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Prevalence and patterns of hospital use for people with frequent alcohol-related hospital admissions, compared to non-alcohol and non-frequent admissions: a cohort study using routine administrative hospital data

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ABSTRACT

Aims This study compared prevalence and hospital use among individuals frequently admitted to hospital in England with wholly attributable alcohol-related diagnoses (WAAD), known as alcohol-related frequent attenders (ARFAs), with those of non-alcohol frequent attenders (NAFAs), non-frequent alcohol attenders (ARNFAs) and non-alcohol non-frequent attenders (NANFAs). **Design** Cross-sectional and longitudinal analyses of 5 years of England's Hospital Episode Statistics (HES). **Setting** Hospital inpatients in England, UK, 2011–16. **Participants** Two cohorts (2011/12 = 489 580/7 654 944 patients and 2015/16 = 490 384/7 660 108 patients) were selected from all adult patients aged ≥ 18 years, treated in English hospitals between 1 April 2011 and 31 March 2016. Patients were categorized as having alcohol-related admissions if diagnoses included a WAAD (ICD-10 classification, WHO, 2016) and frequent admissions if they had more than three hospital admissions during a single HES year. **Measurements** Prevalence of ARFA, number of admissions (spells), occupied bed-days (OBDs), average length of stay (ALOS) and total admission costs over 5 years were compared among ARFAs, ARNFAs, NAFAs and NANFAs. **Findings** On average, 0.7% of people admitted to hospital per annum in England 2011–15 were ARFAs and more than a quarter of all frequent attenders (for all causes) to hospitals had a wholly attributable alcohol diagnosis on admission. ARFAs had longer ALOS than the other patient groups [5.55 days versus ARNFA 4.7, NAFA 3.39 and NANFA 2.57 days, $F = 1088.37$ (3, 488 570, $P < 0.001$)] in the 2015/16 index year; but fewer spells than NAFAs [5.38 ARFAs versus 5.98 NAFAs, $F = 20\,536.25$ (3, 490 380) $P < 0.001$]. The ARFA cohort reduced in size (from 51 934 ARFAs to 20 548) in the course of 5 years. ARFAs had the highest average total cost of admissions per person over 5 years at £38 189. **Conclusions** People with repeated admissions for alcohol-related problems in England appear to be a high-cost, high-need, complex group of patients that makes up more than a quarter of the country's alcohol admissions.

Keywords Alcohol, frequent attender, HES, high-cost high-need, hospital admissions, public health.

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INTRODUCTION

Alcohol is a major global public health problem, resulting in disability, premature mortality and impacting on health, social care, welfare and criminal justice systems [1–4]. Harmful use of alcohol has been identified as one of the leading risk factors for global population health [5]. World-wide, excess alcohol consumption results in approximately 3 million deaths every year (5.3% of all deaths) and 132.6 million disability-adjusted life-years [5]. Alcohol is known to be a causal factor in more than 200 disease and injury-related conditions [6], and increased levels of consumption are associated with risk of developing health problems including alcohol dependence, liver cirrhosis, cancers and injuries [7–9]. The highest levels of alcohol consumption per capita are within Europe [5].

In 2017, the estimated proportion of adults in the UK general population drinking at increased or higher risk of harm was 28% of men and 14% of women; 1.34% of adults in England were estimated to have alcohol

dependence [10]. In UK hospitals, it is estimated that 19.76% [95% confidence interval (CI) = 15.61–24.26%] of all inpatients have an alcohol use disorder and 10.25% (95% CI = 7.06–13.96%) are dependent on alcohol, with rates of alcohol use disorders varying more than twofold by inpatient setting from 36.21% (95% CI = 15.35–60.21%) in mental health inpatient units to 16.10% (95% CI = 13.87–18.45%) in general medical or surgical wards [11].

