20-year outcomes in adolescents who self-harm: a population-based cohort study

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Summary

Background Little is known about the long-term psychosocial outcomes associated with self-harm during adolescence. We aimed to determine whether adolescents who self-harm are at increased risk of adverse psychosocial outcomes in the fourth decade of life, using data from the Victorian Adolescent Health Cohort Study.

Methods We recruited a stratified, random sample of 1943 adolescents from 44 schools across the state of Victoria, Australia. The study started on Aug 20, 1992, and finished on March 4, 2014. We obtained data relating to self-harm from questionnaires and telephone interviews at eight waves of follow-up, commencing at mean age 15·9 years (SD 0·5; waves 3–6 during adolescence, 6 months apart) and ending at mean age 35·1 years (SD 0·6; wave 10). The outcome measures at age 35 years were social disadvantage (divorced or separated, not in a relationship, not earning money, receipt of government welfare, and experiencing financial hardship), common mental disorders such as depression and anxiety, and substance use. We assessed the associations between self-harm during adolescence and the outcome measures at 35 years (wave 10) using logistic regression models, with progressive adjustment: (1) adjustment for sex and age; (2) further adjustment for background social factors; (3) additional adjustment for common mental disorder in adolescence; and (4) final additional adjustment for adolescent antisocial behaviour and substance use measures.

Findings From the total cohort of 1943 participants, 1802 participants were assessed for self-harm during adolescence (between waves 3 and 6). Of these, 1671 were included in the analysis sample. 135 (8%) reported having self-harmed at least once during adolescence. At 35 years (wave 10), mental health problems, daily tobacco smoking, illicit drug use, and dependence were all more common in participants who had reported self-harm during the adolescent phase of the study (n=135) than in those who had not (n=1536): for social disadvantage odds ratios [ORs] ranged from 1·34 (95% CI 1·25–1·43) for unemployment to 1·88 (1·78–1·98) for financial hardship; for mental health they ranged from 1·61 (1·51–1·72) for depression to 1·92 (1·79–2·04) for anxiety; for illicit drug use they ranged from 1·36 (1·25–1·49) for any amphetamine use to 3·39 (3·12–3·67) for weekly cannabis use; for dependence syndrome they were 1·72 (1·57–1·87) for nicotine dependence, 2·67 (2·38–2·99) for cannabis dependence, and 1·74 (1·62–1·86) for any dependence; and the OR for daily smoking was 2·00 (1·89–2·12). Adjustment for socio-demographic factors made little difference to these associations but a further adjustment for adolescent common mental disorders substantially attenuated most associations, with the exception of daily tobacco smoking (adjusted OR 1·74, 95% CI 1·08–2·81), any illicit drug use (1·72, 1·07–2·79) and weekly cannabis use (3·18, 1·58–6·42). Further adjustment for adolescent risky substance use and antisocial behaviour attenuated the remaining associations, with the exception of weekly cannabis use at age 35 years, which remained independently associated with self-harm during adolescence (2·27, 1·09–4·69).

Interpretation Adolescents who self-harm are more likely to experience a wide range of psychosocial problems later in life. With the notable exception of heavy cannabis use, these problems appear to be largely accounted for by concurrent adolescent mental health disorders and substance use. Complex interventions addressing the domains of mental state, behaviour, and substance use are likely to be most successful in helping this susceptible group adjust to adult life.

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Introduction

Self-harm and suicide are major global health problems.[1] Self-harm is one of the strongest predictors of subsequent suicide[2] and, globally, self-inflicted injuries result in the deaths of more girls aged 15–19 years than any other cause.[3] Although the great majority of adolescents who self-harm cease doing so as they enter their adult years, we know little about how these individuals fare later in life.[4]

Recent evidence from longitudinal cohort studies of the general population shows that self-harming during adolescence is associated with mental and substance use disorders in early adulthood, independent of measured confounders.[5] However, the longer-term psychosocial outcomes associated with self-harm during adolescence have yet to be fully described. To date, most follow-up studies have been based on small, selected clinical samples;[6] however, given that only a minority of young people who self-harm require medical attention and present to clinical services,[7] such studies do not provide a clear picture of the long-term natural history of self-harm.

