on. Missing Data were three.

Social Interaction

Participants reported how often they met with friends. Some veterans met at least three times a week (32.4%, n=187), 24% (n=139) once or twice a week, 19.9% (n=115) once or twice a month and 16.6% (n=96) every few months. There were 7.1% (n=41) who reported other.

Validated Psychometric Questionnaires

Survey respondents (N=658) also completed a number of psychometric questionnaires which were embedded within the survey. Results from these psychometric measures are shown in Table 6 below. Full measures are included in Tables 7-10.

The psychometric measures presented in Table 7 show almost half of the sample (47.7%) who completed the survey experience moderate depressive symptoms as determined by the PHQ-9. However, it cannot be determined if this is a result of their hearing impairment and/or other factors. Over half (50.8%) were also categorised as high risk for severe mental health distress. The Hearing Handicap Inventory (HHI) questionnaire (Table 9) demonstrated that most veterans (61.1%) in this study were significantly impacted by their hearing impairment and for those who experience tinnitus, they are moderately-higher impacted (25.3%). (Table 10).

Psychometric Questionnaire	Score range	Mean	Interpretation
Patient Health Questionnaire-9.	**Depression:** 1-4 Minimal; 5-9 Mild; 10-14 Moderate; 15-19 Moderately severe; 20-27 Severe.	10.54	Moderate
Warwick-Edinburgh Mental Wellbeing Scale	**Mental Health**: Scores less than or equal to 40 are associated with a higher risk of major depression.	40.54	Borderline High risk
Hearing Handicap Inventory for Adults	**Level of handicap:** 0-16 No Handicap; 18-42 Mild- Moderate Handicap; 44+ significant Handicap.	53.69	Significant handicap
TFI	**Impact of Tinnitus:** 1-25 Low; 26-50 Lower Moderate; 51-75 Higher Moderate; 76-100 High.	52.72	Higher- Moderate

Table 6. Psychometric Scores

Level of depression	Percentage	N
None-Minimal	29.9	195
Mild	22.5	147
Moderate	17.2	112
Moderately Severe	12.6	82
Severe	17.9	117
Missing	0.76	5
Total	100	658

Table 7. Patient Health Questionnaire-9.

Level of wellbeing	Percentage	N
Low wellbeing/ risk of depression	50.8	331
Average	33.8	220
High level of wellbeing	15.4	100
Missing		7
Total	100	658

Table 8. Warwick-Edinburgh Mental Wellbeing Scale

Level of Handicap	Percentage	N
None	13.6	89
Mild – Moderate	25.3	166
Significant	61.1	401
Missing		2
Total	100	658

Table 9. Hearing Handicap Inventory for Adults

Level of Tinnitus impact	Percentage	N
Low	18.1	93
Lower Moderate	25.9	133
Higher Moderate	35.5	182
High	20.5	105
Missing/Not applicable		145
Total	100	658

Table 10. Tinnitus Functional Index (TFI)

The 145 participants who did not complete the TFI were able to leave the scale blank. Whilst this scale was only populated in the survey to those participants who had indicated they experienced symptoms of tinnitus, it is not known whether the scale was left blank due to not wanting to complete the scale, or because they did not experience tinnitus symptoms. The survey data showed 81.8% (n=532) of participants did report tinnitus, and 18.2% (n=118) did not experience tinnitus, so it could therefore be assumed that of these missing responses, most are due to not experiencing tinnitus.

Interviews

Interview participants were recruited via the online survey whereby survey participants were offered the opportunity to participate in a 1:1 interview. There were 67% (n=440) of survey participants who indicated that they would be willing to be interviewed. Interviews were conducted on a 'first come, first serve' basis. Following informed consent, interviews were conducted via Microsoft Teams or Zoom, recorded using the built-in functions and transcribed verbatim. Participants' demographic information was captured during the interview and summarised in Table 11.

		N
Gender	Male	28
	Female	6
Age	$\bar{x}$	53
	Range	35-65
Region	England	29
	Scotland	3
	Wales	2
	Northern Ireland	0
Ethnicity	White British	34
Religion	None	10
	Christian	21
	Other	3
Sexual Orientation	Heterosexual	31
	LGBTQ	3
Service Length	$\bar{x}$	20
	Range	8-36
Deployed	Yes	29
	No	5
Branch	Army	15
	RAF	12
	Royal Navy/ Royal Marines	6
	Missing	1
Rank (including rank equivalents)	Private	1
	LCpl	1
	Cpl	6
	Sgt	5
	SSgt	5
	Warrant Officer	6
	Captain	4
	Major	4
	Lt Colonel	1
	Missing	1

Table 11: Participant Demographics

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INTERVIEW DEMOGRAPHICS

82.4%	Male
53	Average age (years)
91.2%	Heterosexual
100%	White British
61.8%	Christian
20	Average length of service (years)
17.6%	Rank of Corporal or Warrant Officer or equivalent
85.3%	Experienced at least one operational tour/deployment

Thirty-four interviews were completed with a mean length of 45 minutes (Range 17–120 minutes). Interview Data were analysed using a modified Grounded Theory approach (Charmaz, 2014; Finnegan, 2014; Glaser & Strauss, 1967). Table 12 below shows the analytic framework identified within the qualitative analysis of the interview data. Following the table is an interpretative summary of each category, including quotes from the participants which aid in supporting discussion of the data.

Category	Sub-Category
Cause of hearing impairment	Type of noise experienced Impact of the loud noise experienced Noticing changes in hearing/ length of time suffering
Experiences of the impact of hearing impairment	Coping Impact on support network Sleep issues Current hearing state Compensation
Hearing Protection	Type of protection Reasons not to wear hearing protection
Accessing support	Support from the military Barriers to accessing hearing support Outcomes of accessing hearing support

Table 12. Interview analysis framework

Cause of Hearing Impairment

Type of Noise Experienced

Interviews provided further depth to the survey data whereby it became clear that excessive noise was extremely common for those Serving in the Armed Forces. This was accentuated on operational tours when loud and/or intrusive noise was the norm, with most interview participants citing combat deployment and warfare machinery as reasons for their hearing impairment. These included direct military contact and/or operational training incidents

including the associated noise from rocket propelled grenades, heavy machine guns and sustained missile attacks. Participants were able to state specific experiences during which they were exposed to sudden loud noise and how this affected them at that moment in time.

Interviews explored the balance between the inevitable exposure to noise within the military, and the difficulties this level of noise posed to those needing to conduct their role efficiently.

"There were times when guys were fighting in buildings and stuff, you would take an ammo status from guys on GPMG [General Purpose Machine Gun] and had to write it down cos you just couldn't hear, and that's just how it was. Right back then in 2002, you didn't have what we have now. It was rudimentary." B

In line with research findings, participants expressed frustration that this exposure to noise affected their ability to do their job (Yong & Wang, 2015). Other participants reaffirmed the survey findings by citing sustained noise from military vehicles including aircrafts, ships and tanks. The type of noise exposure was linked to the roles people did and the branch of Armed Forces they served in. Other common issues included family homes on military barracks being situated close to airfields and roles in which people regularly wore headsets and radios with lengthy exposure to white noise. Participants recalled being aware of noise levels at the time but were also acutely aware that their role within the military meant that noise exposure was an operational/occupational requirement.

Impact of the Loud Noises Experienced

For those who were exposed to sudden loud noises, initial impact included shock, ringing in the ears, headaches, high pitched buzzing and physical pain. Other participants described fluid leaking from their ears, a sensation of feeling like being punched in the head and other physical sensations.

"As we were walking down, a guy came out and fired his small machine gun and it felt like someone stabbed me in the ear with a fork. Did a roundabout pin and stabbed it right in and it's always been that way ever since." EE

Noticing Changes in Hearing

Participants acknowledged that it was the role of the military to monitor hearing as part of routine audiometric health surveillance (British Army, 2010). This pure-tone audiometry detects damage in the auditory system, with the results providing the principal measure for quantifying hearing loss.

Analysis of the interview data suggests that for those veterans who were exposed to sudden loud noise, such as during deployment, their hearing loss was identified during annual military audiometry testing and therefore detected in the early stages. It was when participants were notified of their hearing loss during routine annual military audiometry testing that they began to pay more attention to their hearing. Some were referred to Ear,

Nose and Throat (ENT) clinics, although some felt that they did not receive the support they required.

The greater attention to hearing loss post audiometry testing may be explained by concerns about impact on their careers, with prior research highlighting the impact health concerns may have on help-seeking (Finnegan et al., 2014; Williamson et al., 2019). When a medical condition affects Serving Personnel, their ability to perform their duties is assessed. They could also be downgraded, meaning they may be deemed medically unfit to do their job and/or deploy on operational tours. If they are unable to perform their duties and alternative employment within the Armed Forces is unavailable, personnel might be medically discharged (MOD, 2024). This perception that hearing loss might result in medical discharge resulted in a cultural narrative wherein Serving Personnel viewed the MOD as unsupportive,

"The RAF were very reluctant to actually go any further with a diagnosis or anything. The main focus was to get me discharged." L

Other participants described how changes in hearing function went unnoticed for a number of years and how subtle these changes were.

