Changes in poisonings among adolescents in the United Kingdom between 1992 and 2012: a population based cohort study

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ABSTRACT

Background: Poisonings are a common cause of morbidity and mortality among adolescents. Yet surveillance data indicating current incidence rates and time trends are lacking, making policy development and service planning difficult. We utilised population-based primary care data to estimate adolescent poisoning rates according to intent across the United Kingdom.

Methods: A cohort study of 1,311,021 adolescents aged 10-17 between 1992 and 2012 was conducted using routine primary care data from The Health Improvement Network. Incidence rates (IR) and adjusted incidence rate ratios (IRR) with 95% confidence intervals (CI) were calculated for all poisonings, intentional, unintentional, unknown intent and alcohol-related poisonings by age, sex, calendar time and socioeconomic deprivation.

Results: Overall poisoning incidence increased by 27% from the period 1992-96 to 2007-12, with the largest increases in intentional poisonings amongst females aged 16-17 (IR 391.4/100,000 person-years (PY), CI 328.9-465.7 for age 17 in 1992-96; 767.0/100,000 PY, CI 719.5-817.7 in 2007-12) and alcohol-related poisonings in females aged 15-16 (IR 65.7/100,000 PY, CI 43.3-99.8 rising to 130.0/100,000 PY, CI 110.0-150.0 for age 15). A strong socioeconomic gradient for all poisonings persisted over time, with higher rates among the more deprived (IRR 2.63, CI 2.41-2.88 for the most versus least deprived quintile in 2007-12).

Conclusions: Adolescent poisonings, especially intentional poisonings, have increased substantially over time and remain associated with health inequalities. Social and psychological support for adolescents should be targeted at more deprived communities and child and adolescent mental health and alcohol support service provision should be commissioned to reflect the changing need.

INTRODUCTION

Poisoning during adolescence, including self-harm, is a global problem and amongst the most common causes of death at this age.[1, 2] Poisonings leading to death are just the tip of the iceberg[3] with many more resulting in invasive treatment, time off school and long term health effects.[4, 5] Many adolescent self-harm episodes are linked to mental health problems,[6] which are often predictive of mental health problems in adulthood,[7] making adolescence a key window for preventative intervention. However, up to date rates and time trends for adolescent poisonings are lacking, hindering the development of evidence-informed policy and planning of services.

Existing studies of adolescent poisoning incidence have important gaps, such as primarily being based solely on admissions or emergency department (ED) visits to individual hospitals.[8-21] This may not capture the full burden of medically-attended poisonings as some never present to hospital[22] and attendees at single hospitals may not represent the wider adolescent population. This also creates inherent drawbacks in calculating rates because of difficulties identifying appropriate population denominators. While National Poison Centre data can also provide valuable information,[23, 24] these too have inherent limitations.[25] Some countries actively direct intentional poisoning cases away from poison centres prior to any contact being made,[26] therefore limiting the recording of intentional poisonings. In the UK the National Poisons Information Centre (NPIC) can only be accessed by clinicians seeking advice, with no access for members of the public, so will tend to include more severe cases or those from rarer substances. Most existing studies reporting incidence give single incidence figures across wide age-ranges or only report numbers of events, not rates.[10-12, 20, 21] Socioeconomic variations have been demonstrated but are generally based on individual hospital data, as evidenced by a recent review.[27]

Although some strategies, such as stricter prescribing guidelines for more toxic medications, can reduce poisonings of both an intentional and unintentional nature, epidemiological data on differing intent of adolescent poisonings are also required to help tailor other preventative interventions that may need to be very different in order to help prevent poisonings of different intent, such as those relating to alcohol.[28-30] Up to 18% of adolescents report having self-harmed[31] and 84-96% of medically-attended self-harm episodes are poisonings.[11-14, 20] However, not all adolescent poisonings are self-harm.[5, 8, 32] Most studies have not been able to separate poisonings by intent[4, 8, 15-17, 19] or they solely report self-harm or self-poisonings,[9-14, 18, 20] while alcohol-related poisonings are common yet difficult to classify by intent.[5, 32]

To quantify this problem at a national rather than local level and provide recent time trends of poisonings, we used a large population-based sample from routinely collected primary care data. We assessed how intentional, unintentional and alcohol-related poisonings for adolescent males and females vary by age, how these have changed between 1992 and 2012 and whether socioeconomic inequalities exist.

