SUICIDAL BEHAVIOUR IN ADOLESCENCE AND SUBSEQUENT MENTAL HEALTH OUTCOMES IN YOUNG ADULTHOOD

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ABSTRACT

Background: The aim of this study was to examine the linkages between suicidal ideation and attempt in adolescence and subsequent suicidal behaviours and mental health in young adulthood.

Method: Data were gathered during the course of a 25-year longitudinal study of a birth cohort of 1265 New Zealand children. The information collected included: a) measures of suicidal thoughts and attempts in adolescence (<18 years); b) measures of suicidal ideation, suicide attempt, major depression, anxiety disorders, and substance use disorders in young adulthood (18-25 years); and c) measures of childhood and family background, individual characteristics, and mental disorders in adolescence.

Results: After statistical adjustment for confounding factors, suicide attempt in adolescence was associated with increased risks of subsequent suicidal ideation (OR = 5.7) suicide attempt (OR = 17.8) and major depression (OR = 1.5). Those reporting suicidal ideation without suicide attempt showed moderate increases in risks of later suicidal ideation (OR = 2.5) suicide attempt (OR = 2.0) and major depression (OR = 1.6). In addition, there was evidence of an interactive relationship in which suicidal behaviour in adolescence was associated with increased risks of later substance use disorders in females but not males.

Conclusions: Young people reporting suicidal ideation or making a suicide attempt are an at-risk population for subsequent suicidal behaviour and depression. Further research is needed into the reasons for suicidal adolescent females being at greater risk of later substance use disorder.

INTRODUCTION

In recent years, there has been growing research into the prevalence of, and risk and protective factors associated with suicidal behaviours, including suicidal ideation and suicide attempts, in young people (for reviews see, Beautrais 2000; Gould and Kramer 2001; van Heeringen 2001; Wagner *et al.* 2003). This research has established that suicidal behaviours in adolescence are relatively common with up to a quarter of young people reporting suicidal thoughts and in the region of 8% making a suicide attempt (van Heeringen 2001).

Less is known about the longer-term consequences of suicide attempts and ideation in adolescence. Much of the research in this area has focussed on relatively small clinical samples (Kerfoot and McHugh 1992; Kovacs *et al.* 1993) that have been followed up for short periods (Ivarsson *et al.* 1998; Spirito *et al.* 1992; Spirito *et al.* 2003; Stewart *et al.* 2001). However, a number of studies have examined the longer-term consequences of suicidal behaviours in community samples (Dhossche *et al.* 2002; Lewinsohn *et al.* 2001; McKeown *et al.* 1998; Reinherz *et al.* 1995; Wichstrom 2000). For example, in a two year study of a sample of Norwegian students, Wichstrom (2000) found that suicidal ideation and suicide attempts were the strongest predictors of subsequent suicide attempts. However, these results were not supported in an 8-year follow-up of a sample of Dutch adolescents which found that suicidal ideation in adolescence did not predict further suicidal behaviours or mental health problems (Dhossche *et al.* 2002).

Given the limited research in this area to date, there are a number of issues regarding suicidal behaviours in adolescence that require further attention. First, it would seem important to establish the extent to which suicidal ideation in adolescence is transitory and the extent to which it may be a precursor for longer-term suicidal behaviours and mental health problems. Second, it would seem important in such analyses to examine the distinction

between those with suicidal ideation who have made suicide attempts and those who report suicidal ideation without suicide attempts. Finally since suicidal ideation and attempts in adolescence are related to a wide range of social, contextual and related factors, it is clearly important to adjust associations between suicidal behaviours in adolescence and later outcomes for the potentially confounding effects of such factors.

Each of these questions is best examined in the context of longitudinal research into a representative population sample. Such a research design makes it possible to: 1) examine patterns of change and stability in suicidal behaviours over time, and 2) examine the extent to which suicidal ideation and suicide attempts in adolescence are associated with longer-term suicidality and mental health problems when due allowance is made for potentially confounding factors.

