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Trajectories of alcohol use in the UK military and associations with mental health

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Trajectories of alcohol use in the UK military and associations with mental health

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Abstract

Introduction: There are higher levels of alcohol misuse in the military compared to the general population. Yet there is a dearth of research in military populations on the longitudinal patterns of alcohol use. This study aims to identify group trajectories of alcohol consumption in the UK military and to identify associations with childhood adversity, deployment history and mental disorder.

Methods: Data on weekly alcohol consumption across an eight year period and three phases of a UK military cohort study (n=667) were examined using growth mixture modelling.

Results: Five alcohol trajectory classes were identified: mid-average drinkers (55%), abstainers (4%), low level drinkers (19%), decreasing drinkers (3%) and heavy drinkers (19%). Alcohol consumption remained stable over the three periods in all classes, other than in the small decreasing trajectory class. Individuals in the heavy drinking class were more likely to have deployed to Iraq. Abstainers and heavy drinkers were more likely to report post-traumatic stress disorders at baseline compared to average drinkers.

Conclusions: Heavy drinkers in the UK military did not change their drinking pattern over a period of eight years. This highlights the need to develop effective preventive programmes to lessen the physical and psychological consequences of long-term heavy alcohol use. Individuals with a mental health problem appeared more likely to either be drinking at a high level or to be abstaining from use.

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Keywords: alcohol use; trajectories; military; cohort study

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1.1 Introduction

The use of alcohol in the UK Armed Forces remains at a problematic level, whilst general population use appears to be decreasing (Orchard, 2015). Alcohol misuse is one of the only outcomes that is worsened on return from deployment (Fear, et al., 2010; Hooper, et al., 2008). Hazardous drinking is higher in the UK Armed Forces than in civilians across all age groups, although the difference reduces with age (Fear, et al., 2007).

UK military data has shown that individuals who have deployed, and specifically those who experienced combat related traumas, were most likely to evidence increases in consumption and heavy episodic drinking (Hooper, et al., 2008). Individuals who deployed in a combat role were also more likely to meet the criteria for hazardous use (that is harmful to health) (Fear, et al., 2010). US data are consistent with UK findings (Jacobson, Ryan, Hooper, & et al., 2008), whereas German military personnel do not appear to have an increase in alcohol use on return from deployment (Trautmann, et al., 2014). There is also evidence that exposure to trauma in childhood is associated with later alcohol misuse (Clarke-Walper, Riviere, & Wilk, 2014). Similar to civilians, alcohol misuse is often comorbid with other mental disorders, such as Post-traumatic Stress Disorder (PTSD) (Debell, et al., 2014; Head, et al., 2016) and poor mental health is a risk factor for later alcohol misuse (Bell & Britton, 2014).

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Cross sectional data from the Adult Psychiatric Morbidity Survey in England showed the prevalence of hazardous alcohol use decreased with age (McManus, Meltzer, Brugha, Bebbington, & Jenkins, 2009). A recent longitudinal population study of alcohol trajectories across the lifespan showed that in men there is a sharp increase in drinking from adolescence to around 25 years, drinking then decreases and plateaus around middle age and then decreases further from 60 years onwards (Britton, Ben-Shlomo, Benzeval, Kuh, & Bell, 2015). A similar pattern was shown in females, but at a lower level of consumption (Britton, et al., 2015). No equivalent study has been conducted in the military.

Group based trajectory models, including growth mixture modelling, have been used across a range of research areas, classifying individuals into groups dependent on shared longitudinal patterns (Jung & Wickrama, 2008). In military populations, these techniques have tended to focus on PTSD (e.g. Berntsen, et al., 2012; Bonanno, et al., 2012). An advantage of studying individual trajectories is to identify those with a worsening or atypical trajectory and to determine what factors are associated with these patterns in a population. We are not aware of any trajectory studies of alcohol use in a military population, in contrast to the general population (e.g. Chassin, Fora, & King, 2004; Cheadle & Whitbeck, 2011).

The current study aims to 1) investigate trajectories of alcohol consumption in a young to mid-adulthood UK military population. It will 2) identify associations between the

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trajectories with exposure to childhood adversity, deployment history and combat exposure, and mental disorder, and then will 3) determine the associations with general health and mental health outcomes at follow-up.

1.2 Methods

1.2.1 Sample

In 2002 a random sample of 4500 serving personnel from the Royal Navy, Army and Royal Air Force were allocated to receive either a full questionnaire or an abridged questionnaire (Rona, Jones, French, Hooper, & Wessely, 2004) (Supplemental Figure 1). The current study is restricted to those individuals who completed the full baseline questionnaire (n=1392), which included assessment of alcohol use. From June 2004 to March 2006 all responders from the baseline phase, (for whom contact details were available (n=1359)) were re-contacted and asked to complete a follow-up questionnaire (follow-up 1) (Hotopf, et al., 2006), 941 participants completed this. Follow-up 2 was conducted from November 2007 to September 2009 (Fear, et al., 2010). Six hundred and sixty seven responded at follow-up 2, which is the sample for the current study.

1.2.2 Assessment of alcohol consumption at all phases

The 3-item Alcohol Use Disorders Identification Test – Consumption subscale (AUDIT-C) (Bush, et al., 1998) includes the following items: "How often do you have a drink of

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alcohol?"; "How many drinks/units do you have on a typical day of drinking?"; "How often do you have 6 drinks or more on one occasion?". In this study the AUDIT-C was used to calculate average units of alcohol consumed per week by multiplying average units per drinking session (using the mid-point of the response scale) with frequency per week. A definition of alcohol units was provided: "E.g. A pint of standard beer / lager = 2 units. A single measure of spirit / small glass of wine= 1 unit."

