



CONTRIBUTIONS OF ALCOHOL USE TO TEENAGE PREGNANCY AND SEXUALLY TRANSMITTED INFECTION RATES

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Executive summary

Introduction

Teenage binge drinking is a growing concern, with adolescents in the United Kingdom (UK) ranked in the top five of thirty countries for measures of alcohol misuse. Studies from the United States indicate a strong relationship between alcohol misuse, precocious sexual behaviour, and teenage pregnancy. While UK data are sparse, a relationship has been detected between teenage conceptions and teenage hospital admission rates for alcohol harm (Bellis et al., 2009¹). Data available at that time precluded analysis of associations between alcohol and teenage pregnancy at the lowest geographical level. In this study we have utilised data at the lowest level possible for each indicator. Where available, this report uses data at the level of the Lower Super Output Area (LSOA), a geographical unit with an average population size of 1500 people. For remaining datasets, middle super output area (MSOA, average population 7200) was used. Together, these provide a more comprehensive picture of the relationships between alcohol misuse and teenage pregnancy. The recent availability of disaggregate data on sexually transmitted infections (STIs) has facilitated further analyses exploring the relationship between alcohol and sexual infections.

Methods

Datasets

Alcohol and sexual health indicators were based on the lowest level geographical data available, and covered the whole of England. Routinely collected data on alcohol hospital admissions (as a proxy for alcohol misuse) at an LSOA/MSOA level was used to predict

teenage pregnancy and sexual infections. Analyses controlled for the Income Deprivation Affecting Children Index (IDACI). For relationships between alcohol misuse and teenage pregnancy, analyses used data for 15-17 year olds. For STI analyses, data were provided in 5 year age bands, thus restricting our analyses to the number of infections documented in 15-19 year olds. Two sources of data on teenage pregnancy were available: i) a ward-level dataset of teenage conceptions (including abortions and births) between 2005 and 2007 was provided by the Office for National Statistics (ONS) and converted to estimated rates for middle super output areas (MSOA); and ii) numbers of young women aged under 18 years who delivered either a live or still birth (i.e. pregnancies that did not result in an abortion) were extracted from hospital episode statistics (HES) for the year 2008 and available for LSOAs. LSOA-level STI data were derived from the Genito-Urinary Medicine Clinic Activity Dataset (GUMCAD), and, for chlamydia, these were combined with data from the National Chlamydia Screening Programme (NSCP) for the year 2008. Alcohol-attributable hospital admissions (including those both wholly and partly caused by alcohol) were available at LSOA-level for the financial year April 2008 to March 2009 from HES. Data on young people seeking treatment for misuse of drugs and/or alcohol during the financial years 2007/08 and 2008/09 were obtained from the National Treatment Agency (NTA). These were supplied at postcode sector level and converted to estimated rates for MSOAs.

Analysis

Geographical information systems software was used to identify statistically significant clusters of teenage risk indicators. Teenage conception rates at MSOA level (n=6781)

¹ Bellis MA et al., (2009). Contributions of alcohol use to teenage pregnancy: An initial examination of geographical and evidence based associations. Liverpool John Moores University, Liverpool.

were used as the outcome variable in multiple regression, with IDACI scores and alcohol-attributable hospital admission rate as predictor variables. Analysis of STIs and births to teenage girls was carried out at the level of LSOA (n=32482). At this level, adverse outcomes (STIs and births to teenage girls) and predictors (alcohol hospital admissions) were relatively rare, therefore LSOAs were classified in binary form (one or more outcomes versus no outcomes). IDACI scores and LSOA population sizes were also categorised and used as control variables in the analysis. Chi-square was used to describe univariate relationships, while logistic regression was used to identify independent effects of an area's alcohol admissions on sexual health outcomes.

Results

Inspection of hotspots (statistically significant clumping) revealed overlapping risk indicators, especially in urban more deprived areas. At the MSOA level, teenage conception data (including abortions and births) were found to be linearly related to the number of hospital admissions ($p<0.001$), after controlling for the effect of childhood deprivation. At LSOA level, chlamydia was the most common adverse sexual health outcome (59% LSOAs had one or more female diagnoses, and 29% had one or more male diagnoses). A quarter of LSOAs had one or more births to teenage girls. STIs other than chlamydia were less common both in the female (warts 15%; herpes 4.7%; gonorrhoea 2.5% of LSOAs) and in the male (warts 6.3%; herpes 1.0%; gonorrhoea 1.6%) population. Univariate analysis revealed the expected strong relationship between the size of the 15-19 year population and the probability of an adverse outcome, as well as a strong relationship between deprivation and poor sexual health outcomes. After controlling for these factors, the occurrence of at least one alcohol-attributable hospital admission in

females was found to predict the occurrence of one or more births to teenage girls (adjusted odds ratio, AOR=1.29, 95% confidence intervals, 95%CI, 1.22-1.37, $P<0.001$), female and male chlamydia diagnoses (female AOR=1.25, 95%CI 1.19-1.31; male AOR=1.18, 95%CI 1.12-1.24, $P<0.001$) and female and male diagnoses of genital warts (female AOR = 1.20, 95%CI 1.18-1.28; male AOR = 1.16 95%CI 1.06-1.27, $P<0.05$). Independently and additionally, male alcohol-attributable admission to hospital also predicted births to teenage girls (AOR=1.23, 95%CI 1.17-1.30, $P<0.001$), female and male chlamydia diagnoses (female AOR=1.12, 95%CI 1.07-1.17; male AOR=1.21, 95%CI 1.15-1.27, $P<0.001$), female and male diagnoses of clinical warts (female AOR=1.14, 95%CI 1.07-1.22; male AOR=1.23, 95%CI 1.12-1.34, $P<0.001$) and sexual infections in both sexes (any STI in a female: AOR=1.13, 95%CI 1.08-1.19; in a male: AOR=1.18, 95% CI 1.13-1.24, $P<0.001$). Patterns for herpes and gonorrhoea were less clear due to the relative rarity of these conditions at LSOA level.

Discussion

There was an association between alcohol-attributable hospital admissions in both males and females with teenage pregnancy, even after controlling for the overriding and strong effect of deprivation. The same was true of the more common sexually transmitted infections. Hotspots of high rates of teenage conceptions, sexual infections and alcohol admissions illustrated the expected patterns of overlapping risk indicators in urban more deprived areas, particularly in the north of England. However, in some areas (particularly those that are less urban) hotspots did not coincide. The reason for these isolated high levels of individual risk indicators would merit further investigation.

Limitations of the methodology included that it was an area-based analysis; that alcohol

misuse was measured by a proxy (alcohol admissions) with hospital admissions representing the 'tip of the iceberg'; sexually transmitted infections data were influenced by differences in access to sexual health services and the extent to which the National Chlamydia Screening Programme has been implemented; and that complete coverage of teenage conception rates (including abortions) was interpolated from ward and suppressed ward-level data. Despite these, this study had the strength to link harmful outcomes in relation to both alcohol and sexual health at small geographies. Each LSOA has about 50 males and 50 females in the target age (15-19 years). For any given level of deprivation, an LSOA with one or more young people admitted with an alcohol-related condition was around 20% more likely to record a birth to a teenage girl.

Good quality disaggregated STI data have only recently become available for the whole of England, and this study has made use of these to demonstrate that there is also a link between alcohol misuse and sexual infections. For the more prevalent STIs (chlamydia and genital warts), the odds of an LSOA having one or more infections were around 20% higher if that LSOA also had one or more alcohol hospital admissions, after controlling for deprivation.

Subdivision by gender showed that both male and female alcohol admissions predict births to teenage girls. Likewise, both female and male alcohol admissions predict chlamydia in males as well as females.

It would be useful to conduct repeated analyses on teenage pregnancies and sexually transmitted infections over future years to examine trends. The modelling of such data could alert local policy makers to current and potential hotspots and facilitate examination of aspects of service delivery, for example, distance from the nearest contraceptive and

sexual health service. Of particular interest would be the further examination of the local causes of high teenage pregnancy rates (hotspots), including potential peer pressure and social norms; for example, when a number of adolescent girls from the same school become pregnant together. Few studies have explored these types of social factors, or what types of prevention is required to counter them.

Recommendations

- These results should be used to demonstrate to key stakeholders the relationship between alcohol misuse and poor sexual health outcomes, and the urgent need for the integration of health services for young people. It should be routine for professionals to address sexual health and alcohol issues simultaneously.
- Campaigns/services that aim to address teenage conception should include alcohol consumption in young men as well as young women, since alcohol misuse in both sexes independently predicts teenage pregnancy and sexual infections.
- Analysis should be routinely repeated sequentially in future years to capture trends over time, and identify change linked with local policy.
- Future studies could use three years' worth of data for sexual infections to enable calculation of more accurate rates.
- Attention needs to be paid to local factors that may play a role in enhancing risk of conception among groups of young people, and there is a need to investigate the dynamics of hotspots of high rates.
- Areas with overlapping hotspots for both sexual ill-health and alcohol should be compared to those with hotspots for single indicators to gain some insight as to why the relationship between alcohol harm and sexual ill-health differs between areas.

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Introduction

Alcohol misuse among young people in the United Kingdom (UK) is a growing concern. Adolescents in the UK aged 15 to 16 years are ranked in the top five of thirty countries for most measures of alcohol misuse (Hibell et al., 2009). In 2008, half (52%) of 11-15 year olds surveyed in England reported drinking alcohol (Fuller et al., 2009). While this is a decrease from 61% in 2003, between 2007 and 2008 quantities consumed rose by 15% to 14.6 units per week with the greatest rise in 11-13 year old girls (63%). Furthermore, between 2002/03 and 2006/07, hospital admission for alcohol-specific² conditions in those aged under 18 years in England rose from 49 to 64 per 100,000 for males and 58 to 80 per 100,000 for females (Bellis et al., 2009). Adolescent sexual health is also an increasing concern. Rates of teenage pregnancy in the UK are the highest in Western Europe (DH, 2009) and more than a quarter of young people in Britain have had sex before the age of 16 years (Wellings et al., 2001). The former Government invested heavily in interventions to reduce the rate of teenage pregnancy, and set an ambitious target of a 50% reduction from a baseline of 1998 rates by 2010 (DCSF and DH, 2010). Despite this, rates remain stubbornly high: figures for England indicate that between 1998 and 2008 there was only a 13% decrease in rates of under 18 conceptions; and an 12% drop in the under-16 rate (DH, 2010). Rates of sexually transmitted infections (STIs) in the UK have risen dramatically since 1997, and the highest proportion was found in young people aged 16 to 24 years old. In fact, young people

accounted for half of all STIs diagnosed in genitourinary medical (GUM) clinics in 2007, while representing only 12% of the population (Health Protection Agency, 2008).

The association between alcohol consumption and sexual behaviours has been identified by a wide range of studies both in the UK and abroad. Early regular alcohol consumption has been found to be associated with early onset of sexual activity (Robertson & Plant, 1988; Fergusson & Lynsky, 1996), with any amount of current drinking by teenagers associated with being sexually active, especially drinking in greater quantities (Phillips-Howard et al., 2010; Skinner et al., 2008; Miller et al., 2007). There is also evidence to suggest that alcohol use at first sex is associated with lower levels of condom use (Robinson & Plant 1988; Dye & Upchurch, 2006), and higher levels of non-condom use have been found in those who binge drink or have an alcohol problem (Bagnall & Plant, 1991; Kim-Goodwin et al., 2007). Furthermore, alcohol consumption and especially drinking in greater quantities has been associated with an increased risk of becoming pregnant in females and getting someone pregnant in males (Miller et al., 2007) (see Bellis et al., 2009 for full review).