Using data from the Victorian Adolescent Health Cohort Study (VAHCS),[8] we sought to examine the health

Research in context

Evidence before this study

We sought to identify relevant studies that have examined prospective associations between self-harm during adolescence and future mental health and social adjustment, in a non-treatment-seeking sample of adults. We searched MEDLINE and PsycINFO from inception and Embase for studies written in English published from database inception (1974) until April 3, 2017, using the following search terms: "self-harm", "self-injury", "longitudinal study", "cohort study", "community", and "mental health". The Avon Longitudinal Study of Parents and Children (ALSPAC) has reported a range of short-term, prospective, clinical, and social outcomes associated with self-harm at age 16 years in a community sample. The ALSPAC findings showed that any history of self-harm at age 16 years was associated with poorer outcomes in relation to mental and substance use disorders, education attainment, and employment. However, self-harm was measured on one occasion only and the outcomes were short-term in nature (ie, <5 years); as such, the longer-term outcomes remain unclear. To our knowledge, no published studies have reported on the long-term outcomes of self-harm during adolescence in a non-treatment-seeking sample with repeated measures of self-harm in the adolescent and young adult period.

Added value of this study

In this population-based, longitudinal study, we not only examined participants on six occasions during the adolescent years, but we also captured rich data relating to clinical and psychosocial outcomes up to 20 years later. Self-harm during adolescence was linked to increased prevalence of social disadvantage, anxiety, and licit and illicit substance use. Although adjusting for socio-demographic factors, adolescent substance use, and adolescent antisocial behaviour attenuated most of these associations, weekly cannabis use at age 35 years remained independently associated with self-harm during adolescence. Our findings suggest that self-harm during adolescence should be viewed as a conspicuous marker of emotional and behavioural problems that are predictive of poor life outcomes.

Implications of all the available evidence

Self-harm during adolescence is common in the general population and is associated with a distinct cross-sectional pattern of social and health-related disadvantage. Over time, individuals who have self-harmed have worse mental health and poorer psychosocial outcomes than those with no history of self-harm. Our findings suggest that interventions addressing multiple risk domains are likely to be more successful in helping this susceptible group adjust to adult life.

and social outcomes in adulthood of a sample of community-dwelling participants with a history of self-harm during adolescence. We had two main aims: first, to document the prevalence of social difficulties or mental and substance use disorders at the age of 35 years in participants who had reported having self-harmed during adolescence compared with those who had not; and second, to examine the extent to which poor outcomes at 35 years might be explained by other health risks known to be associated with self-harm during adolescence.

Methods

Study design and participants

The Victorian Adolescent Health Cohort Study (VAHCS) is a 10-wave longitudinal cohort study of the health across the second to the fourth decade of life in the state of Victoria, Australia, conducted between Aug 20, 1992, and March 4, 2014. At baseline, a representative sample of mid-secondary school adolescents was selected with a two-stage cluster sampling procedure. At stage one, 45 schools were chosen at random from a stratified frame of government, Catholic, and independent schools, with a probability proportional to the number of Year 9 (aged 14–15 years) students in the schools in each stratum. At stage two, a single intact class was selected at random from each participating school. One class entered the study in the latter part of the ninth school year (wave 1) and the second class 6 months later (wave 2). School retention rates to Year 9 in the year of sampling were 98%. One school did

not continue beyond wave 1, with a loss of 13 participants, leaving 44 schools. Participants were subsequently reviewed at four 6-month intervals between the ages of 15–18 years (waves 3–6) with four follow-up waves in adulthood, ages 20–21 years (wave 7), 24–25 years (wave 8), 28–29 years (wave 9), and 34–35 years (wave 10). In this Article, we present data collected in waves 3–6 and wave 10.

Data collection protocols were approved by the Ethics in Human Research Committee of the Royal Children's Hospital, Melbourne. Informed parental consent was obtained before inclusion in the study. In the adult phase, all participants were informed of the study in writing and gave verbal consent before being interviewed.

Procedures

The background factors measured were sex, age, participant and parental completion of secondary education, and parental divorce or separation up to and including wave 6.

The following measures were summarised across adolescence by identifying any occurrence in waves 3–6 (with the response assumed to be negative or "no occurrence" when missing).

We assessed self-harm at each wave from waves 3–6, using the following question: "In the last [reference period] have you ever deliberately hurt yourself or done anything that you knew might have harmed you or even killed you?" The reference period was 1 year for wave 3 and 6 months for all remaining waves. Participants who responded positively to the main question were then

asked to describe the nature and timing of each self-harm event. These detailed responses were then coded into five subtypes of self-harm by GCP and confirmed by PM. A dichotomous (yes *vs* no) variable was created for each subtype: cutting or burning, self-poisoning, deliberate and potentially life-threatening risk-taking, self-battery, and other (including attempted self-drowning, hanging, intentional electrocution and suffocating). Participants could report more than one category of self-harm within a wave or in different waves. They were classified with "any self-harm" if they were identified to have reported one or more of these individual categories.