METHODS

Study population

Data were obtained from The Health Improvement Network (THIN), a United Kingdom (UK) wide database of anonymised, routinely collected, general practice patient records. At the time of extraction, THIN contained 11.1 million patient records from 562 general practices, equating to 6.2% of the UK population.[33] THIN has previously been shown to be broadly representative of the UK population.[34] In the UK, 98% of the population is registered with a general practitioner (GP)[35] and GP records should give a reasonably complete picture of an individual's medical history as information on secondary and tertiary health care utilisation is passed to the patient's GP and recorded in the electronic record.

The study population was an open cohort capturing the registered THIN population aged 10-17 years between January 1st 1992 and December 31st 2012. Participants entered the cohort on the latest of their tenth birthday, registration date with the GP practice contributing to THIN, date the practice reached a data quality standard for completeness or first date of data collection from the practice within the study period. They exited the cohort at the earliest of their eighteenth birthday, death, date they left the practice contributing data to THIN or last day of data collection from the practice within the study period.

Outcome events

All poisoning events occurring between participants' dates of entry and exit from the cohort were extracted using a comprehensive list of Read codes. Read codes are used by UK GPs to record all diagnoses, symptoms and health related events within patients' electronic medical records and are based on the World Health Organization International Classification of Diseases version 10 (ICD-10). To identify poisoning events we used Read codes based on ICD-10 blocks T36-T65: 'Injury, poisoning and certain other consequences of external causes'[36] but excluded iatrogenic, venomous animal and food poisonings (T61, T63-T64). From the data available we were unable to specify the outcome of poisoning events as cause of death is not specifically recorded in the electronic medical record.

We categorised poisonings as intentional, unintentional, unknown intent or alcohol-related. Where Read codes explicitly described the intent using the words 'deliberate' or 'intentional' (intentional); 'accidental' (unintentional); 'unknown' or 'unspecified' (unknown) then they were classified as such. The words 'suicide', 'self-inflicted', 'self-poisoning' or 'overdose' were also used to categorise a poisoning as intentional, unless otherwise specified. Thomas *et al.*, have previously shown Read Code 'SL…15 Overdose of Drug' to indicate a record of definite self-harm.[37] Based on this, Read Codes including 'overdose' were classified as intentional, unless otherwise specified. Codes including 'intoxication' or 'causing toxic effect' were classified as unknown intent, unless referring to alcohol where they were classified as alcohol-related. Alcohol-related poisonings (with codes including 'alcohol' or 'ethanol') were categorised separately as classifying their intent is complex and, as such they are not accurately described by the other three intent categories.[5, 32] The alcohol-related poisoning category only included poisonings from alcoholic beverages and not from other forms of alcohol, such as methanol or rubbing alcohol. Poisonings from these other forms of alcohol were classified as intentional, unintentional or unknown intent based on the criteria described above. All remaining codes were classified as unknown intent (for example, 'SL…12 Drug poisoning').

Repeat poisonings in the same individual during the study period were included. Multiple Read codes for the same event may exist within a patients' record, for example relating to follow-up care, as GPs receive correspondence for all secondary care encounters (hospital admissions, ED and outpatient visits) and should record Read Codes for these as well as all primary care consultations. Therefore, based on our previous work,[38] any poisoning codes occurring within 30 days of another poisoning code were considered the same event. A sensitivity analysis altering this to lower and upper limits of 7 and 60 days respectively was undertaken.

Although the first poisoning code gave the event date, if multiple codes existed within 30 days the one most accurately describing intent was used to categorise that event. For example, if the first chronological code specified an unknown intent, but another subsequently within 30 days specified unintentional, the latter was used to classify the intent. Where two contradictory codes for intent existed within 30 days codes were preferentially selected in the following order: intentional, unintentional, alcohol-related, unknown intent. To assess how this affected different intent poisoning rates an additional sensitivity analysis, preferentially selecting unintentional and then alcohol-related codes before intentional, was undertaken.

