Self-harm among children and adolescents in a UK-wide primary care patient cohort: Incidence, clinical-management and mortality risk

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Complete List of Authors:	Morgan, Catharine; The University of Manchester, Centre for Pharmacoepidemiology and Drug Safety, Faculty of Biology, Medicine and Health Webb, Roger; The University of Manchester, Centre for Mental Health & Risk, Faculty of Biology, Medicine and Health Carr, Matthew; The University of Manchester, Centre for Mental Health and Risk, Faculty of Biology, Medicine and Health Kontopantelis, Evangelos; University of Manchester, Centre for Health Informatics, Faculty of Biology, Medicine and Health Green, Jonathan; University of Manchester, Division of Neuroscience and Experimental Psychology, Faculty of Biology, Medicine and Health; Royal Manchester Children's Hospital Chew-Graham, Carolyn; University of Keele, Research Insitute for Primary Care and Health Sciences Kapur, Navneet; University of Manchester, Centre for Suicide prevention, Faculty of Biology, Medicine and Health; Greater Manchester Mental Health NHS Foundation Trust, Prestwich Hospital Ashcroft, Darren; University of Manchester, Centre for Pharmacoepidemiology and Drug Safety, Faculty of Biology, Medicine and Health
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Catharine Morgan
Research Associate
Centre for Pharmacoepidemiology and Drug Safety
NIHR Greater Manchester Patient Safety Translational Research Centre
Manchester Academic Health Science Centre (MAHSC)
Division of Pharmacy and Optometry
School of Health Sciences
Faculty of Biology, Medicine and Health
University of Manchester
Stopford Building
Oxford Road
Manchester
M13 9PT, UK

Roger T Webb
Reader in Mental Health Epidemiology
Centre for Mental Health & Risk
NIHR Greater Manchester Patient Safety Translational Research Centre
Manchester Academic Health Science Centre (MAHSC)
Division of Psychology and Mental Health
School of Health Sciences
Faculty of Biology, Medicine and Health
University of Manchester
Jean McFarlane Building
Oxford Road
Manchester
M13 9PL, UK

Matthew J Carr
Biostatistician
Centre for Mental Health & Risk
NIHR Greater Manchester Patient Safety Translational Research Centre
Manchester Academic Health Science Centre (MAHSC)
Division of Psychology and Mental Health
School of Health Sciences
Faculty of Biology, Medicine and Health
University of Manchester
Jean McFarlane Building
Oxford Road
Manchester
M13 9PL, UK

Evangelos Kontopantelis
Reader in Biostatistics and Health Service Research
Centre for Health Informatics
Manchester Academic Health Science Centre (MAHSC)
Division of Informatics, Imaging and Data sciences
School of Health Sciences

Faculty of Biology, Medicine and Health
University of Manchester
Williamson Building
Oxford Road
Manchester
M13 9QQ, UK

Jonathan Green
Professor of Child and Adolescent Psychiatry
Manchester Academic Health Science Centre (MAHSC)
Division of Neuroscience and Experimental Psychology
School of Biological Sciences
Faculty of Biology, Medicine and Health
University of Manchester
Jean Macfarlane Building
Oxford Road
Manchester
M13 9PL, UK
Royal Manchester Children's Hospital
Central Manchester University Hospitals NHS Foundation Trust
Oxford Road,
Manchester
M13 9WL, UK

Carolyn A Chew-Graham
Professor of General Practice Research
Research Institute, Primary Care and Health Sciences
West Midlands, Collaboration for Leadership in Applied Health Research and Care
Keele University
Staffordshire
ST5 5BG, UK

Nav Kapur
Professor of Psychiatry and Population Health
Centre for Suicide Prevention
NIHR Greater Manchester Patient Safety Translational Research Centre
Manchester Academic Health Science Centre (MAHSC)
Division of Psychology and Mental Health
School of Health Sciences
Faculty of Biology, Medicine and Health
University of Manchester
University Place
Oxford Road
Manchester
M13 9PL, UK
Greater Manchester Mental Health NHS Foundation Trust
Prestwich Hospital,
Bury New Road
Prestwich,
Manchester
M25 3BL, UK

Darren M Ashcroft
Professor of Pharmacoepidemiology
Centre for Pharmacoepidemiology and Drug Safety
NIHR Greater Manchester Patient Safety Translational Research Centre
Manchester Academic Health Science Centre (MAHSC)
Division of Pharmacy and Optometry
School of Health Sciences
Faculty of Biology, Medicine and Health
University of Manchester
Stopford Building
Oxford Road
Manchester
M13 9PT, UK

Corresponding author:
Catharine Morgan
Email: Cathy.Morgan@manchester.ac.uk
Telephone: +44(0) 161 306 8116

Abstract

Objectives: To examine temporal trends in gender- and age-specific incidence in child and adolescent self-harm, and patterns of clinical management and cause-specific mortality risk following an index self-harm episode at young age.