The impact of alcohol on emergency room attendance has been documented, including Scotland [12], England [13,14], Germany [15], Australia [16] and the United States [17,18]. Patients may attend for just a few hours for an alcohol-attributable accident or injury or intoxication, or may remain longer as part of their pathway in to a more complex inpatient stay. In terms of hospital admissions, RCTs and qualitative studies from the United Kingdom suggest that there is a group of patients who are frequently admitted to hospital because of alcohol, due to the chronic relapsing nature of alcohol dependence, high levels of chronic and physical mental health, injuries caused by alcohol and general life-style-related health problems (tooth decay and malnutrition) [19–21]. Of all attendances to UK accident and emergency (A&E) departments, 1–2% are made by 'frequent attenders' (who also use other health and social care facilities frequently) and, of those, 7% frequently attend because of an alcohol-related reason [22,23]. This is a familiar patient group for most emergency room staff: 21 hospitals in England have specific clinical pathways for people who frequently attend hospital because of alcohol (alcohol-related frequent attenders, ARFAs) [24], but there is no single definition in terms of the number of visits to hospital a patient must have to be classified as a frequent attender. Recent years have seen a greater relative increase in hospital admissions from alcohol compared to non-alcohol-attributable admissions [25]. The true prevalence of alcohol-related conditions in UK hospitals is thought to be many times greater than published statistics suggest [11]. Estimates suggest that over 5 years the National Health Service (NHS) will incur £17 billion in costs related to alcohol misuse [26].

This study aimed to assess the prevalence of 'frequent hospital admissions' in England due to alcohol and investigated patterns of health service use, prior to and subsequent to episodes of frequent hospital admission for alcohol by analysing longitudinal admissions data from national Hospital Episodes Statistics (HES).

METHODS

A 5-year data set, including records of all adult people admitted to hospital (HES) in England between 2011–16, was obtained from NHS Digital through the Data Access Request Service. The data set was analysed in three ways:

1 A cross-sectional analysis of prevalence of alcohol and frequency of admissions during the 5-year period.
2 Longitudinal analysis of health service use in the 5 years prior to becoming an alcohol-related frequent attender.
3 Longitudinal analysis of health service use and estimate of costs in the 5 years after becoming an alcohol-related frequent attender.

Participants/cases

Included in the data set were: all adult patients aged 18 years or over who were treated in English hospitals between 1 April 2011 and 31 March 2016 and whose hospital episode data were captured, complete and valid on NHS Digital's HES database. An alcohol-related admission was defined as the presence of one of 34 wholly attributable alcohol-related diagnosis (WAAD) as defined by ICD-10 classification [6] within any of the 20 diagnostic fields in the HES data (see Supporting information, Appendix S1) [27]. For the purposes of this analysis, an attendance or admission was counted if it involved an inpatient stay (which could be less than 24 hours' duration, but is recorded as inpatient rather than a visit to an accident and emergency department, an outpatient department or even a prolonged assessment where no inpatient stay has occurred).

All admitted patients were categorized into one of four patient groups (in any given year), depending upon whether they had had an alcohol admission during the year and whether they had three or more admissions to hospital during that year: alcohol-related frequent attenders, ARFA (WAAD plus $>$ 2 admissions); non-alcohol-related frequent attenders, NAFA (no WAAD but $>$ 2 admissions); alcohol-related non-frequent attender, ARNFA (WAAD but $\leq$ 2 admissions); or non-alcohol-related, non-frequent attender, NANFA (no WAAD and $\leq$ 2 admissions).

Cross-sectional analysis of the prevalence of alcohol-related and frequent admissions

Cross-sections of the entire national data set for each year were analysed using Microsoft SQL Server Management Studio. Between 2011/12 and 2015/16, all patients in the data set were categorized using the classification described above, and the prevalence of patients in each of the four groups was calculated for each year (rates per 10 000 admitted patients in England). Within those years HES data ranged from being 99.8–99.9% complete after the removal of poor-quality data. Prevalence of WAAD among all admitted patients was calculated for 2015/16 (rates per 10 000 admitted patients).

Longitudinal analysis of health service use prior to becoming an alcohol-related frequent attender

Longitudinal analyses of the 2015/16 cohort were undertaken in Stata version 12 MP by tracking a sample of patients back to 2011/12. Total sample size was based on the largest overall cohort size that could be analysed in practice within Stata version 12 MP, with a 1 : 3 ratio of index group (ARFAs) to each of the controls (ARNFAs, NANFAs, NAFAs) where possible. Missing data were estimated to be less than 6.0%, therefore the data were analysed in entirety, with no corrections or estimations to account for missing data.