Statistical analysis

Incidence rates (per 100,000 person-years) and 95% confidence intervals (CI) for each poisoning category were calculated as the total number of events divided by the total person-time at risk. These were assessed by sex, age (in single years), socioeconomic deprivation (by Townsend Index quintile, an area-based measure of deprivation based on unemployment, non-car ownership, non-home ownership and household overcrowding[39]), and calendar period (1992-96, 1997-2001, 2002-

06, 2007-12). Because the final calendar period was 6 years whereas all others were 5, we conducted a sensitivity analysis comparing the incidence rates by sex and age for 2008-12 (5 years) compared to the results presented which were for 2007-12 (6 years). We used Lexis expansion to assess age and calendar period as time-varying covariates to allow individuals to contribute to more than one age and calendar period. Townsend Index quintiles were applied by THIN for each Census Output Area (around 125 households) and assigned to each patient, based on their home postcode, before we obtained the data. Townsend index was the only variable with missing data for which we included a 'missing' category in the analysis.

As the Pearson goodness-of-fit test showed over-dispersion of the poisoning event data, negative binomial regression was used to calculate incidence rate ratios (IRR) for each explanatory variable. Multivariate models were built for all poisonings combined and separately by intent. We conducted likelihood ratio tests (LRT) or tests for trend for ordered categorical variables for the unadjusted IRR for each individual covariate. All significant variables at the 0.05 level were included in the initial multivariate model. Further LRTs were then conducted for each covariate and any that were no longer significant were removed. Based on existing evidence and theoretical plausibility, interactions between sex and age,[13] calendar period and sex[13] and calendar period and age[15] were assessed using the LRT at a significance level of <0.01, given the large size of the dataset. Data were analysed using StataSE version 12.

RESULTS

The cohort contained 1,311,021 adolescents contributing 5,520,380 person-years (PY). 15,467 individuals had at least one poisoning with a total of 17,862 events during the study period (table 1). Follow-up time was less for those without a poisoning (median 3.87 PY) than those with a poisoning (6.50 PY). 1,113 participants died during the study period although cause of death was not available. 280,803 participants (21%) were censored during the study period because of leaving the practice contributing data to THIN (51% of these were female and 17% were from the most deprived quintile). Person-time contributed by these individuals prior to leaving the practice was still included.

Table 1. Characteristics of the cohort and poisoning incidence rates

Characteristic	**No poisoning** Number (%) (N=1,295,554)	**Poisoning events** Number of events (%) (N=17,862)	**Total person years**	**Incidence rate (95% CI) per 100,000 person years**
Sex (number, %)				
Female	618,713 (48)	11,967 (66)	2,601,316	460.0 (451.9-468.4)
Male	676,841 (52)	5,895 (34)	2,919,064	202.0 (196.9-207.2)
Age (mean years, SD) entering cohort	11.77 (2.46)	11.67 (2.25)*	-	-
Person-years (median, IQR) contributed	3.87 (1.56-7.21)	6.50 (3.70-8.00)*	-	-
Townsend Index Quintile				
1 (least deprived)	290,500 (23)	2,672 (15)	1,298,046	205.9 (198.2-213.8)
2	247,026 (19)	2,674 (16)	1,079,604	247.7 (238.5-257.3)
3	249,540 (19)	3,617 (20)	1,066,932	339.0 (328.1-350.2)
4	237,677 (18)	4,181 (23)	1,003,331	416.7 (404.3-429.5)
5 (most deprived)	179,773 (14)	3,810 (21)	742,233	513.3 (497.3-529.9)
Missing	91,038 (7)	908 (5)	330,234	274.6 (257.6-293.4)
Calendar period				
1992-1996	259,036	1,599	605,417	264.1 (251.5-277.4)
1997-2001	491,647	3,377	1,180,029	286.2 (276.7-296.0)
2002-2006	630,062	5,684	1,658,241	342.7 (334.0-351.8)
2007-2012	730,056	7,202	2,076,693	346.8 (338.9-354.9)
Intentional poisonings	0	11,140	5,520,380	201.8 (198.1-205.6)
Unintentional poisonings	0	768	5,520,380	13.9 (13.0-14.9)
Alcohol-related poisonings	0	3,029	5,520,380	54.9 (53.0-56.9)
Unknown intent poisonings	0	2,925	5,520,380	53.0 (51.1-54.9)
Total poisonings	0	17,862	5,520,380	323.6 (318.9-328.3)

*Based on 15,467 adolescents with at least one poisoning during the study period

Overall poisoning incidence increased by 27% from 264.1 per 100,000 PY in 1992-96 to 346.8 per 100,000 PY in 2007-12 (table 1). After adjusting for confounders the largest increases over time were in intentional (IRR 1.52, 95% CI 1.40-1.64 for the latest compared to earliest period) and alcohol-related (IRR 1.19, 95% CI 1.05-1.36) poisonings, with a reduction in unintentional poisonings (IRR 0.54, 95% CI 0.44-0.68) (table 2). In the most recent period, 64% of poisonings were intentional, 4% unintentional, 16% alcohol-related, 16% unknown intent.