Design: Population-based cohort study.

Setting: UK Clinical Practice Research Datalink (CPRD) - one of the world's largest routinely anonymised general practice electronic health record databases, capturing general practitioner consultations, with practice-level deprivation measured ecologically using the Index of Multiple Deprivation (IMD). Individuals from eligible English practices were linked to Hospital Episode Statistics (HES) and Office for National Statistics (ONS) mortality records.

Study population: For the descriptive analytical phases we examined data pertaining to 16,912 patients aged 10-19 who harmed themselves during 2001-2014. For analysis of cause-specific mortality following self-harm, 8,638 patients eligible for HES and ONS linkage were matched by age, gender and general practice with up to 20 unaffected children and adolescents (n=170,274).

Main outcome measures:
In phase 1, we examined temporal trends in gender- and age-specific annual incidence rates. In phase 2, clinical management was assessed according to likelihood of referral to mental health services and by whether psychotropic medication was prescribed. In phase 3, for the self-harm cohort versus the matched unaffected comparison cohort, relative risks of all-cause mortality, unnatural death (including suicide and accidental death), and fatal acute alcohol/drug poisoning were estimated as hazard ratios derived from stratified Cox proportional hazards models.

Results
We observed elevated annual incidence rates in girls (37.4 per 10,000) versus boys (12.3 per 10,000), and a sharp 68% rise in incidence among girls aged 13-16 from 45.9 per 10,000 in 2011 to 77.0 per 10,000 in 2014. Referrals within 12 months of index self-harm episode were 23% less likely for young patients registered at the most socially deprived practices, even though incidence rates were considerably higher in these localities. Child and adolescents who harmed themselves were approximately nine times more likely to die unnaturally during follow-up, with especially marked elevations in risks of suicide (deprivation-adjusted hazard ratio 17.5, 95% CI 7.6 to 40.5) and fatal acute alcohol/drug poisoning (deprivation-adjusted hazard ratio 34.3, 95% CI 10.2 to 115.7).

Conclusions
Gaining a better understanding of the mechanisms responsible for the recent steep rise in self-harm incidence among early-mid teenage girls, and coordinated initiatives to tackle health inequalities in the provision of services to troubled children and adolescents, represent urgent priorities for multiple public agencies.

"What this paper adds" box

Section 1: What is already known about the subject

Self-harm is the strongest risk factor for subsequent suicide, with suicide being the second commonest cause of death before reaching age 25 worldwide.

Increases in child and adolescent suicide rates have been identified in recent years, and psychological distress at young age has also been reported as rising sharply, but nonfatal self-harm incidence rates are difficult to quantify at population level in the absence of nationally representative data sources.

A gap exists in the evidence-base for temporal trends relating to self-harm among children and adolescents, with published study periods currently extending no further than 2012.

Section 2: What this study adds

We report a steep 68 percent rise in self-harm incidence among girls aged 13-16 between years 2011 and 2014, which indicates an urgent need to explain this sharp risk elevation and then to intervene to greatly lower risk among early-mid teenage girls.

Likelihood of referral was lowest in the most deprived practice localities where incidence of self-harm was highest, an illustration of Tudor Hart's 'Inverse Care Law' whereby quantity or quality of healthcare service provision is inversely associated with the level of healthcare need.

The high relative risks observed for cause-specific premature mortality, and for suicide and fatal acute alcohol/drug poisonings in particular, highlight the importance of effective inter-agency collaboration to enhance safety and future mental wellbeing for troubled young people.

Background

Self-harm in children and adolescents is a major public health problem in many countries. In Australia, for example, 8% of adolescents under the age of 20 years reported harming themselves at some time in a large population-based cohort study.[1] Self-harm is highly correlated with the presence of anxiety and depression[1,2] with prolonged poor psychological health in childhood linked to the onset of common mental illnesses in adulthood.[3] Nonfatal self-harm is also the strongest risk factor for subsequent suicide,[4] which is the second commonest cause of death in 10-24 year olds after road traffic accidents worldwide.[5] There is considerable variability in the suicide rates globally.[6] In the United Kingdom (UK), suicide rates among adolescents aged 15-19 years have risen from 3.2 to 5.4 per 100,000 between 2010 and 2015, respectively.[7] Half of adolescents who die by suicide have a history of self-harm.[8] In addition, there has been a rise in reports of mental health problems, including self-harm from teachers,[9] charity-based or third sector organisations[10] in frontline contact with children and adolescents. In the UK, the National Suicide Prevention Strategy[11] recently expanded its scope by aiming to reduce self-harm rates as a common precursor to suicide.