Against this background, this paper reports on the results of a seven-year longitudinal study of the longer-term outcomes of suicidal behaviours in adolescence. The aims of the study were to:

i)   Estimate the prevalence of suicidal ideation and suicide attempt in adolescence (<18 years),

ii)   Examine the extent to which suicidal ideation and suicide attempt in adolescence were associated with suicidal behaviours (ideation/attempt) and mental disorders (depression, anxiety, and substance use disorders) in young adulthood (18 - 25 years), and

iii)   To adjust any associations between suicidal behaviours in adolescence and subsequent outcomes for potentially confounding factors including: a) social, family and related life history measures; b) individual characteristics and behaviour; and c) mental disorder at ages 14-18.

METHOD

Sample

Data were gathered as part of the Christchurch Health and Development Study (CHDS). The

CHDS is a longitudinal study of a birth cohort of 1265 children (635 males, 630 females)

who were born in the Christchurch (New Zealand) urban region in mid-1977. This cohort has

been studied at birth, 4 months, 1 year, annual intervals to age 16 years, and again at ages 18,

21 and 25 years using information from a combination of sources including parental

interview, teacher report, psychometric testing, self-report, and medical and police records

(Fergusson and Horwood 2001). All study information has been collected on the basis of

signed and informed consent from study participants. The analyses reported in this paper

were based on the sample of 1025 young people who were assessed on measures of suicidal

behaviour at ages 15 - 18 years and on subsequent mental health outcomes at ages 21 or 25

years. This sample represented 81% of the initial cohort of 1265 sample members. However,

as a result of sample attrition and missing data on some measures, the number of respondents

available for analysis varies with age and with the variables included in the analysis.

History of Suicidal Behaviour (<18 Years)

At ages 15, 16 and 18 years, sample members were interviewed on a comprehensive mental

health interview. As part of these assessments participants were questioned about aspects of

suicidal behaviour (Fergusson and Lynskey 1995a, b; Horwood and Fergusson 1998). At ages

16 and 18, participants were asked whether they had ever thought about killing themselves

over the period since the previous assessment and about the frequency and nature of any

suicidal thoughts or plans. Sample members were also asked whether they had made an

attempt to kill themselves over the period and, for each reported attempt, a detailed

description was obtained of the circumstances leading up to the attempt, the method used, the outcome, and any medical intervention received. Similar questioning was conducted at age 15 years. However, at this age participants were questioned about their lifetime history of suicidal thoughts, plans or attempts. Using this information, the sample was classified into 3 groups reflecting the history of suicidal behaviour prior to age 18 years: (a) those who reported no history of suicidal ideation or suicide attempt (77.4% of the sample); (b) those who reported suicidal ideation but no suicide attempt (17.2% of the sample); (c) those who reported making a suicide attempt (5.4% of the sample).

Mental Health Outcomes (18-21, 21-25 Years)

At age 21 and 25 years, sample members were again interviewed on a comprehensive mental health interview that examined aspects of psychosocial adjustment since the preceding assessment. These interviews combined components of the Composite International Diagnostic Interview (CIDI) (World Health Organization 1993) with custom written survey items to assess a range of mental health outcomes over the intervals 18-21, 21-25 years respectively.

Suicidal behaviours. Sample members were questioned about the frequency of suicidal thoughts or suicide attempts occurring since the previous assessment using similar items to those used in previous phases of the research. This information was used to construct two measures of suicidal behaviour for each interval (18-21, and 21-25 years): (a) Whether the sample member reported any suicidal ideation during the interval; (b) Whether the sample member reported making a suicide attempt during the interval.

Measures of depression. At each interview items from the CIDI were used to assess DSM-IV (American Psychiatric Association 1994) symptom criteria for major depression.

Sample members were questioned about depressive symptoms occurring over the past month, the past 12 months and the period since the previous assessment, as well as any associated impairment. In addition, any participant who reported either of the core major depressive symptoms (depressed mood, loss of interest) was also questioned about treatment seeking for depression. This information was used to construct the following measures of depression for each interval (18-21, and 21-25 years): (a) Whether the individual met DSM-IV diagnostic criteria for major depression at any time during the interval; (b) Whether the respondent sought treatment for depression from a mental health professional (GP, psychiatrist, psychologist, counselor) during the interval.