1.2.3 Demographic and military characteristics

The demographic information available at baseline was sex, age, rank, Service and smoking status. Data on level of education (categorised as O Levels/GCSE or below and A Levels or higher) and marital status were collected at follow-up 1.

1.2.4 Risk factors

1.2.4.1 Deployment history

At baseline, self-reports were gained on whether participants had deployed in the 3 years before the start of the Iraq war. At follow-up 1 (2004 to 2006), data were available on whether or not participants had deployed to Iraq and at follow-up 2 (2007- 2009) if they had deployed on an Iraq or Afghanistan operation. At both follow-up phases, information was available for those who had reported a deployment on whether they had deployed in a combat role as opposed to other roles.

1.2.4.2 Childhood adversity

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Childhood adversity was assessed by two measures (Iversen, et al., 2007), adapted from the Adverse Childhood Exposure study scale (Felitti, et al., 1998). The first assessed family relationship adversity: comprising 4 positive items which were reverse scored (e.g. "I came from a close family") and 4 negative items (e.g. "I used to be hit/hurt by a parent or caregiver regularly") (Iversen, et al., 2007). These 8 items were summed to form a cumulative measure and analysed as 0, 1 and 2+ adversities. The second measure assessed childhood antisocial behaviour, scored positively if participants answered true to "I used to get into physical fights at school" plus one of the following; "I often used to play truant at school" or "I was suspended or expelled from school" or "I did things that should have got me (or did get me) into trouble with the police" (MacManus, et al., 2012).

1.2.4.3 General and mental health at all phases

General health status was assessed using one item from the SF-36 (Ware & Sherbourne, 1992), comparing individuals rating their current health as 'poor' or 'fair', to 'good', 'very good' or 'excellent'.

Probable CMD was assessed using the General Health Questionnaire (GHQ-12). This is a 12-item questionnaire widely used to screen for symptoms of depression and anxiety,

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otherwise known as CMD (Goldberg et al. 1997). Examples of items include: "Felt constantly under strain" and "Been feeling unhappy and depressed". The questionnaire is not a diagnostic interview, but validation studies indicate acceptable criterion validity with the CIS-R (Hardy et al. 1999). Each of the symptoms was rated on a four-point scale. For this study the bi-modal scoring method of 0-0-1-1 was used, with those endorsing a negative symptom as 'rather' or 'much more than usual', or a positive symptom as 'less' or 'much less than usual', were classified as reporting a symptom. Possible scores for the full scale ranged from 0 to 12 and a 3/4 cut-off was used to represent caseness for probable CMD.

Symptoms of PTSD were assessed using DSM-IV criteria by the National Centre for PTSD Checklist – Civilian version (PCL-C; Weathers, Litz, Herman, Huska, & Keane, 1994) a 17-item questionnaire assessing five re-experiencing, seven avoidance and five hyperarousal symptoms. Cases were defined as individuals with a score of 50 or above, referred to as probable PTSD.

1.2.5 Ethical approval

All phases of data collection for this study received ethical approval from the UK Ministry of Defence Research Ethics Committee.

1.2.6 Data analysis

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1. Group based trajectory modelling in MPlus 6 (Muthén & Muthén, 1998-2011) was used to classify individuals into discrete groups, based upon alcohol consumption data across the 3 phases. This model based cluster analysis method allows latent classes of individuals, following common trajectories, to be identified. Group based trajectory models include, latent class growth analysis (LCGA) that does not allow the intercepts (start point) and slopes (rate of change) to vary within a class, whereas growth mixture modelling (GMM) allows for within-person heterogeneity in the intercept and slope within a class. GMM includes random effects for the intercept and slope, whereas a LCGA is a nested model treating the intercept and slope as fixed factors. In the current study we: i) began by running LCGA models (fixed effects), ii) in the second set of GMM models the variance of the slopes were constrained to 0 but intercepts were allowed to vary (random intercepts) and iii) GMM models were conducted in which both the intercepts and slopes could vary within a class (random intercepts and slopes). For each of these steps, models were estimated allowing for 2 to 7 distinct trajectory groups, which were evaluated statistically to assess model fit.

Negative binomial models were selected because the alcohol consumption data was over-dispersed count data. There was minimal missing data for the alcohol consumption measures for the 667 participants who took part across all 3 phases, with 661, 660 and 660 participants with alcohol consumption data at baseline, follow-up 1 and follow-up 2 respectively. Full information maximum likelihood estimation was used to account for

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missing alcohol data for these participants, under the assumption of data missing at random.

Model fit was assessed statistically using the Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), sample size adjusted BIC (SABIC) and the adjusted Lo-Mendell-Rubin likelihood ratio test (LMR-LRT). Lower values for AIC, BIC and SABIC all indicate improved model fit. The LMR-LRT was used to compare improvement in fit between neighbouring class models; that is comparing the model with k classes to one with k-1 classes (Lo, Mendell, & Rubin, 2001). Entropy was examined to evaluate the degree of uncertainty to which individuals were assigned to a class; a maximum score of 1 indicates perfect assignment. The BIC and SABIC have been shown to be the most reliable indicators in simulation studies (Nylund, Asparouhov, & Muthén, 2007) with additional research showing that the SABIC is the best indicator of model fit (Tofighi & Enders, 2008).

Individuals were assigned to classes based upon the probability of class membership and the data on most likely class membership was analysed in STATA 11 (StataCorp, 2009).

2. The associations between the alcohol trajectory classes and the sociodemographic and military characteristics, childhood adversity, deployment history, mental health and general health at baseline were examined by examining the marginal frequencies of these variables

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with the alcohol trajectory variable. Multinomial logistic regressions were then conducted with the alcohol trajectory variable as the outcome (class 1 'average drinkers' as the reference group) and the listed variables as the exposure, adjusting for sex and age.