All ARFAs and ARNFAs were included. Although the number of patients in the ARNFA group fell slightly short of the intended 3 × index group size, this was the entire national sample. Using Microsoft SQL Server Management Studio, a random sample of 150 000 patients from each of the NAFA and NANFA groups was selected. Randomization was achieved by allocating each individual patient within those groups a new row identification number (*NEWID* function) and then selecting 150 000 rows at random from each of the two groups. The make-up of the final 2015/16 cohort is summarized in Table 1 and consisted of 490 384 patients.

Longitudinal analysis of health service use after becoming an alcohol-related frequent attender and estimate of costs

Longitudinal analyses of the 2011/12 cohort were undertaken in Stata version 2 MP by tracking a sample of patients to 2015/16. The total sample size was based on the largest overall cohort size that could be analysed in practice within Stata version 2 MP, with a 1 : 3 ratio of index group (ARFAs) to each of the controls (ARNFAs, NANFAs, NAFAs) where possible. Missing data were estimated to be less than 6.0% and therefore the data were analysed in entirety with no corrections or estimations to account for missing data.

All ARFAs and ARNFAs were included. Using the same method as for the 2015/16 cohort described above, a random sample of 150 000 patients from each of the NAFA and NANFA groups was selected. The make-up of the final 2011/12 cohort is summarized in Table 1 and consisted of 489 580 patients.

Statistical analysis

Within each of the 2011/12 and 2015/16 cohorts, occupied bed-days (OBDs), average length of stay (ALOS) and mean number of spells were compared between ARFAs and the other three patient groups within each year using analysis of variance (ANOVA), including a Bonferroni correction for multiple comparisons. In addition, for the 2015/16 cohort, ALOS was compared between chronic ARFAs (those with a previous history of ARFA in the preceding 4 years) and new ARFAs (ARFAs for the first time in 2015/16).

Costs of the 2011 cohort over the subsequent 5-year period were estimated for each of the four patient groups using NHS reference costs (calculated average unit cost to the NHS of providing secondary health care to NHS patients each year [28–32] and additional costs for excess bed-days (days stayed beyond the expected length assumed in reference costs; in 2015 this was £306 per day) were included. Mean cost per person in each of the four patient groups (as defined in the index year) was derived and results for ARFAs compared to ARNFA, NAFA and NANFA groups.

Research permissions and sponsorship

The study uses pseudonymized annual data from the England national HES database obtained through NHS Digital data access request service (DARS), accessed by

Table 1 Summary of the cohorts and sampling

	2011/12 cohort		*2015/16 cohort*	
	No. of patients included in the sample (% by patient group)	*% All patients in the 2011/12 national data set meeting the inclusion criteria and included in the sample*	*No. of patients included in the sample (% by patient group)*	*% All patients in the 2015/16 national data set meeting the inclusion criteria and included in the sample*
ARFAs[a]	51 934 (10.6)	100	54 369 (11.1)	100
ARNFAs[b]	137 646 (28.1)	100	136 015 (27.7)	100
NAFAs[c]	150 000 (30.6)	13.9	150 000 (30.6)	12.6
NANFAs[d]	150 000 (30.6)	0.025	150 000 (30.6)	0.024
Total	489 580 (100)	6.81	490 384 (100)	6.41

[a]Alcohol-related frequent attenders, ARFA (WAAD plus > 2 admissions); [b]alcohol-related non-frequent attender, ARNFA (WAAD but ≤ 2 admissions); [c]non-alcohol-related frequent attenders, NAFA (no WAAD but > 2 admissions); [d]non-alcohol-related, non-frequent attender, NANFA (no WAAD and ≤ 2 admissions). WAAD = wholly attributable alcohol-related diagnoses.

South London and the Maudsley NHS Trust. South London and the Maudsley NHS Trust was data controller and sole data processing site. Sponsorship for the study was provided by King's College London Research and Development Office (IRAS no. 199295). The analysis plan was not pre-registered; as such, the results should be considered exploratory.