Measures of anxiety disorder. Relevant CIDI items were used to assess DSM-IV criteria for a range of anxiety disorders including generalised anxiety disorder, social phobia, specific phobia, panic disorder, and agoraphobia. In addition, sample members who reported any anxiety symptomatology were also questioned about treatment seeking for anxiety related problems. This information was used to construct the following measures of anxiety disorder for each interval (18-21, and 21-25 years): (a) Whether the individual met DSM-IV criteria for any of the above anxiety disorders during the interval; (b) Whether the sample member sought treatment for anxiety related problems from a mental health professional during the interval.

Measures of substance use disorder. At each interview, sample members were questioned about their use of alcohol, cannabis, and other illicit drugs. As part of this questioning, relevant CIDI items were used to assess DSM-IV symptom criteria for substance dependence. In addition, sample members were also questioned about treatment seeking for problems related to substance use. This information was used to construct the following measures of substance use for each interval (18-21, and 21-25 years): (a) Whether the

individual met DSM-IV criteria for alcohol dependence during the interval; (b) Whether the

sample member met criteria for illicit drug dependence during the interval; (c) Whether the

sample member had sought treatment from a mental health professional for problems related

to alcohol or illicit drug use during the interval.

Confounding Factors

Data gathered during the course of the study provided information on a wealth of factors that

might confound the associations between the history of suicidal behaviour prior to age 18 and

later mental health outcomes. The following factors were selected as potential confounders

on the basis of previous analyses on the cohort (Fergusson *et al.* 2000b; Horwood and

Fergusson 1998) showing that these factors were correlated with early suicidal behaviours

and later mental health outcomes.

Measures of family socio-economic circumstances. (a) *Maternal education* at the

time of the survey child's birth was classified into 3 levels according to the mother's highest

level of educational attainment (no formal qualifications; high school qualifications; tertiary

qualifications). (b) *Maternal age* was coded in whole years at the time of the survey child's

birth. (c) *Family socioeconomic status* was assessed at the point of birth using the Elley-

Irving (Elley and Irving 1976) scale of socioeconomic status for New Zealand. This index

classifies families into 6 levels on the basis of paternal occupation. (d) The quality of *family*

living standards was assessed at annual intervals from age 1-10 years on the basis of

interviewer ratings made on a 5-point scale from very good to very poor. These ratings were

averaged over the 10-year period to provide a global measure of the family's averaged

standard of living over this period.

Measures of family functioning. (a) As part of the study, detailed information was

obtained at annual intervals from birth to age 15 years on any changes in family composition.

An index of family instability during childhood was constructed on the basis of a count of the total number of *changes of parents* including separation, divorce, remarriage and death experienced by the child up to age 15 years. (b) The *quality of parent-child attachments* during adolescence was assessed at age 15 years using the Armsden and Greenberg (Armsden and Greenberg 1987) Parental Attachment Scale. The reliability of this scale, assessed using coefficient alpha, was .87. (c) When sample members were aged 15, parents were questioned about their self-defined history of *alcoholism or problems with alcohol*: 12.1% of the sample had at least one parent who reported alcohol problems. (d) When sample members were aged 15, parents were questioned about their history of involvement in *criminal offending*: 13.3% of the sample had at least one parent with a reported history of criminality. (e) When sample members were aged 11 years, parents were questioned about their use of cannabis or other illicit drugs: 24.6% of the sample had at least one parent with a *history of illicit drug use*.

Measures of child abuse. (a) At ages 18 and 21 years sample members were questioned concerning their experience of *childhood sexual abuse* prior to age 16 years, and the nature/context of any episodes of abuse. Using these data, a 4-level classification of the severity of abuse experience was constructed based on the worst episode of abuse reported at either age (Fergusson *et al.* 2000a). This classification was: no sexual abuse (86.0% of the sample); non-contact sexual abuse only (2.7%); contact sexual abuse not involving attempted or completed intercourse (5.2%); attempted or completed intercourse (6.1%). (b) The extent of *childhood physical abuse* was assessed on the basis of the young person's reports of the extent of parental use of physical punishment during their childhood (prior to age 16 years), also obtained when sample members were aged 18 years and 21 years. The extent of physical punishment was coded on a four-point scale based on the highest level of physical punishment reported at either age (Fergusson *et al.* 2000a): parents never used physical

punishment (4.5% of the sample); parents rarely used physical punishment (78.1%); at least one parent regularly used physical punishment (11.3%); at least one parent used physical punishment too often or too severely (6.1%).