3. Logistic regression analyses with CMD, PTSD and general health at follow-up 2 as the outcome were conducted with the alcohol trajectory variable as a categorical predictor, adjusting for sex and age.

1.3 Results

1.3.1 Characteristics of the sample

The sample was predominantly male (91.9%) and mixed in age, with more than a third over 35 years of age (39.1%). At baseline the median level of alcohol (in units) consumed per week was 9 (interquartile range (IQR) 4 to 20). Full details of the sample are provided in Table 1. Comparisons were made (n=1359) between the 667 participants included in this study with the 692 who participated in the baseline survey, but who did not complete all three phases. Analyses indicated no differences by service, number of deployments, smoking status, general health, mental health and alcohol consumption, but there were small differences by age and rank (Supplemental table 1).

1.3.2 Assessing the model fit

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The 2 to 7 class models for model 1 (fixed effects only), model 2 (random intercepts) and model 3 (random intercepts and slopes) were compared (Table 2). The model fit statistics were generally improved for model 2, compared to model 1, but there appeared to be little improvement in the fit of the models by allowing the slopes to vary (model 3). Model 2 (GMM with random intercepts) was selected. In comparing the 2 to 7 class models, the SABIC was very similar for the 3 to 5 class models, but indicated that the 4-class model had the best fit. There was a small increase in the AIC, BIC and SABIC values for the 5-class, compared to the 4-class model. On examining the plots, the 4 class model included approximately three quarters of participants in a mid-drinking class (data not included in this article but available on request from authors), whereas the 5 class model included an additional higher drinking class which was of relevance to this research. The 5 class model was chosen based upon guidance that model selection should be theoretically as well as statistically driven (Feldman, Masyn, & Conger, 2009).

1.3.3 Overview of the alcohol trajectories

Figure 1 displays the estimated means for the 5 class GMM model (random intercepts) with slopes constrained. Class 1 included more than half of the sample (55.2%) and could be defined as 'mid-average drinkers' who consumed on average 12 units per week. Class 2 included 'abstainers' (4.4%) who drank no alcohol across the three phases. Class 3 'low level drinkers' included almost a fifth of the sample (18.7%) drinking at a low level of 2 units per week across all phases. Class 4 'decreasing drinkers' was the smallest group (2.7%) with average consumption of 11 units at baseline which decreased to 1 unit by follow-up 2. The final class 5 of 'heavy drinkers' (19.0%) all drank at a high level across the three phases, with

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a very small increase in the average level of consumption from 28 units at baseline to 29 units by follow-up 2.

1.3.4 Sociodemographic and military characteristics, baseline health, and the alcohol trajectories

Table 3 shows the findings of the multinomial logistic regression analyses. Classes 2 and 4 were the smallest classes and these analyses may be statistically underpowered. Class 3 'low level drinkers' included significantly more personnel aged 35 years and above at baseline, compared to class 1. There were fewer personnel in the RAF in class 4 'reducing drinkers' compared to class 1. There were significantly fewer females and personnel in an Officer rank in class 5 'heavy drinkers' compared to class 1, but more individuals aged under 30 years of age and who reported being single. Class 5 included significantly more individuals who smoked at baseline and who met the criteria for childhood antisocial behaviour. There was no statistically significant association between CMD at baseline and alcohol trajectory, but there were significantly more individuals meeting the criteria for 'probable' PTSD in class 2 'abstainers' and class 5 'heavy drinkers'.

1.3.5 Military deployments, combat, leaving service and the alcohol trajectories

Personnel who left service between follow-ups 1 and 2 were significantly more likely to be in class 2 'abstainers' compared to class 1. There were more individuals who reported an Iraq deployment before follow-up 1 in class 5 'heavy drinkers' compared to class 1. Deploying in a combat role, either before phase 1 or between phases 1 and 2, was not associated with alcohol trajectory.

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1.3.6 Alcohol trajectories and general and mental health at follow-up 2

Table 4 shows the association between the classes and health outcomes at follow-up 2. Individuals in the 'heavy drinkers' class were significantly more likely to have a CMD at follow-up 2 compared to the 'mid-average drinkers'. Alcohol trajectory was not statistically significantly associated with PTSD or general health status at follow-up 2. There was weak, but non-significant, evidence to suggest that individuals in the 'heavy drinkers' class were more likely to meet criteria for PTSD at follow-up 2. There was a non-significant trend for those in class 4 (decreasing alcohol consumption) to have higher odds for CMD.

1.4 Discussion

Key findings from this trajectory analysis were that 1) over half of this sample were in an 'average drinkers' class who were drinking within recommended UK guidelines, 2) a fifth were in a heavy drinking trajectory and 3) in four of the five trajectory classes identified (including 97% of the participants), drinking remained fairly stable over time. Members of the 'heavy drinkers' class were more likely to be young, single, to report childhood antisocial behaviour, to have deployed in the last 3 years and to report PTSD at baseline. There was additional evidence that the 'abstainers' were also more likely to have reported PTSD.

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Life course studies have suggested that trends for alcohol consumption indicate a decrease beyond 25 years of age (e.g. Britton, et al., 2015; Meng, Holmes, Hill-McManus, Brennan, & Meier, 2014). This study did not find a general decrease in drinking over an eight year time period, except for one small class decreasing their consumption. UK data from a younger military sample than this study also found only a very small decrease in drinking across two time points (Thandi, et al., 2015). These studies underscore the interpretation that for the great majority of military personnel, alcohol consumption does not change. The individual trajectories identified within this study correspond to those found in other populations, for example (e.g. Chassin, et al., 2004), but there was not an increasing alcohol trajectory group in this population. Although this sample was on average older than other studies, for example of adolescent trajectories, there is evidence that an increasing class exists within older samples (Sher, Jackson, & Steinley, 2011). It is possible that such an increase may be less likely to be evidenced within a group already having a sizeable percentage of heavy drinkers at baseline.