RESULTS

Cross-sectional analysis of alcohol-related frequent attenders in England

In 2015/16, of a total 7 654 944 patients admitted to hospital, 54 369 ARFAs, 136 015 ARNFAs, 1 187 312 NANFA and 6 277 248 NAFA were identified. The prevalence of patients within each group by year per 10 000 admissions is shown in Table 2. The prevalence of WAAD among admissions in 2015/16 was 248.7 per 10 000 admitted patients.

From 2011 to 2015, between 50 000 and 55 000 ARFAs were admitted to hospital each year, equivalent to a prevalence rate of approximately 70 per 10 000 (0.7%) people admitted. Rates of alcohol-related frequent attending remained fairly static throughout the 5 years, rising by 1.48% across the 5-year period (compared to 3.2% rise in overall hospital admissions in the same period). In 2011/12, ARFAs made up 27% of all alcohol attenders and 5% of all frequent attenders.

Assessment of health service use prior to becoming an alcohol-related frequent attender

Of the 54 551 ARFAs in the 2015/16 cohort, 36.2% had a chronic history of ARFA. Even among new ARFAs, more than half had had a previous admission for a WAAD in the previous 4 years. As shown in Fig. 1, 5841 patients (10.7%) from the 2015/16 ARFA cohort were traced back to being ARFAs each year from 2011.

ARFAs identified in 2015/16 had an ALOS of 5.55 days in 2015/16, which was longer than all other patient groups in the same year [ARNFA 4.70, NAFA 3.39, NANFA 2.57 days, $F = 1088.37$ (3488570) $P < 0.001$], see Table 3. New ARFAs in 2015 had an ALOS of 4.46 days compared to 4.58 days for people who had been ARFAs prior to 2015. This was not a statistically significant difference in mean length of stay. Frequently attending patients (NAFAs and ARFAs) in 2015/16 had a statistically significant greater number of mean spells per year than non-frequently attending groups; see Table 4, in the years prior to the index year. NAFAs had more spells on average per year than ARFAs.

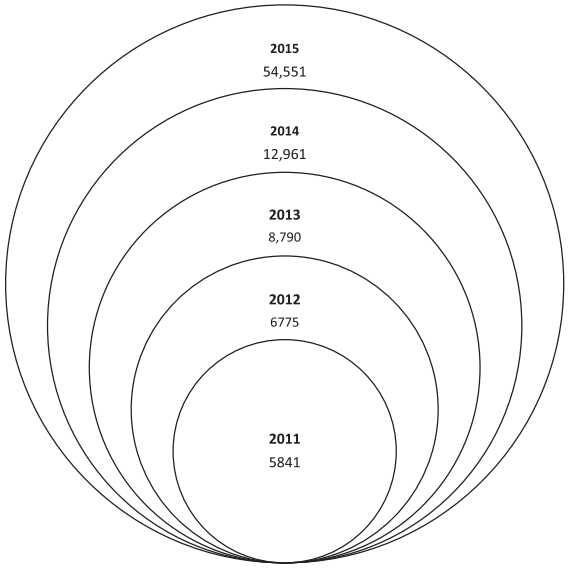

Figure 1 Number of alcohol-related frequent attenders (ARFAs) in the 2015/16 cohort who were also ARFAs in all the previous years

Assessment of health service use after becoming an alcohol-related frequent attender

In 2011, although ARNFAs had a slightly longer ALOS than ARFAs, this was not a statistically significant difference (4.90 versus 5.01 days ARNFA, 3.13 days NAFA and 2.47 days NANFA); see Table 5. The 2011 ARFA cohort had statistically significant and consistently longer average lengths of stay than the three other patient groups

Table 2 Rate of alcohol-related admissions and frequent attending among all hospital admission in England 2011/12–2015/16 per 10 000 admissions

	2011/12	*2012/13*	*2013/14*	*2014/15*	*2015/16*
ARFAs[a]	72.252	69.793	71.260	69.744	71.025
ARNFAs[b]	191.498	186.031	187.423	178.116	177.683
NAFAs[c]	1499.829	1506.836	1521.701	1540.425	1551.039
NANFAs[d]	8236.421	8237.339	8219.616	8211.715	8200.253

[a]Alcohol-related frequent attenders, ARFA (WAAD plus > 2 admissions); [b]alcohol-related non-frequent attender, ARNFA (WAAD but ≤ 2 admissions); [c]non-alcohol-related frequent attenders, NAFA (no WAAD but > 2 admissions); [d]non-alcohol-related, non-frequent attender, NANFA (no WAAD and ≤ 2 admissions). WAAD = wholly attributable alcohol-related diagnoses.