However, the frequency and natural history of self-harm in children and adolescents at population level must first be accurately quantified. The hidden nature of self-harm represents a major obstacle to achieving this goal. Less than a quarter of children and adolescents who self-harm are believed to present to healthcare services.[12] Current figures, based largely on hospital data,[13] are likely to underestimate self-harm incidence. Cases presenting to general practitioners alone are not captured and only half of secondary care self-harm presentations result in hospital admissions.[14,15] In most developed healthcare systems, primary care is often the first point of contact for mental health problems. In the UK, primary care electronic medical records offer the opportunity to identify a large cohort of children and adolescents who have harmed themselves, allowing comprehensive reporting over time and supporting advanced analyses including linkage to mortality data from the Office for National Statistics.

Utilising the Clinical Practice Research Datalink (CPRD), one of the world's largest databases of electronic primary care patient records, we aimed to: 1) investigate temporal trends, 2001-2014, in self-harm incidence among children and adolescents (aged 10-19 years), 2) assess referral rates to specialist mental health services and prescribing of psychotropic medication in the year following the index self-harm episode, and 3) examine all-cause and cause-specific mortality risks among children and adolescents following self-harm versus unaffected peers of the same age and gender.

Methods

Data source

The CPRD is a UK-wide anonymised primary care patient records database, capturing general practitioner (GP) consultations and recording symptoms, diagnoses, and prescribed medication, and referrals to secondary care services. The CPRD contains over 4.4 million active patient records from 674 registered general practices, covering 6.9% of the UK population, and is broadly representative of the national population in terms of age, gender and ethnicity.[16] Approximately 60% of practices, all of which are located in England, participate in the CPRD linkage scheme, which facilitates routine linkage to Office for National Statistics (ONS) mortality records, to Hospital Episode Statistics (HES) and to the Index of Multiple Deprivation (IMD).[17] This deprivation measure is derived from a combination of several socioeconomic indicators for small areas based on practice or patient's residential postcode. It is ranked within each UK country, and then placed in quintiles for least to most deprived areas.

Study design and population

Children and adolescents aged 10-19 years were included in this cohort study, with a self-harm record during calendar years 2001 through 2014. Self-harm was defined using the UK National Institute for Health and Care Excellence (NICE) clinical guidelines as "any act of self-poisoning or self-injury, irrespective of motivation".[18] Non-suicidal self-injury or suicide attempt are classifications used in some settings, but are reliant on establishing the intent of the behaviour, which is difficult to quantify in children and adolescents. Self-harm records were therefore identified across a broad spectrum of codes from milder forms of non-suicidal behaviour to near-fatal suicide, with each code subject to rigorous clinical review (CAC-G, NK).[19] The numbers of patient records included at each analytical phase is outlined in detail in Figure 1.

Statistical analysis

In the first phase of analysis, annual incidence rates were calculated from the number of children and adolescents presenting with a self-harm episode during each calendar year period in relation to the total number of children and adolescents at risk during the same year. Having stratified on age band, IMD and region of residence, strata-specific rates were then applied to calculate directly standardised incidence rates. Age was categorised according to key educational stages: 10-12, 13-16, and 17-19; IMD was placed into quintiles based on general practice location.

In the second analytical phase, clinical management was assessed according to referrals to specialist mental health services and GP prescribing of psychotropic medication in the first year following the index self-harm episode. Psychiatric referrals were captured using the Family Health Services Authority (FHSA) 'Psychiatry' code, National Health Service (NHS) speciality fields and relevant Read codes frequently used during consultations. Psychotropic medication included prescriptions issued for antidepressants, antipsychotics, and hypnotics/anxiolytics. Clinical management variables were stratified by gender, age group, and practice-level IMD quintile. Mental illness comorbidity was examined according to diagnoses of depression, anxiety, attention deficit hyperactivity disorder, eating disorder, personality disorder, and autism spectrum disorders, conduct disorder, schizophrenia, obsessive compulsive disorder, bipolar, tics, and social dysfunction.

For the third and final analytical phase, we implemented a matched cohort design to investigate cause-specific mortality risk. We restricted the study cohort for this phase to include only patients registered at English CPRD practices participating in the HES and ONS linkage scheme. Incident self-harm episodes recorded in the CPRD before 31st March 2014 were included, where no previous self-harm episode was identified from either the primary care record or the linked HES data record. Self-harm episodes in the HES data were delineated using International Classification of Disease 10th

revision (ICD-10)[20] codes X60-X84.9. Each incident episode was matched by age, gender, and registered practice with up to 20 comparison individuals with no record of self-harm on the index self-harm date. This large comparison group maximised statistical power and precision (Figure 1).