This study confirms previous work in finding that the heavy drinkers were more likely to be male, younger and single and less likely to be commissioned officers (Fear, et al., 2007). This study is consistent, with previous work that those of a lower SES are more likely to evidence problematic drinking (Fone, Farewell, White, Lyons, & Dunstan, 2013; Trautmann, et al., 2015). Research in the UK military has not found that ex-serving personnel drink at a lower level than serving personnel (Fear, et al., 2007) and this was reflected in the current findings. Individuals who reported an Iraq deployment were more likely to be in the heavy

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drinking class, which corresponds with findings from both the UK and the US on deployment (Hooper, et al., 2008; Jacobson, et al., 2008).

There are well established associations between heavy alcohol use and mental health, with recent work suggesting that the alcohol misuse is more likely to be a response to the mental health symptoms (Bell & Britton, 2014). This study showed that both heavy drinkers and the abstainers were more likely to report PTSD at baseline, in line with previous findings in the UK military (Thandi, et al., 2015). The latter association could be explained by former treatment guidelines that an alcohol problem must have remitted before PTSD treatment can commence (Foa, Yusko, McLean, & et al., 2013). Those who drank at a high level throughout this study were also more likely to meet the criteria for a CMD by follow-up.

1.4.1 Strengths and limitations:

This study benefits from an eight years period and three alcohol use assessments, and a large sample size which permitted this type of trajectory analysis. Attrition is a common problem in longitudinal studies. However, the participants who completed all phases of data collection, did not appear to be particularly different to those who dropped out of the study at an earlier phase. There was some evidence that individuals who remained in the study were older and more likely to be in a higher rank, and so it is possible that drinking trajectories may have differed slightly with no attrition. In this study we selected the 5-class model, even though a 4-class model could have been better justified purely on the basis of the statistical fit parameters. There appears to be debate as to whether the theoretical

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meaning and applicability of findings should influence model selection. For this work it was important that we could study the heavy drinking class, and given that the model fit parameters were fairly equal we felt that this decision was necessary. Furthermore, the modelling approach that was selected allowed for intercepts to vary within a class, which meant that participants within a class could have been drinking at quite different levels. This variability was most evident in both the 'average drinkers' and 'heavy drinkers' classes. Another limitation of this research relates to the potential for reporting bias to have impacted on the assessment of alcohol consumption; however, the stability of the most common trajectory classes indicates that most participants were consistent in their reports across the study duration.

1.4.2 Implications

This study found that within a UK military population, drinking appears to be fairly stable, so whilst there are not many individuals who increase, there are also only a small number who decrease their consumption. This suggests that preventative interventions may be necessary in order to encourage a healthier pattern of drinking. Whilst there is evidence from the general population on the efficacy of brief alcohol interventions for decreasing hazardous drinking (O'Donnell, et al., 2014), a recent meta-analysis did not find that similar interventions were efficacious in the military (Doherty, et al., In press) and so further research is required to develop efficacious tailored programmes for this population. Compared to those drinking at an average level, both abstainers and heavy drinkers were more likely to have a mental health problem. This study included personnel on average

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older than the UK military. It would be interesting to assess whether the same trajectories are found in a military population younger at baseline.

1.4.3 Conclusions

This study found that heavy drinkers in the UK military do not change their drinking pattern over a period of eight years. This highlights the need to develop effective preventive programmes to lessen the physical and psychological consequences of longer term heavy alcohol use.

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Figure legends:

Figure 1: Estimated means (weekly alcohol units) for the alcohol trajectory classes

Supplemental figure legends:

Supplemental figure 1: Flow diagram of participant recruitment and response

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Figure 1: Estimated means (weekly alcohol units) for the alcohol trajectory classes