Table 3 Average length of hospital stay (days) for the 2015/16 ARFA cohort, compared to other groups in index and preceding years

	2015/16	*2014/15*	*2013/14*	*2012/13*	*2011/12*
ARFA[a]	5.55	4.84	4.58	4.62	4.47*
ARNFA[b]	4.70	5.81	5.80	5.67	5.00*
NAFA[c]	3.39	2.96*	2.87**	2.80_b	2.72_a
NANFA[d]	2.57	3.14*	3.31**	3.20_b	2.85_a
Bonferroni multiple comparison test for difference in means	$F = 1088.37$ (3, 488 570) $P < 0.001$	$F = 285.89$ $P < 0.001$ (3, 213 923)	$F = 85.45$ $P < 0.001$ (3, 179 715)	$F = 41.34$ $P < 0.001$ (3, 160 679)	$F = 114.36$ $P < 0.001$ (3, 148 154)

Values within year are significantly different $P < 0.001$ unless stated otherwise: *$P < 0.05$; **$P < 0.02$. Same subscripts (a,b) indicate where values are not significantly different from each other. [a]Alcohol-related frequent attenders, ARFA (WAAD plus > 2 admissions); [b]alcohol-related non-frequent attender, ARNFA (WAAD but ≤ 2 admissions); [c]non-alcohol-related frequent attenders, NAFA (no WAAD but > 2 admissions); [d]non-alcohol-related, non-frequent attender, NANFA (no WAAD and ≤ 2 admissions). WAAD = wholly attributable alcohol-related diagnoses.

Table 4 Mean number of spells per year for the 2015/16 ARFA cohort, compared to other groups in index and preceding years

	2015	*2014*	*2013*	*2012*	*2011*
ARFA[a]	5.38	5.97	5.79	5.55	5.64
ARNFA[b]	1.31	1.42_a	1.40_b	1.39_c	1.39_d
NAFA[c]	5.98	8.27	8.00	7.68	7.33
NANFA[d]	1.24	1.31_a	1.29_b	1.29_c	1.28_d
Bonferroni multiple comparison test for difference in means	$F = 20\,536.25$ (3, 490 380) $P < 0.001$	$F = 8854.23$ (3, 214 905) $P < 0.001$	$F = 7070.63$ (3, 180 366) $P < 0.001$	$F = 6248.30$ (3, 161 202) $P < 0.001$	$F = 5688.97$ (3, 148 567) $P < 0.001$

Same subscripts (a–d) indicate where values are not significantly different from each other. Values within year are significantly different ($P < 0.001$) unless stated otherwise. [a]Alcohol-related frequent attenders, ARFA (WAAD plus > 2 admissions); [b]alcohol-related non-frequent attender, ARNFA (WAAD but ≤ 2 admissions); [c]non-alcohol-related frequent attenders, NAFA (no WAAD but > 2 admissions); [d]non-alcohol-related, non-frequent attender, NANFA (no WAAD and ≤ 2 admissions). WAAD = wholly attributable alcohol-related diagnoses.

for all years subsequent to the index year. Between 2011 and 2016 ALOS for ARFAs increased from 4.90 days to 6.42 days in contrast to ARNFAs, which reduced, and NAFAs and NANFAs, which remained relatively static.

A plot of the change in OBDs prior to becoming an ARFA for the 2015 cohort and decay in OBDs subsequently for the 2011 ARFA cohort is shown in Fig. 2. The plot shows a sharp increase in activity in the year preceding becoming an ARFA and ensuing sharp reduction in ARFA activity following the index year.