Age and sex

Although the overall poisoning rate in males was less than half the rate in females, sex differences varied by intent. The largest difference was for intentional poisonings which were 80% lower (IRR

0.22, 95% CI 0.21-0.23) in males compared with females whereas alcohol-related poisonings were only 10% lower (IRR 0.90, 95% CI 0.84-0.96). Males had lower rates of unintentional poisonings yet slightly higher rates of unknown intent poisonings (table 2). We found significant interactions between sex and age for all poisoning intents. However, confidence intervals of incidence rates largely overlapped between sexes, other than for intentional poisonings. Interaction between age and time period was significant for all intents except unintentional (figure 1).

The higher total poisoning rates in females compared with males were only at ages 13-17 and largely accounted for by higher intentional poisonings (figure 1a). Over time, intentional poisoning rates increased amongst 15-17 year old females, most markedly in 17 year olds (391.4 per 100,000 PY, 95% CI 328.9-465.7 in 1992-6 to 767.0, 95% CI 719.5-817.7 in 2007-12) (figure 1b), with a small increase in the same ages amongst males. Across this period alcohol-related poisoning rates also increased more amongst females than males (figure 1e), peaking in 15 year olds (65.7 per 100,000 PY, 95% CI 43.3-99.8 in 1992-6 to 130.0, 95% CI 110.0-150.0 in 2007-12). Unintentional poisoning rates reduced among 13-17 year old females over the period studied (figure 1c), leaving very similar rates between the sexes in 2007-12. Rates of unknown intent poisonings were slightly higher in males than females although confidence intervals for all ages overlapped. There was no significant change in the sex distribution of unknown intent poisonings over time (figure 1d).

Socioeconomic deprivation

Poisoning incidence for all intents increased with increasing deprivation (table 2), other than for unknown intent events where the peak was seen in quintile 4 of Townsend index. The largest difference between the most and least deprived groups was for intentional poisonings (IRR 2.75, 95% CI 2.56-2.94). The socioeconomic gradient for all poisonings persisted over time (IRR 2.83, 95% CI 2.34-3.40 in 1992-96 and 2.63, 95% CI 2.41-2.88 in 2007-12).

Sensitivity analysis

Restricting the final time period to 5 instead of 6 years did not change any of the poisoning incidence rates by sex and age for any poisoning intent. Reducing the time interval for repeat codes considered to belong to the same event from 30 to 7 days resulted in a slight increase in the overall poisoning incidence rate from 323.6, 95% CI 318.9-328.3 to 334.5, 95% CI 329.7-339.4 per 100,000 PY. None of the associations between age, sex, deprivation or time were altered. There were no changes in incidence rates or associations when increasing the time interval to 60 days. Preferentially selecting unintentional or alcohol-related codes over intentional codes changed the classification of 80 and 61 events respectively with no changes in incidence rates or associations.

