

# Reflex syncope in the UK Armed Forces

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## ABSTRACT

**Introduction** Reflex syncope is the most common subtype of syncope and, despite not being associated with increased mortality, often results in significant morbidity and costly diagnostics. Reflex syncope can be of concern for certain occupational groups and may be exacerbated by some occupations. Reflex syncope in the military is anecdotally common but the extent in the UK Armed Forces (UKAF) is unknown. The aim of this study was to assess the incidence and prevalence of reflex syncope in the UKAF.

**Methods** A retrospective search of the Defence Medical Information Capability Programme using prespecified read-codes was performed at defence primary healthcare centres over the period of 1 January 2019 to 1 January 2020. Data were obtained on 76 103 service personnel (SP) (53% of the UKAF).

**Results** The overall syncope case rate for the UKAF was 10.5 per 1000 person-years (p-yrs). In comparing services there was a significantly increased risk of syncope in the British Army (10.7 per 1000 p-yrs) compared with the Royal Air Force (8.6 per 1000 p-yrs) ( $p=0.0365$ ), SP who served overseas (16.7 per 1000 p-yrs) in comparison with UK medical centres (10.3 per 1000 p-yrs) ( $p<0.0001$ ), and British Army units that regularly took part in State Ceremonial and Public Duties (15.8 per 1000 p-yrs vs 10.2 per 1000 p-yrs) ( $p=0.0035$ ). Army training units conferred a significantly reduced risk of syncope ( $p<0.0001$ ).

**Conclusions** These data are the first to define the incidence and prevalence of syncope in the UKAF. Orthostasis and heat are probable triggers, although recruits are potentially protected. These data offer opportunities to improve the health and well-being of SP, with economic, logistical and reputational benefits for the UKAF. Further research to identify personnel at risk of future syncopal events may allow for targeted use of countermeasures.

## INTRODUCTION

Syncope is a symptom of cardiovascular disease and can be subclassified into reflex syncope, orthostatic hypotension and cardiac syncope.<sup>1</sup> Reflex syncope (previously termed neurally mediated syncope or neurocardiogenic syncope) is a transient loss of consciousness due to a reflex response that encompasses (1) withdrawal of sympathetic vasoconstriction resulting in vasodilatation and subsequent loss of total peripheral resistance and/or (2) cardio-inhibitory bradycardia resulting in loss of cardiac output. The bradycardia is often not profound but is incongruent with the falling BP, often leading to a 'mixed' picture. Reflex syncope is the most common subtype of syncope and, despite not being associated with increased mortality,<sup>2</sup> often results in significant morbidity and costly diagnostics.<sup>3</sup> Reflex

## Key messages

- ▶ There is an increased incidence of reflex syncope in the UK Armed Forces in contrast to comparable civilian data.
- ▶ Reflex syncope is significantly more common in service personnel serving abroad and in units regularly performing state ceremonial and public duties.
- ▶ These data suggest that this is due to increased exposure to triggers of reflex syncope, such as heat and prolonged orthostasis.
- ▶ Controlling occupational triggers may reduce episodes of reflex syncope.
- ▶ Identifying military personnel at risk of fainting would allow for more targeted use of countermeasures.

syncope can be of obvious concern for certain occupational groups, such as those working at height, as well as drivers and pilots,<sup>4</sup> and may even be exacerbated by some occupations such as in healthcare workers.<sup>5</sup>

Military populations have long been used to inform the incidence and prevalence of syncope.<sup>6,7</sup> Commonly described precipitating factors include intercurrent illness, vaccinations or venepuncture, orthostatic or posturally mediated, or due to heat or 'sunstroke'.<sup>7</sup> More contemporary studies suggest incidence rates are higher in the US Armed Forces (USAF)<sup>8</sup> (7.2 per 1000 person-years (p-yrs)) than in comparable civilian populations<sup>2</sup> (3.8 per 1000 p-yrs). As yet, the syncope case rate in the UK Armed Forces (UKAF) is unknown, although syncope appears to exert a significant impact during operational deployments,<sup>9</sup> as well as during State, Ceremonial and Public Duties (SCPD), where collapsing (SP) commonly attract media interest.<sup>10</sup>

The primary aim of this study was to assess the incidence and period prevalence of reflex syncope in the UKAF. The secondary aims were to assess (1) if syncope differed by service (British Army (Army), Royal Air Force (RAF) and Royal Navy/Royal Marines (Navy)); (2) the impact of serving overseas in comparison with the UK; (3) whether recruits suffered syncope more than trained SP; and (4) if SP who regularly take part in SCPD would have higher syncopal rates.