Individual characteristics/behaviour. (a) *Gender.* (b) *Child neuroticism* was assessed using a short form version of the neuroticism scale of the Eysenck Personality Inventory (Eysenck and Eysenck 1964) administered when sample members were aged 14 years. The reliability of this scale, assessed using coefficient alpha, was .80. (c) *Novelty seeking* was assessed using the novelty seeking subscale of the Tridimensional Personality Inventory (Cloninger 1987) administered when sample members were aged 16 years. The reliability of this scale, assessed using coefficient alpha, was .76. (d) A measure of *self-esteem* was obtained at age 15 years using the Coopersmith Self-Esteem Inventory (Coopersmith 1981). The full scale score was used in the present analysis and this measure had reliability (alpha) of .76. (e) At age 16 years, sample members were questioned about their *peer affiliations* using a series of items examining the extent to which their friends used tobacco, alcohol or illicit drugs, truanted, broke the law or were in trouble with the police. These items were combined to produce a scale score measure of the extent to which the young person affiliated with delinquent or substance using peers (Fergusson and Horwood 1999). The reliability of this measure, assessed using coefficient alpha, was .74.

Mental disorders (15-18). As part of the mental health interviews conducted at ages 15, 16, and 18 years information was obtained on a range of other mental disorders that were comorbid with suicidal behaviours. At ages 15 and 16 years, the interview combined an array of standardised assessment tools including components of the Diagnostic Interview Schedule for Children (Costello *et al.* 1982), the Rutgers Alcohol Problems Index (White and Labouvie 1989) and the Self-Report Early Delinquency scale (Moffitt and Silva 1988) to assess DSM-

III-R diagnostic criteria (Fergusson *et al.* 1993). At age 18 questioning was based on the CIDI, supplemented by the Self-Report Delinquency Inventory (Elliott and Huizinga 1989) and other custom written items to assess DSM-IV diagnostic criteria (Horwood and Fergusson 1998). Using these data, DSM diagnostic criteria were used to classify sample members on a range of psychiatric disorders over the interval from age 14-18 years. These included: (a) *major depression*; (b) *anxiety disorders* including generalised anxiety disorder, social phobia, simple/specific phobia, panic disorder, and agoraphobia; (c) *substance use disorders* including alcohol abuse, alcohol dependence, illicit drug abuse, and illicit drug dependence; (d) *conduct disorder*.

Statistical Methods

The statistical significance of the bivariate associations between the history of suicidal behaviour prior to age 18 and subsequent mental health outcomes at 18-21, and 21-25 years was tested using the chi-square test of independence. Tests of the linearity of the observed associations were conducted using the Mantel-Haenszel chi-square test of linear trend.

To adjust the observed associations for confounding by childhood and family factors and comorbid disorders, generalised estimating equation (GEE) methods (Liang and Zeger 1986; Zeger and Liang 1986) were used to fit a series of logistic regression models to the data. The GEE approach pools the repeated measures on each outcome at ages 18-21 and 21-25 years to produce an estimate of the population averaged effect of level of suicidal behaviour prior to age 18 on each outcome after adjustment for covariates. The general form of the fitted model was:

$$\text{logit}(Y_{it}) = B_0 + B_1 X_{i1} + B_2 X_{i2} + \Sigma B_j Z_{ij} + U_{it}$$

where $\text{logit}(Y_{it})$ represented the log odds of outcome Y for subject i in interval t; X_{i1} and X_{i2} were design variables representing membership of the ideation only and suicide attempt