Table 2. Multivariate analyses of risk factors for poisonings by intent category

	Adjusted incidence rate ratios for poisonings (95% confidence intervals)				
	All†	**Intentional†**	**Unintentional†**	**Alcohol-related†**	**Unknown Intent‡**
Sex					
Female	1.00	1.00	1.00	1.00	1.00
Male	0.43 (0.41-0.44)	0.22 (0.21-0.23)	0.69 (0.60-0.80)	0.90 (0.84-0.96)	1.24 (1.15-1.34)
Age group (years)					
10	1.00	1.00	1.00	1.00	Not included in multivariate model (LRT *p*=0.09)
11	1.19 (1.06-1.35)	1.80 (1.30-2.48)	0.91 (0.62-1.31)	2.84 (1.69-4.80)	
12	1.92 (1.72-2.15)	5.58 (4.22-7.40)	1.31 (0.93-1.84)	8.56 (5.32-13.76)	
13	3.79 (3.43-4.19)	15.59 (11.93-20.36)	1.66 (1.20-2.31)	24.26 (15.33-38.40)	
14	6.47 (5.87-7.12)	35.14 (27.01-45.72)	1.92 (1.39-2.66)	36.93 (23.41-58.26)	
15	7.95 (7.22-8.76)	48.87 (37.57-63.56)	2.43 (1.77-3.34)	38.18 (24.21-60.22)	
16	8.02 (7.28-8.84)	54.16 (41.64-70.45)	2.10 (1.52-2.91)	29.81 (18.87-47.09)	
17	7.94 (7.21-8.75)	57.09 (43.88-74.28)	2.08 (1.50-2.87)	21.94 (13.85-34.77)	
Calendar period					
1992-1996	1.00	1.00	1.00	1.00	1.00
1997-2001	1.07 (1.01-1.14)	1.29 (1.18-1.40)	0.61 (0.48-0.77)	1.14 (0.99-0.31)	0.67 (0.58-0.78)
2002-2006	1.26 (1.19-1.33)	1.46 (1.34-1.58)	0.44 (0.35-0.57)	1.24 (1.08-1.42)	1.16 (1.02-1.32)
2007-2012	1.27 (1.20-1.34)	1.52 (1.40-1.64)	0.54 (0.44-0.68)	1.19 (1.05-1.36)	1.06 (0.93-1.20)
Townsend Index Quintile					
1 (least deprived)	1.00	1.00	1.00	1.00	1.00
2	1.20 (1.13-1.26)	1.09 (1.02-1.18)	1.20 (0.93-1.56)	1.31 (1.15-1.49)	1.46 (1.29-1.66)
3	1.62 (1.54-1.71)	1.60 (1.50-1.72)	1.59 (1.25-2.03)	1.55 (1.37-1.75)	1.84 (1.63-2.08)
4	2.00 (1.90-2.11)	2.01 (1.88-2.15)	1.83 (1.43-2.33)	1.97 (1.75-2.22)	2.18 (1.92-2.47)
5 (most deprived)	2.47 (2.34-2.60)	2.75 (2.56-2.94)	2.25 (1.75-2.91)	2.65 (2.35-2.98)	1.66 (1.45-1.90)
Missing	1.32 (1.22-1.43)	1.50 (1.36-1.66)	1.61 (1.15-2.26)	1.22 (1.01-1.48)	0.73 (0.57-0.92)

† Mutually adjusted for sex, age, calendar period and Townsend index

‡ Mutually adjusted for sex, calendar period and Townsend index

Interaction tests between sex and age group (LRT): Total poisonings $p<0.001$; Intentional poisonings $p<0.001$; Unintentional poisonings $p<0.001$; Unknown intent poisonings – *not tested as age group was not significant in the final multivariate model*; Alcohol-related poisonings $p<0.001$

Interaction tests between age group and time period (LRT): Total poisonings $p<0.001$; Intentional poisonings $p<0.001$; Unintentional poisonings $p=0.45$; Unknown intent poisonings – *not tested as age group was not significant in the final multivariate model*; Alcohol-related poisonings $p<0.001$

Interaction tests between sex and time period (LRT): Total poisonings $p=0.004$; Intentional poisonings $p=0.29$; Unintentional poisonings $p=0.03$; Unknown intent poisonings $p=0.02$; Alcohol-related poisonings $p=0.96$

DISCUSSION

Using routine UK primary care data we have shown that recorded adolescent poisonings, especially intentional poisonings, have increased substantially over the last 20 years. The largest increases were for intentional poisonings among females aged 16-17 and alcohol-related poisonings among females aged 15-16 with a smaller reduction in unintentional poisonings in females aged 13-17. Sex differences in intentional and alcohol-related poisonings have widened over time with females having many more records of intentional events and females aged 13-15 overtaking males to have more alcohol-related poisonings in the most recent period. A strong socioeconomic gradient has persisted over time across all poisoning intents, with higher rates amongst more deprived groups.