Recent research conducted at both lower tier local authority and ward levels found a significant positive relationship between teenage conceptions and alcohol-attributable hospital admissions in young people in England, independent of deprivation (Bellis et al., 2009). After accounting for deprivation at ward level, the teenage conception rate was 34 per 1000 females (aged 15 to 17) in wards with the lowest levels of alcohol-attributable hospital admissions, compared with 41 per 1000 females in wards with the highest levels of alcohol-attributable hospital admissions. Furthermore, local authorities that had seen

² Alcohol-specific conditions are those that are wholly caused by alcohol (e.g. alcoholic poisoning, mental and behavioural disorders due to alcohol); alcohol-related conditions are those both wholly and partially attributable to alcohol e.g. injuries, assault, self-harm, epilepsy (Jones et al., 2008).

increases in teenage conceptions between 2006 and 2007 also experienced disproportionate annual increases in teenage alcohol-attributable hospital admissions. Study data available at the time precluded analyses of associations between alcohol and teenage pregnancy at the lowest geographical level. Sexually transmitted infections data have recently become available at a low level of geography. Thus, here we are able to provide a more comprehensive picture of the relationships between alcohol consumption, teenage pregnancy and other key sexual health issues.

Aims

To further understand the relationship between alcohol consumption and teenage sexual risks in England, utilising data at the lowest geographic level available, and to identify hotspots of overlapping risk behaviour in young people.

Methods

The lowest level of geography used in the analysis is lower super output area (LSOA), a geographical unit designed to have a resident population of between 1000 and 3000 and an average of 1500 people. There are 32,482 LSOAs in England. Other data are presented at the level of middle super output area (MSOA), of which there are 6781 in England. MSOAs were designed to have a minimum population of 5000 and an average of 7200. Alcohol misuse and level of deprivation were used to predict sexual health at LSOA level (sexually transmitted infections and births to teenage girls) or MSOA level (teenage conceptions including abortions). Alcohol-attributable hospital admissions data were used as a proxy measure of alcohol misuse. The Income

Deprivation Affecting Children Index (IDACI)³ was applied to indicate the level of deprivation within each LSOA and MSOA. Those data that were not available at a geography that could be directly mapped to MSOA were interpolated⁴ using geographical information systems software (ArcGIS version 9.3) to provide MSOA-level estimated rates⁵. Since LSOA, MSOA, postcode sector and ward-level data are sensitive, Liverpool John Moores University (LJMU) and data providers agreed the scope of the analysis and established protocol around data transfer and storage prior to data exchange. Data were stored securely on LJMU servers according to all relevant policies and practices regarding data confidentiality.

Teenage pregnancy

Two sources of data on teenage pregnancy were available. The Office for National Statistics (ONS) provided ward-level teenage conception statistics⁶ for 2005 to 2007. Wards with fewer than five cases were merged within quintile of deprivation within local

³ IDACI shows the percentage of children in each area that live in families that are income deprived (i.e. in receipt of Income Support, Income based Job-Seekers Allowance, Working Families Tax Credit or Disabled Persons' Tax Credit below a given threshold).

⁴ Interpolation: estimation of a value at a point where there is no measurement, based on available measured points. For example, if area A had a teenage conception rate of 30 per 1000 and area B, 40 per 1000, then a point halfway between would have an interpolated value of 35 per 1000.

⁵ A continuous surface was created from point values using the ArcGIS interpolation function tool (inverse distance weighted method). MSOA-level average values of the grid surface (raster images) were summarised using ArcGIS zonal statistics tool.

⁶ Census area statistics (CAS) or statistical table (ST) wards depending on number of cases. www.statistics.gov.uk/geography/faq_statistical_cas_wards.asp

authority boundaries⁷. Ward and merged ward data were converted to estimated rates for MSOAs⁵. For LSOA-level analysis (in keeping with the other sexual health data on infections), we additionally extracted data on the number of young women aged under 18 years who delivered either a live or still-born baby during 2008 from Hospital Episode Statistics (HES). The age range 15 to 17 years was selected for analysis in keeping with Office of National Statistics (ONS) definitions of teenage conception in those aged under 18 years. Throughout this report we use the term 'birth to a teenage girl' to refer to HES data on pregnancies that result in a delivery (including both live and still births, excluding abortions), and 'teenage conceptions' to refer to ONS data on all conceptions including those leading to abortion.

Sexually Transmitted Infections

Data for four of the five key sexually transmitted infections (chlamydia, genital warts, herpes and gonorrhoea) for 2008 for both males and females were provided by the Health Protection Agency (HPA) from the Genitourinary Medicine Clinic Activity Dataset (GUMCAD)⁸. Syphilis was considered too rare to be studied at this level. The data were supplied in five year age bands, thus the age range 15 to 19 years was selected as being that most closely aligned with the target age (15 to 17 year-olds). GUMCAD data were incomplete for 0.5% of LSOAs. Further data

for chlamydia for the same period was provided by the National Chlamydia Screening Programme (NCSP)⁹. The age range 15 to 19 years for both males and females was extracted to align with data from GUMCAD. For chlamydia diagnoses, data from GUMCAD and NCSP were combined. This is because there is geographical variation in the extent to which chlamydia is diagnosed in the community via the screening programme or in genito-urinary medicine (GUM) clinics. Also, the extent to which the NCSP has been implemented could differ between areas (NCSP, 2006). Taken together, the two datasets are assumed to provide a comprehensive dataset of chlamydia diagnoses. Since the NCSP aims to test and treat in the community without need for GUM attendance, the likelihood that individuals access both settings is assumed to be very small, and therefore each individual is only counted once per infection. The likelihood of double counting is assumed to be low, but it is not possible to quantify the extent to which this occurs.

Alcohol misuse

Alcohol-attributable hospital admissions for both males and females for the financial year April 2008 to March 2009 were extracted from HES¹⁰. Alcohol-attributable admissions include those that are both wholly caused by alcohol (e.g. alcoholic poisoning, mental and behavioural disorders due to alcohol; providing the highest alcohol-attributable fraction, AAF, of 1.0) and partially attributable

⁷ 70% of the wards were single. The rest were grouped (with the same IDACI quintile or, if none available, the next closest): 9% were paired (25% of which have different IDACI quintiles); 15% were in triplets (23% with different IDACI quintiles); 4% were groups of four and <1% were grouped as five or more.

⁸ Data from the Genitourinary Medicine Clinic Activity Dataset (GUMCAD), Health Protection Agency. GUMCAD provides diagnoses of STIs reported by all genito-urinary medicine (GUM) clinics in England.

⁹ NCSP facilitates the provision of screening in core sexual health services (community contraceptive services, general practice, abortion services and community pharmacies). Data are collected in those aged 15 to 24 years tested for chlamydia outside of GUM clinics (NCSP, 2010).

¹⁰ Alcohol-attributable hospital admissions used the NI39 definition (derived from HES supplied by DH).

to alcohol (e.g. pedestrian traffic accidents, injuries, self-harm, epilepsy; providing a lower AAF; Jones et al., 2008)¹¹. In these analyses, any positive AAF represented an alcohol-attributable admission even if the AAF was low. Data were extracted for the 15 to 19 year old age group to align with the STI datasets. Data relating to 15 to 17 year old females were also obtained for comparison with the teenage births and teenage conceptions data.

Alcohol and drug treatment

Alcohol and drug treatment data for the financial years 2007/08 and 2008/09 relating to young people aged up to 19 years were obtained from the National Treatment Agency, at the lowest geographical area possible, the postcode sector¹². Data were converted to estimated rates at MSOA level⁵.

Data analysis

Statistical analysis was performed using SPSS version 17. Data were analysed at the smallest geography possible. For sexually transmitted infections and births to teenage girls, this was the LSOA. For teenage conceptions (including both abortions as well as deliveries), MSOA-level data were used.

Hotspot analysis

Geographical data were analysed using ArcGIS, and utilised MSOA boundaries. The hotspot analysis used the Getis-Ord Gi* function in ArcGIS to identify hot and cold spots

(statistically significant clumping of high or low values)¹³.

Analysis at middle super output area level

Inspection of the distribution of teenage conception data and hospital admissions data at MSOA-level revealed that the vast majority of MSOAs had one or more admissions or conceptions, and that the denominator populations were sufficiently large to calculate rates per 1000. Analysis used multiple regression with teenage conception as the outcome variable and childhood deprivation score and hospital admission rates as predictor variables. All variables were transformed using natural logarithms to improve the normality of the distributions.

Analysis at lower super output area level

The total number of 15 to 19 year olds varied between LSOAs, ranging from 8 to 1894, with an average number per LSOA of 102.6 (standard deviation, SD=52.50). Clearly, the probability of a given LSOA having one or more alcohol-attributable hospital admissions and/or sexual health outcomes was dependent on the baseline number of people (denominator population). Thus, each LSOA was assigned to one of three groups depending on how many 15 to 19 year olds were resident within it: medium (defined as the range encompassed by the mean plus/minus the SD, n=29,938 LSOAs); low (less than the mean minus one SD, n=982); or high (more than the mean plus one SD, n=1562). The size category of the population of young people was included in logistic regression models so that the impact of population size could be identified.

¹¹ Except for persons aged under 15 years, where only conditions for which alcohol is wholly attributable were included. This is because relative risk estimates for most alcohol-attributable conditions are available only for adults. See NI39 technical document:
www.nwph.net/alcohol/lape/nationalindicator.htm

¹² Postcode sector is a partial postcode comprising the first part (postal district) and the number at the beginning of the second part (e.g. M16 5)

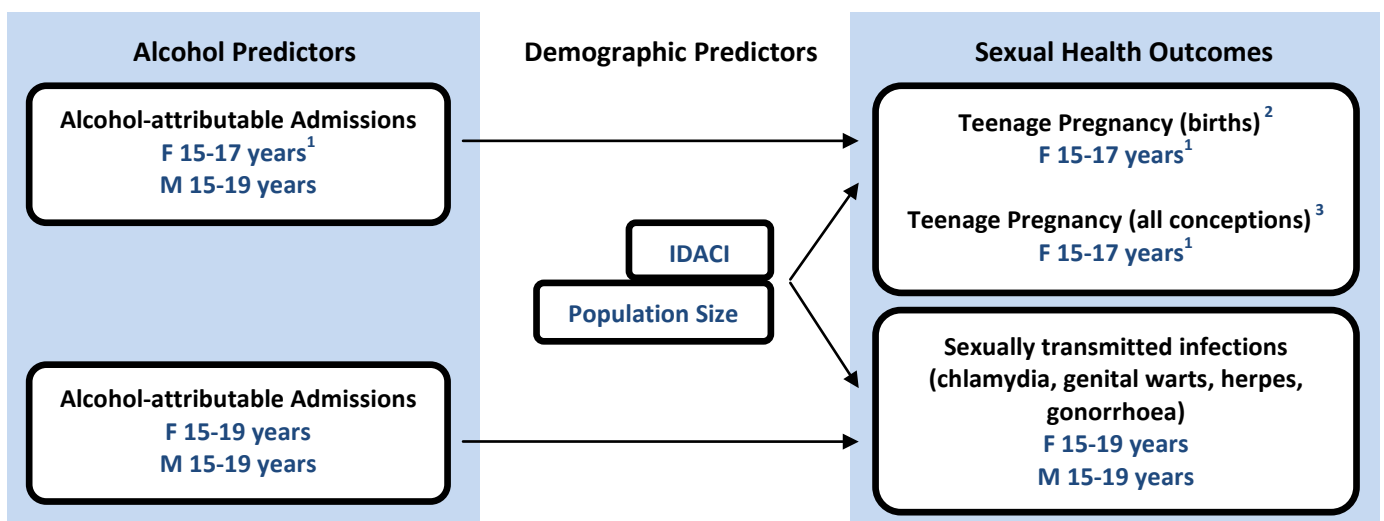
¹³ Getis-Ord Gi* calculates a z score for each MSOA. High z scores (and low p values, p<0.05) indicate spatial clusters of high values (hot spots), while low z scores (and a significant p value of <0.05) indicate low values (cold spots). The fixed distance parameter was set at 6500m.