"I didn't notice anything because it had been a series of events and a sort of gradual decline. It wasn't until I took a hearing test that it was like, right I'm more aware of it now if that makes sense. I just didn't really notice it before then. But the minute you're made aware of it, you're like oh, now it makes sense, and the value of hearing is now looking back." B

These changes included those exposed to low level noise and/or persistent noise such as RAF veterans who were regularly exposed to aircraft noise during their Service. Their hearing loss was deemed to have declined at a slower and more gradual rate than for those who experienced sudden loud noises, and in terms of hearing loss detection, this was often only noticed by the veterans themselves when they struggled to hear during day-to-day life.

In 2023/24, 4% (n=53) of Serving Army personnel were medically discharged for severe hearing loss and/or tinnitus, 2% (n=8) from the Royal Navy/Royal Marines and there were no hearing related medical discharges during this period from the RAF (MOD, 2024). However, for many veterans who were interviewed in this study, their hearing difficulties emerged when they had left the Armed Forces. This is supported by survey data which indicated 39% of veterans noticed their hearing loss post Service.

Experiences of the Impact of Hearing Impairment

Communication

The impact of hearing loss was profound, with participants describing their struggles to hear during conversations which had a huge impact on their ability to communicate overall. Communication is an essential part of daily life and maintains relationships (Braithwaite & Schrodt, 2022). Prior research has concluded that auditory deprivation can detract from

quality of life and access to spoken communication, which can impede spoken language (Nordvik et al., 2018). This can contribute to the risk of dementia and cognitive decline in older ages (Myrstad et al., 2023) as hearing loss requires areas of the brain that interpret sounds and speech to work harder to understand what sounds are (Griffiths et al., 2020). This additional effort may lead to changes in the brain that affects our memory and thinking abilities. People with hearing loss also have greater difficulty understanding speech both receptively and expressively and this can have a negative impact on an individual, including reduced self-esteem and confidence (Kaland & Salavatore, 2002). This was a finding discussed by participants in this study.

"I would say the main thing about my hearing loss is I get a little anxious about work. For quite a few years before I even left the Army, I would dread speaking to people on the phone because I always felt like, what, what? I would have to say, 'can you repeat that?" and it was just really awkward, so that gives me anxiety if I've got to make a call, or in a meeting if there's any background noise, I feel like I have to lip read people and that gives me anxiety." K

Coping and Quality of Life

Participants felt they missed out on activities because of their hearing loss.

"There are things I miss out on so much, I miss out on lots of things. I remember being out on a walk with colleagues and they were like, oh can you hear that woodpecker, and I said oh I can't hear it, and that was with hearing aids. That saddens me massively because that's part of the joy of, of being in that world… you're always missing out and that's the hardest bit for me." C

Prior evidence has revealed that individuals with hearing loss may attempt to control social situations in order to avoid bringing attention to their hearing impairment (Podury et al., 2023). That was apparent in this study whereby some participants talked about withdrawing from social situations because of their hearing, sometimes feeling like it was 'pointless' taking part in activities they once used to do. The psychological effects of hearing loss are well documented, and the impact of the physical difficulties associated with hearing loss have been linked to feelings of depression, anxiety and loneliness (Niazi, Ejaz & Muazzam, 2020; Timmer et al., 2024).

"Hearing as you know is a sensory impairment as a physical injury and a loss is annoying, it made me constantly tired, constantly angry and constantly miserable. Constantly grumpy at the kids, constantly grumpy at her and it was just a self-perpetuating cycle of just being miserable basically and not wanting to be here." B

For veterans with tinnitus, they described how this hearing impairment created a barrier to communication with friends, family, work colleagues and health professionals. Prior evidence has revealed how key aspects of cognition, participation, getting along, and life activities are related to tinnitus severity and hearing difficulties (Burns-O'Connell, 2019). However, as hearing impairment is generally associated with the older population, much of the research explores older veterans' experiences of hearing impairment. For instance,

symptoms were worse in veterans over the age of 68 than the general population, particularly so in measures of intrusiveness and the effect of tinnitus on listening ability (Burns-O'Connell et al., 2019). Participants who were interviewed spoke of how tinnitus affects their life.

"I don't really sing or do music anymore. Especially singing because I don't feel I can accurately hear myself anymore because I've got this constant noise over the top." K

Participants also felt generally unsupported by others when experiencing hearing loss. This may impact on their mood in withdrawal from social situations and isolation (Arlinger, 2003; Gopinath et al 2012; Kramer 2002; Monzani et al., 2008), leading to anger and frustration due to embarrassment or self-criticism (Shukla et al., 2020).

Participants discussed the progressive decline of their hearing impairment and for those with tinnitus, likened it to being able to hear a washing machine, helicopter or a 'sea.'

"Like a sea rushing through my hearing." L

Sleep Issues

Whilst not all participants experienced sleep difficulties, for those participants with tinnitus, many reported exacerbated night-time difficulties as daytime sounds quietened. Some described severe sleeping difficulties including being unable to fall asleep at night because of the constant noise, and/or their sleep being disturbed.

"I would have to stay awake until I was so tired that I would fall asleep so I couldn't hear it and then I'd be gone, if I went to bed to try to sleep and it was quiet where there's no ambient noise, it's just dark and there's nothing, it was just going and going and going. My wife would be upstairs in bed, and I'd be on the sofa asleep." B

Managing tinnitus and its impact on sleep often involves a combination of strategies, including sound therapy, behavioural therapies, and sometimes medication (NHS, 2025). Some participants had been prescribed medication to enable a healthy sleep pattern. These findings were consistent with prior evidence which reveals a higher risk of sleep disorders, including insomnia, in people with tinnitus (Awad et al., 2024). However, **for veterans with tinnitus, support was perceived to be poor and veterans struggled to manage the daily challenges associated with it.**

Compensation

Veterans with hearing impairment are able to claim compensation under the Armed Forces Compensation Scheme (MOD, 2024). Compensation awards are given for hearing loss, blast injury to the ears, acoustic trauma and tinnitus if associated with other hearing difficulties. Tinnitus alone cannot be awarded compensation (MOD, 2024).

"They don't recognise tinnitus within the compensation scheme, nor do they recognise hyperacusis or auditory processing disorders as conditions." Q

However, the level of compensation awarded is dependent on the level of hearing loss experienced (MOD, 2024). Claims for compensation were a key feature of the interview discussions with participants describing the lengthy battles they faced with the MOD whilst highlighting how difficult it can be to prove to the MOD that hearing loss was Service related.

"They do everything they can to clock your complaint, and very few people seem to be successful." H

Participants described the MOD compensation system as challenging, suggesting the MOD required proof of hearing impairment annotated on medical records from the time they served. However, as hearing impairment can develop after an individual has served, participants felt it was difficult to prove that their time in Service had contributed to the current hearing impairment. Some veterans described having to wait for long periods of time, sometimes five years, to be awarded compensation which resulted in participants becoming angry and frustrated. Others were unhappy with the amount of compensation received, believing the payment from the MOD to be inadequate whilst some of the participants had used legal services to claim for compensation.

"If you don't have it written down on your medical records when you leave the Army, that's it. So again, it's another thing for the soldiers to try and understand isn't it, you've got to have this written down, I didn't but I had to fight and fight and fight and fight." G

A Freedom of Information request to the MOD published on 21 February 2024 shows that between 6 April 2005 and 30 September 2023, there were 3118 accepted claims for hearing related compensation to the MOD, and 203 of these claims were rejected. Compensation awards for hearing loss range from £4,850 to £72,000 (MOD, 2024b).

In 2024, the British Broadcasting Corporation reported that after many years of opposing these claims for compensation, the MOD have accepted exposure to noise may be a cause of hearing loss meaning those discharged after 1987 may now be eligible to claim for compensation (Symonds, 2024).

Hearing Protection

Type of Protection

Interview participants felt that all types of hearing protection were insufficient or ineffective or not worn often enough. Internationally, evidence highlights an association between hearing loss and lack of hearing protection with Kim et al., (2020) reporting that a sample which occasionally wears earplugs was 1.48 times more likely to have a hearing loss than the sample which always uses earplugs. The group which never uses earplugs was 1.53 times more likely to have a hearing loss than the group which always uses earplugs. In this study, this was not the case, with no difference between hearing loss rates across those who did or did not report wearing hearing protection as identified in the survey data. What must be considered, however, is the combat experiences of the samples across different research

studies and how much noise those samples have been exposed to during their time in Service.

Interview participants confirmed that hearing protection was always offered in the military and throughout the years, the types of hearing protection have changed. The commonly issued small plugs which fitted inside the ear were the subject of criticism.

"Little foam yellow plugs, they were about as much use as a chocolate fireguard. So you just kinda cracked on. Basically, there was nothing much more you could do than that." B

Whilst others were issued large sets of hearing defence which fitted around the ear, such as the 'amplivox' which was provided for situations during which greater noise would be expected were also perceived to be inadequate.