Strengths and limitations

Ours is the first study among adolescents to examine how these risk factors relate to poisonings of different intent separately. We were also able to examine alcohol poisonings independently. This study provides the most recent data on adolescent poisoning time trends that we are aware of and is the largest examining their epidemiology in the UK. As the first such study using primary care data we have been able to examine nationwide poisoning rates, not just those within a local population. In the UK 98% of the population is registered with a GP[35] and THIN has previously been shown to be demographically representative of the UK,[34] potentially making this generalizable to the whole UK and other similar western countries. However, a slight under-representation of adolescents within THIN has been demonstrated, with the female population aged 10-19 years in THIN being 4.2% lower than would be expected based on the total UK female population and the male population in THIN being 6.3% lower than expected based on the total UK male population.[34]

Although UK primary care data should provide a complete picture of an individual's medical history, we may have underestimated true poisoning incidence. A previous study suggested under-recording of self-harm events by up to 30% when using routine primary care data compared to a self-harm register encompassing attendance at three English hospitals.[37] However, this validation study examined an adult population and all self-harm events, including but not limited to poisonings. The only other UK study specifically reporting adolescent poisoning incidence rates was from admissions to a poisoning unit in South Wales in the 1980s/90s and included all individuals aged over 15.[9] It showed higher rates of poisoning among 15-19 year olds than we have but this may be explained by their inclusion of 18-19 year olds as rates are higher among these ages.[13] Our rates are consistently higher than those from hospital admissions or ED attendances in Australia[4] and the US.[8, 19]

Non-medically attended poisonings will not have been identified in our study and nor will UK poison centre data as this is not linked to the electronic medical record. However, poisonings do have much higher attendance rates than other forms of self-harm due to their potentially serious consequences.[22] Ascertaining intent during a clinical encounter can be difficult due to patient embarrassment or unwillingness to disclose, potentially leading to some events being coded as unknown intent because of this. The accuracy of GP coding practices is a potential source of bias in all large routine primary care database research. However, GP practices in THIN must pass stringent thresholds for data quality before being accepted.[40]

THIN is based on routinely collected data from primary care and so not reliant on return of questionnaires for example, therefore patients will not be lost to follow up in this manner. However, 21% of the study population was censored due to moving GP practices. Given that there was more such loss to follow up amongst the groups with higher rates of poisoning (areas of deprivation and females) this may have led to an underestimation of our poisoning incidence rates.

Interpretation

Total poisonings increased over the period studied, predominantly intentional and alcohol-related poisonings amongst females aged 15-17. We must consider whether this reflects real changes, increased health-seeking behaviour or changes in GP coding practices or popular trends, such as clinicians perceiving intentional poisonings as more frequent, therefore recording events as such.

The simultaneous reduction in unintentional poisonings among females alongside the increase in intentional events suggests this may be a partial explanation. However, the increase in intentional poisonings was much larger than the reduction in unintentional poisonings indicating that this is only a partial explanation.

Hawton *et al.* also showed an increase in all self-harm, including poisonings, amongst females aged 12-18 between 1990 and 2000 in the UK, but static rates among males.[13] We could not identify more recent studies of adolescent poisoning time trends in the UK although a reduction in self-poisonings from 2000-2007 has been reported for all ages combined.[41] A 2012 international review of adolescent self-harm prevalence suggested that although rates have increased over time, they may have stabilised in the preceding 5 years.[31] Our data suggest a continued rise in intentional poisonings in the most recent period studied (2007-12) in the UK, increasing over the adolescent years and being highest in 16-17 year olds, raising the consideration that examining large age ranges together, as in almost all existing literature, may mask changes in specific age groups.

Overall, we found a higher incidence of poisoning in females than males, which is consistent with existing literature.[4, 8, 10, 15, 18, 21, 32] Total and intentional poisonings increasing with age has also been shown previously,[4, 13, 21, 32] but this is the first study showing age-specific poisoning rates for each poisoning intent separately to assess how more specific age patterns vary among adolescents.

Alcohol-related poisoning rates increased much more among females than males over time and peaked at an earlier age (15 years) than intentional poisonings (17 years). Our findings are consistent with the reported increasing rates of binge-drinking among female adolescents from 1995-2011, but static rates among males, shown across Europe in a recent review.[42] However, the UK is one of few countries with more binge-drinking among females than males at these ages.[42] Given this evidence around binge drinking, it does raise additional questions of whether alcohol poisonings should be classed as intentional, although other authors suggest more epidemiological use from examining alcohol as a separate intent.[32] One potential explanation for the increase in alcohol poisonings over time is increased availability, with the relative affordability of alcohol in the UK increasing steadily between 1980 and 2012[43], licensing hours having increased since 2003 and numbers of outlets increasing alongside alcohol harm.[44] With evidence that the strongest influences on excessive drinking and drunkenness in young people are the drinking levels of friends, drunkenness within the family and sources of alcohol, supporting and educating parents is likely to be a key strategy to bring about change.[45] There is also evidence to show that nationwide environmental and economic changes, such as reducing the density of alcohol outlets, tighter controls on alcohol advertising and increasing the price of alcohol can reduce harm.[44]