We hypothesised that due to greater exposure to precipitating factors, phase 1/2 training establishments, overseas units and the Household Division (due to their role in SCPD) would have significantly higher syncope incidence rates than their respective controls.



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**Table 1** Defence Medical Information Capability Programme prespecified read-codes used to search for syncopal service personnel

	1B62	Syncope/vasovagal faint
	1B6-2	Syncope symptom
	1B6-3	Vasovagal symptom
	1B65	Had a collapse
	1B65-1	Collapse symptom
	1B66	Had a blackout
	1B66-1	Blackout symptom
	1B68	Felt faint
R002	R0021	(D) Fainting
	R0020	(D) Syncope and collapse
	R002z	(D) Syncope and collapse NOS
	R002-1	(D) Syncope
	R0022	(D) Vasovagal attack
	R0023	(D) Collapse
	R0024	(D) Micturition syncope
	R0025	(D) Defecation syncope
	R0026	(D) Asystolic vasovagal syncope
	R0027	(D) Drop attack
SN21	SN21	Heat syncope or collapse
	SN21-2	Heat syncope or collapse
	SN21-1	Collapse – heat
147	147C	H/O: collapse
	147B	H/O: vasovagal faint
	147D	H/O: blackout
224	2247	O/E: collapse NOS
	2244	O/E: collapse – syncope
Other	EMISNQFu2	Funny turn
	EMISCSY1	Syncopal episodes (fainting)/dizziness
	EMISNQC0160	Collapse during exercise
	^ESCTNE707423	Near syncope

D defined as 'Symptoms, signs and ill-defined conditions.'

H/O, history of; NOS, not otherwise specified; O/E, on examination.

## METHODS

A retrospective search of the Defence Medical Information Capability Programme (DMICP) using prespecified read-codes (Table 1) was performed at defence primary healthcare medical centres (DPHCs). DMICP is based on the EMIS PCS system (EMIS Group, Leeds, UK). To maintain medical confidentiality the searches were performed by individual medical centres' healthcare providers using inbuilt DMICP audit tools under the direction of one of the authors (JE).

The search was limited to UK regular forces personnel and the read-code search was limited to 1 January 2019 to 1 January 2020 inclusive. A case of 'syncope' was defined as a service member with at least one medical encounter for any relevant read-code (Table 1) recorded any time during the surveillance period. Each individual could be a case only once during the period. We included read-codes pertaining to presyncope (1B68, 'felt faint'; 1B6d, 'funny turn'; and ^ESCTNE707423, 'near syncope'). An analysis of the accuracy of the read-codes was performed over a five-year period in 73 participants. All recruited participants self-identified as having previously fainted and had consented to review of their medical notes. All participants had at least one read-code as detailed in Table 1 and, on review of their medical notes, the cause of their collapse with transient loss of consciousness was consistent with reflex syncope and diagnosed as such by the participant's usual medical team.

DPHCs were separated by service (RAF, Army, Navy) for the purposes of analysis. We also separated the medical centres into those that primarily looked after recruits in either phase 1 (basic) or phase 2 training (specialist training which follows basic training). For Army medical centres we specifically targeted DPHCs which cared for SP who participate in SCPD. This included units of the Household Division: Grenadier Guards, Coldstream Guards, Scots Guards, Irish Guards and Welsh Guards (known as the Foot Guards), as well as the Massed Bands of the Household Division, Household Cavalry Mounted Regiment and Royal Horse Artillery. The Foot Guards are also the primary regiments that provide Guard to Her Majesty the Queen at St James's Palace and Buckingham Palace, as well as the Windsor Castle Guard and the Tower of London Guard. Where DPHCs cared for multiple units, we requested that the medical centres, with extant DMICP access, proportioned syncopal episodes by their units so as to meet the study aims. Where this was not possible, we presumed an equal distribution in syncope across units. Where the medical centres provided care to several services (Army, Navy, RAF), these were excluded from comparisons by service but included in overall incidence and prevalence rates. DPHCs were requested to also provide their population at risk for regular SP only. Reservist personnel were excluded.

Army recruit data were compared with British Army regular (trained) serving personnel. Data on all units that regularly perform SCPD (Royal Horse Artillery and Household Division (Foot Guards, Household Cavalry Mounted Regiment and Massed Bands of the Household Division)) were collected. Overseas medical centres surveyed were limited to British Forces Gibraltar (Gibraltar) and British Forces Cyprus (Dhekelia and Episkopi only). SCPD units were compared against the remainder of the British Army. Overseas serving personnel were compared against UK medical centres. The Army, Navy and RAF were also compared with one another.