We assessed symptoms of depression and anxiety at each wave using the revised Clinical Interview Schedule (CIS-R).[9] The total scores on the CIS-R were dichotomised at a cutoff point of 11 (≤11 *vs* >11) to delineate a mixed depression-anxiety state at a lower threshold than syndromes of major depression and anxiety disorder but for which clinical intervention would still be appropriate.[10]

We assessed antisocial behaviour using ten items from the Self Report of Early Delinquency Scale[11] relating to property damage, interpersonal conflict, and theft in the previous 6 months. To distinguish participants with multiple antisocial behavioural problems, antisocial behaviour was categorised according to whether two or more behaviours were reported as having occurred more than once at any wave.

To measure substance use, participants who consumed alcohol in the past week completed a 7-day retrospective diary of drinking days, with detailed beverage and quantity specific reports. We calculated the number of alcohol units (1 unit=10 g of alcohol) consumed each day of the diary week. Very high-risk alcohol use was defined according to Australian guidelines[12] as having drunk more than 20 units for boys and more than 11 units for girls on any day in the week preceding the interview. Participants reporting tobacco smoking on 6 or 7 days in the week preceding the survey were classified as daily smokers. Those reporting using cannabis at least weekly as well as those using any amphetamines were identified.

At age 35 years (wave 10), we recorded the following outcome measures.

Participants were assessed on five measures of social disadvantage: (1) ever divorced or separated from a long-term partner (cohabitation of >2 years), (2) not currently in a relationship, (3) not earning money, (4) being in receipt of government welfare, and (5) experiencing financial hardship (ie, those with a positive response to one or more of the following statements: unable to pay gas, electricity, or telephone bills on time; unable to pay mortgage or rent on time; or could not afford a night out once a fortnight and/or a holiday away for at least 1 week a year). Multiple social disadvantage was identified in participants reporting two or more measures of social disadvantage.

For participants who completed the full wave 10 survey, we obtained two measures of depression and anxiety from computer-assisted telephone interviews using the Composite International Diagnostic Interview (CIDI): major depressive disorder and anxiety disorder were both defined according to ICD-10 criteria, with major depressive disorder assessed using the CIDI-Auto[13] and anxiety disorder using the CIDI-Short Form.[14] Participants were classified with anxiety disorder if they were diagnosed with generalised anxiety disorder, social phobia, agoraphobia, or panic disorder. Participants who did the short interview in wave 10 completed the General Health Questionnaire (GHQ).[15] Any participant with a diagnosis of major depressive disorder, anxiety disorder, or with a GHQ score of more than 2 (short interview only) was classified with common mental disorder.[16]

Participants who reported tobacco smoking on 6 or 7 days in the week preceding the survey were classified as daily smokers. Nicotine dependence was assessed using the Fagerstrom Test for Nicotine Dependence.[17] Nicotine dependence was defined at a cutoff point of 3 (≤3 *vs* >3), which corresponds with a cutoff point of 6 (≤6 *vs* >6) on the Fagerstrom Tolerance Questionnaire.[18]

We assessed alcohol use using a beverage-specific and quantity-specific diary for Friday, Saturday, Sunday, and the most proximal weekday in the week preceding the interview. Very high-risk alcohol use was calculated in the same way as the equivalent adolescent measure (ie, having consumed more than 20 units for men and more than 11 units for women on any day in the week preceding the interview). Alcohol dependence (according to DSM-IV criteria) in the past year was assessed using the CIDI 12-month version.[19]

Cannabis use at least weekly in the past year was identified. We administered the computerised CIDI to generate the DSM-IV criteria for a diagnosis of cannabis dependence in participants reporting at least weekly cannabis use in the past 12 months. We applied this filter to minimise respondent fatigue as we considered that a diagnosis of cannabis dependence was only consistent with regular cannabis use, given the DSM-IV description of substance dependence as occurring with a "pattern of repeated (substance) self-administration".[20]

Other illicit substances recorded were any use of amphetamines, cocaine, and ecstasy or designer drugs in the past 12 months. We categorised any illicit drug use as any use in the past year of either (or a combination of) cannabis, amphetamines, ecstasy or designer drugs, or cocaine. We identified any substance dependence syndrome from any of the three measures of dependence (nicotine, alcohol, and cannabis).