We found a socioeconomic gradient for all poisonings that persisted over time, with 2-3 times higher incidence among the most compared to least deprived groups across the different intents. Although a similar relationship has previously been shown in self-harm for all ages, including adolescents, all studies examining this relationship in the UK have been individual hospital based studies as shown by a recent review.[27] No existing literature has examined the temporal relationship between socioeconomic status and poisoning specifically. With the majority of poisonings being intentional, this socioeconomic gradient may reflect a difference in psychological distress, stress, lack of control, social environment and support.[46]

Implications

Since intentional and alcohol-related adolescent poisoning rates are increasing, both child and adolescent mental health and alcohol treatment service provision needs to be commissioned to reflect this changing need. Social and psychological support for adolescents should be targeted within more deprived communities to help reduce the current social inequalities. With intentional and alcohol poisonings peaking at different ages, interventions should be tailored to consider the age and sex profiles of risk, starting in the early adolescent years.

Schools, youth services and indeed parents are in a key position to identify and signpost to appropriate services adolescents at risk of self-poisoning, based on these characteristics, especially those showing signs of psychological distress, while supporting and educating parents around alcohol use appears key.[45] There is existing evidence for nationwide environmental and economic changes reducing harm across age groups, in particular with relation to alcohol.[44] There may also be implications for the wider determinants of health in young people, including improving education and employment opportunities[47], which could have benefits in reducing occurrence across the different intentionalities of poisoning through improving psychological wellbeing.

With evidence that around half the individuals attending ED due to self-harm have seen their GP in the last month,[29] GPs should look for signs of anxiety or depression in consulting adolescents, ensure a risk assessment is completed where indicated and keep supplies of medication to a minimum when prescribing for these patients and their relatives if concerns over potential self-harm exist.

Key Messages

What is already known on this subject

- Adolescent poisonings are a global problem and amongst the most common causes of death in this age group, many being related to self-harm.
- Existing evidence on adolescent poisoning incidence and risk factors is generally limited to hospital admissions or emergency department attendances from individual hospitals.
- We lack current data on time trends of different types of poisonings, which are required for appropriate planning and scaling of preventative services.

What this study adds

- Adolescent poisonings in the UK have increased substantially from 1992 to 2012, the vast majority being intentional followed by alcohol-related poisonings.
- Poisoning rates are 2-3 times higher in the most deprived socioeconomic groups compared with the least deprived and this inequality has not improved over time.
- Intentional poisonings in females are considerably higher than in males and this gap has increased over time. Tailoring of interventions based on the age and sex profiles of risk need consideration in planning and commissioning services.

Authors' contributions: All authors were involved in the conception and design of the study. LT and EO were involved in acquisition and preparation of the data. ET undertook the analysis and drafted the manuscript. All authors contributed to interpreting the findings and revising the manuscript.

Competing interests: We declare no competing interests

Ethics statement: The Health Improvement Network (THIN) primary care data was used for this research. The company that owns THIN (Cegedim Strategic Data Medical Research) has received ethical approval for studies using only pre-collected, anonymised data to undergo only a scientific review. This applies to this study and the authors have complied fully with this procedure. A research protocol was submitted to the scientific review committee and the protocol was approved in October 2009. Patient informed consent is not required under this agreement, nor is additional ethics approval from either the NHS ethics committees or from The University of Nottingham.