The DMICP search was registered with Research and Clinical Innovation, Royal Centre for Defence Medicine (RCDM/Res/Audit/1036.20.0526). For the purposes of comparison, we used Fisher's exact test for significance. Relative risk (RR) was calculated with CI (Koopman Asymptotic Score) along with incidence rate ratio (IRR). The  $\alpha$  level was set to 0.05. All statistical analyses were performed using GraphPad Prism V.8.0 (GraphPad Software, San Diego, California).

## RESULTS

Data were obtained on 76 103 SP, representing approximately 53% of the UKAF drawn from 26% (37 of 142) of DPHC medical centres. These data included 33% (10 846 of 32 470) of the Royal Navy, 55% (42 759 of 78 480) of the British Army and 43% (13 932 of 32 380) of the RAF. Data and results concerning the individual populations at risk, number of syncopal cases, incidence rates and one-year period prevalence can be reviewed in Table 2.

In comparing services there was a significantly increased risk of syncope in the Army (10.7 per 1000 p-yrs) compared with the RAF (8.6 per 1000 p-yrs) ( $p=0.0365$ ; RR 1.05 (1.00–1.09), IRR 1.24). There were no other significant differences in comparing the three services. There was a significantly increased risk of syncope comparing overseas (16.7 per 1000 p-yrs) with UK medical centres (10.3 per 1000 p-yrs) ( $p=0.0096$ ; RR 1.60 (1.14–2.24), IRR 1.62). Army training units (5.66 per 1000 p-yrs) conferred a significantly reduced risk of syncope compared with trained regular SP (12.3 per 1000 p-yrs) ( $p<0.0001$ ; RR 0.53 (0.41–0.68), IRR 0.47). There was a significantly increased

**Table 2** Population at risk, number of syncopal episodes, one-year incidence rate and one-year prevalence of syncope in the British Army, Royal Air Force, Royal Navy/Royal Marines and the total UK Armed Forces

	Population at risk	Syncopal cases (n)	One-year incidence rate per 1000 person-years	One-year prevalence (%)
British Army	42 759	457	10.7	1.1
State ceremonial and public duties	3536	56	15.8	1.6
Training establishments	9365	53	5.66	0.6
Royal Navy/Royal Marines	10 846	113	10.4	1.0
Royal Air Force	13 932	120	8.6	0.9
Triservice	6587	74	11.2	1.1
British Forces Cyprus/Gibraltar	1979	33	16.7	1.7
UK Armed Forces	76 103	797	10.5	1.0

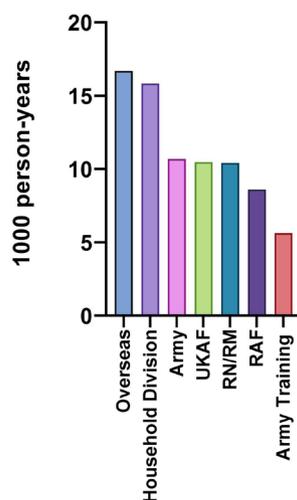
Triservice units and triservice overseas units (British Forces Cyprus/Gibraltar) are also detailed. The population at risk, number of syncopal cases, one-year incidence rate and one-year prevalence are detailed for the British Army units that undertake state ceremonial and public duties, and training establishments.

risk of syncope in personnel performing SCPD (15.8 per 1000 p-yrs) ( $p=0.0035$ ; RR 1.490 (1.16–1.90), IRR 1.55) compared with Army units not primarily engaged in SCPD (10.2 per 1000 p-yrs). A comparison of incidence rates can be seen in [Figure 1](#).

## DISCUSSION

This is the first study to investigate the epidemiology of syncope in the UKAF, where we found a significantly higher incidence of syncope in the Army compared with the RAF and a significantly higher incidence in those serving overseas in comparison with UK-based. We also found a significantly higher incidence of

### Incidence of reflex syncope in the UK Armed Forces



**Figure 1** Incidence of reflex syncope in the UKAF. A comparison of incidence rates in the UKAF service personnel serving overseas in in Cyprus and Gibraltar (Overseas), British Army in the Household Division performing state ceremonial and public duties (Household Division), British Army overall (Army), UK Armed Forces overall (UKAF), Royal Navy/Royal Marines (RN/RM), Royal Air Force (RAF), and British Army recruits in training establishments (Army Training).

syncope in units performing SCPD but found training environments to be protective.