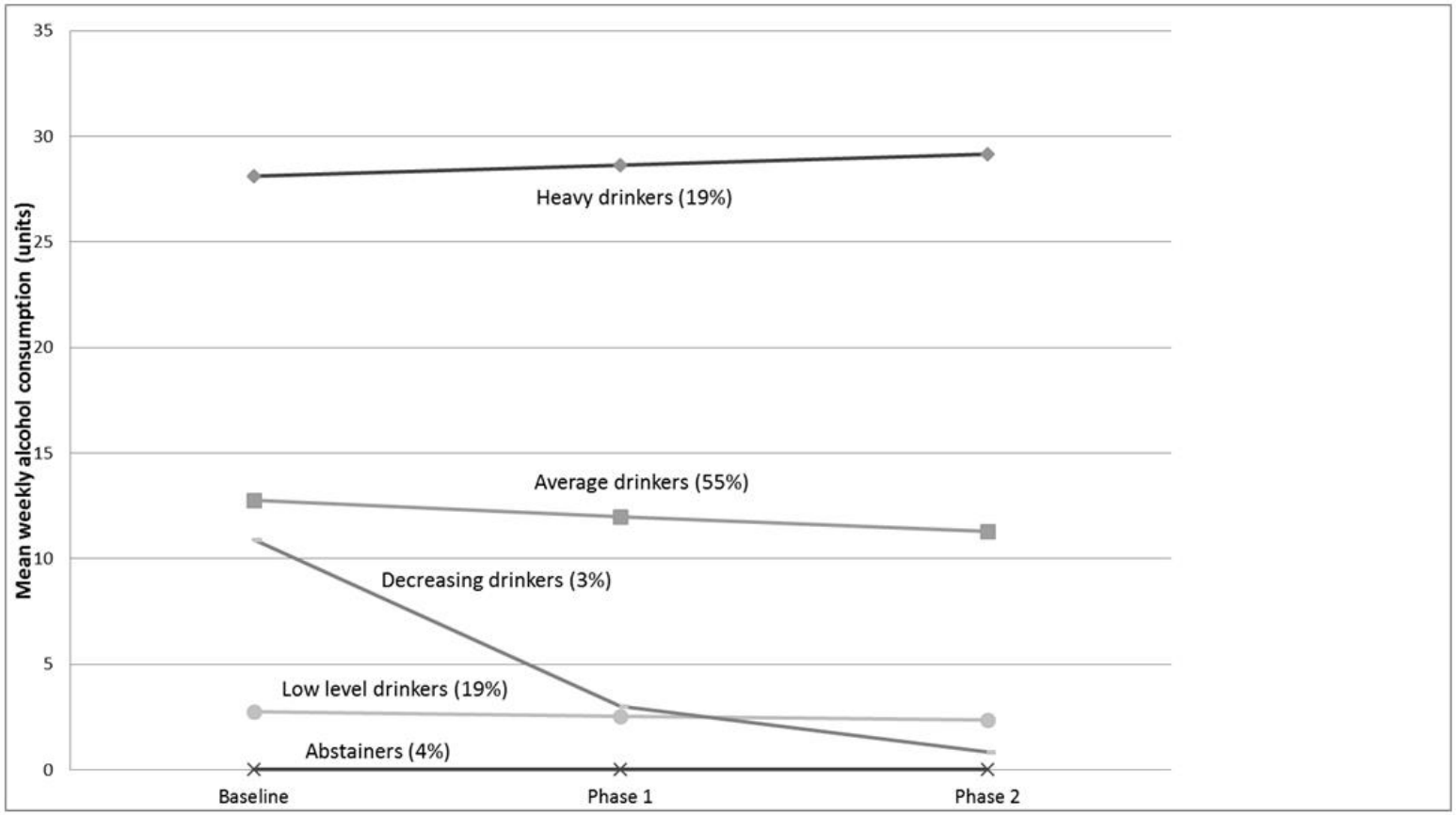

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Table 1: Sample baseline characteristics (n= 667)

		n (%)
Sex	Male	613 (91.9)
	Female	54 (8.1)
Age (years)	< 30	229 (34.3)
	30-34	177 (26.5)
	35+	261 (39.1)
Rank	Other ranks/NCOs	527 (79.0)
	Officers	140 (21.0)
Service	Naval Service	164 (24.6)
	Army	326 (48.9)
	RAF	177 (26.5)
Educational attainment (from follow-up 1)	Lower attainment (O Levels/GCSEs or no qualifications)	249 (38.8)
	Higher attainment (A Levels, Degree or above)	393 (61.2)
Marital status (from follow-up 1)	Married/cohabiting/ in a relationship	557 (83.5)
	Single	68 (10.2)
	Separated/ divorced/widowed	42 (6.3)
Previous deployment	No	289 (43.3)
	Yes	378 (56.7)
Family relationship adversity (from follow-up 1)	0	291 (44.4)
	1	116 (17.7)
	2+	248 (37.9)
Childhood antisocial behaviour (from follow-up 1)	No	587 (88.4)
	Yes	77 (11.6)
Current smoker	No	472 (71.3)
	Yes	190 (28.7)
General health rating	Excellent/good	581 (87.5)
	Fair/poor	83 (12.5)
Probable CMD	Not a case	532 (79.8)
	Case	135 (20.2)
Probable PTSD	Not a case	653 (97.9)
	Case	14 (2.1)
Weekly alcohol consumption at baseline (median, IQR)		9 (4-20)

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Table 2: Model fit statistics for 2- to 7-class models

		2-class	3-class	4-class	5-class	6-class	7-class
LCGA – slopes and intercepts constrained (Model 1)	AIC	13868	13668	13550	13542	13538	13536
	BIC	13904	13717	13613	13619	13628	13640
	SABIC	13879	13682	13569	13565	13565	13567
	Entropy	0.844	0.749	0.802	0.693	0.700	0.693
	LMR-LRT	450 (p<0.001)	196 (p<0.001)	117 (p<0.001)	13 (p>0.05)	10 (p>0.05)	7 (p<0.05)
GMM – slopes constrained (Model 2)	AIC	13576	13537	13531	13533	13536	13539
	BIC	13616	13591	13599	13614	13631	13647
	SABIC	13588	13553	13551	13557	13564	13570
	Entropy	0.907	0.811	0.811	0.715	0.730	0.652
	LMR-LRT	107 (p<0.05)	42 (p<0.001)	12 (p<0.001)	4 (p>0.05)	3 (p>0.05)	3 (p>0.05)
GMM – slopes and intercepts allowed to vary (Model 3)	AIC	13574	13540	13535	13539	13543	13548
	BIC	13624	13603	13611	13629	13647	13665
	SABIC	13589	13559	13557	13566	13574	13582
	Entropy	0.916	0.811	0.813	0.815	0.807	0.623
	LMR-LRT	106 (p<0.05)	38 (p<0.001)	11 (p<0.005)	1 (p>0.05)	-1 (p>0.05)	-3 (p>0.05)

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Table 3: Associations between sociodemographic and military characteristics, childhood adversity, deployment history and health with the alcohol trajectories (n=667)