The distributions of the variables were investigated using histograms, and bivariate relationships were first assessed via boxplots. Alcohol-attributable hospital admissions were relatively rare at an LSOA level, with 58% of LSOAs having none in 2008/09. Sexual health outcomes were also rare, with, for example, 89% of LSOAs having no births to teenage girls in 2008. For the two more prevalent conditions (chlamydia infection and alcohol harm), there was evidence of a ‘dose-response’ curve, whereby higher alcohol-attributable admissions correlated with an increase in chlamydia diagnoses. However, areas with more than one chlamydia diagnosis were relatively rare, and for this reason, data were converted into binary form (i.e. present/absent, where 1= one or more chlamydia diagnoses; 0= no chlamydia diagnosis). In the case of alcohol-attributable hospital admissions, LSOAs were coded as 0 if they had no such admissions and 1 if they had one or more admissions.

Figure 1 shows predictor and outcome variables used in the LSOA-level analysis. Sexual health outcomes were analysed in

turn, and Chi square tests were used to highlight any significant associations at LSOA level between having one or more sexual health outcomes and an alcohol-attributable hospital admission. Each LSOA was categorised according to its rank of childhood deprivation and divided into five equal categories (quintiles). Chi square tests were repeated within deprivation quintile. Finally, logistic regression models were constructed to predict LSOAs with one or more occurrences of a birth to a teenage girl or STI from the predictor variables deprivation quintile and male and female alcohol-attributable admissions. These models provided the adjusted odds ratios (AOR) for an LSOA having a birth to a teenage girl or an STI diagnosis in a person aged 15 to 19 years, given that the LSOA was categorised as having one or more alcohol-attributable hospital admissions in males or females. In the model to predict births to teenage girls, alcohol-attributable admissions in females used an age range of 15-17 years, while alcohol-attributable admissions for males used an older age group (15 to 19 years). Using this

Figure 1: Predictor and outcome variables used in the multivariate analyses



¹Where possible, the age range 15-17 years was chosen for females to align with the target age for teenage pregnancies

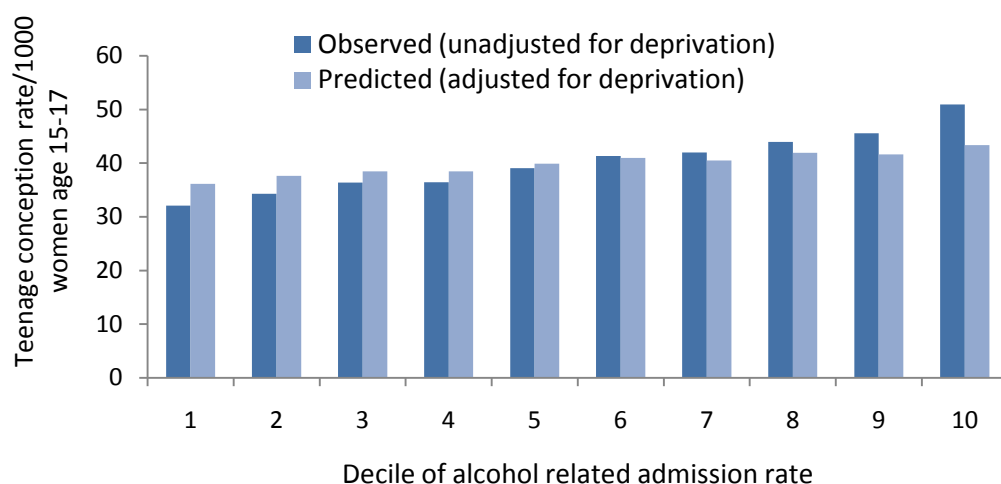
²HES data on pregnancies that lead to a delivery, both live and still-birth

³ONS data on all teenage conceptions, including both abortions and deliveries

older age range for males slightly increased the predictive power of the model and is consistent with literature suggesting that females on average choose older sexual partners (Mercer et al. 2009). For the STI models, the age range used was 15-19 years for both males and females, to align with the age bands in which the data were supplied by the HPA. In all models, the size category of the LSOA was included to control for the fact that all outcomes were more likely in those LSOAs where the baseline number of young people available to experience the harm was higher.

LSOA size was significant in each of the models (i.e. there was more likely to be one or more harms in the biggest, compared with the smallest), but is not displayed in the tables. Analysis was repeated using LSOA size and IDACI score as linear variables (rather than categories). However, there was no improvement in model fit, and adjusted odds ratios and statistical significance of alcohol predictors remained similar. Thus, the models with categorised predictors are presented for ease of interpretation.

Figure 2: Observed and predicted teenage conception rate by deciles of alcohol-attributable admission rate 2008-2009; showing measures unadjusted and adjusted for income deprivation affecting children (MSOA-level data)



Results

Teenage conception rates at middle super output area level

Analysis of teenage conception data (i.e. conceptions leading to abortion as well as those leading to a delivery) at the level of MSOA¹⁴ confirmed the highly statistically significant effect of deprivation ($p < 0.001$) and the additional highly significant effect of alcohol hospital admissions ($p < 0.001$)¹⁵.

Figure 2 shows that after adjustment for levels of income deprivation affecting children, the predicted relationship between alcohol admission rates and teenage conception remains highly significant but shows a slightly reduced gradient. After adjusting for levels of deprivation, the predicted rate of teenage conceptions increased from 36 per 1000 in

female alcohol admission rate in 15-19 year olds (Beta=0.126, $t=13.6$, $p < 0.001$) entered as continuous variables. Overall model explains 48% of the variance ($R^2=0.48$). Model statistics: $F=3076$, $df=2,6780$, $p < 0.001$.

¹⁴ Interpolated from ward level data, see methods

¹⁵ Multiple regression analysis with deprivation (Beta=0.641, $t=69.6$, $p < 0.001$) and male and

areas with the lowest alcohol-attributable admissions to 43 per 1000 in areas with the highest admission rates.

Hotspots of sexual health and alcohol indicators

Figure 3 shows hotspots of STIs in females (blue) and teenage conceptions (pink) with overlapping hotspots represented by purple. Alcohol admissions hotspots are shown with a black stippling pattern. Overlapping hotspots occur in the north of England, but less commonly in the south. The London area has an overlapping hotspot for the two sexual health indicators, but not for alcohol admissions. There are alcohol admissions hotspots in more rural areas (e.g. South Lakeland, East Cambridgeshire, South Norfolk) that do not overlap with teenage conceptions or STI hotspots. Figure 4 shows hotspots of male STIs (blue) alongside teenage conceptions (pink), again showing overlapping hotspots (purple) to be more prevalent in urban areas in the north. Male data show additional smaller sexual infection hotspots in the south of England that are absent in the female data, for example over towns of Reading, Winchester and Chelmsford. Figure 5 shows hotspots of sexual ill-health (male and female STIs and teenage conceptions combined) in blue and alcohol/drugs treatment in pink, with overlapping hotspots in purple. The alcohol admissions hotspots (black stippling pattern) frequently do not co-occur with the drug/alcohol treatment, highlighting additional areas where risk factors cluster, which would otherwise not be apparent from hospital admissions data alone. For example, London had overlapping hotspots for drugs/alcohol treatment and sexual health indicators, but no hotspot for alcohol-attributable hospital admissions.

Analysis at Lower Super Output Area level

The proportion of LSOAs with one or more alcohol-attributable hospital admissions rose with increasing category of population size. This same relationship was apparent with the sexual health outcomes; thus, LSOA size was taken into account in the multivariate models.

Alcohol and deprivation

Over two fifths (42%) of LSOAs in England had at least one female aged 15 to 19 years admitted to hospital with a condition wholly or partly due to alcohol in 2008/09. During the same period, nearly half of LSOAs (48%) had an admission among males in the same age group. For 15 to 17 year olds, nearly a quarter (24%) of LSOAs had one or more female admissions and 27% had one or more male admissions. Alcohol-attributable admissions were strongly related to deprivation. For females (figure 6a) and males (figure 6b) aged 15 to 17 years, the proportion of LSOAs with one or more admissions rose with each increasing deprivation quintile. The inclusion of 18 to 19 year olds substantially increased the proportion of LSOAs with at least one admission (Figure 6 a, b).

Alcohol and births to teenage girls

In total, 26% of LSOAs had one or more births to teenage girls (aged 15 to 17 years) during 2008. Overall, there was a significant association at LSOA level between having one or more births to teenage girls and an alcohol-attributable hospital admission among females ($\chi^2(1)=3.16$, $p<0.001$). The proportion of LSOAs with at least one birth to a teenage girl and at least one alcohol-attributable admission increased with each increasing deprivation quintile (figure 7).

Figure 3: Hotspots of sexually transmitted infections in females aged under 20 years (2008), teenage conceptions in females aged under 18 years (2005-2007) and alcohol-related hospital admissions in males and females aged under 20 years (2008/09)