"If you have ever been in a chinook, no matter what amplivox you put on, it's very, very noisy. So yeah, you carried those all cause you had your webbing on that time and there was space to put your webbing on, so you pull your amplivox out, but if they fell out and you didn't have time to put them back out, you'd put your little yellow ones in, which either way is no good to man or beast." R

Those who served in a role which involved regular flying activity said hearing protection was always worn as it was built into the helmets. Those who served in the 1970s described hearing protection becoming mandatory during their Service, and improving as the years went by, yet were perceived as being poor in comparison to the US Armed Forces hearing protection. Some who served in the 1980s reported using cloths as hearing protection.

"We didn't have hearing defence back then, if we got ear defence it was the flannel we used to clean our rifle with to pull through to clean the barrel, we used to roll that up and put it on our lugs." Y

Most of the interview participants also described covering their ears with their hands as additional protection because they knew that regardless of the protection they were wearing, the noise was still too loud. However, it is important to understand that many of the views were related to historical hearing protection. Acknowledging the need for advancements in hearing protection technology, in 2022 and in line with the US, the MOD partnered with INVISIO; a range of tactical communication and hearing protection devices for use in extreme environments, to deliver a new dual hearing system aimed at protecting Serving Personnel serving in loud and critical environments (Defense Advancement, 2024).

Reasons Not to Wear Hearing Protection

Prior research exploring attitudes of UK Armed Forces personnel towards hearing protection demonstrated an awareness of how their role within the military could affect their hearing. Factors such as impracticality, communication and comfort prevented proper use of this hearing protection (Okpala, 2007). These findings align with the research survey respondents who cited that the most common reason for not wearing hearing protection

was that the ear defenders were not compatible with operational effectiveness and the best form of protection was not always available. For example, whilst conducting military training on weapons ranges, although hearing protection was mandated, there were times when hearing protection had to be removed and at this stage, they could be directly exposed to severely loud noise.

"We got radios on range days, they weren't issued to us personally, but on range days, the range master would shout orders at you but you couldn't hear them through the ear defenders so you just had to take them off." L

For those deployed in combat roles, wearing hearing defence was sometimes considered a hindrance.

"Amplivox hearing defence, it doesn't work when you use it with a pro headset under a helmet in 50 degrees heat, so you can appreciate it's not the best thing in the world." B

There were times when participants had to remove this defence in order to remain operationally engaged, and at times, this meant in life-or-death situations.

"If you're fighting in a built-up area, or on open ground, being commanded by people above me and they're barking orders, it's a sensory overload and your perception is bang everywhere, so you're heightened in what you're doing and don't wanna get caught out, you don't wanna step on something. So yeah, I would rather be able to hear my command and do my job effectively than shove something in my ears or over my ears that's gonna take that sense away, 'cos you need everything firing." B

"So there's this conflict between protecting your ear defence, your hearing versus not hearing something because of it and potentially killing a colleague because you didn't hear." H

Participants also illustrated an awareness of a need to make a momentary decision about whether hearing or protecting their colleagues was more important. There were also instances where participants' senior commanders requested, they remove their protection.

"You're being ordered to take them out. Literally instructors screaming at you to take your hearing defence out because you can't hear what you're being told to do." H

However, there were also times where participants described seeing their peers without hearing protection. This in turn led others do the same and this behaviour became normalised, suggesting a need to review the education for Serving personnel in understanding the importance of wearing hearing protection within the military.

Accessing Support

Support from the Military

The UK Armed Forces are a predominantly young population with MOD (2024) data reporting an average age of 31 in the UK Regular forces (37 in Officers, 30 in non-commissioned ranks). The interview data suggested hearing impairment and its long-term implications may not be taken seriously early on in their careers. Hearing loss is common in the older population (Ray, Dening & Crosbie, 2019), and this may explain why the younger generation may not fully appreciate the progressive decline in hearing after constant exposure to noise.

However, accessing support for those with tinnitus was considered extremely challenging. Participants reported not understanding the severity of the issue and thought nobody would be able to help, so decided not to access support. There were also elements of comparison across the data whereby participants felt hearing impairment was not a severe condition when compared to other physical conditions.

"We didn't go sick about it because people were being killed and seriously wounded, and in comparison, your hearing issues were trivial." H

Some Serving personnel received hearing aids through in Service referrals to ENT specialists, and there were incidents of receiving surgery for their hearing problems. Of those veterans who had received support after leaving Service, they were able to hear again, and should they require future support with their hearing aids, they knew exactly where they could get that support.

Some tinnitus sufferers were provided with a specialised pillow which could play music, so the tinnitus sounds were dulled down, whilst other tinnitus sufferers had to take medication to help them sleep. Indeed, studies investigating the delivery of tinnitus services have demonstrated considerable patient dissatisfaction and a marked disconnect between the aims of healthcare providers and those of tinnitus patients (McFerran et al., 2019). This was also identified within this study.

"Oh you've got tinnitus, oh it's just a bit of tinnitus, you'll have to live with that so I'm a bit sceptical and I don't really think anything will help." K

Barriers to Accessing Support

Some participants felt there was limited support available and perceived that there are no adjustments that are effective. UK research indicates that veterans have mixed views on social support for tinnitus and many did not want to discuss with others and/or did not want to burden their family (Burns-O'Connell et al., 2019), despite families having a positive influence on the help-seeking behaviour of the individual experiencing hearing loss (Manchaiah et al., 2013). However, some participants described how their partners offered an ultimatum for support seeking.

"It was a 'go and get your ears tested or I'm leaving you' type thing. It was a reality check if I'm honest." J

Another issue raised by participants was the associated cost of accessing treatment or obtaining hearing aids.

"I haven't had my hearing tested lately because I don't think I can have hearing aids. I'd want to but don't think I can. I'd love to go get hearing aids, they'll be too expensive though and I can't afford that so for now, I'll just speak up, that's what I do." T

Other participants felt that it was sometimes easier not to seek help due to feeling embarrassed. Stigmatised beliefs have previously been associated with hearing loss due to altered self-perception (Wallhagen, 2010), and participants felt that as an 'invisible illness', hearing loss was very challenging to live with.

QUOTES

Living with hearing loss

‘I just smile and politely nod and just pretend that I had heard what they’d said.’

‘You get to the point where you’re just saying yes, yes, and you don’t have a clue what they’re saying, you’re just trying to be polite.’

‘I often feel like I really eyeball people when talking to them because I’m like, looking at them. I don’t think I can lip read but this is obviously something there.’

‘I would dread speaking to people on the phone.’

‘I just can’t hear and that saddens me massively because that’s part of the joy of, of being in that world.’

‘Scared of ending up looking like an idiot.’

‘Society as a whole, not just the military, are very bad at seeing disabilities. If you can’t see it, then it’s not a problem.’

QUOTES

Living with tinnitus

‘I just find it upsetting that I’ll never hear or experience peace or quiet.’

‘It constantly sounds like there’s a washing machine on or a helicopter above my head.’

‘It's there, it's constant. There's nothing that dampens the noise.’

‘I live with white noise, like a sea rushing through my head.’

Focus Groups

Two focus groups were conducted. Focus group one was made up of six participants who had completed the interview and survey components of the research project. For focus group two, there were seven participants who were ERG members. Overall, both groups provided a broad representation of veterans across the UK with participants from England, Scotland and Northern Ireland, the ERG did not have a Welsh member, nor did any Welsh interview participants come forward to participate in the focus groups. Therefore, there was no representation from Wales for the focus groups. Analysis of focus group data revealed three key themes: Hearing Protection, Support, Compensation. These are presented in Table 13.

Category	Sub-category
Hearing Protection	Type of hearing protection Developments in hearing protection over time
Support	Inadequate NHS support Tinnitus debilitating
Compensation	Difficult to prove to MOD hearing loss is Service-related MOD need to understand hearing loss is progressive and can manifest post-discharge

Table 13. Focus group analytic framework

Focus group participants were presented with the findings from the interview and survey components of the study and asked whether they agreed with the findings, or disagreed, and whether they had anything further to add. Participants broadly agreed with the interview findings and survey results and spoke about the importance of understanding that these experiences were largely historic, and that hearing protection had developed over time. Some suggested that this was due to the MOD needing to take more accountability for their perceived role in hearing impairment. These issues were focused upon a perceived lack of support from the MOD during the time they served, for not providing suitable hearing protection and the challenges which persist during claims for compensation.

"And I think nowadays, and this is society, not just in the MOD, there's more accountability. And I think maybe that's why it's taken more seriously."
PPT 5

However, there was also much discussion around the causes of hearing impairment with some participants describing a multitude of factors contributing towards hearing impairment.

"So, for instance, I had headphones on, but they were playing white noise or most key or whatever, but clearly there's no chance to get your ears protected. For me, yes, I wore headphones, but they were playing crappy noise through it. I couldn't really point to one thing and say that's what caused my hearing loss, but the patchwork of it has definitely.

You know, I would say probably hearing the white noise is probably the major contributor, but I've been around when Thunder flashes have gone round off next to me and small arms, you know, so it's all those things together, isn't it?"
PPT 1

Others agreed that support from health services had been less than ideal, particularly for those with tinnitus.