		Class 1 "Average drinkers" (n=368) **(ref. group)**	Class 2 "Abstainers" (n=29)	Adjusted MOR (95% CI)±	Class 3 "Low level drinkers" (n=125)	Adjusted MOR (95% CI)±	Class 4 "Decreasing drinkers" (n=18)	Adjusted MOR (95% CI)±	Class 5 "Heavy drinkers" (n=127)	Adjusted MOR (95% CI)±
Sex	Male	333 (54.3)	27 (4.4)	1.00	112 (18.3)	1.00	16 (2.6)	1.00	125 (20.4)	1.00
	Female	35 (64.8)	2 (3.7)	0.87 (0.19, 4.00)	13 (24.1)	1.33 (0.66, 2.67)	2 (3.7)	0.95 (0.20, 4.52)	2 (3.7)	**0.12 (0.03, 0.49)**
Age (years)	< 30	120 (54.4)	7 (3.1)	1.00	30 (13.1)	1.00	9 (3.9)	1.00	63 (27.5)	1.00
	30-34	106 (59.9)	7 (4.0)	1.12 (0.38, 3.32)	38 (21.5)	1.49 (0.85, 2.57)	3 (1.7)	0.37 (0.10, 1.44)	23 (13.0)	**0.37 (0.22, 0.65)**
	35+	142 (54.4)	15 (5.8)	1.78 (0.68, 4.62)	57 (21.8)	**1.69 (1.00, 2.86)**	6 (2.3)	0.56 (0.19, 1.66)	41 (15.7)	**0.47 (0.29, 0.75)**
Baseline rank	Other ranks/NCOs	275 (52.2)	25 (4.7)	1.00	102 (19.4)	1.00	16 (3.0)	1.00	109 (20.7)	1.00
	Officers	93 (66.4)	4 (2.9)	0.40 (0.13, 1.19)	23 (16.4)	0.62 (0.37, 1.05)	2 (1.4)	0.36 (0.08, 1.64)	18 (12.9)	**0.45 (0.26, 0.80)**
Service	Naval Service	98 (59.8)	4 (2.4)	0.32 (0.10, 1.01)	28 (17.1)	0.71 (0.42, 1.21)	3 (1.8)	0.35 (0.10, 1.31)	31 (18.9)	0.81 (0.48, 1.35)
	Army	167 (51.2)	17 (5.2)	1.00	61 (18.7)	1.00	14 (4.3)	1.00	67 (20.6)	1.00
	RAF	103 (58.2)	8 (4.5)	0.64 (0.26, 1.58)	36 (20.3)	0.85 (0.52, 1.39)	1 (0.6)	**0.12 (0.02, 0.97)**	29 (16.4)	0.85 (0.50, 1.44)
Educational	Lower attainment (O	128	12	1.00	48	1.00	7	1.00	54	1.00

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attainment (from follow-up 1)	Levels/GCSEs or no qualifications)	(51.4)	(4.8)		(19.3)		(2.8)		(21.7)	
	Higher attainment (A Levels, Degree or above)	227 (57.8)	15 (3.8)	0.69 (0.31, 1.53)	72 (18.3)	0.83 (0.54, 1.27)	11 (2.8)	0.91 (0.34, 2.41)	68 (17.3)	0.72 (0.47, 1.11)
Marital status (from follow-up 1)	Married/cohabiting/in a relationship	313 (56.2)	28 (5.0)	1.00	108 (19.4)	1.00	16 (2.9)	1.00	92 (16.5)	1.00
	Single	34 (50.0)	1 (1.5)	0.40 (0.05, 3.22)	6 (8.8)	0.58 (0.23, 1.49)	2 (2.9)	0.83 (0.17, 4.07)	25 (36.8)	**2.26 (1.21, 4.23)**
	Separated/ divorced/widowed	21 (50.0)	0	-	11 (26.2)	1.48 (0.69, 3.18)	0	-	10 (23.8)	1.70 (0.76, 3.80)
Previous deployment at baseline	No	168 (58.1)	11 (3.8)	1.00	57 (19.7)	1.00	8 (2.8)	1.00	45 (15.6)	1.00
	Yes	200 (52.9)	18 (4.8)	1.45 (0.66, 3.16)	68 (18.0)	1.05 (0.69, 1.58)	10 (2.7)	1.01 (0.39, 2.64)	82 (21.7)	1.44 (0.94, 2.20)
Family relationship adversity	0	158 (54.3)	13 (4.5)	1.00	58 (19.9)	1.00	7 (2.4)	1.00	55 (18.9)	1.00
	1	72 (62.1)	3 (2.6)	0.52 (0.14, 1.90)	21 (18.1)	0.82 (0.46, 1.45)	2 (1.7)	0.60 (0.12, 2.97)	18 (15.5)	0.67 (0.36, 1.24)
	2+	131 (52.8)	12 (4.8)	1.10 (0.48, 2.49)	43 (17.3)	0.88 (0.55, 1.39)	8 (3.2)	1.43 (0.50, 4.07)	54 (21.8)	1.20 (0.76, 1.88)
Childhood antisocial behaviour	No	332 (56.6)	24 (4.1)	1.00	114 (19.4)	1.00	17 (2.9)	1.00	100 (17.0)	1.00
	Yes	35 (45.5)	5 (6.5)	2.05 (0.73, 5.79)	10 (13.0)	0.88 (0.42, 1.84)	1 (1.3)	0.54 (0.07, 4.22)	26 (33.8)	**2.12 (1.21, 3.74)**
Smoker at baseline	No	268 (56.8)	20 (4.2)	1.00	97 (20.6)	1.00	14 (3.0)	1.00	73 (15.5)	1.00
	Yes	97 (51.1)	9 (4.7)	1.29 (0.57, 2.95)	27 (14.2)	0.79 (0.48, 1.28)	3 (1.6)	0.57 (0.16, 2.04)	54 (28.4)	**2.03 (1.32, 3.12)**
Left service by follow-	No	318 (55.9)	21 (3.7)	1.00	106 (18.6)	1.00	14 (2.5)	1.00	110 (19.3)	1.00