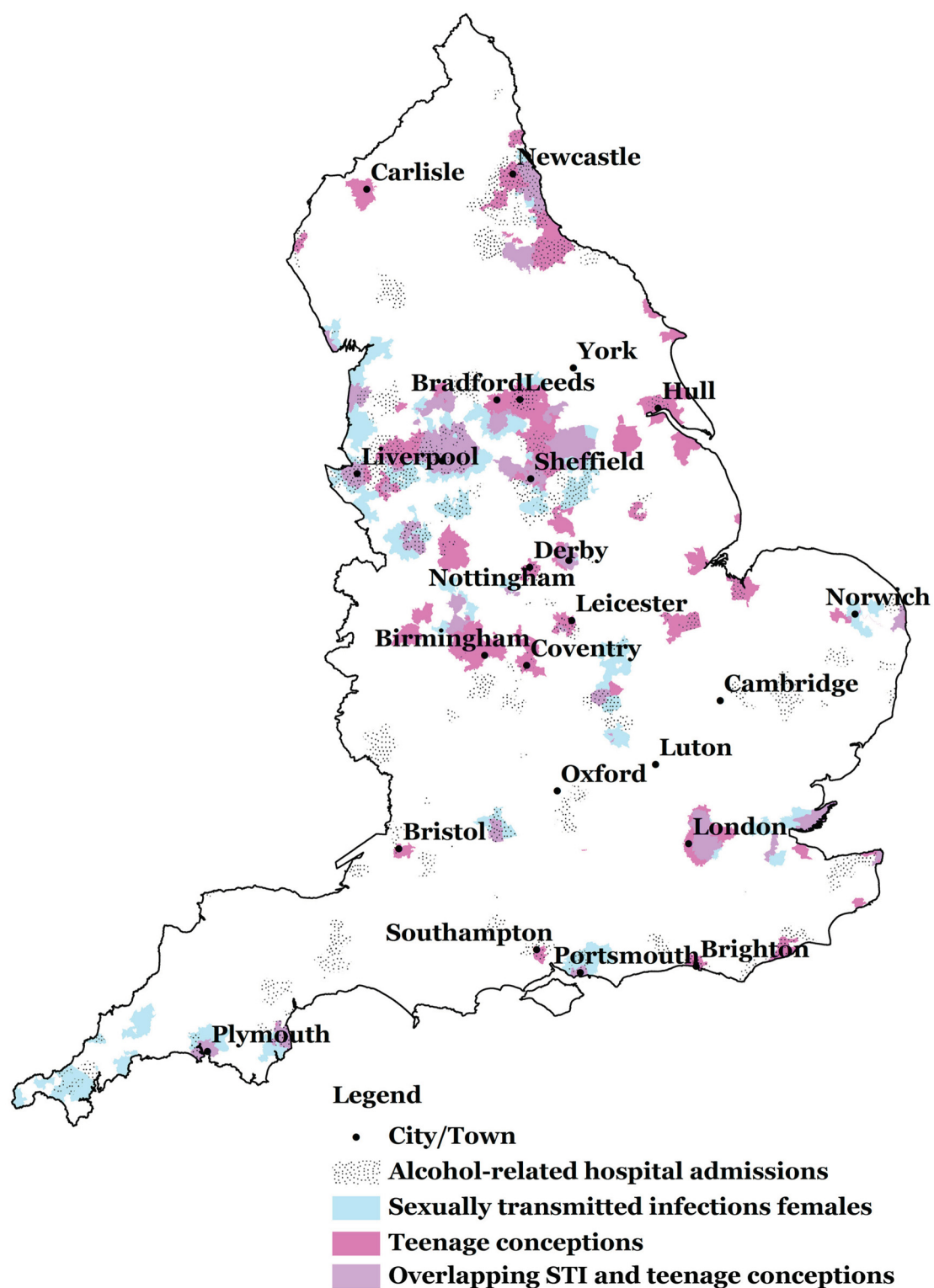


Figure 4: Hotspots of sexually transmitted infections in males aged under 20 years (2008), teenage conceptions in females aged under 18 years (2005-2007) and alcohol-related hospital admissions in males and females aged under 20 years (2008/09)

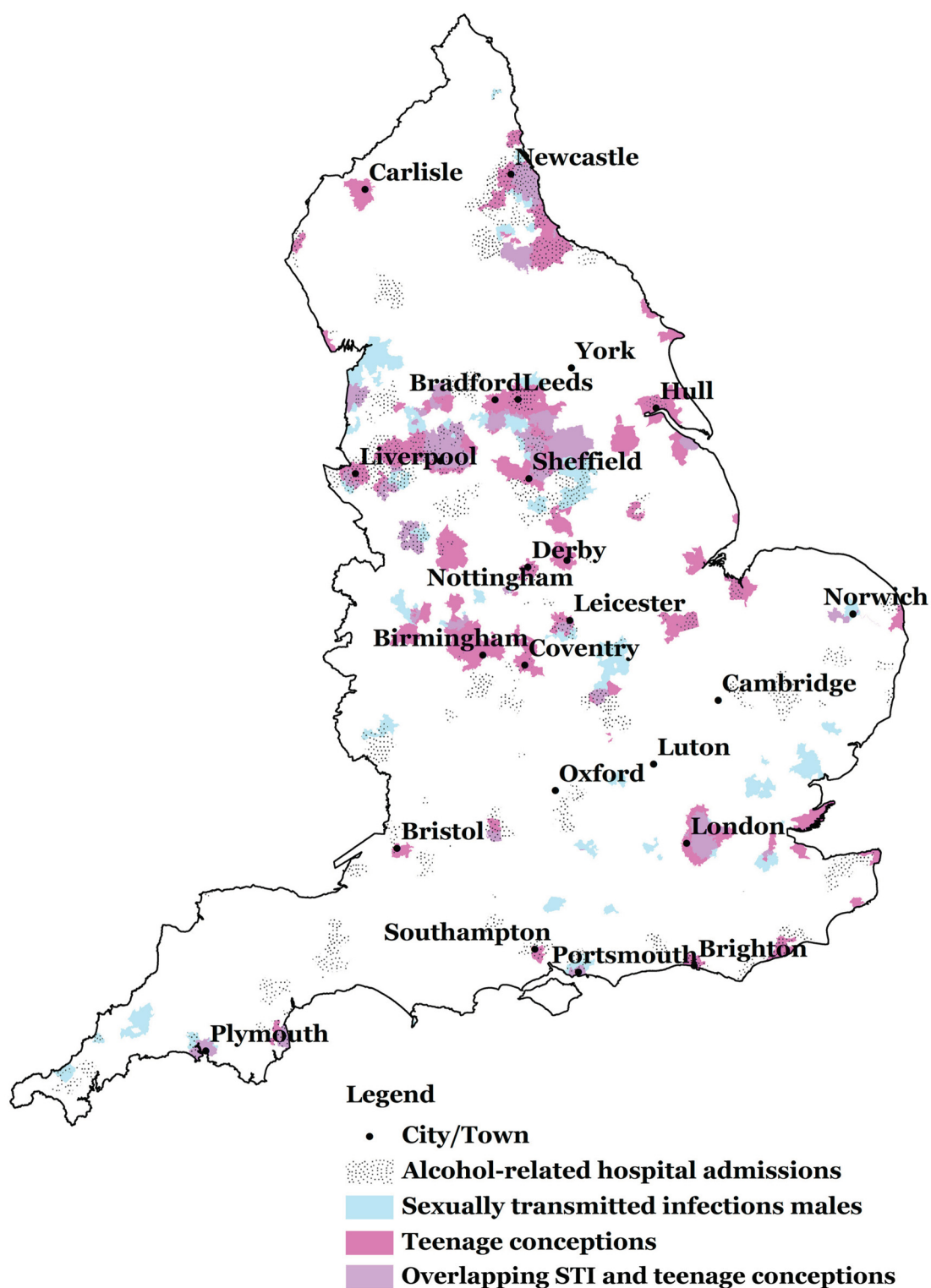


Figure 5: Hotspots of sexual ill-health, and alcohol-related hospital admissions in males and females aged under 20 years (2008/09) and alcohol and drugs treatment in males and females aged under 20 years (2008-2009)

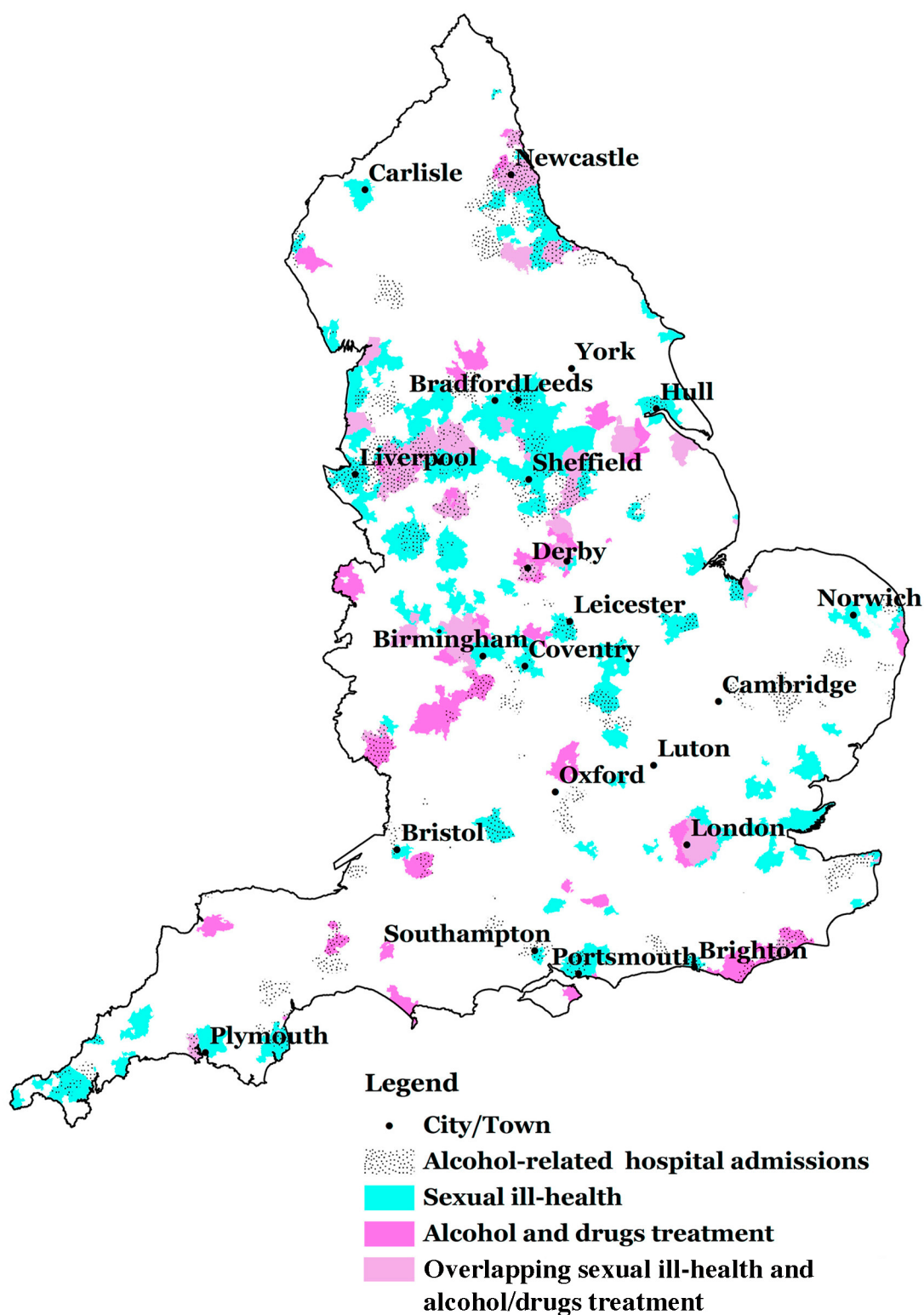


Figure 6: Relationship between the proportion of LSOAs with one or more alcohol-attributable hospital admissions in (a) females and (b) males aged 15 to 19 years, by childhood deprivation of LSOA (IDACI score) in 2008/09.