groups respectively for each subject; Zij were the set of confounding factors for subject i; and Uit was a disturbance term for the model. The disturbance terms Uit were assumed to be correlated over time. From the fitted model, estimates of the covariate adjusted population averaged odds ratios (ORs) and corresponding 95% confidence intervals were computed comparing the rate of disorder/treatment seeking in the suicidal ideation only and suicide attempt groups relative to the group with no suicidal behaviour for each outcome. These ORs were given by e^{B1}, e^{B2} respectively, where e is the base of natural logarithms. A test of the overall significance of the adjusted effect of history of suicidal behaviour on each outcome was obtained from a Wald chi square test of the hypothesis that $B1 = B2 = 0$. All GEE models were fitted using STATA 6.0 (StataCorp 1999) and all models included a further age term to allow for changes in the base rate of each outcome with age.

Finally, to examine the implications of loss to follow-up, missing data and possible sample selection bias on the results, the data weighting methods described by Carlin et al (Carlin *et al.* 1999) were used. These methods involved a two-stage analysis process. In the first stage, a sample selection model was constructed by using data gathered at birth to predict participation at each time point. This analysis showed that there were statistically significant (p<.05) tendencies for the attained sample at each age to under-represent children from more socially disadvantaged backgrounds (low parental education, low socioeconomic status, single parent family). On the basis of the fitted selection models, the sample was then post-stratified into a series of groups and the probability of study participation estimated for each group at each age. In the second stage of the analysis the data were re-analyzed with the observations for each individual weighted by the inverse of the probability of study participation at each age. This analysis produced essentially identical conclusions to the

analysis reported here, suggesting that the effects of missing data and possible sample

selection bias on the results were likely to be minimal.

RESULTS

Associations Between Extent of Suicidal Behaviour (<18 years) and Subsequent Mental Health Problems

Table 1 shows the cohort classified into three groups (no suicidal behaviour, suicidal ideation

only, and suicide attempt) on the basis of the respondent's reported history of suicidal

behaviours prior to age 18 years. For each group the Table reports on the subsequent history

of mental health problems over the intervals 18-21 and 21-25 years. Outcomes considered

include: subsequent suicidal ideation and suicide attempt; DSM-IV major depression and

treatment seeking for depression; DSM-IV anxiety disorder and treatment seeking for anxiety

related problems; DSM-IV alcohol and illicit drug dependence and treatment seeking for

substance use problems. Each comparison is tested for statistical significance using the chi-

square test of independence.

The Table shows that, for all measures, there were clear and significant ($p<.05$)

tendencies for the extent of suicidal behaviour prior to age 18 to be associated with

subsequent mental health outcomes at ages 18-21 and 21-25 years. In nearly all cases the

results suggested a dimensional model in which those who had made a suicide attempt prior

to age 18 had the highest rates of subsequent suicidal behaviours, mental disorders and

treatment seeking for mental health problems; those without a history of suicidal behaviour

had the lowest rates of mental health problems; and those with a reported history of suicidal

ideation only had rates of mental health problems that were intermediate between the other

two groups. To test this dimensional model, Mantel-Haenszel chi-square tests of linearity

were applied to the data. These tests showed that, with one exception, there was evidence of significant (p<.001) linear trends between the extent of suicidal behaviour prior to age 18 and later outcomes. The one exception was the measure of alcohol dependence at age 21-25 years. For this measure, rates of alcohol dependence were lowest amongst those with a history of suicide attempt. However, given the relatively small number of participants who had made a suicide attempt by age 18 and the low base rate of alcohol dependence at age 21-25, it seems likely that this finding may simply reflect chance aberration in the data.

TABLE 1 ABOUT HERE

Covariate Adjusted Results

A limitation of the findings in Table 1 is that these results fail to take into account potential confounding factors that may have been related to increased risks of early suicidal behaviour and also to later outcomes. As noted in Methods, a number of potentially confounding factors were identified on the basis of previous analyses on this cohort. These confounding factors spanned: a) social, family and related life history measures; b) individual characteristics and behaviour; and c) mental disorder at ages 14-18.