To classify cause-specific mortality following self-harm, the underlying cause of death code was categorised according to ICD-10, as follows: all-cause mortality, all natural deaths; all unnatural deaths, suicide (including/excluding open verdicts); accident; acute alcohol/drug poisoning. To estimate the risk of all-cause and cause-specific mortality, Cox regression analysis stratified by matched set was performed, producing both unadjusted hazard ratios and those adjusted by IMD quintile by patient postcode. The index date in the self-harm and matched comparison cohorts was defined when the first recorded self-harm event occurred. Records were right-censored at the end of the follow up period (31st March 2014), the practice last data collection date, date of transfer out, or death, whichever date was earliest. Evidence for differences in gender-specific hazard ratios was assessed using likelihood ratio interaction tests. The proportional hazards assumption was assessed using Schöenfeld's residuals,[21] with no evidence of this being violated in any of the fitted models.

All relevant code lists are published online www.clinicalcodes.org[22] and analyses were performed using Stata/SE 14.2.

Results

Phase 1: Characteristics of the self-harm cohort, incidence rates and temporal trends

During the 2001-2014 observation period, 16,912 children and adolescents were identified with at least one self-harm episode of which 12,398 (73.3%) were girls and 4,514 (26.7%) were boys. There was a relatively high prevalence of depression and anxiety in the self-harm cohort, with depression diagnoses recorded in over a third of girls and in over a quarter of boys (Appendix 1). Of the 13,980 (82.7%) of index episodes with self-harm method recorded, 84.1% were coded as drug overdoses with an additional 2.5% identified as other self-poisonings. A further 12.3% were self-cutting episodes and the remaining 1.1% involved methods including hanging, suffocation, jumping and scalding. Within 12 months of the index episode, repeat self-harm was common (n=3,628, 21.5%) and more frequent among girls (22.6%) than boys (18.3%; χ^2=35.3; p<0.0001). Among the individuals who had records of repeat self-harm, 2,685 (74.0%) had one repeat episode recorded, 641 (17.7%) had two, and 302 (8.3%) had three or more further episodes within 12 months of their index episode.

Higher standardised annual incidence rates of self-harm were observed in girls 37.4 (95% CI 36.8 to 38.1) per 10,000 compared to boys 12.3 (95% CI 11.9 to 12.6). Among children and adolescents registered with practices in the most deprived areas, there was a raised annual incidence per 10,000 (27.1, 95% CI 26.1 to 28.2) compared to those consulting practices in the least deprived areas (19.6, 95% CI 18.6 to 20.6). Age-specific incidence rates per 10,000 showed a marked 68% increase in self-harm episodes among 13-16 year old girls rising from 45.9 (95% CI 41.7 to 50.0) in 2011 to 76.9 (95% CI 70.7 to 83.2) in 2014 (Figure 2). For years 2012, 2013 and 2014, the incidence rate in girls aged 13-16 was higher than those aged 17-19 years. Thus, from a lower baseline the incidence among females in their early-mid teen years advanced and surpassed that seen in older female teenagers. The sharp rise was specific to 13-16 aged girls, as no marked increases in incidence over time were seen in females aged 10-12 or 17-19, or among males in any of the three age strata.

Phase 2: Clinical management during 12 months following self-harm

There were 7,552 (55.8%) children and adolescents for whom no referral to mental health services was documented. However, 1,676 (12.4%) were referred before the index self harm and a further 1,905 (14.1%) with a referral more than 12 months afterwards. Of the 2,395 (17.7%) children and adolescents referred within 12 months, a higher percentage of girls were referred than boys (18.2% vs 16.5%; χ^2=5.06; p=0.02 Table 1). Children and adolescents from GP practices located in the most deprived areas were 23% less likely to be referred in the first 12 months following an index self-harm episode compared to those practices in the least deprived areas (HR=0.77; 95% CI 0.67 to 0.89; p=0.001). In addition, girls consulting to GP practices from the most deprived localities were 19% less likely to receive a psychotropic prescription in the first 12 months compared to the least deprived localities (HR=0.81; 95% CI 0.71 to 0.92; p=0.002). Overall, more than a fifth of children and adolescents were prescribed antidepressants, with more girls prescribed them than boys (22.9% vs 20.4%; χ^2=9.7; p=0.002, Table 2). Conversely boys were more likely to be prescribed hypnotics/anxiolytics (8.3% vs 5.8%; χ^2=28.0; p<0.0001) or antipsychotics (5.6 vs 3.6%; χ^2=28.3; p<0.0001) than girls during the first year following self-harm.

