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Manuscript Title: Trends in hospital admissions for non-fatal self-inflicted, drug/alcohol-related or violent injury in young people aged 10 to 24 years in England, 2002-2016.

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Background

Recent increases in health care contacts for self-inflicted injury have been reported for females but not for males in the United States (US) and England. In the US, rates of emergency department attendances for non-fatal self-inflicted injury increased in females aged 10-19 (2009-2015) and 15-19 years (2008-2015).[1] In England, annual incidence rates of self-inflicted injury in primary care increased from 2011 to 2014 for females aged 13-16 years.[2] Four percent of all males and females aged 10-19 years have had an emergency hospital admission with a non-fatal adversity-related injury (ARI) – reflecting mutually exclusive groups of self-inflicted injuries (coded as *intentional* "self-harm" or "self-poisoning"), injury admissions related to drug and alcohol-use (excluding intentional alcohol/drug self-poisoning), or violence.[3] Increasing rates of ARIs in England among girls, but not boys, have been previously reported, but not for older adolescents (aged 20-24 years) or for recent years[4]. We analysed temporal trends in non-fatal ARI admissions overall and for self-inflicted injury among young people in England.

Methods

We analysed Hospital Episode Statistics records for all emergency (acute, unplanned) injury admissions[3] to the National Health Service in England (from 2002-2016 inclusive) for ages 10 to 24 years (n=2,017,117). Annual incidence of emergency admissions with ARI, the subset relating to self-inflicted injury, and injuries with no recorded ARI, were calculated using Office for National Statistics mid-year population estimates as denominators. Patients who died during admission (n=3,625; of whom 956 had an ARI, of which 492 were self-inflicted injury) were excluded. Joinpoint regression (see Table 1) was used to estimate the annual

percentage change in the rate of ARI and self-inflicted injury admissions (per 100,000 population) throughout the study period.

Results

ARI admissions accounted for 35% (n=422,692) of all emergency injury admissions in males and 65% (n=482,927) in females. Self-inflicted injury accounted for 39% (n=164,684) of ARI admissions in males, and 81% (n=392,526) in females.

The rate of emergency admissions with any ARI has fluctuated over time, with striking variation by age and sex (**Table 1, Figure 1**). Rates increased in all age and sex groups between 2002 and 2004. Since 2012, the rate of admission with any ARI increased by 3% per year in males aged 10-14 years, but declined by 4-5% per year in males aged 15-19 and 20-24 years. In contrast, ARI rates in females aged 10-14 years declined (at a rate of 7% per year) during 2014-2016, but remain higher than before 2012. The rate of ARI admissions has increased most (6% per year since 2012) for females aged 15-19 years, and has remained almost constant (0.2% increase per year) for 20-24 year olds.

For females, the magnitude and temporal pattern of self-inflicted injury closely mirrored those for any ARI. However, for males aged 15-19 years there was a 1% increase per year (2008 to 2016) in self-inflicted injury admissions, which contrasted with declining rates for any ARI (**Table 1**).

Discussion

We find recent increases in rates of admission with ARIs – including intentional self-injury – in females, with the greatest increase (6% per year since 2012) in 15-19 year olds. These changes are consistent with increases reported in the US (in emergency department visits

for self-inflicted injury) and English primary care consultations for self-inflicted injury.[1,2] The consistent increases across all age and sex groups between 2002-4 suggest growing recognition and/or coding. However, subsequent changes - divergent between age and sex groups – may indicate a growing problem, particularly for females, and for intentional self-injury in males aged 15-19 years. Further research is needed to determine how early preventative interventions in community services (schools, family and neighbourhood interventions, primary care) can impact on presentations to hospital.[5-6]

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Figure 1 Title: Figure 1: Emergency admission rates (per 100,000) with any adversity-related injury (ARI) (in males (left) and females (right)) aged 10 to 24 years in England, 2002 to 2016.

Figure 1 Legend: Note. Each data point (connected by dashed lines) indicates the observed rate of emergency admissions with ARI. Solid coloured lines indicate modelled rates.

Table 1: Trends in emergency admission rates (per 100,000) with any adversity-related injury (ARI) among young people aged 10 to 24 years in England, 2002 to 2016.

Sex	Age (years)	2002	2016	Time period 1[a]	Time period 2[a]	Time period 3[a]
		N (Rate)	N (Rate)	Period (Annual Change[b])	Period (Annual Change[b])	Period (Annual Change[b])
Any Adversity-Related Injury (ARI)						
Male	**10-14**	1,752 (99.1)	1,593 (96.1)	2002-2004 (13%)	2004-2012 (-5%)	2012-2016 (3%)
	15-19	7,074 (419)	9,198 (533)	2002-2004 (19%)	2004-2007 (5%)	2007-2016 (-4%)
	20-24	9,255 (574)	13,624 (705)	2002-2004 (18%)	2004-2010 (2%)	2010-2016 (-5%)
Female	**10-14**	3,807 (226)	6,418 (406)	2002-2011 (0.3%)	2011-2014 (18%)	2014-2016 (-7%)
	15-19	8,088 (505)	19,438 (1188)	2002-2005 (15%)	2005-2012 (2%)	2012-2016 (6%)
	20-24	5,170 (320)	13,229 (720)	2002-2005 (17%)	2005-2010 (4%)	2010-2016 (0.2%)
Any Self-Inflicted Injury						
Male	**10-14**	565 (32.0)	814 (49.1)	2002-2004 (9%)	2004-2010 (-11%)	2010-2016 (3%)
	15-19	2,243 (133)	4,775 (277)	2002-2005 (13%)	2005-2008 (3%)	2008-2016 (1%)
	20-24	3,274 (203)	6,267 (324)	2002-2004 (13%)	2004-2010 (6%)	2010-2016 (-2%)
Female	**10-14**	2,735 (162)	5,847 (370)	2002-2011 (2%)	2011-2014 (22%)	2014-2016 (-8%)
	15-19	6,259 (390)	17,652 (1079)	2002-2005 (15%)	2005-2011 (4%)	2011-2016 (7%)
	20-24	3,884 (240)	10,948 (596)	2002-2005 (17%)	2005-2010 (5%)	2010-2016 (0.9%)

95% confidence intervals are not presented as they were too narrow to convey any useful information.

[a] Linear splines with 0, 1 or 2 knots were used to model trends in ARI rates. Akaike's Information Criterion guided model selection for all knot-placements ≥2 years apart, and the log-likelihood ratio test used to indicate superior fit for equivalent Poisson and negative binomial models. In all instances a negative binomial regression model with 2 knot spline had best fit.

[b] Annual Change in ARI admission rates was estimated using a regression model with the number of emergency ARI admissions as the outcome and population denominator as an offset.