While syncope has been labelled a '*persistent problem*' in military formations for decades,<sup>11</sup> few militaries have published figures which reveal the extent. The Iranian and German militaries have described risk factors for syncope in soldiers<sup>12 13</sup> and syncope has been described in military aircrew,<sup>7 14</sup> particularly in the context of restricted flying duties.<sup>15 16</sup> In a study of active component SP of the USAF over a 14-year period (1998–2012), the incidence rate of all-cause syncope cases (ICD-9-CM [International Classification of Diseases, Clinical Modification] code: 780.2D) was 7.2 per 1000 p-yrs, with a syncope rate (number of syncopal episodes) of 15.1 per 1000 p-yrs. Despite describing all-cause syncope, the USAF appears to have a lower syncopal rate than we found for reflex syncope in the UKAF (10.5 per 1000 p-yrs) ([Table 2](#)). US data also found that the syncope case rate was increasing over time, with the crude incidence rate of syncope cases increasing by 88.6% from 1998 (rate: 4.6 per 1000 p-yrs) to 2012 (8.6 per 1000 p-yrs). This may reflect a greater willingness for SP to seek medical attention due to shifting attitudes away from fainting being seen as a '*weakness*' to a medical condition requiring evaluation and treatment. This may obviate any differences between the two Armed Forces; however, a true increase in syncope cases over time cannot be excluded.

The Framingham Heart and Offspring Study (FHS) is a landmark longitudinal multigenerational cohort study originally set up in 1948.<sup>17</sup> We found a nearly three times higher incidence of syncope in the UKAF (10.7 per 1000 p-yrs; mean age 31, 10.6% women) contrasted to comparable male civilian data (3.8 per 1000 p-yrs in men aged 30–39) in the FHS.<sup>2</sup> These civilian data from the FHS found an overall incidence rate of reflex syncope of 2.26 per 1000 p-yrs, with an overall non-cardiac syncope incidence rate of 6.4 per 1000 p-yrs. A further study estimated the number of patients presenting with syncope in general practice and in the general population using data from three epidemiological studies all performed in the same area in the Netherlands.<sup>17</sup> This found that for patients less than 25 years syncope accounted for 8.2 visits per 1000 p-yrs (8.5 visits per 1000 p-yrs in patients <65 years old). It is of interest that the syncope case rate incidence in the UKAF was greater even than the visit rate incidence (per 1000 p-yrs) in this cohort.<sup>17</sup> Given the greater incidence of syncope in the UKAF in comparison with comparable civilians, it is plausible that the triggers of syncope play a more substantial role than the characteristics of the service population.

Reflex syncope in a younger population is known to be triggered by warm environments, prolonged standing, pain, illness, alcohol, emotion and venepuncture/seeing blood,<sup>7 18</sup> as well as potentially, to a lesser extent, exercise (postexertional).<sup>19</sup> Hot environments resulting in passive heat stress are known to reduce orthostatic tolerance, resulting in syncope,<sup>20</sup> although heat acclimatisation<sup>21</sup> may be protective. These factors may explain the significantly increased syncope rates in SP serving overseas and in units performing SCPD.

We found a significantly lower incidence of syncope in soldiers during training. This was surprising as we considered that they would be subjected to multiple triggers of syncope, particularly prolonged orthostasis (drill training), vaccination, venepuncture and exercise. In the prior reviewed USAF study<sup>8</sup> the syncope cases were higher among recruits (30.5 per 1000 p-yrs), although this spans from 1998 to 2012 and may not reflect changes in training practices. By comparison, in a further study performed between 1 August 2012 and 31 July 2013 in 34 791 US Air Force trainees, the syncope rate was 3.2 per 1000

(3.0 per 1000 male trainees and 5.9 per 1000 female trainees). This included presyncope and syncope. This more closely mirrors our findings in the UKAF. Potential explanations for this lower incidence of syncope include a degree of 'tilt training',<sup>22</sup> the effect of an improvement in physical fitness,<sup>23</sup> or efforts by directing staff to avoid prolonged exposure to potential triggers and to holistically manage recruits, for example, by limiting time of parade. Further research into syncope among phase 2 and phase 1 recruits would be of use.