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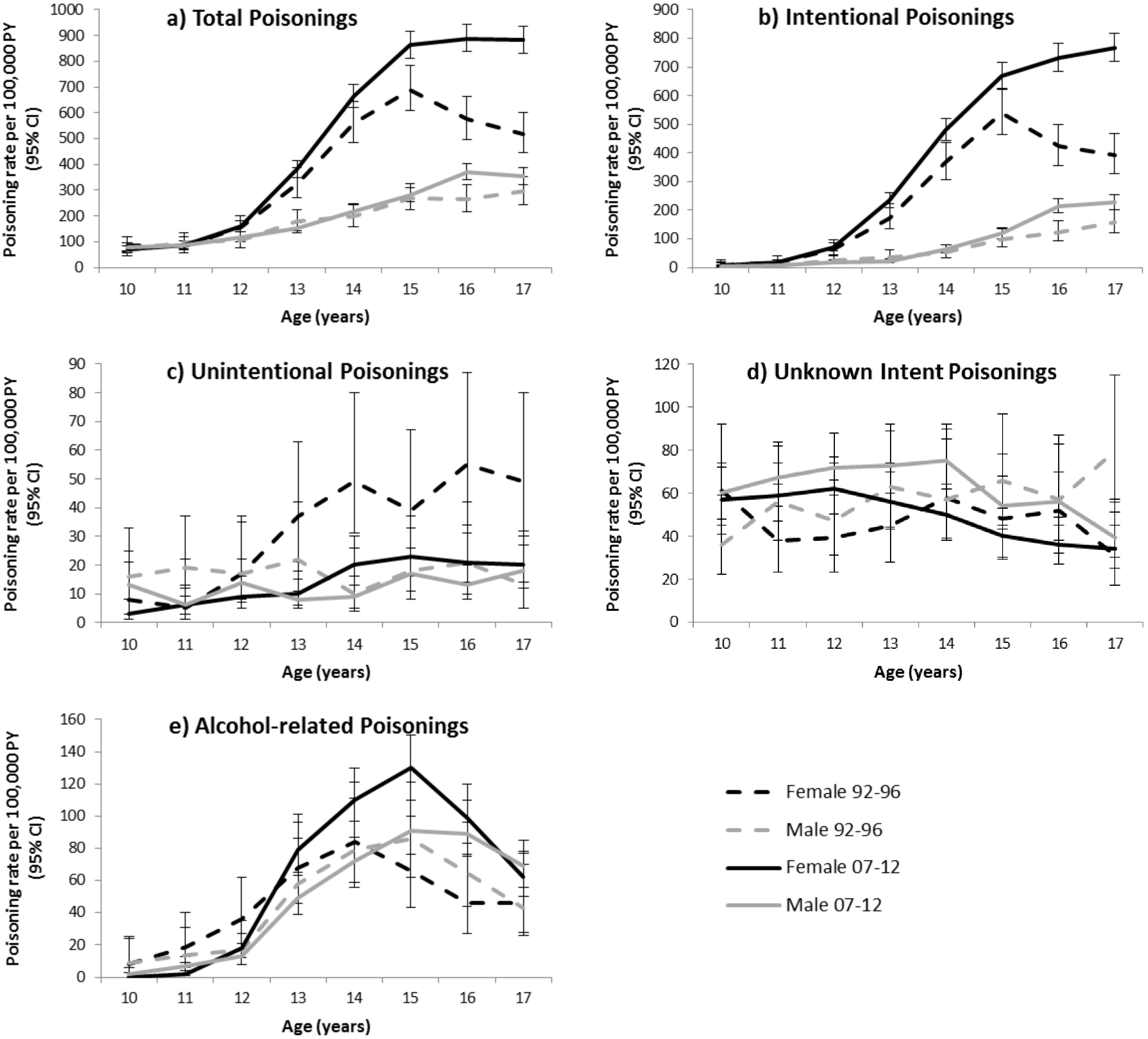
Figure 1. Poisoning incidence rates by sex and age for 1992-96 and 2007-12 for **a)** total poisonings, **b)** intentional poisonings, **c)** unintentional poisonings, **d)** unknown intent poisonings, **e)** alcohol-related poisonings



Interaction tests between sex and age group (LRT): Total poisonings $p<0.001$; Intentional poisonings $p<0.001$; Unintentional poisonings $p<0.001$; Unknown intent poisonings – *not tested as age group was not significant in the final multivariate model*; Alcohol-related poisonings $p<0.001$

Interaction tests between age group and time period (LRT): Total poisonings $p<0.001$; Intentional poisonings $p<0.001$; Unintentional poisonings $p=0.45$; Unknown intent poisonings – *not tested as age group was not significant in the final multivariate model*; Alcohol-related poisonings $p<0.001$

Interaction tests between sex and time period (LRT): Total poisonings $p=0.004$; Intentional poisonings $p=0.29$; Unintentional poisonings $p=0.03$; Unknown intent poisonings $p=0.02$; Alcohol-related poisonings $p=0.96$