"So, I feel for everybody because I think the tinnitus, especially when you have them in both ears is debilitating and it does cause issues through the day and headaches too."
PPT 6

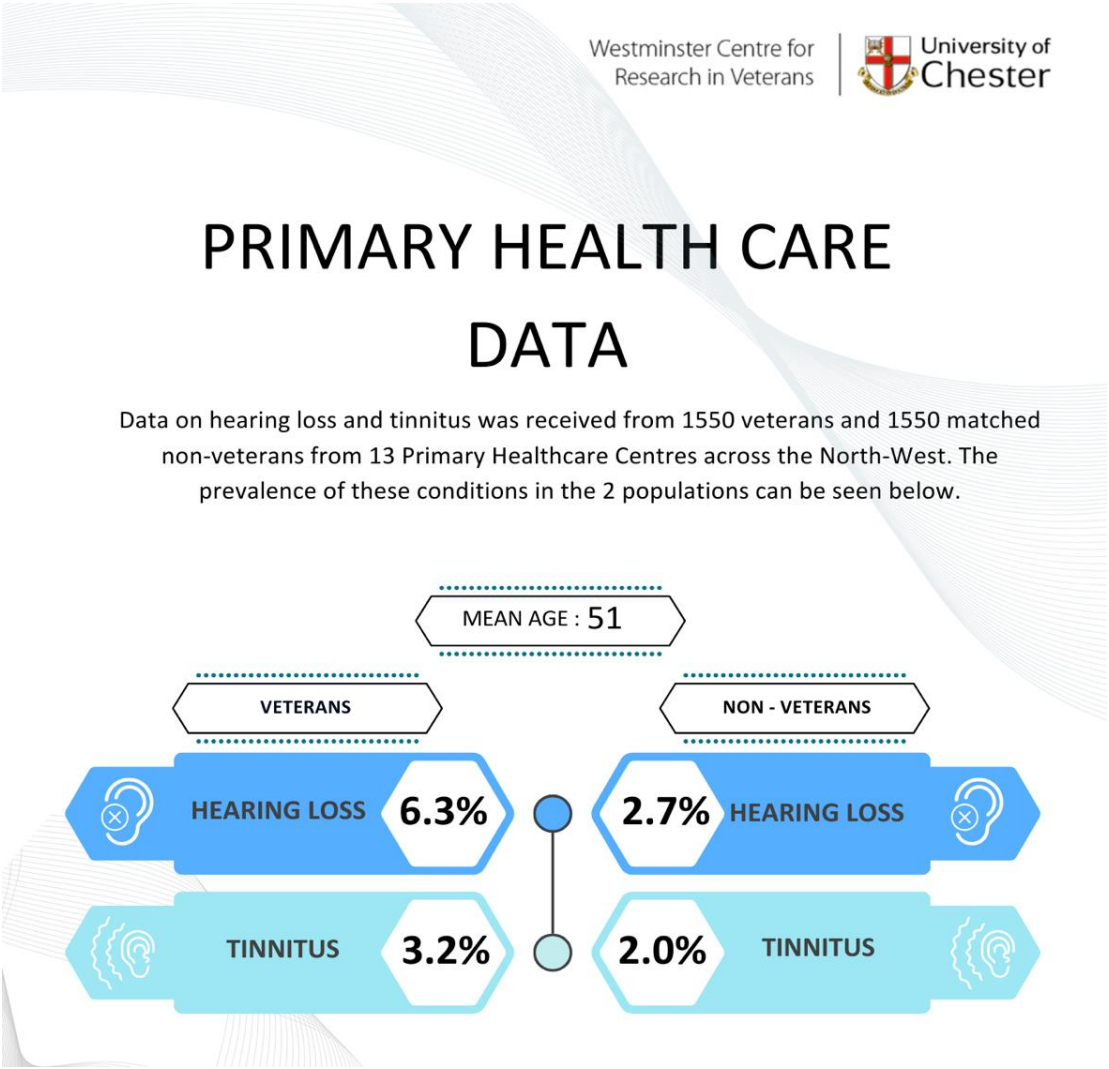
Although similar to interview and survey participants, those who had been fitted with hearing aids felt this had a positive impact on their quality of life. For those who had experience of applying for MOD compensation, they reaffirmed negative and challenging experiences. They described lengthy 'battles' to acquire compensation and whilst most participants were awarded compensation, they were unhappy with the amount awarded.

Image 4. Causes of participant hearing loss

Comparison of PHC Hearing Loss Data across a Veteran and Non-Veteran Sample

The Centre received data on a demographically matched veteran and non-veteran sample (N=3100) within the 18-67 working age range. This includes 1550 veterans and 1550 non-veterans. This matched sample permitted comparison of demographics and morbidity across the two groups. Table 14 below shows the number of veterans information transmitted within each dataset. Detail from the Census 2021 indicated that the veteran population in North-West England was 3.8%. However, regionalised figures were utilised to make direct comparisons across regions within the North-West. These regional figures were then used to estimate the number of veteran patients expected within each collaborating PHC practice, where correct coding ranged from 22% to 27%. This is presented in Table 15.

The results from the PHC data indicate that veterans were twice as likely to experience hearing loss than their demographically age and gender matched civilian counterparts. The average age across the matched data sets was 51 (Range 18-67). **The rate of hearing loss was higher in all categories from age 28 onwards. The rate of tinnitus was higher in veterans than non-veterans across all age bands**. Although the numbers were small, hearing loss was more prevalent in female veterans at 6.7% compared to 6.2% of male veterans. In non-veterans, 6.2% of females have hearing loss compared to 2.2% of males. There were 3.6% of female veterans who have tinnitus compared to 3.1% of male veterans.



Region	Medical Centre	Current List	Veterans	%	Census Veterans by Region (%)	% of expected
Chester					**4.5**	
Chester	City Walls	15745	251	1.59	709	35%
Chester	Heath Lane	7573	72	.97	341	21%
Chester	Park	10200	89	.87	459	19%
Chester	Lache	7374	64	.87	332	19%
	Total	**40,892**	**476**	**1.16**	**1,841**	**26%**
Warrington					**4**	
Warrington	Helsby	9789	138	1.41	392	35%
Warrington	Culcheth	12366	94	1.06	495	19%
Warrington	Fearnhead	13808	199	.76	552	38%
Warrington	Penketh	13069	98	.75	523	19%
	Total	**49,032**	**529**	**1.07**	**1,962**	**27%**
Wirral					**5.1**	
Wirral	Orchard	6150	120	1.96	314	38%
Wirral	Eastham	11404	110	.96	582	19%
Wirral	The Village	8613	71	.82	439	16%
	Total	**26,167**	**301**	**1.15**	**1335**	**23%**
Poulton					**5.1**	
Poulton	Queensway	9255	85	.92	472	18%
Fleetwood	Mountview	12064	159	1.32	615	26%
	Total	**21,319**	**244**	**1.14**	**1087**	**22%**

Table 14. PHC Partners and veteran population compared to some regions within North-West England ONS Data

Of 1550 veterans there were 6.3% (n=97) recorded as having hearing loss compared with 2.7% (n=42) non-veterans. Of 3.2% (n=49) of veterans recorded with tinnitus compared to 2% (n=31) non-veterans. (See Table 15).

	Hearing loss		Tinnitus	
	%	**N**	**%**	**N**
Veteran	6.3%	97	3.2%	49
Non-veteran	2.7%	42	2.0%	31

Table 15. Hearing loss across veteran and non-veteran sample

Veterans in this sample are 2.33 times more likely to have diagnosed hearing loss than non-veterans in this sample. This difference was found to be statistically significant (X^2 (1, n=3100)=22.784, p<.05). Veterans in this sample were also 1.6 times more likely to have tinnitus than non-veterans in this sample. This difference was also found to be statistically significant (X^2 (1, n=3100)=4.157, p<.05).

Hearing Loss by Age

Table 16 shows hearing loss in veterans and non-veterans stratified by age categories. The average age across the matched data sets was 51 (Range 18-67; SD 11.37). The rate of hearing loss is higher in all categories from age 28 onwards. There is a significant association between different age groups and hearing loss in the non-veteran sample (X^2 (1, n=1550)=78.512, p<.05) but this difference was not significant in the veteran sample (X^2 (1, n=1550)=31.52, p=.975).

	18-27	28-37	38-47	48-57	58-67
Veteran (n)	0	9	15	29	34
Non-veteran (n)	2	3	6	11	17

Table 16. Hearing loss by age

Tinnitus by Age

Tinnitus is higher in veterans than non-veterans in this sample across all age bands. Differences between age groups and tinnitus in the non-veteran sample (X^2 (1, n=1550)=40.498, p=.801) and veteran samples were not significant (X^2 (1, n=1550)=39.46, p=.833). See Table 17.