Phase 3: Cause-specific mortality risks following self-harm

There were 8,638 children and adolescents in the self-harm cohort and 170,274 in the matched comparison cohort, 74% were girls and 26% boys. A total of 43 deaths occurred among individuals in the self-harm cohort and 176 in the comparison cohort, of which 65.1% (self-harm cohort) versus 26.6% (comparison cohort) were classified as unnatural deaths. Children and adolescents who self-harmed were an estimated nine times more likely to die unnaturally during the follow-up period than their unaffected peers (IMD-adjusted HR 9.35; 95% CI 5.84 to 14.97). Risk was raised in the self-

harm cohort for all-cause mortality and for each cause of death category examined, with especially marked risk elevations observed for suicide (IMD-adjusted HR 17.48; 95% CI 7.55 to 40.46) and for fatal acute alcohol/drug poisoning (IMD-adjusted HR 34.33; 95% CI 10.19 to 115.69) (Table 3). Boys in the self-harm cohort had a higher elevation in risk of all-cause mortality versus their unaffected male peers compared to the equivalent gender-specific relative risk among girls (likelihood ratio: χ^2 =5.0; p=0.03). Across all of the mortality categories examined, the IMD-adjusted hazard ratios were of a similar magnitude to the unadjusted estimates.

Figure 1: Summary of the derivation of each cohort for the three analytical phases

Standardised by Index of Multiple Deprivation quintile and region of residence

Figure 2: Temporal trends in annual age-specific standardised self-harm incidence rates stratified by gender

				Referred to mental health services			Prescribed medication[a]		
			N	n	(%)	Chi^2 test†	n	(%)	Chi^2 test†
Overall			13, 528	2,395	(17.7)		3,514	(26.0)	
Boys			3, 645	601	(16.5)		949	(26.0)	
Age in years		10-12	192	27	(14.1)		15	(7.8)	χ^2=124.0
		13-16	1,260	230	(18.3)		223	(17.7)	p=0.0001
		17-19	2,193	344	(15.7)	χ^2=1.8	711	(32.4)	
IMD quintile	Least	1	513	98	(19.1)		134	(26.1)	
		2	584	110	(18.8)	χ^2=8.5	153	(26.2)	
		3	709	115	(16.2)	p=0.004	192	(27.1)	χ^2=0.3
		4	913	149	(16.3)		237	(26.0)	
	Most	5	926	129	(13.9)		233	(25.2)	
Girls			9, 883	1,794	(18.2)		2,565	(26.0)	
Age in years		10-12	258	46	(17.8)	χ^2=1.6	18	(7.0)	χ^2=777.6
		13-16	5,469	969	(17.2)		871	(15.9)	p=0.0001
		17-19	4,156	779	(18.7)		1,376	(40.3)	
IMD quintile	Least	1	1, 526	321	(21.0)		417	(27.3)	
		2	1, 828	384	(21.0)	χ^2=35.3	518	(28.3)	χ^2=8.8
		3	1, 940	359	(18.5)	p=0.0001	489	(25.2)	p=0.003
		4	2, 268	380	(16.8)		582	(25.7)	
	Most	5	2, 321	350	(15.1)		559	(24.1)	

†Kruskal-Wallis test

[a] Including: antidepressants, antipsychotics, and hypnotics/anxiolytics

Table 1: Clinical management stratified by demographic subgroups in the year following an index self-harm episode

Psychotropic medication	All (N=13,528) n (%)	Boys (N=3,645) n (%)	Girls (N=9,883) n (%)	Chi^2 test
Antidepressants	3,005 (22.2)	743 (20.4)	2,262 (22.9)	χ^2=9.7; p=0.002
- Serotonin reuptake inhibitors	2,610 (86.9)	621 (83.6)	1,989 (87.9)	
- Tricyclic antidepressants	186 (6.2)	46 (6.2)	140 (6.2)	
- Other antidepressants	209 (7.0)	76 (10.2)	133 (5.9)	
Antipsychotics	555 (4.1)	204 (5.6)	351(3.6)	χ^2=28.3; p<0.0001
- First generation	208 (37.5)	42 (20.6)	166 (47.3)	
- Second generation	346 (62.3)	161 (78.9)	185 (52.7)	
Hypnotics/anxiolytics	872 (6.5)	302 (8.3)	570 (5.8)	χ^2=28.0; p<0.0001

Table 2: Psychotropic prescribing by medication type in the year following index self-harm episode