Statistical analysis

We first used logistic regression to estimate the sex-adjusted and age-adjusted associations between self-harm during adolescence and background factors, mental health, and health risk behaviours during adolescence. We then assessed the associations between self-harm during adolescence and the outcome measures at wave 10 (35 years) using logistic regression models,

with progressive adjustment: (1) adjusted for sex and age; (2) further adjustment for background social factors; (3) additional adjustment for common mental disorder in adolescence; and (4) final additional adjustment for adolescent antisocial behaviour and substance use measures. We tested the effect modification by sex using the Wald χ^2 test. All analyses were conducted in Stata version 14.0.[21]

To minimise the effects of attrition bias due to missing wave 10 data, we used multiple imputation to impute these outcomes. Imputation was performed separately for men and women, with multivariate imputation by chained equations. The imputation model for each wave 10 variable included all background analysis variables, three auxiliary background variables associated with incomplete participation (at least one parent smokes cigarettes most days [p=0·010], no parent drinks alcohol most days [p=0·002], and having attended a metropolitan school [p=0·009]), and the wave 8 variables most closely

associated with the wave 10 outcome. We imputed age with linear regression and all other variables with logistic regression. We obtained the final estimates by averaging results across the 50 imputed datasets using Rubin's rules for multiple imputation inference.[22] We found no statistical evidence of effect modification by gender of the association between self-harm during adolescence and outcomes. We conducted a sensitivity analysis including the 1341 participants who had data for self-harm during adolescence, background and adolescent covariates, and at least one outcome measure at wave 10.

Role of the funding source
The funders had no role in the design, data collection or analysis, data interpretation, or writing of the article. RB had full access to all of the data in the study, had final responsibility for the decision to submit for publication and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Results
In this Article, we present data collected in waves 3–6 and wave 10. 1943 adolescent participants completed at least one survey in waves 1–6, and 1802 participants were assessed for self-harm between waves 3 and 6 (figure).[4] Of these, 1339 (74%) were assessed at all four waves, 250 (14%) missed one wave, 111 (6%) missed two waves, and 102 (6%) missed three waves. Of the 1802 assessed for self-harm, 16 (1%) had died by before wave 10. A further 115 participants were missing covariate data (83 with no educational outcome due to missing all adult waves [7 to 10], 16 missing parental education, and 16 missing one or more adolescent measure), leaving 1671 participants in the analysis sample. Of these 1671, a total of 330 were missing all wave 10 data, and a further 118 had at least one wave 10 outcome missing. We imputed the missing data so as to produce 50 completed datasets for the 1671 participants.

By wave 10, 1348 participants completed the full interview, 95 participants (willing to participate, but with limited time) completed a partial survey, 340 participants refused, 140 participants were lost to follow-up, and 20 had died (six deaths due to accident, two to suicide, three to illness, one related to drug use, and eight to unknown causes). 1341 (69%) completed at least one wave in waves 3–6, had full background data, and completed wave 10. These 1341 participants were included in the sensitivity analysis.

Of the 1802 participants assessed for self-harm, 16 (1%) had died by wave 10 and 115 were missing covariate data, leaving 1671 participants in the analysis sample.

Of these 1671 participants, 135 (8%) reported having self-harmed at least once during waves 3–6 (101 [6%] at one wave only, 26 [2%] at two waves, and eight [<1%] at three waves; none reported self-harm at all four waves). A total of 135 (8%) of the 1671 participants in the sample reported having self-harmed at least once during waves 3–6, comprising of 85 (10%) of 899 girls and
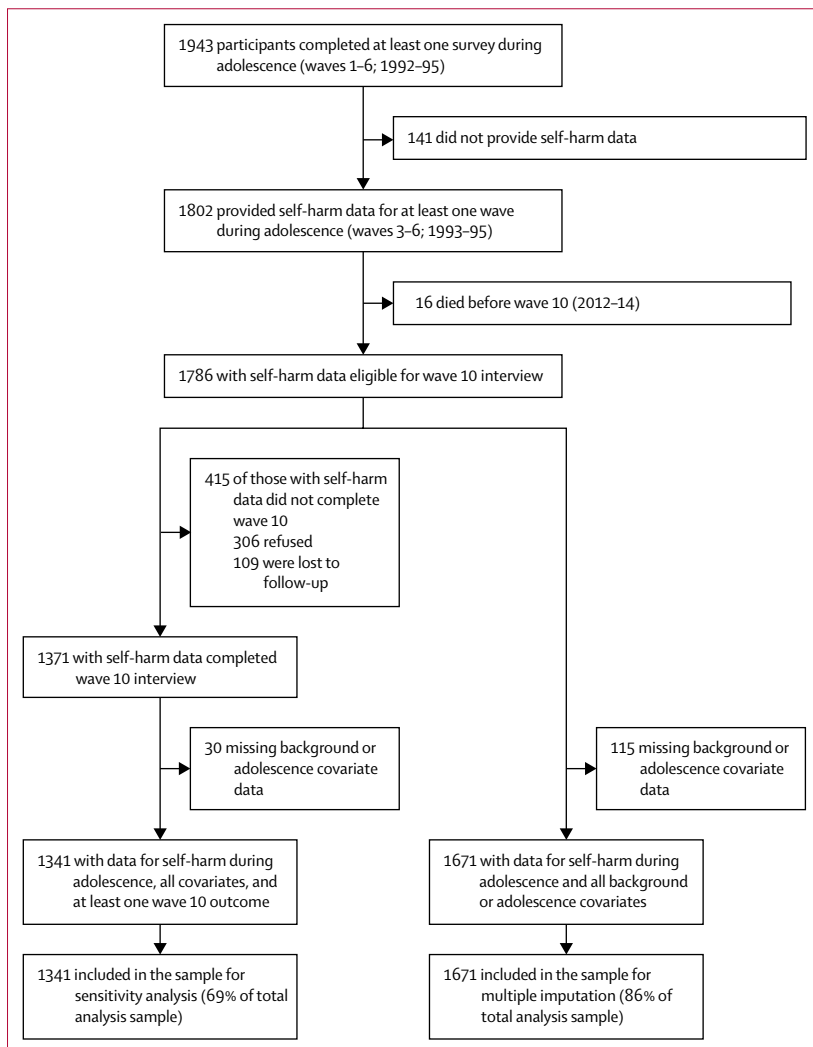