Relative costs of health service use by alcohol-related frequent attenders

ARFAs had the highest average total cost of admissions per person over 5 years at £38 189, followed by NAFA at £32 714, ARNFAs £9837 and NANFAs £6743. ARFAs made up 0.7% of all patients in the 2011 national cohort, ARNFAs 1.9%, NAFAs 15% and NANFAs 82.4%. However, in terms of share of total inpatient costs in 2011, ARFAs were 2.8% of costs, ARNFAs 1.5%, NAFAs 53.7% and NANFAs 42.1%, showing ARFAs to be the cost-intensive patient group with a ratio of percentage cost: percentage patients of 4.0, followed by NAFAs at 3.6, ARNFAs at 0.8 and NANFAs at 0.5. Taking into account the size of each of the four patient groups on a national basis, extrapolating these figures to include all patients admitted in England in 2011 estimates that the cost for 1 year for all ARFAs was £764 million on inpatient admissions, which was higher than the costs for all other alcohol (ARNFA) admissions at £392 million, but lower than the total costs for NAFAs (£14 billion) and NANFAs (£11 billion). Estimated share of total inpatient costs in 2011 were ARFAs 2.8%, ARNFAs 1.5%, NAFAs 53.7% and NANFAs 42.1%.

DISCUSSION

Cross-sectional analysis of prevalence

The European Union defines rare diseases as those affecting fewer than five per 10 000 people [33]. While ARFA is not a disease in its own right, our prevalence figures suggest this is certainly not a rare condition. Our estimate of prevalence of WAAD is low compared to other studies included in a meta-analysis [11]; however, those estimates were deemed to be below quality according to

Table 5 Trends in average length of hospital spell (days) for the 2011/12 cohort, compared to other groups in index and subsequent years

	2011	*2012*	*2013*	*2014*	*2015*
ARFA[a]	4.90_{a}	4.76	6.02	5.88	6.42
ARNFA[b]	5.01_{a}	4.47	4.66_{b}^{*}	3.56_{cd}	3.41_{ef}
NAFA[c]	3.13	3.34^{*}	3.83_{b}^{**}	3.67_{c}^{*}	$3.88_{e}^{\dagger}$
NANFA[d]	2.47	2.98^{*}	$3.05^{*,**}$	2.55_{d}^{*}	$2.68_{f}^{\dagger}$
Bonferroni multiple comparison test for difference in means	$F = 2250.41$ (3, 487 785) $P < 0.001$	$F = 377.64$ (3, 208 435) $P < 0.001$	$F = 158.34$ (3, 177 654) $P < 0.001$	$F = 126.11$ (3, 160 351) $P < 0.001$	$F = 79.69$ (3, 147 108) $P < 0.001$

Values within year are significantly different, $P < 0.001$, unless stated otherwise: $^{*}P < 0.005$; $^{**}P < 0.02$; $^{\dagger}P < 0.05$. Same subscripts (a–f) indicate where values are not significantly different from each other. [a]Alcohol-related frequent attenders, ARFA (WAAD plus > 2 admissions); [b]alcohol-related non-frequent attender, ARNFA (WAAD but ≤ 2 admissions); [c]non-alcohol-related frequent attenders, NAFA (no WAAD but > 2 admissions); [d]non-alcohol-related, non-frequent attender, NANFA (no WAAD and ≤ 2 admissions). WAAD = wholly attributable alcohol-related diagnoses.