Death by	Self-harm cohort (N=8,638)		Comparison cohort (N=170,274)		Hazard ratio (95% CI)	
	No. of deaths	Rate per 1000 PYs	No. of deaths	Rate per 1000 PYs	Unadjusted	Adjusted*
All causes	43	5.47	176	1.11	5.78 (4.08, 8.20)	5.71 (4.02, 8.11)
- Boys	25	12.03	74	1.76	8.61 (5.31, 13.95)	8.64 (5.29, 14.12)
- Girls	18	3.11	102	0.88	3.95 (2.35, 6.63)	3.93 (2.33, 6.62)
All natural causes	15	1.91	104	0.66	3.38 (1.93, 5.90)	3.41 (1.95, 5.99)
All unnatural causes	28	3.56	72	0.45	9.31 (5.85, 14.81)	9.35 (5.84, 14.97)
Suicide	13	1.65	17	0.11	18.67 (8.32, 41.87)	17.48 (7.55, 40.46)
Suicide (incl. open verdicts)	16	2.04	24	0.15	17.31 (8.52, 35.16)	16.95 (8.28, 34.68)
Acute alcohol/drug poisoning	11	1.40	6	0.04	38.20 (13.23, 110.28)	34.33 (10.19, 115.69)
Accident	12	1.52	47	0.30	5.96 (3.08, 11.53)	5.97 (3.05, 11.68)

*Adjusted by Index of Multiple Deprivation quintile

PYs: Person years

Table 3: Hazard ratios for all-cause and cause-specific mortality for the self-harm cohort vs. the age-, gender- and practice-matched comparison cohort

Discussion

This is the first study to examine self-harm frequency, temporal trends, clinical management and mortality risk of from natural and unnatural causes in a nationally representative cohort of children and adolescent primary care patients. We found high incidence rates of self-harm in this cohort. There were significant differences in incidence rates between boys and girls, with a sharp 68% increase in rates among girls aged 13-16 between 2011 and 2014. Lower likelihood of referral to specialist mental health services was observed at practices in more socially deprived localities, although self-harm incidence rates were elevated in these poorer practice populations. Following the initial self-harm episode, there was a high frequency of repeat self-harm in both girls and boys. Children and adolescents were at markedly elevated risk of dying at a young age following self-harm, by suicide and by acute alcohol/drug poisoning in particular, versus their peers of the same age and gender without history of self-harm.

Incidence of self-harm

We report elevated annual incidence rates of self-harm in girls (37.4 per 10,000) compared to boys (12.3 per 10,000). This is consistent with previous hospital-based studies[13,23] and a recent primary-care based study addressing self-poisoning.[24] Lower annual rates in girls aged 10-14 years from six hospitals of 302 (95% CI 269 to 335) per 100,000 compared to 67 (95% CI 52 to 82) per 100,000 for boys were reported,[13] although caution is required when comparing rates across studies, as differences in self-harm definitions, derivation of rates, age ranges and age categorisations and timescale used must be carefully considered.

Temporal trends in gender- and age-specific incidence rates

In girls aged 13-16 years, there was a marked rise in self-harm incidence over time specifically for years 2011-2014. This might be an artefact caused by ascertainment anomalies occurring over this time period, but this seems an unlikely explanation given that there was little change in incidence rates observed for the other female age groups, or for any of the three male age groups. It therefore seems fair to assume no differential misreporting over time. Previous published reports have also suggested an upward trend, although only for the period up to 2012, with few specifically focussing on younger age categories.[24-26] A threefold increased rate of probable and deliberate self harm was reported in females aged 10-19 years from 1994 to 2011 in a Danish hospital registry study.[26] Another UK-based study of primary care data from The Health Improvement Network (THIN) investigating poisonings, found that intentional poisoning incidence rates in females aged 15-17 rose from 391.4 to 465.7 per 100,000 person years between the two successive calendar periods, 1992-96 to 2007-2012.[24] Recent data from the Adult Psychiatric Morbidity Survey in England,[27] based on clinical interviews, indicate that 11.7% of female 16-24 year olds in 2007 reported ever self-harming rising to 19.7% in 2014. In a multicentre hospital-based study in England,[25] age-standardised rates of self-harm appeared to decline from 2000 until 2009 with a possible increase and stabilising of rates from 2009-2012, although figures were based on combined age range of 15-24 years. The trends in this study are consistent with the observed increase in psychological distress among adolescent girls[28] and the rise of suicide rates in England in females aged 10-29 years, of 2.7 per 100,000 in 2012 to 3.2 per 100,000 in 2015.[7]

The high incidence of self-harm among this age group is potentially due to the emergence of common mental health problems in females at this age and biological factors such as puberty and onset of sexual activity.[29] However reasons for the recent temporal increase that we observed are less obvious and speculative. Exposure to digital media and the effect on children and adolescents' mental health is the centre of continued debate. Of course such media can be helpful and facilitate access to care but there is also a suggestion that extreme 'connectedness' could have detrimental effects.[30,31] It is possible that marked gender differences in the nature of online interactions play an important role. Early-mid teenage girls may become likely to engage in more communicative or

socialising online in recent years, thereby becoming exposed to content that encourages or normalises self-harm as a reaction to stressful events. In a recent report of self report child wellbeing, it was noted during the period from 2009-2014 there was most striking dissatisfaction with self appearance[32] among girls over 12 years, with dissatisfaction increasing two-fold from 2008 to 2013-14. England show the largest gender gap in children's satisfaction on this issue as reported by the Children's World Survey of over 15 countries.[33] It is also possible however, that the increased incidence among early-mid teenage girls may be indicative of differential surveillance bias, where frontline services may be more likely to be alert to and enquire about self-harming behaviour in girls than boys in this age range. Girls aged 13-16 may also be more likely to consult with a GP than boys at these ages.