	18-27	28-37	38-47	48-57	58-67
Veteran (n)	2	3	6	15	23
Non-veteran (n)	1	2	3	10	15

Table 17. Tinnitus by age

	Male		Female	
	%	N	%	N
Veteran	6.2%.	82	6.7%	15
Non-veteran	2.2%	29	6.2%	13

Table 18. Hearing loss by gender

Hearing Loss by Gender

There were 6.7% of female veterans in this sample with hearing loss compared to 6.2% of male veterans. In the non-veteran sample, 6.2% of females have hearing loss compared to 2.2% of males. A significant difference was observed between gender and hearing loss in the non-veteran sample (X^2 (1, n=1550)=11.164, p<.05) but this difference was not significant across the veteran sample (X^2 (1, n=1550)=.097, p=.755) (See Table 18).

Tinnitus by Gender

Table 19 shows tinnitus in veterans and non-veterans stratified by gender. 3.6% of female veterans have tinnitus compared to 3.1% of male veterans in this sample. Amongst non-veterans 1.9% of females have tinnitus compared to 2.0% of male non-veterans in this sample. There were no significant differences between gender and tinnitus across the non-veteran (X^2 (1, n=1550)=.011, p=.916) and veteran (X^2 (1, n=1550)=.155, p=.694) samples.

	Male		Female	
	%	N	%	N
Veteran	3.1%	41	3.6%	8
Non-veteran	2.0%	27	1.9%	4

Table 19. Tinnitus by gender

Hearing Loss by Ethnicity

All veterans (n=97) and non-veterans (n=41) with hearing loss in this sample identify as White British. All veterans (n=49) and non-veterans (n=29) with tinnitus in this sample were White British.

Discussion

This report presents findings from the first large scale independent research study into hearing loss with working aged (18 to 67 years old) UK Armed Forces veterans. This 18-month research study was designed to improve insight into awareness around the impact of Serving in the UK Armed Forces where constant exposure to noise is an occupational hazard. To achieve this, information was gathered through multiple sources including the first comparison study of veterans and non-veterans using PHC data. The study was welcomed by the veteran community who were very keen to engage, and whilst study survey target was to obtain 200 questionnaires there were 658 completed, along with 34 in-depth interviews. Data were collected between June 2023 and June 2024.

Survey Data

Survey responses were predominantly comprised of male veterans (89%), and average length of Service was 18 years. Most had served in the Regular Armed Forces, and most had served with the Army. Demographically, these characteristics align with MOD (2024) data which reports males make up approximately 88.3% of the Armed Forces, although there was a slight underrepresentation of females in comparison to the 13.6% female veterans identified in the Census of 2021 (ONS, 2023a). Therefore, this survey was representative of gender across the military population. The mean age of the survey participants was 54 years (range 27-67). The UK Armed Forces veteran population differs substantially to non-veterans in relation to gender and age distributions, with ONS (2022) data reporting veterans in England and Wales as predominantly male (86%) and older; with 34.8% over the age of 80 in comparison with over 80's in non-veterans (5.2%)**.**

The majority of survey participants identified as heterosexual (93%) with members of the Lesbian, Gay, Bisexual, Transgender and Queer (LGBTQ+) community representing 3%. These are figures similar to those presented by the ONS (2022) wherein 91% of veterans in England and Wales identified as heterosexual and 1.4% identified as gay, lesbian or bisexual. The survey participants were mostly White British at 99%; higher than the Census 2021 (ONS, 2023a), where the proportion of those in the England and Wales Census 2021 who served in the UK Armed Forces are white at 96%. The reason for this difference was unclear.

The majority of respondents had served in the Regular Armed Forces (91%), 5% in the Reserves and 4% served in both Regular and Reserves, and over half (56%) of served in the Army. The average length of Service was 18 years. However, this is a longer than average Service length. MOD (2021) states individuals serve on average for 10 years; officers for 18 years, other ranks for 9 years. However, a more recent FOI request made by RBL to the MOD has revealed that male officers serve for longer than female officers, 20 years and 15 years respectively, whilst non-commissioned male and female Service personnel serve on average for 10 years (MOD, 2024). Whilst in this study, only 15% of survey participants were officers, 40% of participants held senior ranks which means they are likely to have served for longer, explaining the longer than average Service length in this study.

The most common rank upon leaving the Armed Forces was a Private soldier and 90% of survey respondents had completed an OT, with data analysis indicating that veterans who

had completed an OT were 1.982 times more likely to experience hearing impairment than veterans who had not completed an OT. This provides further support to prior evidence which has reported higher levels of hearing loss in veterans who have deployed than those who have not deployed (Brown, 2010; Theodoroff et al., 2015).

Survey data also revealed that whilst 60.8% of participants had worn hearing protection at some point during their time in Service, participants felt that the hearing protection provided was not compatible with operational effectiveness and lacked practicability; an issue reported previously (Fink et al., 2019). Over half (55%) of veterans who completed the survey noticed their hearing impairment during their Service although 39.7% noticed after they had left the Armed Forces. Noticing these changes after leaving the Armed Forces provides further evidence to support the argument that veterans find it difficult to 'prove' their hearing impairment was caused during their time in Service.

Over half of survey respondents (52%) were currently, or had previously, sought help for their hearing impairment, mostly from NHS services. However, 69% of these participants were dissatisfied with the support they had received.

Prior evidence shows that help-seeking for hearing loss is associated with perceived benefits of hearing aids and to provide better support for hearing impairment with the RBL having received a £2M grant to administer the Veterans Hearing Fund on behalf of His Majesty's Treasury in 2015. During that time the RBL issued 2,400 grants ensuring that those whose hearing loss was acquired during their Service were able to receive hearing devices, peripherals and therapies that were not available through the NHS at that time (RBL, 2015). Whilst hearing aids were indeed perceived as having a positive impact on the lives of veterans in this study, those with tinnitus experienced greater challenges in terms of receiving support.

Further, the anonymous nature of the survey increases the likelihood that questions were answered truthfully without fear of any form of sanction or reduced potential for compensation. Nevertheless, this data reveals novel results about attitudes towards health service provision for hearing impairment and demonstrates a need to improve the services available for veterans with hearing impairment.

Interview Data

Thirty-four interviews provided insight into the experiences of veterans living with Service-related hearing impairment, highlighting how veterans cope with hearing impairment, how their sleep is affected and how their entitlement to claim MOD compensation is challenging to prove. Interview participants described the hearing protection offered to them during Service and explained why it was not always used. The main reasons included the need to remain operationally alert, poor fit, and the inability to hear commands – particularly in high-risk, life-or-death situation

Qualitative interviews also explored health service provision for hearing impairment and attitudes towards help-seeking for hearing loss and/or tinnitus. Similar to the survey data, interview participants generally reported reduced quality of life as a result of hearing

impairment and its associated challenges whilst for those with tinnitus, their challenges were exacerbated by the lack of understanding surrounding this condition. Whilst prior evidence has reported the reduced quality of life and health comorbidities in veterans living with tinnitus (e.g., Crönlein et al., 2016; Maes et al., 2013; McCormack et al., 2014; Stockdale et al., 2017), this study adds qualitative depth by highlighting how veterans personally describe the emotional, cognitive, and social impact of these symptoms which has revealed the need to improve health service provision for veterans living with tinnitus.

Focus Group Data

With representation from England, Scotland and Northern Ireland, the focus groups offered an opportunity to validate the study results and ensure the interpretation of the data was an accurate representation of veteran's experiences of hearing impairment. Focus group discussion acknowledged that the experiences of participants in this study reflect a certain point in time and that as time progressed, so did hearing protection. As a result, these perspectives may not fully reflect the experiences of currently Serving personnel or recent Service leavers. Nevertheless, focus group participants felt frustrated with the type of protection provided and with the support services available, describing them as inadequate.

Primary Healthcare Data

Thirteen PHC practices located within the North-West of England provided a demographically matched (on age and gender) sample of veterans and non-veterans (N=3100) whose medical records had been annotated with a hearing impairment. This permitted comparison of hearing impairment across veterans and non-veterans which could provide an indication of whether veterans have greater hearing needs than non-veterans. Hearing loss and tinnitus were both higher in female veterans than male veterans. The data indicated that hearing loss and tinnitus were higher in veterans than non-veterans. This difference was apparent across all age groups. Research previously conducted by The Ear Foundation (2014) also found that veterans under the age of 75 were 3.5 times more likely to experience hearing difficulties than their counterparts in the UK civilian population of the same age.

Development of the Grounded Theory Model

The Grounded Theory Model presented in Figure 10 conceptualises the processes involved in understanding Service-related hearing impairment. Data from the four research components presented in this study (i.e., survey, interviews, focus groups, PHC data) provided a comprehensive understanding of hearing impairment in working age UK Armed Forces veterans. Each of these components were compared and contrasted through a process of triangulation, which allowed the identification of patterns and themes to be identified across the datasets (Carter et al., 2014). Each of the studies validated and reinforced the other, enhancing the validity and credibility of the results. The triangulated data from the different sources was amalgamated to form a theoretical model (Figure 10) which demonstrates the key processes associated with Service-related hearing impairment.

These processes include the identified causes of hearing impairment, factors related to noticing changes in hearing, the wider impact hearing impairment might have upon veterans and how they access support for their hearing impairment. The model also presents the suggested recommendations which have been informed by this research.