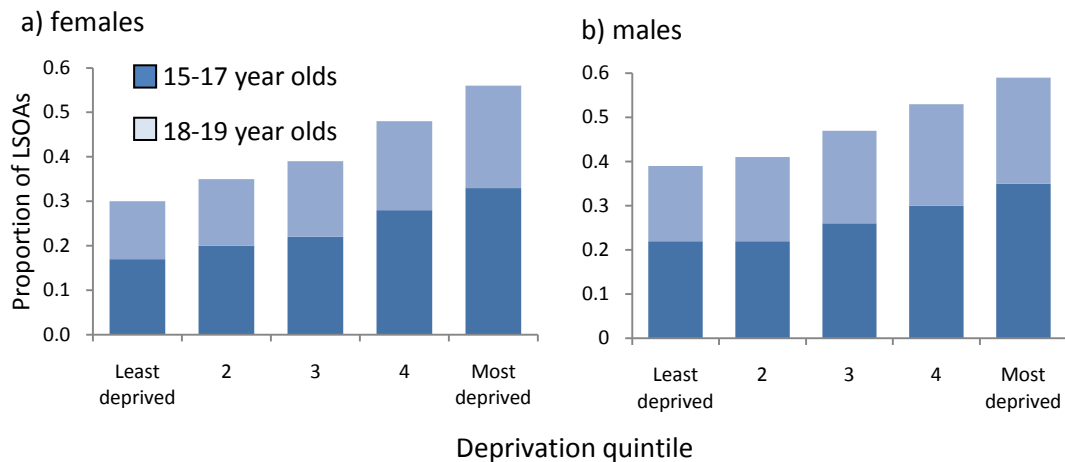
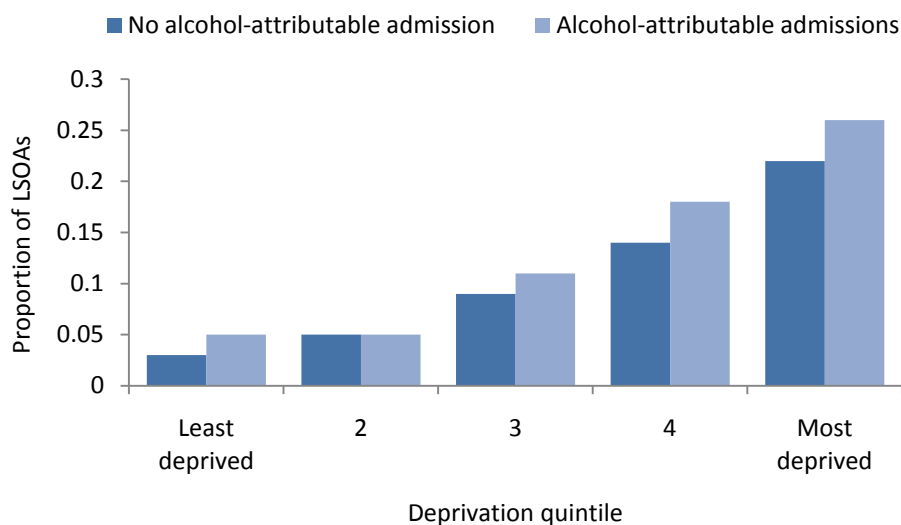


Figure 7: The proportion of LSOAs with one or more births to teenage girls in 2008 and alcohol-attributable hospital admissions 2008/09 in females aged 15 to 17 years by child deprivation score.



Within each deprivation quintile, there was also a significant association between having one or more births to teenage girls and alcohol-attributable admissions in all ($P < 0.001$) but the second least deprived quintile (see table in appendix 1).

The table in appendix 2 (section a) summarises the logistic regression model to identify the independent effects of alcohol-

attributable hospital admission on the odds of an LSOA having one or more births to teenage girls. Deprivation was found to have a strong positive effect on the odds of an LSOA having at least one birth to a teenage girl (AOR of most deprived compared with least deprived=8.66, 95%CI 7.87-9.53). Having had at least one admission at least partially attributable to alcohol among females (AOR=1.29, 95%CI 1.22-1.37) and males

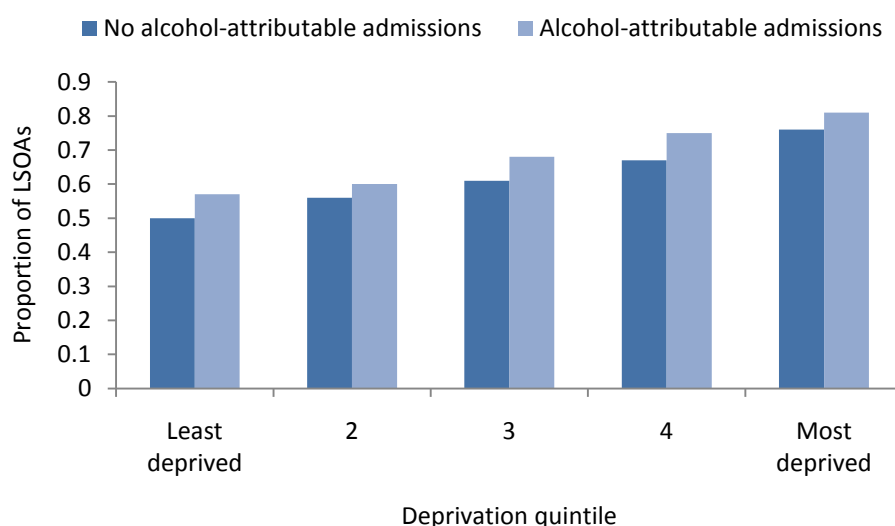
(AOR=1.23, 95%CI 1.17-1.30) significantly increased the odds of that LSOA also having one or more births to teenage girls once deprivation had been accounted for.

Alcohol and sexually transmitted infections

In total, 64% of all LSOAs had one or more STI diagnoses in females aged 15 to 19 years during 2008. Overall, there was a significant association at LSOA level between having one or more STI cases and an alcohol attributable

admission for females ($\chi^2(1) = 307, p<0.001$). The proportion of LSOAs with one or more diagnoses of any STI in females was found to be strongly related to deprivation with diagnosis increasing with each increasing deprivation quintile (figure 8). Within quintile there was also an association between having one or more STI case and an alcohol-attributable admission across all deprivation quintiles ($p<0.01$) (see appendix 1).

Figure 8: The proportion of LSOAs with one or more diagnoses of any sexually transmitted infection in 2008 in females by alcohol-attributable hospital admissions in 2008/09 in females aged 15 to 19 years and child deprivation.



The table in appendix 2 (section b) summarises the logistic regression model to identify independent effects of alcohol-attributable hospital admission on the odds of an LSOA having any STI diagnosis in females. Deprivation was found to have a strong positive effect on the odds of an LSOA population having at least one STI case (AOR of most deprived compared to least deprived=3.08, 95%CI 2.85-3.33). Having had at least one admission at least partially attributable to alcohol among females (AOR=1.26, 95%CI 1.20-1.33) and males (AOR=1.13, 95%CI 1.08-1.19) significantly

increased the odds of that LSOA also having a STI diagnosis.

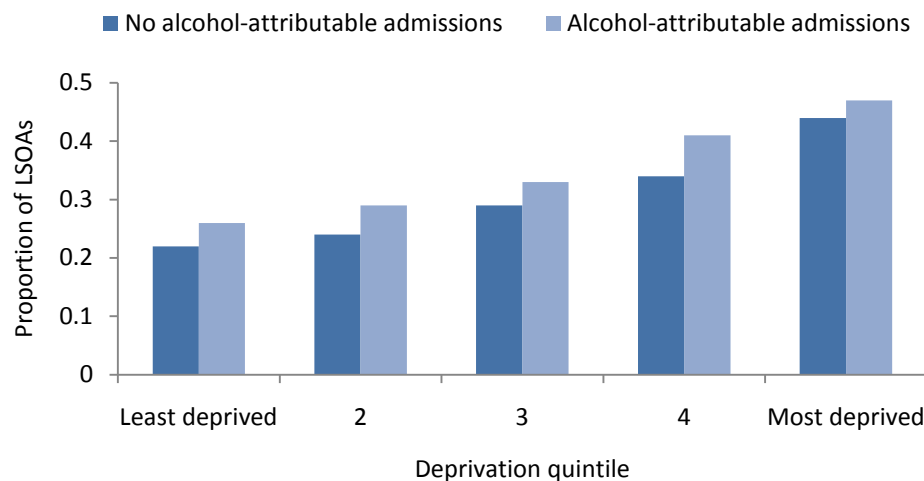
There were fewer STI diagnoses in males. In total, 33% of all LSOAs had one or more STI diagnoses in males aged 15 to 19 years during 2008 (compared to 64% for females). Overall, there was a significant association at LSOA level between having one or more STI cases and an alcohol-attributable admission for males ($\chi^2(1) = 177, p<0.001$). The proportion of LSOAs with one or more diagnoses of any STI in males was found to be strongly related to deprivation with diagnosis increasing with each increasing deprivation quintile (figure 9).

Within quintile there was also an association between having one or more STI case and an alcohol-attributable admission across all deprivation quintiles ($p < 0.001$) (see appendix 1).

The table in appendix 2 (section c) summarises the logistic regression model to identify independent effects of alcohol-attributable hospital admission on the odds of an LSOA having any STI diagnosis in males.

Deprivation was found to have a strong positive effect on the odds of an LSOA population having at least one STI case (AOR, of most deprived compared to least deprived = 2.52, 95%CI 2.34-2.72). Having had at least one admission at least partially attributable to alcohol among males (AOR = 1.18, 95%CI 1.13-1.24) and females (AOR = 1.18, 95%CI 1.12-1.23) significantly increased the odds of that LSOA also having a STI diagnosis.

Figure 9: The proportion of LSOAs with one or more diagnoses of any sexually transmitted infection in 2008 in males by alcohol-attributable hospital admissions in 2008/09 in males aged 15 to 19 years and child deprivation.

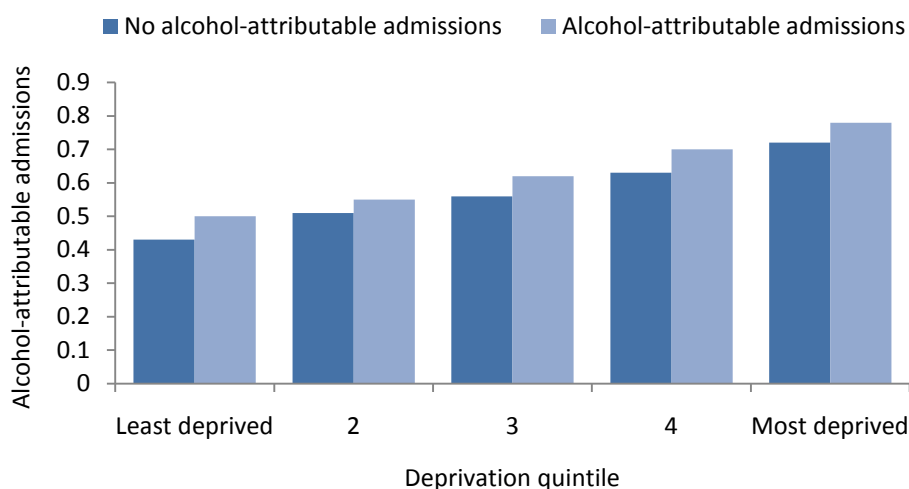


Alcohol and chlamydia

In total, 59% of all LSOAs had one or more chlamydia diagnoses in females aged 15 to 19 years during 2008. Overall, there was a significant association at LSOA level between having one or more chlamydia cases and an alcohol-attributable admission for females ($\chi^2(1) = 321, p < 0.001$). Chlamydia in females was found to be strongly related to deprivation with diagnosis increasing with each increasing deprivation quintile (figure 10). Within quintile, there was also an association between having one or more chlamydia cases and an alcohol-attributable admission across all deprivation quintiles ($P < 0.05$) (see appendix 1).

The table in appendix 2 (section d) summarises the logistic regression model to identify the independent effects of alcohol-attributable hospital admissions on the odds of an LSOA having a chlamydia diagnosis in females. Deprivation was confirmed to have a strong positive effect on the odds of an LSOA population having at least one chlamydia case (AOR of most deprived compared with least deprived = 3.43, 95%CI 3.18-3.70). Having had at least one alcohol admission among females (AOR = 1.25, 95%CI 1.19-1.31) and males (AOR = 1.12, 95%CI 1.07-1.17) significantly increased the odds of also having a chlamydia diagnosis after controlling for deprivation.