Clinical management 12 months following self-harm

In the first 12 months following an initial self-harm episode, a high proportion of prescriptions for antidepressants was observed. This was substantiated by a recent CPRD study of children where increases in the last five years of depression assigned prescription records were noted particularly among girls aged 15-17.[34] Referral rates to psychiatric services following self-harm were low in our study, suggestive of less severe cases or possible reflection of the challenges to access specialist services in a timely manner.[35] Likelihood of referral was lowest in the most deprived localities where incidence of self-harm was highest. This provides a stark illustration of Tudor Hart's 'Inverse Care Law' whereby quantity or quality of healthcare service provision is inversely associated with the level or severity of healthcare need in the population.[36]

Mortality risks following self-harm

In our study, children and adolescents who had harmed themselves were over nine times more likely to die unnaturally during the follow-up period; specifically, they were seventeen times more at risk of suicide. Although thought of being a lower risk behaviour in very young children,[37] the link between self-harm and suicide is well established. Among children and adolescents in our study, 21.5% had a repeat self-harm episode within 12 months, compared to hospital attendance based data, where frequency of repetition was 17.7%[37] further emphasising the primary care opportunity for earlier intervention to reduce the risk of suicide.

Strengths and limitations

This is the first cohort study to report on self-harm among children and adolescents using the CPRD, which is one of the world's largest longitudinal primary healthcare datasets. However, the study did have some limitations. Firstly, accuracy of GP coding may be a potential source of bias in primary care databases, although the CPRD currently have data quality assessment criteria, and only data from practices graded as being at appropriate standard for academic research were included. We aimed to describe the incidence and clinical management of self-harm from a primary care perspective. However, this was not a complete community sample of young people who harmed themselves. An illustration of this is that self-cutting was less frequently recorded in our study and self-poisoning episodes predominated, whereas the opposite has been found in community surveys.[38] We did, however, identify additional episodes of children and adolescent self-harm presenting at GP consultation that would not have been recorded from hospital data alone. Secondly, studies investigating death by suicide tend to underestimate numbers since some coroners may be reluctant to return a death by suicide verdict where intent is difficult to establish especially in younger people. Thus, we reported suicide coding alone and also inclusive of open verdicts, and found very little difference between the two relative risk estimates generated.

Conclusion

This large cohort study provides a unique primary care perspective on self-harm among children and adolescents. We have shown a marked increase in recorded self-harm episodes among early-mid

teen girls, and at younger ages than previously reported. The recent sharp rise appears to be specific to 13-16 year old girls. This marked increase prompts the urgent need to identify the causes for this phenomenon. Our findings highlight the important role of primary care for early intervention and opportunistic enquiry, monitoring and targeting of children and adolescents who may not openly engage with healthcare services for their current self-harming behaviour. The elevated risks of all-cause and cause-specific mortality observed emphasise the urgent need for integrated care involving families, schools and healthcare provision to enhance safety among these troubled young people in the short term, and to help secure their future mental health and wellbeing.

Contributors
CM completed the literature search. CM, DMA, MJC and RTW designed the study and data analysis plan. CM performed the data analysis. CM, DMA, EK, JG, MJC, NK and RTW interpreted the results. CAC-G and NK agreed on the final clinical Read code lists. All authors critically reviewed the manuscript and approved the final version.

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Competing interests
All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf
Professor Ashcroft, Dr Carr, Professor Chew-Graham, Professor Green, Dr Kontopantelis, Dr Morgan, Dr Webb have no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.
Professor Kapur Chaired NICE self-harm guidelines; is current Chair NICE depression Guidelines, topic expert NICE suicide prevention guidelines, member of Department of Health Suicide Prevention Strategy Advisory Group. Views expressed in the paper are those of the authors and not those of NICE or Department of Health.

Ethical approval
This study is based on data from the Clinical Practice Research Datalink obtained under licence from the UK Medicines and Healthcare Products Regulatory Agency. The study was approved by the independent scientific advisory committee (ISAC) for Clinical Practice Research Datalink research (protocol number: 13_122ARA).