Figure: Sampling and ascertainment in the adolescent health cohort in Victoria, Australia, from 1992 to 2014

50 (6%) of 772 boys. The frequency of self-harm was greatest at wave 3 (mean age 15·9 years, SD 0·5) for both girls (51 [6%]) and boys (29 [4%]). At wave 6 (mean age 17·4 years, SD 0·4), two (<1%) boys and 21 (2%) girls reported self-harm.

After adjustment for sex and age, our analysis showed that participants who reported having self-harmed during adolescence were more likely to report parental divorce, a common mental disorder, and antisocial behaviour during adolescence than those who did not report having self-harmed (table 1). They were also more likely to be daily tobacco smokers, and to report high-risk alcohol use, weekly cannabis use, and amphetamine use during adolescence.

At age 35 (wave 10; mean age 35·1 years, SD 0·6), we assessed the proportion of adverse social adjustment, substance use, mental and substance use disorders in participants who reported having self-harmed during adolescence compared with those who did not (table 2). The proportion of participants reporting financial hardship, daily tobacco smoking, and weekly cannabis use was clearly higher in those who had reported self-harm during adolescence.

Other differences between the two groups were also apparent at 35 years, including the proportion of participants reporting a history of divorce or separation, multiple social disadvantage, anxiety, illicit drug use, and a common mental disorder.

Table 3 displays results from a series of predictive models examining the associations between self-harm during adolescence and outcomes at 35 years, with progressive adjustment for background factors and adolescent measures associated with self-harm. After adjusting for sex and age, self-harm during adolescence was associated with the occurrence of divorce or separation, financial hardship, multiple social disadvantages, anxiety, common mental disorder, daily tobacco smoking, weekly cannabis, use of ecstasy, use of any illicit drug, cannabis dependence, and any substance dependence syndrome.

Adjustment for the participant's history of parental divorce, level of parental education, and level of participant education had little effect on these associations (table 3). However, further adjustment for adolescent mental health status, substance use, and antisocial behaviour, attenuated all of these associations, except for the association between self-harm during adolescence and weekly cannabis at age 35 years, which persisted after adjustment for all background and adolescent measures.

The sensitivity analysis of observed data showed similar findings, confirming the pattern of results obtained with imputed data (appendix).

Discussion

In this population-based cohort study, adolescents who self-harmed were more likely to experience a wide range of other health and social problems during adolescence. These included common mental disorder, antisocial

	No adolescent self-harm (n=1536)	Adolescent self-harm (n=135)	OR (95% CI)*
Female	814 (53%)	85 (63%)	
Background			
Parental divorce	308 (20%)	37 (27%)	1·51 (1·01–2·25)
No parent completed secondary school	495 (32%)	45 (33%)	1·00 (0·69–1·45)
At adolescence			
Participant did not complete secondary school	106 (7%)	14 (10%)	1·66 (0·92–3·00)
Any common mental disorder	471 (31%)	100 (74%)	6·63 (4·36–10·09)
Any anti-social behaviour	176 (11%)	48 (36%)	5·45 (3·59–8·29)
Substance use			
Daily tobacco smoking	294 (19%)	67 (50%)	4·12 (2·88–5·91)
Very high-risk alcohol use	209 (14%)	48 (36%)	3·61 (2·46–5·31)
Weekly cannabis use	141 (9%)	39 (29%)	4·36 (2·86–6·64)
Amphetamine use	48 (3%)	27 (20%)	7·77 (4·68–12·89)

Data are n (%) and OR (95% CI). OR=odds ratio. *Odds ratios from logistic regression models with robust standard errors adjusted for gender and age.