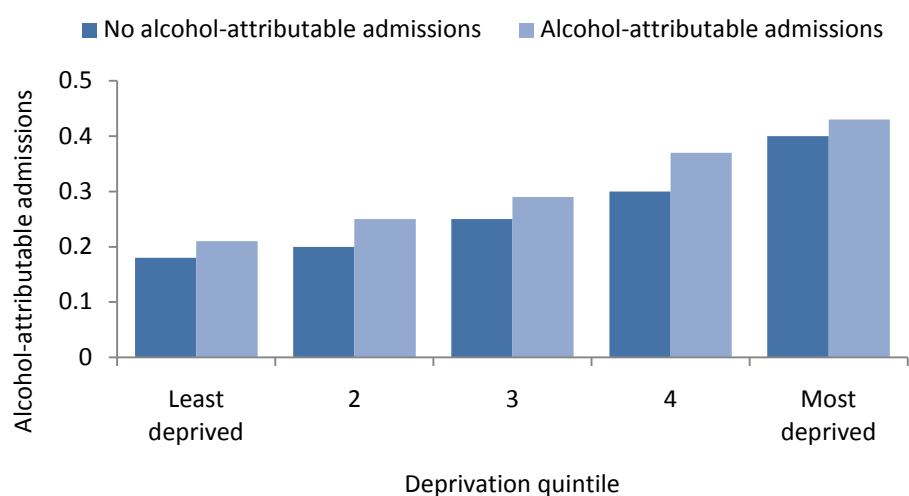
Figure 10: The proportion of LSOAs with one or more chlamydia diagnoses in 2008 in females by alcohol-attributable hospital admissions in 2008/09 in females aged 15 to 19 years and child deprivation score.



There were fewer chlamydia diagnoses in males: over a quarter (29%, compared to 59%) of LSOAs in England had one or more chlamydia diagnoses. Overall, there was a significant association at LSOA level between having one or more chlamydia cases and an alcohol-attributable admission for males ($\chi^2(1) = 194$, $p < 0.001$). Figure 11 shows that

chlamydia in males is strongly related to deprivation with diagnosis increasing with each increasing deprivation quintile. Within quintile, there was also a significant association between having one or more chlamydia cases and an alcohol-attributable admission across all deprivation quintiles ($P < 0.05$) (see appendix 1).

Figure 11: The proportion of LSOAs with a chlamydia diagnoses in 2008 in males by alcohol-attributable hospital admissions in 2008/09 in males aged 15 to 19 years and child deprivation.



The table in appendix 2 (section e) summarises the logistic regression model to identify the independent effects of alcohol-attributable hospital admission on the odds of an LSOA having a chlamydia diagnosis in males. Deprivation was confirmed to have a strong positive effect on the odds of an LSOA population having at least one chlamydia case (AOR of most deprived compared with least deprived=2.76, 95%CI 2.55-2.99). Having had at least one admission at least partially attributable to alcohol among males (AOR=1.21, 95%CI 1.15-1.27) and females (AOR=1.18, 95%CI 1.12-1.24) significantly increased the odds of that LSOA also having a chlamydia diagnosis after controlling for deprivation.

Alcohol and genital warts

In total, 15% of LSOAs in England had one or more genital warts diagnoses in females aged 15 to 19 years. Overall, a significant association at LSOA level was found between having one or more genital warts cases and an alcohol-attributable hospital admission for females ($\chi^2(1) = 56.08$, $p < 0.001$). The proportion of LSOAs with one or more genital

warts case varies across deprivation quintile (figure 12). There was a strong relationship with alcohol: within quintile, there was a significant association between having one or more warts cases and an alcohol-attributable admission across all quintiles ($P < 0.05$) (see appendix 1).

The table in appendix 2 (section f) summarises the logistic regression model to identify independent effects of alcohol-attributable hospital admission on the odds of an LSOA having a genital warts diagnosis in females. The proportion of LSOAs with a diagnosis of genital warts in females tended to increase with deprivation, although this was not true at the highest level of deprivation (AOR of most deprived compared with least deprived=1.05, 95%CI 0.95-1.16). Having had at least one admission at least partially attributable to alcohol among females (AOR=1.20, 95%CI 1.18-1.28) and males (AOR=1.14, 95%CI 1.07-1.22) increased the odds of that LSOA also having a warts diagnosis after controlling for deprivation.

Figure 12: The proportion of LSOAs with a genital warts diagnoses in 2008 in females by alcohol-attributable hospital admissions in 2008/09 in females aged 15 to 19 years and child deprivation.

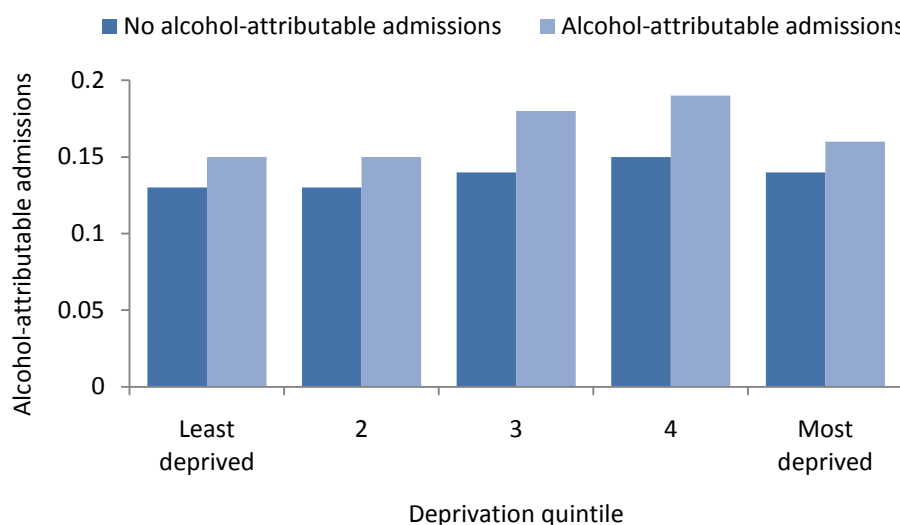
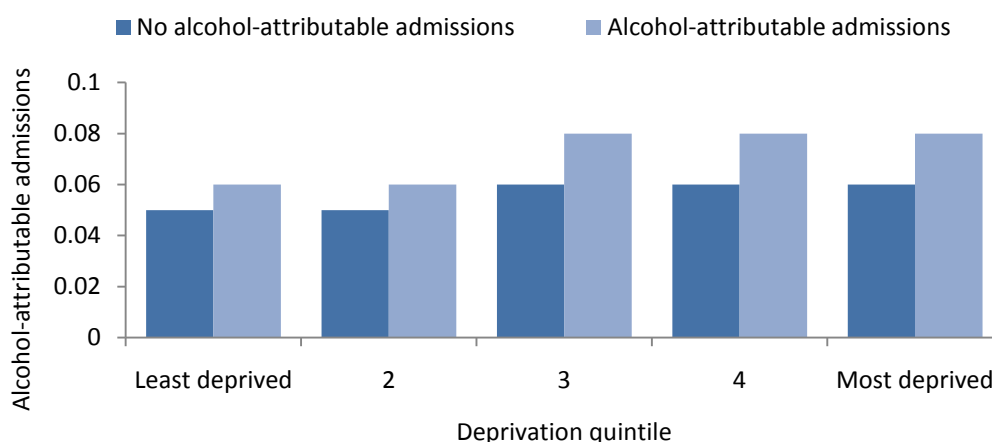


Figure 13: The proportion of LSOAs with one or more genital warts diagnoses in 2008 in males by alcohol-attributable hospital admissions in 2008/09 in males aged 15 to 19 years and child deprivation.



Data for males showed that 6.3% of LSOAs in England had one or more genital warts diagnoses in males aged 15 to 19 years during 2008. Overall, there was a significant association at LSOA level between having one or more genital warts case and an alcohol-attributable admission for males ($\chi^2(1) = 37$, $p < 0.001$). The proportion of LSOAs with one or more genital warts diagnoses varies across deprivation quintile (figure 13). Within deprivation quintile there was a significant association between having one or more warts cases and an alcohol-attributable admission in all quintiles ($p < 0.05$) with the exception of the second least deprived quintile (see appendix 1).

The table in appendix 2 (section g) summarises the logistic regression model to identify independent effects of alcohol-attributable hospital admission on the odds of an LSOA having a genital warts diagnosis in males. Deprivation was confirmed to have a positive effect on the odds of an LSOA population having at least one warts case (AOR of most deprived compared with least deprived=1.30, 95%CI 1.27-1.50). Having had at least one admission at least partially attributable to alcohol among males

(AOR=1.23, 95%CI 1.12-1.34) and females (AOR=1.16, 95%CI 1.06-1.27) significantly increased the odds of that LSOA also having a warts diagnosis after controlling for deprivation.

Alcohol and herpes

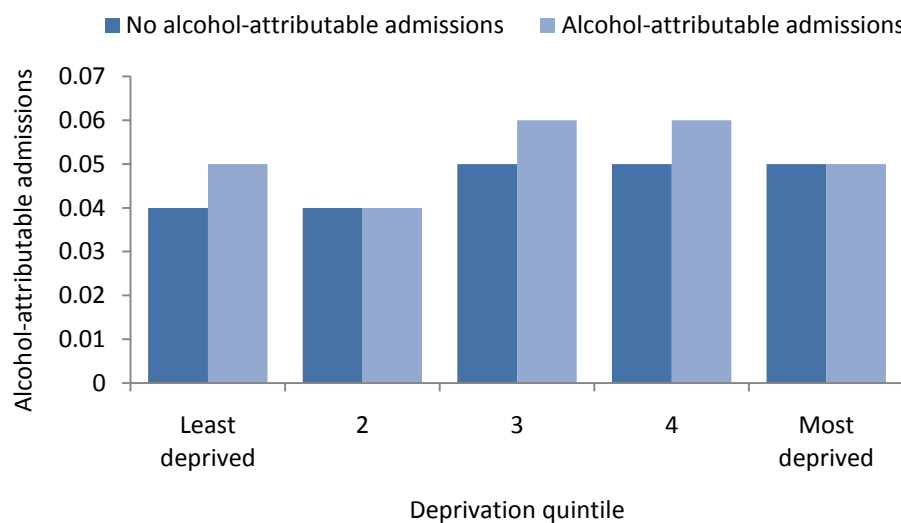
In total, 4.7% of LSOAs in England had one or more herpes diagnoses in females aged 15 to 19 years during 2008. Overall, there was a significant association at LSOA level between having one or more herpes cases and an alcohol-attributable admission for females ($\chi^2(1) = 18.94$, $p < 0.001$). The proportion of LSOAs with a herpes case does not appear to have a linear relationship with deprivation (figure 14). Within quintile, there is a significant association between having one or more herpes cases and an alcohol-attributable admission in the least deprived quintile ($p = 0.001$) and fourth most deprived quintile ($P < 0.05$; see appendix 1).

The table in appendix 2 (section h) summarises the logistic regression model to identify independent effects of alcohol-attributable hospital admission on the odds of an LSOA having a herpes diagnosis in females. There is no linear effect of deprivation on the

odds of an LSOA population having at least one herpes case, with only quintiles 3 and 4 having significantly increased odds of a herpes case in females (AOR of quintile 3 compared with least deprived=1.26, 95%CI 1.07-1.48; quintile 4 AOR=1.25, 95%CI 1.06-1.48). Having had at least one admission at least partially

attributable to alcohol among females (AOR=1.19, 95%CI 1.07-1.32) significantly increased the odds of that LSOA also having a herpes diagnosis. The association with a male hospital admission was not significant (AOR=1.07, 95%CI 0.96-1.19).