Data sharing
Read codes used are published on Clinicalcodes.org. Electronic health records are, by definition, considered "sensitive" data in the UK by the Data Protection Act and cannot be shared via public deposition because of information governance restriction in place to protect patient confidentiality. Access to data is available only once approval has been obtained through the individual constituent entities controlling access to the data. The primary care data can be requested via application to the Clinical Practice Research Datalink (https://www.cprd.com); secondary care data can be requested via application to the hospital episode statistics from the UK Health and Social Care Information Centre (www.hscic.gov.uk/hesdata); and mortality data are available by application to the UK Office for National Statistics (www.ons.gov.uk/ons/index.html).

Transparency
The lead author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained. The corresponding author had full access to all the study data and final responsibility for publication submission.

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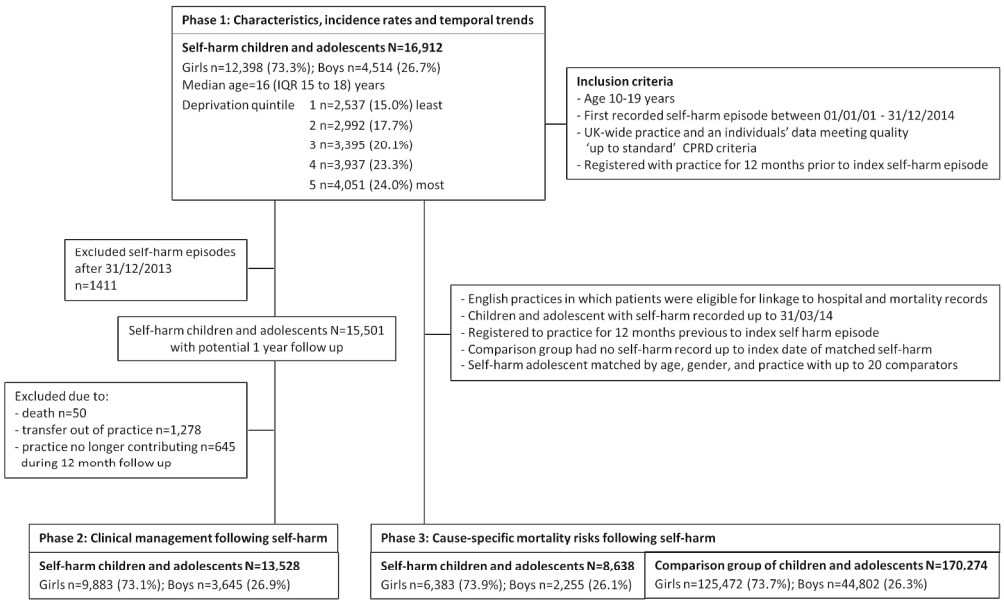
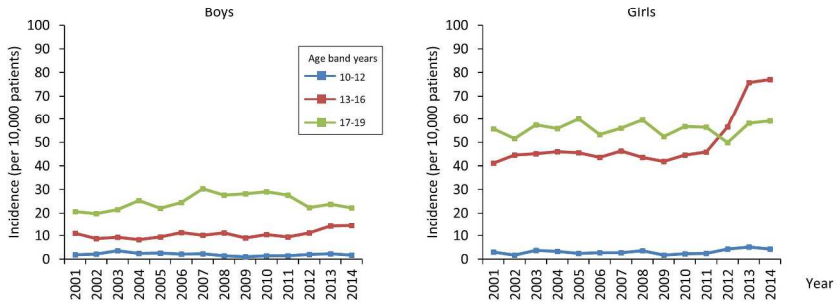


Summary of the derivation of each cohort for the three analytical phases

254x190mm (300 x 300 DPI)



Temporal trends in annual age-specific standardised self-harm incidence rates stratified by gender

254x190mm (300 x 300 DPI)

Appendix 1

Ever recorded mental health comorbidity	All (N=16,912) n (%)	Girls (N=12,398) n (%)	Boys (N=4,514) n (%)
Depression	5, 293 (31·3)	4, 117 (33·2)	1,176 (26·1)
Anxiety	3, 991 (23·6)	3,114 (25·1)	877 (19·4)
Attention deficit hyperactivity disorder	635 (3·8)	226 (1·8)	409 (9·1)
Eating disorders	840 (5·0)	770 (6·2)	70 (1·6)
Personality disorder	389 (2·3)	282 (2·3)	107 (2·4)
Autism spectrum disorders	311 (1·8)	130 (1·1)	181 (4·0)
Conduct disorder	227 (1·3)	103 (0·8)	124 (2·8)
Schizophrenia	285 (1·2)	152 (1·2)	133 (3·0)
Obsessive Compulsive Disorder	188 (1·1)	138 (1·1)	50 (1·1)
Bipolar	151 (0·9)	117 (0·9)	34 (0·8)
Tics	80 (0·5)	40 (0·3)	40 (0·9)
Social dysfunction	22 (0·1)	16 (0·1)	6 (0·1)

Proportion children and adolescents who have harmed themselves with a co-morbidity ever recorded over follow up