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up 1	Yes	48 (51.6)	7 (7.5)	2.01 (0.79, 5.10)	18 (19.4)	1.07 (0.59, 1.95)	3 (3.2)	1.37 (0.37, 5.06)	17 (18.3)	1.02 (0.55, 1.89)
Left service by follow-up 2	No	263 (57.1)	14 (3.0)	1.00	85 (18.4)	1.00	11 (2.4)	1.00	88 (19.1)	1.00
	Yes	104 (50.7)	15 (7.3)	**2.53 (1.12, 5.75)**	40 (19.5)	1.10 (0.69, 1.76)	7 (3.4)	1.76 (0.63, 4.93)	39 (19.0)	1.20 (0.75, 1.93)
Iraq deployment before follow-up 1	No	244 (57.0)	19 (4.4)	1.00	79 (18.5)	1.00	18 (4.2)	-	68 (15.9)	1.00
	Yes	124 (51.9)	10 (4.2)	1.11 (0.50, 2.47)	46 (19.3)	1.18 (0.77, 1.82)	0	-	59 (24.7)	**1.75 (1.15, 2.68)**
Combat deployment before follow-up 1 ǂ	No	111 (53.4)	8 (3.9)	1.00	41 (19.7)	1.00	0	-	48 (23.1)	1.00
	Yes	12 (40.0)	2 (6.7)	4.69 (0.70, 31.21)	5 (16.7)	1.54 (0.47, 5.06)	0	-	11 (36.7)	1.60 (0.62, 4.14)
Iraq or Afghanistan deployment between follow-ups 1 & 2	No	218 (56.6)	21 (5.5)	1.00	75 (19.5)	1.00	9 (2.3)	1.00	62 (16.1)	1.00
	Yes	150 (53.2)	8 (2.8)	0.60 (0.25, 1.44)	50 (17.7)	1.04 (0.68, 1.60)	9 (3.2)	1.45 (0.55, 3.84)	65 (23.1)	1.48 (0.97, 2.26)
Combat deployment between follow-ups 1 & 2 ǂ	No	137 (55.7)	7 (2.9)	1.00	40 (16.3)	1.00	6 (2.4)	1.00	56 (22.8)	1.00
	Yes	7 (33.3)	1 (4.8)	3.58 (0.36, 36.18)	5 (23.8)	3.07 (0.89, 10.60)	1 (4.8)	3.74 (0.35, 40.27)	7 (33.3)	2.17 (0.71, 6.61)
Probable CMD at baseline	Not a case	299 (56.2)	23 (4.3)	1.00	101 (19.0)	1.00	14 (2.6)	1.00	95 (17.9)	1.00
	Case	69 (51.1)	6 (4.4)	1.14 (0.45, 2.91)	24 (17.8)	1.02 (0.61, 1.71)	4 (3.0)	1.24 (0.39, 3.89)	32 (23.7)	1.52 (0.93, 2.48)
Probable PTSD at baseline	Not a case	366 (56.1)	27 (4.1)	1.00	122 (18.7)	1.00	17 (2.6)	1.00	121 (18.5)	1.00
	Case	2 (14.3)	2 (14.3)	**14.89 (1.98,**	3 (21.4)	4.59 (0.75,	1 (7.1)	10.02 (0.85,	6 (42.9)	**9.31 (1.77,**

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			111.62)		28.02)		117.98)		**48.96)**

± = Adjusted for sex and age (categorical)

‡ = Restricted to those who had deployed

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Table 4: Associations between the alcohol trajectories and health outcomes at follow-up 2

	Probable CMD			Probable PTSD			General health		
	Not case	Case	OR (95% CI) ±	Not case	Case	OR (95% CI) ±	Excellent/ good	Fair/poor	OR (95% CI) ±
Average drinkers (class 1)	298 (81.6)	67 (18.4)	1.00	357 (97.5)	9 (2.5)	1.00	318 (87.6)	45 (12.4)	1.00
Abstainers (class 2)	22 (75.9)	7 (24.1)	1.41 (0.58, 3.46)	28 (96.6)	1 (3.5)	1.58 (0.19, 13.06)	24 (82.8)	5 (17.2)	1.43 (0.52, 3.96)
Low level drinkers (class 3)	97 (78.2)	27 (21.8)	1.22 (0.74, 2.02)	119 (96.0)	5 (4.0)	1.76 (0.57, 5.41)	104 (83.2)	21 (16.8)	1.37 (0.78, 2.42)
Decreasing drinkers (class 4)	12 (66.7)	6 (33.3)	2.22 (0.80, 6.17)	17 (94.4)	1 (5.6)	2.15 (0.26, 18.20)	13 (76.5)	4 (23.5)	2.53 (0.78, 8.23)
Heavy drinkers (class 5)	92 (74.2)	32 (25.8)	**1.63 (1.00, 2.67)**	116 (93.6)	8 (6.5)	2.68 (0.98, 7.33)	107 (84.3)	20 (15.8)	1.46 (0.82, 2.62)

± = Adjusted for sex and age (categorical)