Table 1: Frequency and prevalence of background and adolescent covariates in 1671 participants by adolescent self-harm, and their association with adolescent self-harm, adjusted for gender and age

behaviour and both licit and illicit substance use.[5] These problems appeared to persist into the mid-thirties, as participants who reported having self-harmed during adolescence reported greater financial hardship, daily tobacco smoking, and weekly cannabis use at 35 years, before adjustment for known confounders. Even allowing for baseline differences in sex and age, participants with a history of self-harm during adolescence were much more likely to encounter serious social problems in their thirties, including higher rates of divorce or separation, greater financial hardship, and multiple social dis-advantages. Furthermore, those who had self-harmed during adolescence had poorer mental health, with an excess prevalence of anxiety disorders, antisocial behaviour, and substance use. The associations with self-harm during adolescence were only marginally reduced after adjustment for adolescent social factors. Further adjustment for adolescent common mental disorders substantially reduced many of the associations, but did not fully attenuate the increased odds of tobacco smoking, or use of cannabis and ecstasy at age 35 years. After adjusting for all adolescent health and social risks, self-harm during adolescence remained independently associated with a more than two-fold increase in the odds of using cannabis on a weekly basis at age 35 years.

Previous research examining the longer-term outcomes of self-harm during adolescence in non-treatment-seeking samples is scarce. Using data from the Avon Longitudinal Study of Parents And Children [ALSPAC][23] cohort, Mars and colleagues[24] examined short-term health and social outcomes between the ages of 16–21 years of 4799 community-dwelling adolescents, of whom 19% reported having self-harmed by the age of 16. In that study,[24] participants reporting self-harm during

See **Online** for appendix

	No adolescent self-harm (n=1536)	Adolescent self-harm (n=135)	OR (95% CI)†
Social disadvantage			
History of divorce or separation	24%	35%	1·69 (1·60–1·78)
Not partnered	19%	19%	1·00 (0·94–1·06)
Not in paid employment	14%	18%	1·34 (1·25–1·43)
Receiving government welfare	5%	9%	1·78 (1·63–1·94)
Experiencing financial hardship	22%	34%	1·88 (1·78–1·98)
Multiple social disadvantages (two or more of above)	20%	30%	1·71 (1·62–1·81)
Mental health			
Depression	11%	17%	1·61 (1·51–1·72)
Anxiety	10%	18%	1·92 (1·79–2·04)
Common mental disorder (depression or anxiety, or both)	17%	26%	1·72 (1·62–1·82)
Licit substance use			
Daily tobacco smoking	15%	26%	2·00 (1·89–2·12)
Very high-risk alcohol consumption	7%	6%	0·88 (0·79–0·97)
Illicit drug use			
Weekly cannabis use	4%	12%	3·39 (3·12–3·67)
Any amphetamine use	6%	8%	1·36 (1·25–1·49)
Any cocaine use	7%	6%	0·90 (0·82–1·00)
Any ecstasy use	4%	8%	1·90 (1·73–2·09)
Any illicit drug use	17%	26%	1·70 (1·60–1·80)
Dependence syndrome			
Nicotine dependence	6%	9%	1·72 (1·57–1·87)
Alcohol dependence	4%	4%	1·03 (0·91–1·16)
Cannabis dependence	2%	6%	2·67 (2·38–2·99)
Any dependence syndrome	10%	16%	1·74 (1·62–1·86)

Data are % or OR (95% CI). OR=odds ratio. *Multiple imputation was used to handle missing data for wave 10 in this analysis. †ORs from univariate logistic regression models with robust standard errors.