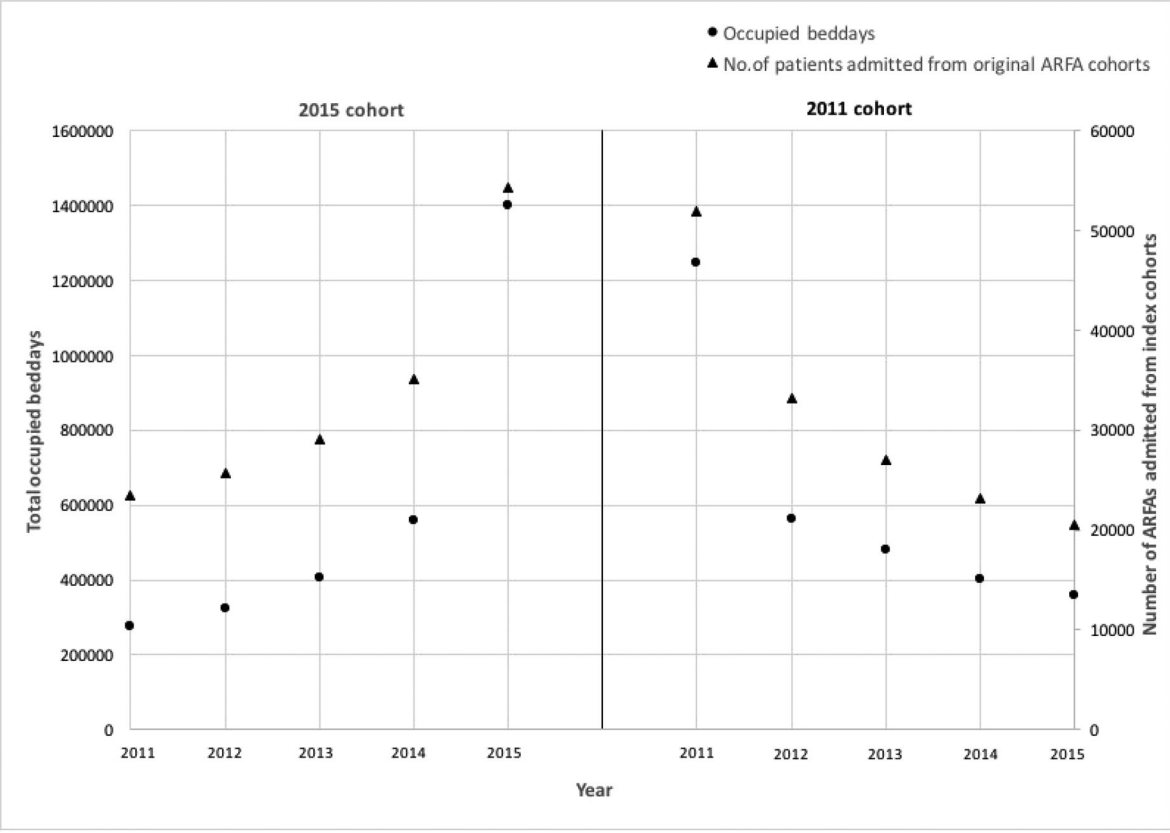

Figure 2 Plot of number of alcohol-related frequent attenders (ARFAs) from 2011 and 2015 index cohorts admitted each year and total ARFA occupied bed-days each year

Grading of Recommendations Assessment Development and Evaluation framework.

Health service use prior to becoming an alcohol-related frequent attender

While the majority of ARFAs did not have a prior history of frequently attending for alcohol, more than half had had an admission for alcohol in the previous 4 years. The possibility of future frequent admissions should be considered in any patients presenting for alcohol-related admissions.

Overall, increasing ALOS and frequency of admission were seen during the 5 years prior to patients becoming ARFAs, suggesting a crescendo of the complexity of health problems culminating in more frequent admissions. In the index year, compared to the previous year, an increase in ALOS for ARFAs coincided with a decrease in ALOS for

ARNFAs, suggesting a transition from ARNFA status to ARFA.

Differences observed in patterns of attending prior to becoming an ARFA suggest that, alcohol diagnoses aside, ARFAs have a different health profile compared to other frequent attenders and should be regarded as a distinct group with distinct needs. This difference is emphasized by the comparison of OBDs, with an average ARFA accounting for more than 10 additional bed-days per year per person compared to an average NAFA. This reinforces the point that the longer ALOS for an ARFA has a significant impact on the burden borne by the NHS of frequently attending patients, even though NAFAs are admitted more frequently on average than ARFAs.

Health service use and costs after becoming an alcohol-related frequent attender

Following an ARFA diagnosis, ALOS increased for ARFAs (in contrast with the other patient groups) despite the size of the ARFA cohort declining, meaning that fewer patients were having longer stays. Contributing factors are likely to include: increasing complexity of patients, increasing severity of chronic illness and increasing complexity of social situation resulting in delayed discharge. The reduction in ALOS for ARNFAs during the corresponding time-period suggests a different clinical picture for ARFAs compared to ARNFAs. From 2012 onwards, the ARNFA cohort mean number of spells increased each year to above the threshold for becoming an ARFA. This perhaps supports the explanation of a shift in characteristics of the ARFA group over time, showing a transition between ARNFA to ARFA.