There are several limitations to these data which require acknowledgement. Due to the mobile aspect of service life, we were only able to estimate incidence over a one-year period. While this enabled us to make comparisons more accurately, we were unable to calculate the syncope rate and therefore ascertain the burden of syncope in affected SP. Equally it is quite possible that units/subunits will have deployed/returned from deployment in the study period, which, given the known significant levels of syncope on operations,<sup>9</sup> could have increased numbers. We specifically targeted medical centres serving British Forces Cyprus and Gibraltar as we considered that these would be more static overseas populations.

We opted to include presyncope as we considered that, if the SP were sufficiently affected to seek medical attention, this merited inclusion with the investigation and management the same for both syncope and presyncope. Similarly, the 'read-codes' for presyncope could be aptly used to code for an aborted syncopal event, for example, using physical countermeasures, and we thought it important to capture these. We opted to only include reflex syncope as we did not consider cardiac syncope or syncope due to orthostatic hypotension to be the likely culprit, in the vast majority, due to the younger age of the population at risk. The discharge rate of all cardiac diseases in the UKAF is 13.9 per 100 000 p-yrs.<sup>24</sup> Equally some of the read-codes pertaining to collapse could have had a neurological or psychosomatic cause. We endeavoured to mitigate this by assessing the accuracy of the read-codes in identifying reflex syncope on 73 consenting SP. However, these notes were reviewed in one DPHC location in a relatively small population and so may not be representative of the wider Armed Forces.

We considered it likely that SP may have fainted and have not presented for medical assessment, although what proportion is unknown. This is also the case in civilian data, where but a fraction of the general population present to any clinical setting with syncope.<sup>25</sup> We used the Framingham Study as a comparator, yet 36.6% of participants had an 'unknown' cause of syncope where the participant did not seek medical attention for and the history, physical examination and electrocardiographic findings were not consistent with any specific cause.<sup>2</sup> While one could hypothesise that repeated syncope is likely to prompt the service person to seek medical assistance, there are factors which might deter the service person, such as the perceived impact on their occupational status. This may account for the lower incidence rate in recruits compared with trained soldiers, where recruits may consider that by declaring a syncopal event it may affect their progress through training. Similarly, reporting bias could account for all the significant differences observed in these data as well as the differences between civilian and USAF data. Statistically we have not corrected for multiple comparisons; however, we predefined our hypotheses prior to analysis.

Due to our responsibility to maintain participant anonymity, we were also reliant on the DPHCs for data collection. Although we collected data on over half of the UKAF, we only surveyed a quarter of DPHCs. We targeted phase 1 and 2 training establishments, overseas and Household Division medical centres

due to our predefined hypotheses. While we aimed to capture a disparate number of DPHCs by service, geography and unit role, we may have unintentionally introduced bias by not randomly selecting medical centres. Furthermore, bias may have been introduced in that we were unable to capture information from medical centres that did not engage with our requests. However, we would hope that 76 103 SP would be a large enough sample size to mitigate this. Finally, these data are based on the accuracy of the diagnosis and the subsequent read-codes inputted on DMICP. Clinicians have the option to 'free-text', which if performed would not be picked up by our search. If personnel were to be seen by clinicians outside of the medical centre (eg, on exercise), the medical notes may be handwritten and scanned and saved on the service person's medical notes as an attachment, where again they would not be picked up by our search.

Due to the nature of the method of this study, we were unable to provide a read-code breakdown or collect in-depth patient data to examine potential risk factors, referral rates, proportion presenting to medical care or precipitating circumstances for reflex syncope. Further research to provide a more comprehensive assessment of reflex syncope in the UKAF is recommended particularly in recruits, the Household Division and units serving overseas.

## CONCLUSION

These data are the first to estimate the incidence and prevalence of syncope in the UKAF. Syncope case rates in the UKAF appear higher than rates reported in young adult civilian and other military cohorts. The increased syncope case rate in the UKAF may be partly explained by SP characteristics, but is perhaps more likely to be due to a greater exposure to triggers of reflex syncope, particularly orthostasis and heat, than comparable civilian populations. Further research is required to fully understand the triggers of syncope in the UKAF and the targeted use of countermeasures to mitigate these. These data offer opportunities to improve the health and well-being of SP, with economic, logistical and reputational benefits for the UKAF.

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**Contributors** IP conceived the study, performed the analysis and drafted the manuscript. JE performed data collection, performed the analysis, and drafted and reviewed the manuscript. MJS critically edited the manuscript and contributed to the content. NG and PC critically edited the manuscript and reviewed the content. MG-B critically edited the manuscript and reviewed the manuscript. DW edited the manuscript, provided insight to data analysis and was responsible for the overarching review of the content. All authors reviewed the manuscript.

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