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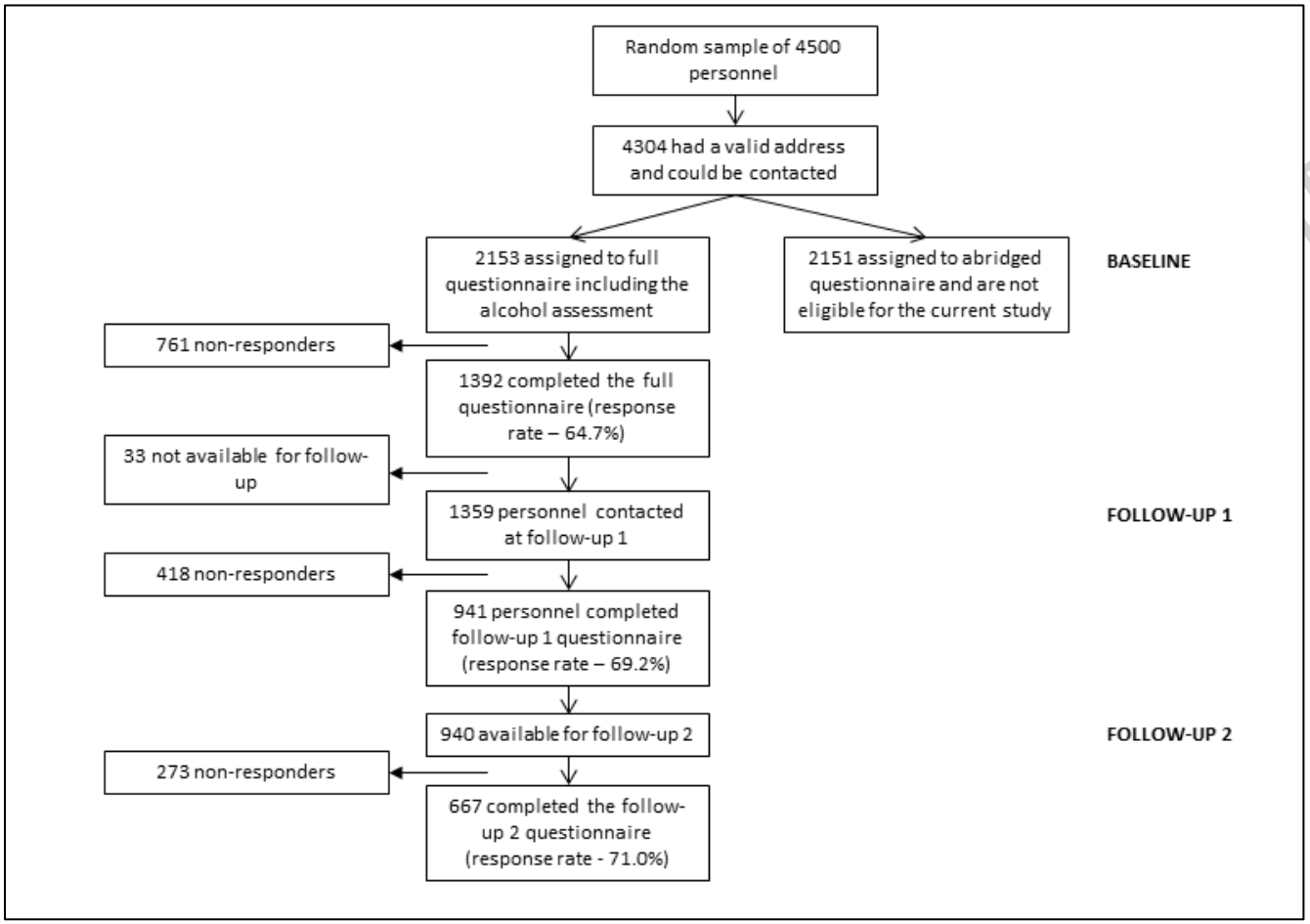
Supplemental Figure 1: Flow diagram of participant recruitment and response



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Supplemental Table 1: Comparing the baseline demographic and health factors for those who took part at all 3 phases and those who dropped out

		Participants who left the study at an earlier follow-up (n=692)	Sample for this study – completed all phases (n=667)	Chi-square (p-value)
Age (years)	<30	297 (42.9%)	229 (34.3%)	11.07 (p<0.005)
	30-34	150 (21.7%)	177 (26.5%)	
	35+	245 (35.4%)	261 (29.1%)	
Rank	Other ranks/NCOs	576 (83.2%)	527 (79.0%)	3.97 (p<0.05)
	Officers	116 (16.8%)	140 (21.0%)	
Service	Naval service	158 (22.8%)	164 (24.6%)	3.01 (p>0.05)
	Army	321 (46.4%)	326 (48.9%)	
	RAF	213 (30.8%)	177 (26.5%)	
Deployment before baseline	Not deployed	315 (45.5%)	289 (43.3%)	0.66 (p>0.05)
	Deployed	377 (54.5%)	378 (56.7%)	
Smoking	No	201 (74.4%)	472 (71.3%)	0.95 (p>0.05)
	Yes	69 (25.6%)	190 (28.7%)	
Probable CMD	Not a case	557 (80.5%)	532 (79.8%)	0.11 (p>0.05)
	Case	135 (19.5%)	135 (20.2%)	
Probable PTSD	Not a case	671 (97.0%)	653 (97.9%)	1.19 (p>0.05)
	Case	21 (3.0%)	14 (2.1%)	
General health	Excellent/good	599 (86.8%)	581 (87.5%)	0.14 (p>0.05)
	Fair/poor	91 (13.2%)	83 (12.5%)	0.14 (p>0.05)
Alcohol consumption	Mean (S.D.)	14.87 (15.51)	13.04 (14.52)	t=1.72 (p>0.05)

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Contributors: LG and RJR designed the study. LG and SN conducted the statistical analysis. LG wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

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

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Highlights

- Group trajectories of alcohol use were examined in a representative military population
- A fifth of military personnel were in a heavy drinking class
- Across four of five classes alcohol use did not decrease over an 8 year period
- Mental health problems were more common in both heavy drinkers and abstainers
- Effective alcohol interventions are required for this population

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