Grounded Theory Model

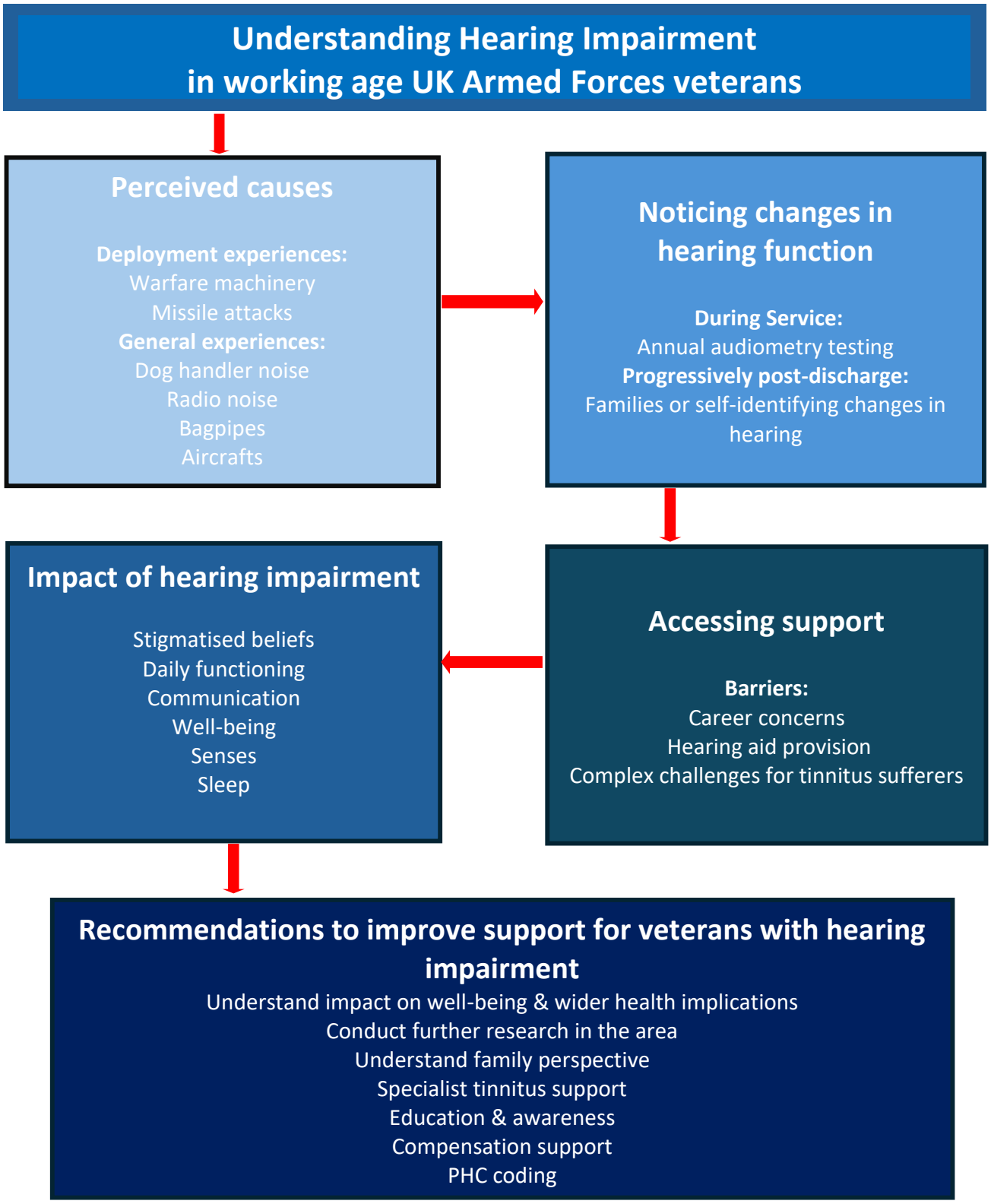


Figure 10. Grounded Theory Model illustrating the impact of Service-related hearing impairment in veterans

Strengths and Limitations

The mixed-methods approach to this research ensured stronger inference of data interpretation, whilst data triangulation served to strengthen and validate the overall results. However, as with all research, there are limitations which must be acknowledged.

The classification of a UK "veteran" requires an individual to have served for only one day, therefore the results presented in this study may include those unlikely to be affected by military Service. The majority of respondents (95%) had served in the Regular Armed Forces and only 5% were Reservists which would however suggest that these findings may likely represent the experiences of Regular Serving Personnel better than Reservists.

In recent years, hearing protection for Service personnel has improved. However, participants in this research served and left the Armed Forces at different times, meaning some may not have experienced these developments. As a result, reported experiences of protection and exposure may reflect earlier standards rather than current provision. Villavisanis et al., (2020) identified gender differences in hearing loss in individuals but the number of female respondents in this study (9%) was low, and future research should fully appreciate any veteran gender differences. Whilst recruitment for this study did aim to be gender inclusive, reasons for low numbers of female participants are unknown.

Further, the study exclusion criteria excluded most of the veteran population as 53% are aged 65 years old or over. Given hearing loss is a degenerative issue, the older generations may be more likely to experience more severe hearing loss which subsequently is more negatively impactful on their lives.

Demographically, the sample was largely White British which means the findings of this study are not representative of the whole veteran population, therefore caution must be applied if applying these findings to non-White British veterans.

Moreover, the sample also had a longer than average Service length; veterans who serve for longer periods may experience greater exposure to noise which may increase the risk of hearing impairment. Therefore, these findings may not be representative of veterans who had served for shorter periods of time and potentially had less exposure to excessive noise when compared to those who have served for longer periods.

Further, as a self-selecting sample, the veterans who participated may have more severe needs in relation to hearing impairment and this should be considered when applying these findings to the veteran population. Additionally, the study did not capture the wider impact of hearing impairment on the participants' family and did not directly collect data from family members.

The survey provides only a snapshot of veteran's views regarding occupational and employment status and their self-declaration on health. Whilst inferential statistical results are provided, the study is limited by a lack of robust matched sample principles. Further, when drawing comparisons between the survey data presented in this study to data

collected by other organisations, differences in questions and response options must also be considered.

In the PHC comparison study, multiple SNOMED-CT codes that are available for the same clinical morbidity impacts on consistency of reporting, and Defence Medical Services (DMS) patient records are not always added to PHC records. Hearing assessments may be accessed from high street organisations such as Specsavers and if a hearing impairment is identified, then that information may not be recorded on the person's PHC medical record. This means that people may have hearing impairment without it being recorded or may have more complex difficulties and conditions than are recorded. Further analysis of PHC data to explore different types of hearing impairment, could help understand more about this limitation and opportunities to address it.

While this study worked with PHCs that have higher than average recording of veteran status, it is still the case that some veterans may not be recorded as such in their medical records, since they will need to have been asked, and/or to self-identify as a veteran. It is possible that those with medical concerns that are, or which they believe to be, related to their Service may be more likely to consider their veteran status relevant to share with their GP or other healthcare services. Further work to increase the completeness and accuracy of reporting of veteran status in medical records is needed, to ensure future analysis of PHC data is as representative of all veterans (who use GP services) as possible.

The comparison study was in North-West England which included variance across social scales of deprivation but cannot be definitively applied to veterans in all parts of the UK, where there may be wider differences in socio-economic conditions, demographic profiles, and access to services and support. The numbers included in the comparison study were relatively small, particularly for females with tinnitus and therefore these results should be interpreted with caution. Further work to explore larger-scale datasets of medical data will be valuable, to provide additional evidence of increased prevalence of hearing impairment among veterans compared to non-veterans – or otherwise.

The study psychometrics provide a snapshot of certain factors but lacked a longitudinal element. Longitudinal studies would be of benefit to this research area in providing understanding of the progression of hearing impairment.

Conclusions and Recommendations

The aim of this research was to understand and determine the impact of hearing impairment on working age UK Armed Forces veterans as a direct result of Service or acquired whilst in Service, and to use this information to establish whether their support needs were being met by current provision. It was clear throughout this study that noise is a significant occupational hazard within the Armed Forces, especially on operational tours. The recommendations in this report were developed from the research findings and further refined through consultation with both sector stakeholders and individuals with lived experience. A roundtable with key stakeholders from across the sector was held in June 2025 to gather feedback on the draft report and discuss practical approaches for putting the recommendations into practice.

A separate session with RBL's Lived Experience Panel took place in August 2025, ensuring that the views and priorities of those closely connected to these issues were fully reflected.[4] Bringing together these different perspectives has helped to ensure that the recommendations are robust, realistic, and grounded in the realities of the Armed Forces community's experiences and priorities.

The recommendations from this research have been grouped under three overarching themes: **Inform, Support, and Minimise**, to reflect their focus on improving awareness and access to information, strengthening the availability and quality of services, and reducing future risk of hearing impairment among Serving personnel and veterans. These recommendations are intended to complement the significant work already undertaken across health services, the voluntary sector and government to improve support for hearing impairment and the Armed Forces community. RBL will use these insights to continue championing further improvements ensuring this momentum is sustained and strengthened.