To take these factors into account, generalised estimating equation (GEE) methods were used to fit a series of logistic regression models in which the repeated measures of each outcome at age 18-21 and 21-25 years were regressed on suicidal behaviour prior to age 18 and the confounding factors (see Method). These models provided an estimate of the covariate-adjusted association between the extent of previous suicidal behaviour and later outcomes pooled over the two observation periods. The results of these analyses are summarised in Table 2 which shows estimates of the covariate-adjusted population averaged odds ratios comparing the odds of mental health problems in the suicidal ideation only and suicide attempt groups relative to the no suicidal behaviour group for each outcome. For all

analyses, the Table also reports the overall statistical significance of the association with each outcome after adjustment for confounding. The Table shows:

1.   Even after adjustment for confounding there remained highly significant (p<.0001) associations between the extent of suicidal behaviour prior to age 18 and subsequent suicidal ideation and attempt. In particular, there was evidence of strong associations between earlier suicide attempt and both later suicidal ideation (OR=5.7, 95%CI=3.0-10.8) and later suicide attempt (OR=17.8; 95%CI=5.6-56.7). By comparison, those in the suicidal ideation only group showed only modest elevations in risk of subsequent suicidal behaviours with adjusted ORs ranging from 2-2.5.

2.   For the measures of depression, the adjusted associations with the extent of prior suicidal behaviour also remained statistically significant (p<.05). However, the adjusted associations were modest with ORs ranging from 1.5-2.1. In addition, the odds of subsequent major depression and treatment seeking were no higher for those with a history of suicide attempt than for those with a history of ideation only.

3.   For the measures of anxiety disorder, substance dependence and associated treatment seeking the adjusted associations with the extent of prior suicidal behaviour were all non-significant. In common with the associations for depression, the adjusted ORs were modest at best (range 1.0-2.3) and there was no evidence to suggest that those with a history of suicide attempt were at any greater risk of subsequent anxiety or substance use outcomes than those with a history of ideation only.

TABLE 2 ABOUT HERE

Testing for Gender Interactions

The results in Table 2 summarise the main effect associations between early suicidal behaviour and later mental health outcomes. However, it could be suggested that these

associations may vary with gender such that adolescent suicidal behaviour may be more prognostic of later outcomes for males or females. To examine this issue, the models in Table 2 were extended to include interactions between gender and the extent of prior suicidal behaviour. For the measures of subsequent suicidal behaviour, depression, and anxiety, no significant gender interactions were found, suggesting that the associations between the extent of prior suicidal behaviour and these outcomes were generally similar for males and females. However, for the measures of substance dependence/treatment seeking there were significant ($p<.05$) gender interactions. In all cases, these interactions reflected the fact that after adjustment for confounding, early suicidal behaviour was unrelated to later risks of substance dependence/treatment seeking for males but was associated with increased risks of these outcomes for females.

These interactions are summarised in Table 3, which reports the adjusted odds ratio estimates for levels of suicidal behaviour prior to age 18 on later substance use outcomes separately for males and females. For males, the adjusted associations were clearly non-significant ($p>.60$) and the adjusted odds ratio estimates suggest no evidence of increased risk of these outcomes amongst those with previous suicidal ideation or attempt. However, for females the adjusted associations were statistically significant ($p<.01$) in all cases. Further, the results suggest evidence of moderate to strong associations between previous suicidal ideation or suicide attempt and later risks of alcohol dependence, illicit drug dependence and treatment seeking for substance use problems, with the adjusted ORs ranging between 2.3-7.6.

TABLE 3 ABOUT HERE

DISCUSSION

It has been well documented that suicidal ideation in adolescence is common and this is confirmed in the present study which shows that nearly 25% of young people reported experiencing suicidal thoughts or making a suicide attempt by age 18. An important issue raised by this result concerns the extent to which those reporting suicidal ideation or making suicide attempts are at increased risks of longer term suicidal behaviours and mental health problems. In the present study we have been able to study the outcomes of those with suicidal ideation or making suicide attempts into young adulthood. This analysis led to the following findings and conclusions.