Table 2: Prevalence of outcomes at 35 years in 1671 participants by self-harm during adolescence, and unadjusted associations between adolescent self-harm and outcomes at 35 years*

adolescence were more likely to have mental and substance use disorders at age 18 years and less likely to be in education, employment or training at age 19 years, than those who had not self-harmed. We have previously reported the outcomes of self-harm during adolescence in the third decade of life.[5] In this further follow-up, we have found that the psychosocial sequelae of self-harm during adolescence persist into the fourth decade. Our findings suggest that individuals who self-harm earlier in life are more likely to use cannabis heavily later in life, an association which may be mediated by the occurrence of emotional distress.[25] Although there was a persisting association between self-harm during adolescence and common mental disorders two decades later, it was less than it had been during the adolescent years, reflecting remission of earlier mental disorders.[26] This profile of self-harm in community settings may therefore differ both in levels of comorbid mental disorders and health outcomes from those presenting to clinical services.[27]

Risky behaviours such as harmful alcohol consumption and antisocial behaviour tend to cluster during the adolescent years.[28] These risky behaviours can compromise teenage health and jeopardise the successful transition into adulthood.[29] Our findings indicate that self-harm in adolescence is clearly part of this cluster of risk behaviours that have potential to disrupt normal social development. There are several possible explanations for the clustering of these behaviours. First, adolescence is the period when sensation-seeking is at an all-time high,[30] yet the neurodevelopment and underlying brain circuitry implicated in the inhibition of inappropriate desires, emotions, and actions in favour of appropriate ones continues to develop well into young adulthood.[31] Second, both self-harm and substance use are used to regulate emotion in young people, and it is possible that the same psychosocial risk factors underlie the two behaviours.[28] Finally, social influences, such as the influence of deviant peer group[32] feature heavily in the development and maintenance of both substance use[33] and self-harm.[34]

There is some evidence of effectiveness for several therapeutic interventions aimed at reducing self-harm during the adolescent years. In a recent systematic review and meta-analysis of 19 randomised controlled trials,[35] the interventions with the largest effect sizes were dialectical behaviour therapy, cognitive-behavioural therapy, and mentalisation-based therapy. However, the evidence base is small. There is an urgent need for larger pragmatic trials and independent replication of these findings, and this should be considered a research priority. Future research should also seek to examine the effect of sustained intervention, beyond the time at which self-harm ceases, on the health and social outcomes for this population.

Our study is noteworthy for its large, close to representative sample, high retention rates and multiple waves of follow-up over a 20-year period from mid-adolescence to the mid-thirties. However, our findings need to be considered in light of certain methodological limitations. First, we used a broad definition of self-harm that encompassed behaviours with and without suicidal intent, and did not have the capacity to examine individual subtypes of self-harm. We deliberately adopted this approach because a substantial overlap exists between suicidal and non-suicidal self-harm during adolescence and behavioural intention with respect to suicide is changeable.[36] Second, we relied exclusively on self-reported self-harm and we did not check the validity of these reports against other sources, such as hospital records. Recent UK research has highlighted discrepancies between self-reported accounts of self-harm and those assessed by hospital admissions or emergency department presentations, with about 20% of those resulting in a hospital admission not being disclosed by participants during self-report surveys.[37] Additionally, many adolescents in this UK sample provided inconsistent accounts of their self-harm histories on different assessment dates, and these adolescents were less likely to be depressed or to have self-harmed with suicidal intent. It is possible,