Figure 14: The proportion of LSOAs with one or more herpes diagnoses in 2008 in females by alcohol-attributable hospital admissions in 2008/09 in females aged 15 to 19 years and child deprivation.

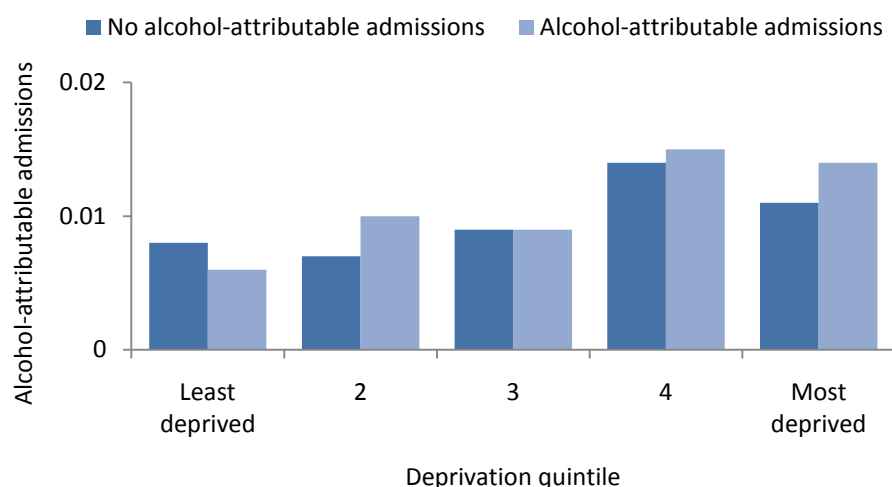


Only 1% of LSOAs in England had one or more herpes diagnoses in males aged 15 to 19 years in 2008. Overall, there was no significant association at LSOA level between having one or more herpes cases and an alcohol-attributable admission for males ($\chi^2(1) = 1.27$, $p=0.25$). The proportion of LSOAs with a herpes case and alcohol-attributable admission varies across deprivation quintile (figure 15). Within quintile, there is no significant association between having one or more herpes cases and an alcohol-attributable admission (see appendix 1).

The table in appendix 2 (section i) summarises the logistic regression model to identify

independent effects of alcohol-attributable hospital admission on the odds of an LSOA having a herpes diagnosis in males. Deprivation was confirmed to have a positive effect on the odds of an LSOA population having at least one herpes case (AOR of most deprived compared with least deprived=1.71, 95%CI 1.19-2.44). Having had at least one admission at least partially attributable to alcohol among males (AOR=1.0, 95%CI 0.80-1.25) or females (AOR=1.02, 95%CI 0.81-1.27) did not significantly increase the odds of that LSOA also having a herpes diagnosis after controlling for deprivation.

Figure 15: The proportion of LSOAs with one or more herpes diagnoses in 2008 in males by alcohol-attributable hospital admissions in 2008/09 in males aged 15 to 19 years and child deprivation.

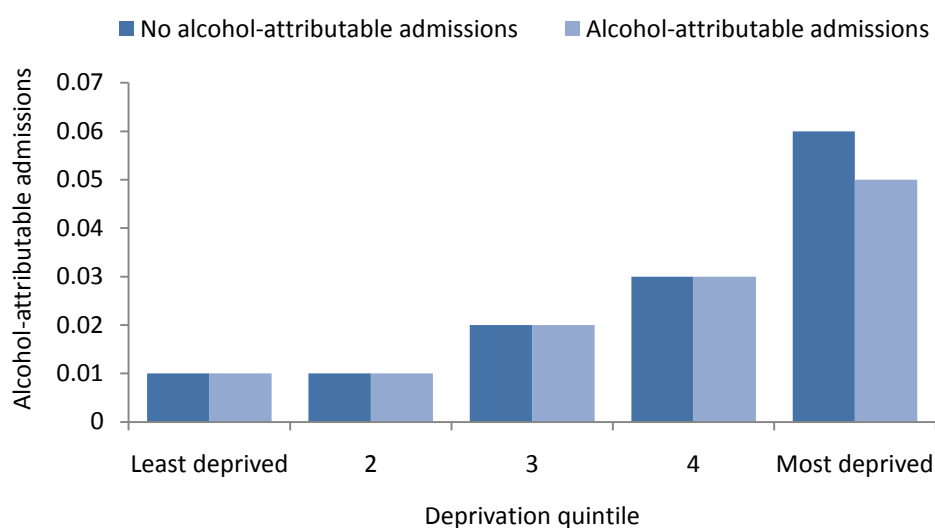


Alcohol and gonorrhoea

In total, 2.5% of LSOAs in England had one or more gonorrhoea diagnoses in females aged 15 to 19 years during 2008. Overall, there was a significant association at LSOA level between having one or more gonorrhoea cases and an alcohol-attributable admission for females ($\chi^2 (1) = 4.68, p < 0.05$). Gonorrhoea in females was found to be strongly attributable to deprivation, with

diagnosis increasing with increasing deprivation quintile (figure 16). There was however little association with alcohol: within quintile, only the most deprived quintile showed a significant association between having one or more gonorrhoea cases and an alcohol-attributable admission ($p = 0.05$). However, this was in the reverse direction to that predicted, with LSOAs with no admissions more likely to have a gonorrhoea diagnosis (see appendix 1).

Figure 16: The proportion of LSOAs with one or more gonorrhoea diagnoses in 2008 in females by alcohol-attributable hospital admissions in 2008/09 in females aged 15 to 19 years and child deprivation.



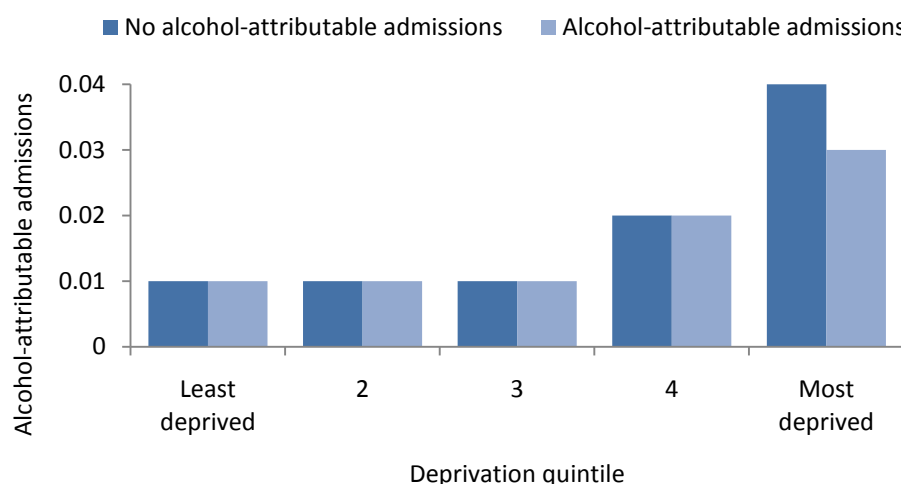
The table in appendix 2 (section i) summarises the logistic regression model to identify independent effects of alcohol-attributable hospital admission on the odds of an LSOA having a gonorrhoea diagnosis in females. Deprivation was confirmed to have a positive effect on the odds of an LSOA population having at least one gonorrhoea case (AOR of most deprived compared with least deprived=4.80, 95%CI 3.72-6.20). Having had at least one admission at least partially attributable to alcohol among females (AOR=0.93, 95%CI 0.80-1.08) and males (AOR=0.96, 95%CI 0.83-1.11) did not significantly increase the odds of that LSOA also having a gonorrhoea diagnosis after controlling for deprivation.

Only 1.6% of LSOAs in England had one or more gonorrhoea diagnoses in males aged 15 to 19 years during 2008. Overall, there was no significant association at LSOA level between having one or more gonorrhoea cases and an alcohol-attributable admission for males ($\chi^2(1) = 2.98$, $p=0.84$). Gonorrhoea in males was found to be strongly related to deprivation

with diagnoses highest in quintiles 4 and 5 (figure 17). As with females, little association with alcohol was found: within quintile, only the most deprived quintile showed a significant association between having one or more gonorrhoea cases and an alcohol-attributable admission ($p=0.05$). However, this was in the reverse direction to that predicted, with LSOAs with no admissions more likely to have a gonorrhoea diagnosis (see appendix 1).

The table in appendix 2 (section k) summarises the logistic regression model to identify independent effects of alcohol-attributable hospital admission on the odds of an LSOA having a gonorrhoea diagnosis in males. Deprivation was confirmed to have a positive effect on the odds of an LSOA population having at least one gonorrhoea case (AOR of most deprived compared with least deprived=4.10, 95%CI 3.01-5.57). There was no association between gonorrhoea in males and alcohol-attributable admission among either males (AOR=0.94, 95%CI 0.79-1.13) or females (AOR=1.19, 95%CI 1.00-1.42).

Figure 17: The proportion of LSOAs with one or more gonorrhoea diagnoses in 2008 in males by alcohol-attributable hospital admissions in 2008/09 in males aged 15 to 19 years and child deprivation.



Discussion

This report confirms the strong relationships between deprivation, alcohol-attributable hospital admissions and teenage conceptions, and builds on findings reported previously (Bellis et al., 2009). This is the first time that analysis of conception rates at a low geographic level (middle super output area, MSOA, average population 7200) has been carried out using an unsuppressed dataset with complete coverage for England¹⁶. There was a linear relationship between alcohol-attributable hospital admissions and teenage conceptions once controlling for deprivation. Taken together, alcohol-attributable hospital admissions and deprivation explain nearly half the variation in teenage conception rates. Mapping of these data highlighted hotspots. Urban more deprived areas (notably in the north of England) were particularly likely to show overlapping hotspots. However, there were a number of alcohol admissions hotspots in more rural areas that were not co-located with hotspots of teenage conceptions, and *vice versa*. The data analysed at the level of lower super output area (LSOA, average population 1500) also show an association between alcohol-attributable hospital admissions in both males and females with births to teenage girls, once the effects of deprivation are controlled. These low level geographical data show a relationship between alcohol admissions and sexual infections in the same age groups, notably with chlamydia and genital warts, among both genders. The association with herpes was restricted to females and no association was seen for gonorrhoea.

Associations at LSOA and MSOA level have a number of limitations, however. First, the

¹⁶ Previously suppressed wards were aggregated by deprivation, and the ward data converted to estimated prevalence at MSOA level; see methods.

findings are area based 'ecological' analysis (aggregating individual data for local areas) and are therefore subject to ecological fallacy.¹⁷ The use of hospital admissions is clearly a proxy measure of alcohol misuse and makes the assumption that such events represent the 'tip of the iceberg' of population use of alcohol. While there are no studies showing that admissions proportionately represent alcohol misuse, it is currently the best and most consistent proxy measure available throughout the country. In the analysis at LSOA level, a single admission for a condition with a low alcohol-attributable fraction¹⁸ would count as an alcohol-attributable admission having occurred in that LSOA. Differences in the presence or absence of an event thus contributed towards the analyses, whereas no account is taken of the frequency within each LSOA. Sexually transmitted infections data were dominated by the most prevalent infection, chlamydia; the levels of which were likely to have been influenced by differences in the extent to which the National Chlamydia Screening Programme has been implemented across the country. Chlamydia data were derived from two sources, clinics and community, and were assumed to count each infection only once (see methods). Although true for the majority of cases, a very small proportion of individuals will have accessed both settings for a single infection and been counted twice; within the current analyses we were unable to quantify this potential small bias. The newly available sexually transmitted dataset from clinics

¹⁷ The ecological fallacy refers to the fact that relationships observed for populations aggregated at an LSOA/MSOA level do not necessarily hold for individuals living within those areas

¹⁸ Such as pedestrian traffic accidents where the alcohol attributable fraction is 0.36 for males and 0.18 for females (Jones et al., 2008).