In these recommendations, the term hearing impairment refers to both hearing loss and tinnitus, unless stated otherwise.

Inform

Recommendation 1: The Ministry of Defence must strengthen guidance issued to all Service personnel, and their families, transitioning out of the Armed Forces. Guidance must provide clear and consistent information regarding support for hearing impairment regardless of how long after transition this condition may present, or their reasons for leaving Service. This should include clear and practical information about the circumstances under which compensation is available, and how to pursue this. Information and communication methods must be appropriate for, and accessible to, Serving personnel, veterans and their families, and informed by those with experience of Service-attributable hearing impairment.

[4] The Royal British Legion's pilot Lived Experience Panel is a diverse group of individuals from across the Armed Forces community, including Serving personnel, veterans and family members, who draw on their personal experiences to inform, shape and co-produce RBL's research, policy and service design.

It ought to be provided in multiple formats and accessible to personnel after they have left Service.

Recommendation 2: Statutory and charity services providing support for the Armed Forces community affected by Service-attributable hearing impairment and/or tinnitus should undergo robust systematic monitoring and evaluation. This will ensure that services are evidence-based, and experiences of those accessing support are captured, to continually improve tailored hearing impairment services.

Recommendation 3: This project has identified research priorities which could broaden understanding and inform more tailored support for specific groups within the Armed Forces community in relation to hearing impairment and tinnitus. Further research is recommended to examine additional health conditions and population needs, including:

- Needs and effective support for veterans aged 65 and older
- Effective support for veterans with tinnitus
- Needs and experiences of female veterans
- Employment experiences and outcomes among veterans with hearing impairment
- Needs and effective support for families of those with hearing impairment
- Differences in barriers to help-seeking across different demographic groups, additional needs, e.g. mental health, other disabilities; and testing approaches to increasing help-seeking

Support

Recommendation 4: The Ministry of Defence and Veterans UK must do more to understand and address barriers veterans experience to accessing appropriate and timely compensation for Service-attributable hearing impairment, including exploring whether the impact and progressive nature of hearing impairment is adequately recognised within compensation policies, tariffs, and frameworks for assessing eligibility.

Recommendation 5: NICE (England & Wales), SIGN (Scotland), and Department of Health Northern Ireland (DoH NI) must produce an evidence-based review on the most effective treatments and support for veterans experiencing Service-attributable hearing impairment and/or tinnitus. This must be informed by large-scale trials and further high-quality research that enables full cost-benefit analysis and identification of the most effective interventions for addressing these conditions and related impacts, including wellbeing and mental health.

Recommendation 6: The Ministry of Defence must reinstate dedicated funding for veterans' hearing support, financed by HM Treasury. The Veterans Hearing Fund should function to provide hearing aids and related support for needs not met through statutory services and mitigate potential disadvantage owing to the unique experiences of military Service.

Recommendation 7: The NHS across all UK nations must implement regularly updated training modules, and supplementary guidance, on Service-attributable hearing impairment. Training must reflect the unique experience of the Armed Forces community and address the wider impact that hearing impairment can have on wellbeing. This must be delivered

within professional development frameworks, such as the Veteran Friendly GP Practice programme and Devolved equivalents, as well as being embedded in staff guidance and accessible patient information materials.

Minimise

Recommendation 8: The Ministry of Defence must implement standard timelines for reviewing policies in relation to hearing protection and impairment. These policies must reflect the implications of hearing impairment, as well as lived experience through co-production with affected Serving and ex-Serving personnel and families. This could include exploring ways to ensure that hearing tests during Service are as accurate as possible, and that barriers to help-seeking are minimised where possible.

Recommendation 9: NICE (England & Wales), SIGN (Scotland), and Department of Health Northern Ireland (DoH NI) must recommend, and the NHS must ensure that audiology assessments are embedded as a routine element of treatment and care pathways for veterans experiencing Traumatic Brain Injury(s) (TBI) and any mental health conditions. This would facilitate early intervention and treatment to minimise the impact of Service-attributable hearing loss.

Recommendation 10: The NHS must strengthen clinical coding guidelines to ensure the regular and accurate recording of specific hearing impairments (including tinnitus), and veteran status, across primary healthcare practices. This coding must be applied by practices, with support from external providers, to facilitate the timely transfer of relevant medical information, to inform appropriate and coordinated support pathways.

Ethics

The Hearing Impairment study received ethical approval from the Faculty of Health. Medicine and Society, University of Chester Health and Social Care Research Ethics Committee on the 30th of March 2023 (RESC0223-1151 Staff Project). No further amendments were required

Support

If someone you know is a member of the Armed Forces Community and needs support, contact the RBL contact centre, open 8am to 8pm, 7 days a week, on 0808 802 8080 for practical help and guidance.

You can also find out more about the services and support we provide at: Royal British Legion | Armed Forces Charity including expert guidance on military hearing loss claims.

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Glossary	
Armed Forces Community	People who have served in the Armed Forces, their families, and others associated with the Armed Forces.
Captain	The rank of Captain is typically held for five to ten years. Normally made second-in-command of a company (or squadron) of up to 120 soldiers.
Civilian	A person not in the Armed Forces.
Colonel	The lowest rank in the general staff. They typically serve as staff officers and senior advisers to senior officers.
Colour Sergeant (CSgt)	This is a senior role in a sub-unit, and is responsible for training, equipment, training and discipline. They often serve in technical or command roles.
Corporal (Cpl)	Corporals command sections of around eight to ten people. Often, they are responsible for large pieces of equipment. In this rank, additional trade and instructor qualifications can be gained, for example as a recruit section commander.
Decibel (dB)	A unit used to measure the intensity of a sound or the power level of an electrical signal by comparing it with a given level on a logarithmic scale.
Defence Medical Services (DMS)	DMS is a group of military medical healthcare services that cares for armed forces personnel, ensuring that they are fit to fight and can fight back to fitness.
Deployment	The movement of troops or equipment to a place or position for military action.
Ear, Nose and Throat (ENT)	ENT, also known as otolaryngology, is a medical specialty that diagnoses, evaluates, and manages diseases and disorders of the head and neck, primarily focusing on the ears, nose, throat, and related structures.
Expert Reference Group (ERG)	An ERG consists of a group of individuals with specialized knowledge and experience in a particular field, who provide advice and insights to inform decision-making and guide actions within a project.
General Practitioner (GP)	A doctor based in the community who treats patients with minor or chronic illnesses and refers those with serious conditions to a hospital.
General Purpose Machine Gun (GPMG)	A belt-fed general-purpose machine gun which can be used as a light weapon and in a sustained fire (SF) role.
Hearing Handicap Inventory (HHI)	A self-assessment questionnaire used to measure the perceived effects of hearing impairment on an individual's emotional and social well-being, with variations for elderly (HHIE) and adult (HHIA) populations.
Hearing Impairment	A (degree of) reduced function in an individual's ability to hear.
Hearing Loss	Loss of all or part of one's ability to hear, due to a congenital condition of because of ageing, injury, medical condition later in life etc.
His Majesty (HM)	A formal title used to address or refer to a king or ruler, signifying their supreme power and authority.

Hyperacusis	A condition that causes people to be overly sensitive to everyday sounds.
Improvised Explosive Device (IED)	A type of unconventional explosive weapon that can take any form and be activated in a variety of ways.
Joint Information Services Committee (JISC)	A UK-based not-for-profit organization that supports tertiary education and research through technology innovation and digital services.
Lance Corporal (LCpl)	A Lance Corporal commands and administers a team of around four people. They are often responsible for large weapons. In this rank, they will have opportunities to specialise and undertake specialist military training.
LGBTQ+	An acronym to describe Lesbian, Gay, Bisexual, Transgender, Queer or Questioning, plus more.
Lieutenant	The rank of Lieutenant is typically held for two to three years. They normally command a platoon or troop of around 30 soldiers, with increased responsibilities from being a Second Lieutenant.
Lieutenant Colonel	Lieutenant Colonels typically command battalions or regiments of up to 650 soldiers. In this role they are known as the Commanding Officer.
Major	Typically, a Major will command a sub-unit typically around 120 officers and soldiers. They are responsible for their training, welfare, and administration both in barracks and on operations, as well as the management of their equipment.
Masker Therapy	Masker or sound therapy aims to provide relief by using external sounds to mask or distract from the internal sounds of tinnitus.
Mental Health (MH)	A state of mental well-being that enables people to cope with the stresses of life, realise their abilities, learn well and work well, and contribute to their community. It has intrinsic and instrumental value and is integral to our well-being.
Ministry of Defence (MOD)	A government department responsible for matters of national defence, including the country's military forces and related agencies.
Musculoskeletal (MSK)	MSK conditions affect many people and can affect your joints, bones and muscles and sometimes associated tissues such as your nerves.
National Health Service (NHS)	A publicly funded healthcare system in the United Kingdom, providing healthcare to all legal residents, with most services free at the point of use.
National Health Service England (NHSE)	The publicly funded healthcare system in England.
National Institute for Health and Care Excellence (NICE)	An executive non-departmental public body of the Department of Health and Social Care.