First, there were pervasive associations between suicidal ideation/attempt in adolescence and longer-term mental health with those reporting suicidal ideation or attempt being at increased risks of subsequent suicidal behaviours, major depression, anxiety disorders and substance use disorders. Furthermore, in most comparisons there was evidence of a dose/ response relationship in which those making suicide attempts were at greatest risk and those reporting suicidal ideation only were at greater risk than those reporting neither suicidal ideation nor attempts. These findings highlight the fact that suicidal ideation and attempt in adolescence is an indicator of longer-term vulnerability to suicidal behaviours and mental health problems in young adulthood (Ivarsson *et al.* 1998; Kovacs *et al.* 1993; Lewinsohn *et al.* 2001; Otto 1972; Pfeffer *et al.* 1993; Spirito *et al.* 2003; Wichstrom 2000). In part, the associations between suicidal ideation/attempt in adolescence and longer-term mental health were explained by the fact that those reporting suicidal behaviours experienced other risk factors for later mental health problems. These risk factors included: a) social, family and related life history measures; b) individual characteristics and behaviour; and c) mental disorder at ages 14-18. Statistical adjustment tended to reduce the associations

between suicidal behaviours prior to 18 and later outcomes. However, these results varied with outcome. The adjusted results show a strong relationship between suicide attempt prior to 18 and later suicide ideation or attempt (OR > 5.0) suggesting that those making early suicide attempts were an at risk population for future suicidal ideation and attempts. There were moderate associations (OR < 2.5) between suicidal ideation and later suicidal ideation and attempts suggesting that those reporting early suicidal ideation experienced some elevation in the risks of later suicidal thoughts and behaviours. In addition, those making suicide attempts and reporting suicidal ideation showed modest increases in rates of major depression and treatment seeking for depression. Finally, earlier suicidal thoughts and behaviours were not related to later anxiety disorders or substance use behaviours in the cohort.

These findings suggest that adolescent suicidal behaviours tended to have their greatest continuity with future suicidal behaviours and depression. The pathways by which early suicidal behaviours and tendencies lead to later suicidality and depression are not clear from this study but are likely to involve a combination of genetic and environmental factors that encourage the recurrence of suicidality and mood disorders.

Overall, there was no consistent association between suicidal ideation/attempt and substance use disorders. However, further analysis suggested the presence of a gender interaction in which suicide attempt and suicidal ideation in adolescence were predictive of later substance use disorders in females but not in males. This finding was quite unexpected and we have no clear explanation why suicidality in females should be associated with later substance dependence when this does not occur for males. One possible explanation is that the result may reflect chance variation in our data, but against this conclusion is the fact that the interaction was present for a series of measures of substance dependence including

alcohol dependence, illicit drug dependence, and treatment seeking for substance use problems. There clearly is a need for this finding to be replicated in further studies and for an examination of the pathways that lead suicidal female adolescents to be at greater risk of later drug dependence.

In summary, the results of this study suggest that suicidal thoughts and actions in adolescence are, to some extent, prognostic of future suicidal behaviours and mental health. These associations reflect the presence of a series of pathways that link earlier suicidal behaviours to later outcomes. First, the associations are in part spurious and reflect the fact that those reporting suicidal tendencies in adolescence were an at-risk population characterised by a wide range of adverse family, social, and personality factors during childhood and adolescence, and in particular, mental disorders during adolescence. Second, there was evidence of clear across-time continuities in suicidal behaviours with those making suicide attempts in adolescence being at markedly increased risk of later suicidal ideation and attempts. Finally, there was evidence to suggest that associations between suicidal behaviours and substance use may be moderated by gender with suicidal ideation or attempts in adolescent females being associated with increased risks of longer term substance use disorders.

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DECLARATION OF INTEREST

All authors declare that they have no conflicts of interest.

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Table 1. Associations between extent of suicidal behaviour (<18 years) and rates (%) of subsequent mental health problems (18-21, 21-25 years).