Reasons for the sudden drop in ARFA activity (OBDs) following the index year could be due to deaths within the cohort or improvement in health status within the cohort (reducing the need for hospital admission); however, the increase in mean OBDs per person suggests that the remaining members of the cohort are spending more time in hospital each year, and deaths may therefore be the more likely explanation for reduced activity among the ARFA cohort. The rise and subsequent fall in health-care activity mirrors that seen in previous studies pre- and post-treatment for substance misuse disorder [34].

Equally, ARFAs could be accessing treatments elsewhere, such as local community-based alcohol services or assertive outreach treatment (AOT) services, and activity in these types of services is not included within HES. These services have demonstrated reductions in emergency department attendances, hospital stays and admissions [13,21]. If ARFAs were accessing such services, then it could be feasible that the reduction in OBDs seen for the 2011 ARFA cohort is merely the shift in care burden from hospital inpatient services to community-based services. Applying average case-load figures for AOT services [13] to each of the 76 assertive outreach treatment services in England [35], 4104 people could receive AOT, and combined with findings from our study we estimate that this could equate to 241 320 fewer OBDs (7.9% reduction) throughout the 5-year study period. In our study, we found a larger reduction throughout the 5-year period, so take-up into AOT, even if offered across England, cannot explain attrition in the 2011 cohort: death or remission must also play a part.

A substantial proportion of dependent drinkers are known to recover without treatment [34,36], and estimates range from 46% of men with alcohol abuse [37] to 82% heavy and dependent drinkers [36] remitting without treatment. Therefore, if the upper estimate of natural remission among dependent drinkers also applies to the dependent drinkers among ARFAs we can assume that 82% or 11 072 people would have recovered better without treatment. Given the complexity of ARFAs from a mental and physical health viewpoint, it may well be too grandiose an assumption to make that ARFAs could recover without any clinical input.

In relation to the average costs per patient group, although nationally the number of ARNFAs outweighs ARFAs by almost 3 : 1, the overall cost of the ARFA group is almost double that for ARNFAs. This is because ARFAs have more frequent admissions than ARNFAs and have longer ALOS, due to their complexity. ARFAs can therefore be described as being higher-cost and higher-need than other (non-frequent) alcohol admissions.

One of the main strengths of the study was the use of a very large sample: the England national data set provides information on all inpatient admissions to NHS hospitals in England for the 5 years included in the studies. The data set is rich with details of not only primary presenting problems, but up to 19 additional secondary diagnoses coded from a single dictionary (ICD-10). The data set is very complete because it is the data set used to calculate payments to hospitals for the care they have delivered and because the vast majority of health care in the United Kingdom is NHS-delivered [38]. Cases and controls came from within the same data set, reducing the potential for bias. By drawing patient group samples from the national (England) hospital records this meant that the entire ARFA populations of 2011/12 and 2015/16 could be included, as well as the entire ARNFA populations. There is therefore no doubt that these groups are representative of the all-England picture, and this study provides accurate estimates of the prevalence and incidence of ARFAs. Even if patients relocate within England, their hospital data will still be captured and linked to their record, which adds to the data set's completeness. This is also the first study that attempts to document the number of new ARFAs in England each year, as well as providing insight into health service usage for chronic ARFAs.

A limitation of the cost estimates for ARFAs and ARNFAs is that they only take into account the costs associated with admissions for people who had a WAAD. If partially attributable conditions were also taken into account, a much greater share of the overall inpatient NHS costs would be borne by ARFAs and ARNFAs than currently. Costs included do not take into account mental health inpatient, community health, ambulance, outpatient or emergency department costs. Without investigating deaths outside hospital, we cannot be sure why the ARFA cohort declined in size during the study period, and this is a limitation.

This study adds to the growing body of literature that ARFAs are a high-cost, high-need, complex group of patients who make up a not-insignificant part of England's hospital admissions.

Declaration of interests

None.

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Author contributions

Rosalind Ann Blackwood: Conceptualization; formal analysis; investigation; writing-original draft. **Michael T. Lynskey:** Formal analysis; investigation; supervision; writing-review & editing. **Colin Drummond:** Conceptualization; investigation; supervision; writing-review & editing.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix S1 Conditions identified as being wholly attributable to alcohol and their ICD10 diagnostic codes; Jones, Bellis (2013)