(GUMCAD) was 99.5% complete. However, since missing data are geographically clustered, it is possible that a small number of hotspots were not identified.

Despite some limitations, our current study has the strength to link harmful outcomes in relation to both alcohol and sexual health at a small geography. Out of an LSOA population of an average of only around 100 young people aged 15 to 19 years, if one of those young people had been admitted to hospital for an alcohol related condition, there would be approximately a 20% increased odds that the particular LSOA would also have one (out of a population of 50 teenage girls) giving birth. At this small level of geography, the definition of deprivation is relatively accurate, and, as expected, is strongly related to both the probability of an area having an alcohol admission and poor sexual health outcomes. Whilst deprivation is not the important factor in adolescent initiation of sexual behaviours (Kirby 2002), our analysis showed that deprivation had strong associations with sexual risks, in particular for births to teenage girls (which had the strongest association with deprivation of all the sexual risks discussed). The association between alcohol misuse and births to teenage girls was evident within each deprivation quintile. Thus, the findings are able to detect statistical differences between areas with and without an alcohol admission, with the likelihood of also having a poor sexual health outcome, even after controlling for deprivation.

Good quality disaggregated data on sexual infections have only become available for the whole of England via the genito-urinary medicine clinic activity dataset (GUMCAD) since 2008. This has made it possible, for the first time, to explore the small area-level link between sexual infections and alcohol use. For the more prevalent sexually transmitted infections (chlamydia and genital warts), the

odds of an LSOA having one or more infections were around 20% higher if that LSOA also had one or more alcohol hospital admissions, after controlling for deprivation. Use of sexually transmitted infections as a proxy for unsafe sexual activity provides further evidence of an inter-relationship between alcohol misuse and sexual harms. The analysis of the less prevalent infections (gonorrhoea and herpes) was not robust at the LSOA level, since very few LSOAs had one or more of these infections.

Subdivision by gender also shows that alcohol-associated harms affect both males and females. Male and female alcohol associated harms also independently contributed to the prediction of a poor sexual health outcome. This supports other studies showing an overlap between risk behaviours among young people, emphasising the need to integrate interventions to reduce these behavioural risks (Phillips-Howard et al., 2010).

It would be useful to conduct repeated analyses on teenage conceptions and sexually transmitted infections over future years to examine trends. Such analysis would benefit from using three or five year datasets on sexually transmitted infections to gain more accurate estimates of rates. The modelling of such data could provide local policy makers with an alert of current and potential hotspots and facilitate examination of aspects of service delivery, for example, distance from the nearest contraceptive and sexual health service. Of particular interest would be the further examination of the local causes of high teenage conception rates, including potential peer pressure and social norms; for example, when a number of adolescent girls from the same school become pregnant together. Few studies have explored these types of social factors, or what types of prevention is required to counter them. Deprivation

strongly influenced the prevalence of both alcohol-attributable hospital admissions in young people and teenage conceptions. Thus efforts to address these complex issues must take such social circumstances into account.

Recommendations

- These results should be used to demonstrate to key stakeholders the relationship between alcohol misuse and poor sexual health outcomes, and the urgent need for the integration of health services for young people. It should be routine for professionals to address sexual health and alcohol issues simultaneously.
- Campaigns/services that aim to address teenage conception should include alcohol consumption in young men as well as young women, since alcohol misuse in both sexes independently predicts teenage pregnancy and sexual infections.
- Analysis should be routinely repeated sequentially in future years to capture trends over time, and identify change linked with local policy.
- Future studies could use three years' worth of data for sexual infections to enable calculation of more accurate rates.
- Attention needs to be paid to local factors that may play a role in enhancing risk of conception among groups of young people, and there is a need to investigate the dynamics of hotspots of high rates.
- Areas with overlapping hotspots for both sexual ill-health and alcohol should be compared to those with hotspots for single indicators to gain some insight as to why the relationship between alcohol harm and sexual ill-health differs between areas.

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Appendix 1: The percentage of LSOAs with at least one teenage pregnancy¹ or STI diagnosis in 2008² by alcohol-attributable hospital admissions status in 2008/09 and child deprivation score in females (a) and males (b).

Child deprivation score	Alcohol Hospital admissions	Total number	Teenage pregnancy	Chlamydia	Warts	Herpes	Gonorrhoea	Any STI
	a) Females		Percentage of LSOAs with at least one occurrence in females					
1 Least deprived	None	4893	8.5%***	43.5%***	12.6%**	3.6%***	1.1%	49.9%***
	One or more	2107	12.4%	49.9%	14.9%	5.2%	1.0%	56.8%
	Total	7000	9.1%	45.4%	13.3%	4.1%	1.1%	52.0%
2	None	4033	14.4%	51%**	12.9%*	4.1%	1.4%	56.4%**
	One or more	2148	14.3%	54.7%	14.8%	4.2%	1.4%	59.9%
	Total	6181	14.4%	52.3%	13.5%	4.2%	1.4%	57.6%
3	None	3936	22.4%***	55.6%***	14.3%***	4.8%	1.8%	60.5%***
	One or more	2559	27.3%	62.1%	17.7%	5.7%	2.3%	67.7%
	Total	6495	23.5%	58.2%	15.6%	5.1%	2.0%	63.4%
4	None	1681	33.7%***	62.8%***	14.9%***	4.7%*	3.1%	67.2%***
	One or more	1810	41.1%	70.4%	18.9%	5.8%	3.0%	74.5%
	Total	3491	35.8%	66.5%	16.8%	5.2%	3.1%	70.8%
5 Most deprived	None	2856	45.4%***	72.5%***	13.7%**	4.6%	5.5%*	75.6%***
	One or more	3685	54.6%	77.9%	15.9%	5.3%	4.5%	80.6%
	Total	6541	48.5%	75.6%	14.9%	5.0%	5.0%	78.4%
	b) males		Percentage of LSOAs with at least one occurrence in males					
1 Least deprived	None	4284	-	17.9%***	4.7%*	0.8%	0.7%	21.9%***
	One or more	2716	-	21.3%	5.9%	0.6%	0.9%	25.7%
	Total	7000	-	19.20%	5.2%	0.7%	0.8%	23.4%
2	None	3666	-	20.4%***	5.0%	0.7%	0.7%	24.3%**
	One or more	2515	-	25.4%	5.9%	1.0%	1.0%	29.3%
	Total	6181	-	22.5%	5.4%	0.8%	0.8%	26.4%
3	None	3467	-	24.8%***	6.3%*	0.9%	1.0%	29.4%***
	One or more	3028	-	29.4%	7.7%	0.9%	1.3%	33.5%
	Total	6495	-	27.0%	6.9%	0.9%	1.1%	31.3%
4	None	2915	-	29.9%***	5.8%***	1.4%	2.0%	34.2%***
	One or more	3350	-	36.6%	8.1%	1.5%	2.0%	41.1%
	Total	6265	-	33.5%	7.0%	1.4%	2.0%	37.9%
5 Most deprived	None	2662	-	39.7%**	6.3%*	1.1%	3.8%*	43.6%**
	One or more	3879	-	43.1%	7.9%	1.4%	2.8%	46.8%
	Total	6541	-	41.8%	7.2%	1.3%	3.2%	45.5%

*Significant at .05 level; **Significant at .01 level; ***Significant at .001 level

¹HES data based on pregnancies resulting in a delivery (both live and still births). Abortions not included

²Aged 15 to 17 years for teenage pregnancy, 15-19 for sexual infections data

Appendix 2: Adjusted odds¹ of an LSOA having a teenage pregnancy² or STI by quintile of childhood deprivation³ and alcohol-attributable admissions.

		Deprivation				One or more alcohol-attributable admissions	
		2	3	4	5	Females	Males
a. Teenage Pregnancy	AOR	1.66***	3.01***	5.33***	8.66***	1.29***	1.23***
	95% CI	1.49 - 1.85	2.72 - 3.33	4.83 - 5.87	7.87 - 9.53	1.22 - 1.37	1.17 - 1.30
b. Any STI (females)	AOR	1.25***	1.58***	2.14***	3.08***	1.26***	1.13***
	95% CI	1.17 - 1.34	1.47 - 1.69	1.99 - 2.31	2.85 - 3.33	1.20 - 1.33	1.08 - 1.19
c. Any STI (males)	AOR	1.17***	1.48***	1.93***	2.52***	1.18***	1.18***
	95% CI	1.08 - 1.27	1.37 - 1.60	1.79 - 2.08	2.34 - 2.72	1.12 - 1.23	1.13 - 1.24
d. Chlamydia (females)	AOR	1.31***	1.66***	2.29***	3.43***	1.25***	1.12***
	95% CI	1.22 - 1.40	1.55 - 1.77	2.14 - 2.46	3.18 - 3.70	1.19 - 1.31	1.07 - 1.17
e. Chlamydia (males)	AOR	1.22***	1.54***	2.04***	2.76***	1.18***	1.21***
	95% CI	1.12 - 1.32	1.42 - 1.67	1.88 - 2.12	2.55 - 2.99	1.12 - 1.24	1.15 - 1.27
f. Genital Warts (females)	AOR	1.02	1.19***	1.26***	1.05	1.20***	1.14***
	95% CI	0.92 - 1.12	1.08 - 1.31	1.15 - 1.39	0.95 - 1.16	1.18 - 1.28	1.07 - 1.22
g. Genital Warts (males)	AOR	1.03	1.33***	1.31***	1.30***	1.16**	1.23***
	95% CI	0.88 - 1.20	1.15 - 1.53	1.13 - 1.52	1.27 - 1.50	1.06 - 1.27	1.12 - 1.34
h. Herpes (females)	AOR	1.02	1.26**	1.25**	1.15	1.19***	1.07
	95% CI	0.85 - 1.21	1.07 - 1.48	1.06 - 1.48	0.97 - 1.36	1.07 - 1.32	0.96 - 1.19
i. Herpes (males)	AOR	1.15	1.3	2.01***	1.71**	1.02	1
	95% CI	0.77 - 1.69	0.89 - 1.89	1.42 - 2.85	1.19 - 2.44	0.81 - 1.27	0.80 - 1.25
j. Gonorrhoea (females)	AOR	1.25	1.80***	2.89***	4.80***	0.93	0.96
	95% CI	0.92 - 1.71	1.35 - 2.40	2.21 - 3.78	3.72 - 6.20	0.80 - 1.08	0.83 - 1.11
k. Gonorrhoea (males)	AOR	1.06	1.45**	2.56***	4.10***	1.19	0.94
	95% CI	0.72 - 1.56	1.02 - 2.07	1.85 - 3.55	3.01 - 5.57	1.00 - 1.42	0.79 - 1.13

*Significant at .05 level; **Significant at .01 level; ***Significant at .001 level

¹Models also control for population size of 15-19 year age group. This is significant in all cases (with medium sized and larger populations more likely to have a sexual health outcome than are smaller populations), but results are not displayed here. Alternative models with deprivation and population size entered as continuous variables yielded similar results (not shown here). Separate models presented for each outcome, one per row. ²HES data based on pregnancies resulting in a delivery (both live and still births). Abortions not included. ³The most affluent group acted as the reference category.

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