Outcome	Extent of Suicidal Behaviour (<18 years)			p
	No Suicidal Behaviour	Suicidal Ideation Only	Suicide Attempt	
18-21 Years	(N = 780)	(N = 172)	(N = 52)	
Suicidal ideation	8.7	27.9	48.1	<.0001
Suicide attempt	1.8	7.0	21.2	<.0001
Major depression	17.8	41.3	50.0	<.0001
Sought treatment for depression	7.8	23.3	38.5	<.0001
Anxiety disorder	9.3	23.3	32.7	<.0001
Sought treatment for anxiety related problems	3.5	9.3	15.4	<.0001
Alcohol dependence	4.2	10.5	17.3	<.0001
Illicit drug dependence	5.5	11.1	21.2	<.0001
Sought treatment for substance use problems	1.8	5.2	13.5	<.0001
21-25 Years	(N = 770)	(N = 175)	(N = 51)	
Suicidal ideation	9.1	20.0	37.3	<.0001
Suicide attempt	1.0	2.3	15.7	<.0001
Major depression	17.5	32.6	47.1	<.0001
Sought treatment for depression	11.6	27.4	35.3	<.0001
Anxiety disorder	15.1	26.3	35.3	<.0001
Sought treatment for anxiety related problems	6.2	10.3	23.5	<.0001
Alcohol dependence	4.6	9.7	3.9	<.05
Illicit drug dependence	6.1	10.3	25.5	<.0001
Sought treatment for substance use problems	2.6	6.9	9.8	<.01

Table 2. Odds ratios (95% CIs) between extent of suicidal behaviour (<18 years) and

subsequent mental health outcomes (18-25 years) after adjustment for confounding.

Outcome	Extent of Suicidal Behaviour (<18 years)			
	No Suicidal Behaviour	Suicidal Ideation Only	Suicide Attempt	p
Suicidal ideation	1	2.5 (1.7-3.8)	5.7 (3.0-10.8)	<.0001
Suicide attempt	1	2.0 (0.8-5.3)	17.8 (5.6-56.7)	<.0001
Major depression	1	1.6 (1.2-2.3)	1.5 (0.8-2.8)	<.05
Sought treatment for depression	1	2.1 (1.4-3.1)	2.1 (1.1-4.0)	<.001
Anxiety disorder	1	1.3 (0.9-1.9)	1.2 (0.6-2.4)	>.30
Sought treatment for anxiety related problems	1	1.0 (0.6-1.8)	1.8 (0.8-4.0)	>.30
Alcohol dependence	1	1.9 (1.1-3.4)	1.0 (0.4-2.9)	>.05
Illicit drug dependence	1	1.3 (0.7-2.3)	2.3 (1.0-5.2)	>.10
Sought treatment for substance use problems	1	2.0 (0.9-4.1)	2.3 (0.8-6.5)	>.10

N = 887

All associations were adjusted for all of the following covariate factors: maternal age; maternal education; family socio-economic status; family living standards; changes of parents (0-15 years); parental attachment (15 years); parental alcohol problems (15 years); parental criminality (15 years); parental illicit drug use (11 years); childhood sexual abuse (<16 years); childhood physical abuse (<16 years); gender; neuroticism (14 years); self-esteem (15 years); novelty seeking (16 years); deviant peer affiliations (16 years); major depression (14-18 years); anxiety disorder (14-18 years); substance use disorders (14-18 years); conduct disorder (14-18 years). See Method for a description of these factors.

Table 3. Adjusted odds ratios (95% CIs) between extent of suicidal behaviour (<18 years) and substance use outcomes (18-25 years) by gender.

Outcome	Extent of Suicidal Behaviour (<18 years)			
	No Suicidal Behaviour	Suicidal Ideation Only	Suicide Attempt	p
Alcohol dependence				
Males	1	1.0 (0.5-2.4)	0.6 (0.1-2.7)	>.80
Females	1	4.5 (1.8-11.1)	2.3 (0.6-9.4)	<.01
Illicit drug dependence				
Males	1	0.8 (0.4-1.7)	1.1 (0.3-3.2)	>.80
Females	1	3.7 (1.3-10.7)	7.6 (2.3-25.2)	<.01
Treatment seeking for substance use problems				
Males	1	0.8 (0.3-2.4)	1.6 (0.4-5.8)	>.60
Females	1	7.0 (2.0-24.4)	6.4 (1.4-29.3)	<.01

N = 887