	Adjusted for gender and age; OR (95% CI)†	Further adjusted for parental divorce, parental education, and participant education; OR (95% CI)‡	Further adjusted for any adolescent common mental disorder; OR (95% CI)§	Further adjusted for adolescent risky substance use and any adolescent anti-social behaviour; OR (95% CI)¶
Social disadvantage				
History of divorce or separation	1·67 (1·10–2·51)	1·57 (1·03–2·39)	1·46 (0·94–2·28)	1·27 (0·80–2·00)
Not partnered	1·03 (0·64–1·65)	0·99 (0·61–1·59)	1·04 (0·64–1·71)	1·03 (0·61–1·72)
Not in paid employment	1·20 (0·73–1·98)	1·17 (0·71–1·93)	1·06 (0·64–1·76)	1·00 (0·59–1·69)
Receiving government welfare	1·77 (0·91–3·46)	1·58 (0·78–3·20)	1·32 (0·63–2·75)	1·41 (0·65–3·04)
Experiencing financial hardship	1·81 (1·19–2·75)	1·72 (1·12–2·64)	1·48 (0·96–2·30)	1·25 (0·80–1·96)
Multiple social disadvantages (two or more of above)	1·64 (1·07–2·53)	1·53 (0·98–2·39)	1·39 (0·88–2·20)	1·21 (0·74–1·98)
Mental health				
Major depressive disorder	1·59 (0·94–2·68)	1·53 (0·91–2·59)	1·19 (0·68–2·07)	1·11 (0·61–2·01)
Anxiety disorder	1·84 (1·11–3·06)	1·71 (1·02–2·88)	1·39 (0·82–2·37)	1·17 (0·65–2·11)
Common mental disorder (depression or anxiety, or both)	1·67 (1·08–2·58)	1·60 (1·03–2·47)	1·25 (0·79–1·97)	1·15 (0·70–1·87)
Licit substance use				
Daily tobacco smoking	2·11 (1·35–3·28)	2·00 (1·27–3·15)	1·74 (1·08–2·81)	1·19 (0·70–2·01)
Very high-risk alcohol consumption	0·91 (0·40–2·05)	0·87 (0·38–1·96)	0·83 (0·35–1·94)	0·65 (0·26–1·61)
Illicit drug use				
Weekly cannabis use	3·79 (2·02–7·10)	3·64 (1·91–6·94)	3·18 (1·58–6·42)	2·27 (1·09–4·69)
Any amphetamine use	1·49 (0·75–2·97)	1·44 (0·72–2·88)	1·28 (0·61–2·68)	0·87 (0·39–1·94)
Any cocaine use	0·99 (0·44–2·22)	0·97 (0·43–2·16)	0·91 (0·39–2·11)	0·70 (0·28–1·71)
Any ecstasy use	2·08 (1·02–4·26)	2·07 (1·00–4·28)	2·03 (0·93–4·45)	1·68 (0·73–3·86)
Any illicit drug use	1·93 (1·23–3·03)	1·88 (1·19–2·96)	1·72 (1·07–2·79)	1·13 (0·66–1·95)
Dependence syndrome				
Nicotine dependence	1·82 (0·94–3·52)	1·67 (0·87–3·22)	1·31 (0·64–2·67)	0·91 (0·42–1·98)
Alcohol dependence	1·17 (0·45–3·02)	1·14 (0·44–2·95)	0·96 (0·35–2·67)	0·90 (0·32–2·53)
Cannabis dependence	3·02 (1·29–7·04)	2·88 (1·22–6·82)	2·37 (0·90–6·24)	1·85 (0·70–4·91)
Any dependence syndrome	1·91 (1·11–3·26)	1·79 (1·05–3·07)	1·44 (0·81–2·55)	1·06 (0·58–1·93)

Data are OR (95% CI). OR=odds ratio. *Multiple imputation was used to handle missing wave 10 data in this analysis. †ORs from logistic regression models with robust standard errors adjusted for gender and age. ‡ORs from logistic regression models with robust standard errors adjusted for gender, age, parental divorce, parental education, and participant education. §ORs from logistic regression models with robust standard errors adjusted for gender, age, parental divorce, parental education, participant education, and any adolescent common mental disorder. ¶ORs from logistic regression models with robust standard errors adjusted for gender, age, parental divorce, parental education, participant education, any adolescent common mental disorder, any adolescent anti-social behaviour, and adolescent substance use.

Table 3: A series of predictive models examining the associations between self-harm during adolescence and outcomes at 35 years with progressive adjustment for adolescent confounders or mediators in 1671 participants*

therefore, that self-harm events were under-ascertained in our cohort, possibly resulting in conservative estimates of association. Third, some of the fully adjusted models were underpowered, resulting in poor precision of some estimates with large confidence intervals. Fourth, despite our high retention rates, it is possible that attrition bias might have affected our findings. For example, participants with complicated or chaotic lives might have been more likely to refuse participation, or to be absent from survey at individual waves. We addressed possible attrition bias by using multiple imputation for wave 10 missing data to obtain least biased estimates of associations. Fifth, we cannot rule out the possibility that some of the detected findings may have arisen due to chance, given the fact that multiple outcomes were investigated. However, the associations we report are consistent with the medical literature and are clinically intuitive; as such, we are confident in reporting them with appropriate confidence intervals. Finally, because of resource limitations, we were unable to link participant data to national health, education, social, or justice datasets to obtain a more informed picture of non-respondents.

Self-harm during adolescence is part of a cluster of other adolescent mental and behavioural problems and, for some adolescents, may be associated with substantial psychosocial difficulties later in life. Self-harm during adolescence should be viewed neither in isolation nor as merely a passing phase. Rather, it is a marker for a range of risk behaviours that, in turn, pose hazards for social and emotional development through young adulthood. Therefore, interventions addressing other key individual-level risk domains (particularly substance use, mental health, and antisocial behaviour) are likely to be more successful in helping this susceptible group of

young people as they make their way through life.[29] Further research currently underway using these data will help us to better understand the pathway between self-harm during adolescence and later psychosocial adversity, and this will be essential to inform the development of effective individual-level interventions. Coherent policy approaches should focus on reducing the prevalence of common underlying population-based risk factors and, to maximise the effectiveness of such policies, a response from multiple sectors, including the education, health, and community sectors, is required.[38]

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