National Service	A standardised form of peacetime conscription.
Noise Induced Hearing Loss (NIHL)	A type of hearing impairment caused by exposure to loud noises, leading to damage to the delicate structures within the inner ear, particularly the hair cells, which can be permanent.
Office for National Statistics (ONS)	The UK's largest independent producer of official statistics and the recognised national statistical institute, responsible for collecting, analysing, and disseminating data on the UK's economy, society, and population.
Operational Tours	A period of time when members of the armed forces are deployed to a hostile environment, or to carry out combat operations.
Participant Information Sheet (PIS)	A document that provides potential research participants with clear, concise, and easily understandable information about a study, enabling them to make an informed decision about whether to participate.
Post-Traumatic Stress Disorder (PTSD)	A mental health condition that can develop after experiencing or witnessing a traumatic event, leading to persistent symptoms like flashbacks, nightmares, and avoidance of triggers, significantly impacting daily life.
Prefer Not to Say (PNTS)	A response option that allows respondents to decline answering a question, particularly when it involves sensitive or personal information, while still completing the survey.
Premature Voluntary Release (PVR)	PVR has been approved or have given their notice to terminate their Service in the Armed Forces.
Primary Healthcare (PHC)	A whole-of-society approach to health that focuses on people's needs as early as possible along the spectrum from health promotion and disease prevention to recovery, rehabilitation, and palliative care, and as close as possible to individuals' daily environment.
Principle Investigator (PI)	The lead researcher responsible for the intellectual leadership and overall management of a research project, including ensuring compliance with regulations and ethical guidelines.
Private	On completion of their basic training, all new soldiers start as Privates although the title may be Trooper, Gunner, Signaller, Sapper, Guardsman, Rifleman or even Kingsman depending on the corps or regiment in which they are Serving.
Quick Response (QR)	QR codes are two-dimensional codes that you can scan with a smartphone. The code contains information, and once you scan it, the code connects you with a resource on the web.
Royal Air Force (RAF)	The air and space force of the United Kingdom, British Overseas Territories and Crown Dependencies.
Regular	A full-time role in the British Armed Forces.
Reserve	Part of the British Armed Forces that may be called to duty during national emergencies.
Ripple Effects	The continuous and spreading results of an event or action.

Royal British Legion (RBL)	A British charity that provides support to Serving and ex-Serving personnel of the British Armed Forces and their families.
Sensorineural Hearing Loss	Of, relating to, or belonging to the sensory part of the nervous system. Designating a form of hearing impairment resulting in damage to the cochlea, auditory nerve, or other neural structure involving hearing.
Sergeant (Sgt)	A Sergeant is typically the second in command of a troop or platoon of around 30 soldiers. In this role they are responsible for administration and tactics. Their most important role is advising and assisting their platoon or troop commander, who is a junior officer.
Service Personnel	People Serving in the Armed Forces.
Staff Sergeant (SStg)	In the infantry this rank is known as Colour Sergeant. This is a senior role in a sub-unit, and is responsible for training, equipment, training and discipline. They often serve in technical or command roles.
Standard Deviation (SD)	A measure of how spread out or dispersed a set of data is.
Statistical Package for the Social Sciences (SPSS)	A suite of software programs that analyses scientific data related to the social sciences.
Systematized Nomenclature of Medicine- Clinical Terms (SNOMED-CT)	A structured clinical vocabulary for use in an electronic health record.
Tinnitus Functional Index (TFI)	A 25-item self-report questionnaire that doctors and audiologists may use to assess the severity of tinnitus and the extent to which it affects daily functioning.
Tinnitus Retraining Therapy (TRT)	Tinnitus retraining therapy is a form of habituation therapy designed to help people who experience tinnitus.
Traumatic Brain Injury (TBI)	A brain injury that is caused by an outside force.
Triangulation	Data triangulation is a research method used to enhance the credibility and validity of research findings by cross-verifying information from multiple sources or using multiple methods.
UK	United Kingdom.
US	United States.
Veteran	An ex-member of the Armed Forces.

Warrant Officer	Warrant Officer Class One (WO1) is the most senior soldier rank in the British Army. A Regimental Sergeant Major, who is a WO1, is the senior advisor to the Commanding Officer. They are responsible for leadership, discipline and welfare in their regiment or battalion. Warrant Officer Class Two (WO2), are often referred to as Sergeant Major, this is a senior management role focussing on the training, welfare and discipline of a company, squadron, or battery, a 'sub-unit' of around 120 soldiers.

Appendices

Appendix A

Westminster Centre for Research in Veterans | University of Chester

ROYAL BRITISH LEGION

Research looking for working age veterans with hearing problems

If you are a veteran aged 16-67 with a hearing n problem, including tini tus, then we invite you to complete our survey.

The aim of this survey is to understand the impact of hearing impairment on British Armed Forces veterans acquired whilst in service, and establish whether your support needs are being met by the current accessible services offered.

Hearing your experiences will help us to show the real world impact of hearing impairments and whether veteran's needs are being appropriately met and discover what may be done to improve services.

Follow this link or scan the QR code to participate:

https://chester.onlinesurveys.ac.uk/rbl-hearing-survey

Or email WCVeterans@chester.ac.uk with any qnestio s or to request a paper version.

Recruitment Poster

Appendix B

Brigadier (Rtd) Professor Robin Simpson OSt, RCGP Veterans Champion

Professor Nirmal Kumar, Consultant ENT Director of Medical Education and Research lead Northwest ENT and President of ENT UK

Professor Andy Bacon, Former Assistant Head AF NHSE & former Infantry and Staff Officer

Professor Steven Jones, Professor of Mental Health & Director of International Health, UoC

Dr Shehan Hettiaratchy, Lead Surgeon & Major Trauma Director Imperial College Healthcare NHS Trust, Chair of NHSE CRG

Andy Simpson, Former Research Manager Royal British Legion

Professor Hilary Meredith - Beckham, CEO of Hilary Meredith Solicitors Ltd. Chairman RBL Solicitors Group

Professor Beverly Bergman, Scotland, Occupational Health Civilian Consultant to the British Army

Dr Neil Kitchiner, Director & Consultant Clinical Lead Veterans NHS Wales

Mark Ewing, Northern Ireland, Veterans' Adviceline for Statutory Professionals NI Veterans Office

Carl Marsh, Place Director Warrington, ICB Cheshire & Merseyside, former RAMC

Professor Lt Col Bev Sapre, Consultant Psychiatrist, Cheshire and Wirral Partnership NHS Trust

Appendix C

Distributed to:	1st Contact Date:	2nd Contact Date
ERG (Appendix A)	08/08/23	07/11/23
RBL social media	08/08/23	07/11/23
COBSEO	09/08/23	07/11/23
Centrica Armed Forces Network	09/08/23	07/11/23
FiMT	10/08/23	07/11/23
ENT UK	10/08/23	07/11/23
University of Chester Website	10/08/23	07/11/23
RBL website	10/08/23	07/11/23
Radio Merseyside – Professor Alan Finnegan interview	13/08/23	Results Launch
RAMC association	11/08/23	07/11/23
AFCFT to VPPP leads	15/08/23 21/08/23	07/11/23
Hilary Meredith military client database	15/08/23	07/11/23
RGCP newsletter	31/08/23	07/11/23

Veterans Hearing Foundation	31/08/23	07/11/23
Specsavers	13/09/23	07/11/23
Boots	13/09/23	07/11/23
Help the Heroes	25/10/23	07/11/23
Royal Navy & Marines Charity	27/10/23	07/11/23
Royal Naval Association	27/10/23	07/11/23
The Not Forgotten	27/10/23	07/11/23
BLESMA	27/10/23	07/11/23
RNID	27/10/23	07/11/23

List of organisations who shared the study flyer

Research Team

Professor Alan Finnegan

Alan was Director of the Centre and Professor of Nursing and Military Mental Health until Jan 2025. He served in the British Army from 1987 to 2016. As Principal Investigator, Alan secured the funding from RBL, provided oversight of the research study design and development of the draft report.

Kate Salem BSc MRes

Kate is a Senior Researcher at the Centre who has led on multiple Armed Forces Community research projects. Kate is also the wife of a military veteran. Kate was responsible for data analysis, including the systematic review and writing and producing the final report.

Professor Basma Ellahi

Basma is Associate Dean of Research and Innovation in the Faculty of Health, Medicine and Society at the University of Chester. Basma has been the Principal Investigator for this study since January 2025 and was responsible for grant management and supporting and reviewing the production of the final report.

Kate Sawyers

Kate was an administrator at the Centre. In addition to general administrative duties, Kate assisted with the creation of the final report infographics. Kate is married to an Officer serving in the Royal Marines.

Lauren Graham

Lauren is an Executive Assistant and Principal Administrator at the Centre. In addition to general administrative duties, Lauren assisted with the creation of infographics for the final report.

We would like to acknowledge the contributions of Gabrielle Andrews and Heather Burroughs to the project. We would also like to thank the members of the Expert Reference Group who assisted in the development of this research.

Finally, we would also like to acknowledge the RBL research management team for their constructive inputs and supporting this project to completion.