Adolescent depression, adult mental health and psychosocial outcomes at 30 and 35 years

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Financial Support

This research was funded by grants from the Health Research Council of New Zealand (HRC 11/792), the National Child Health Research Foundation, the Canterbury Medical Research Foundation and the New Zealand Lottery Grants Board.

Abstract

Background. There is limited information on long term outcomes of adolescent depression. This study examines the associations between severity of depression in adolescence and a broad array of adult functional outcomes.

Methods. Data were gathered as part of the Christchurch Health and Development Study, a 35 year longitudinal study of a birth cohort of 1,265 children born in Christchurch, New Zealand in 1977. Severity of depression at age 14-16 was classified into three levels according to DSM symptom criteria for major depression (no depression/sub-threshold symptoms/major depression). This classification was related to adult functional outcomes assessed at ages 30, 35 years using a generalized estimating equation modeling approach. Outcome measures spanned domains of mental disorder, education/economic circumstances, family circumstances and partner relationships.

Results. After adjustment for confounding, there were modest but statistically significant and marginally significant associations between severity of adolescent depression and rates of: major depression (p=0.034), anxiety disorder (p=0.051) and intimate partner violence victimization (p=0.049) in adulthood. Estimates of attributable risk for these outcomes ranged from 2-8.9%. For two outcomes there were significant (p<0.05) gender by adolescent depression interactions such that: for women, increasing depression severity was associated with increasing rates of unintended pregnancy and victimization; whereas for men, the associations were either much weaker or in the opposite direction.

Conclusions. Adolescent depression was associated with later adult mental health and intimate partner violence victimization. For some family and partnership outcomes severity of depression was more strongly related to adverse outcomes for females than for males.

Key words: major depression, sub-threshold depression, adolescents, adult, mental health, psychosocial, longitudinal

Introduction

Depression during adolescence is a common and growing problem in Western society where prevalence rates are reported to be 3%-8% (Bhatia and Bhatia, 2007; Goodman *et al.*, 2011; Lynch and Clarke, 2006; Prager, 2009; Smith and Smith, 2010). Adolescent depression is an important area to understand as symptomology may interfere with normal growth and development, educational achievement, interpersonal relationships and lead to suicidality during adolescence/young adulthood (Bhatia and Bhatia, 2007; Prager, 2009; Thapar *et al.*, 2012). However, more knowledge is needed on two aspects of adolescent depression in the literature:

First, most published studies using longitudinal data to examine the mental health and psychosocial consequences of adolescent depression only follow-up into young adulthood (eg, Dunn and Goodyer, 2006; Fergusson and Woodward, 2002; Hammen *et al.*, 2013; Lehrer *et al.*, 2006; Marmorstein, 2009; Nduna *et al.*, 2010; Tuisku *et al.*, 2014; Weissman *et al.*, 1999a; Weissman *et al.*, 1999b). These studies with follow-up into young adulthood report that adolescents experiencing depression have increased risks of later mental health problems of depression, anxiety, substance dependence, suicidality (Dunn and Goodyer, 2006; Fergusson and Woodward, 2002; Tuisku *et al.*, 2014; Weissman *et al.*, 1999a; Weissman *et al.*, 1999b), interpersonal difficulties and adverse parenting outcomes (Hammen *et al.*, 2013; Nduna *et al.*, 2010), risky sexual behavior (Lehrer *et al.*, 2006; Nduna *et al.*, 2010), alcohol use problems (Marmorstein, 2009). However, it is unclear what the longer-term developmental pathways are for these adolescents who experience depression when they reach mature adulthood.

Second, recent research has focused on adolescents who experience sub-threshold depression; individuals who report relevant depressive symptoms, but do not meet criteria for a major depressive episode (Bertha and Balázs, 2013). Bertha and Balázs (2013) concluded that adolescent sub-threshold depression is a significant health problem which reduces quality of life and increases the risk of developing a major depressive episode. Sub-threshold depression may be placed on a spectrum of severity of symptoms of major depression which may have similar impacts

to major depression (Bertha and Balázs, 2013; Fergusson *et al.*, 2005; Thapar *et al.*, 2012; Wesselhoeft *et al.*, 2013). For example, Fergusson et al. (2005) examined adolescent extent of depression categorized as none, sub-threshold or major depression at ages 17-18 years and later mental health outcomes to age 25. It was found that those with sub-threshold depressive symptoms during adolescence had elevated risks of both later depression and suicidal behaviors that were similar to the risks for those who had met criteria for major depression. However, for these comparatively few studies (Cuijpers and Smit, 2004; Wesselhoeft *et al.*, 2013), it is also unclear what the longer-term outcomes are for those adolescents who experience sub-threshold depression.

More generally, the literature on the outcomes of adolescent depression is characterized by a number of additional limitations including: use of cross-sectional research designs (Kessler *et al.*, 1997; Wesselhoeft *et al.*, 2013), limited control for confounding (Devries *et al.*, 2013), using clinical samples or samples of convenience (Fombonne *et al.*, 2001; Hammen *et al.*, 2013; Kessler *et al.*, 1997; Tuisku *et al.*, 2014; Weissman *et al.*, 1999a; Weissman *et al.*, 1999b); small sample sizes (Fombonne *et al.*, 2001; Tuisku *et al.*, 2014; Weissman *et al.*, 1999a; Weissman *et al.*, 1999b) (Hill *et al.*, 2014); using retrospectively reported childhood psychological illness (Smith and Smith, 2010); examining only a limited number of adult outcomes such as teenage parenthood (Kessler *et al.*, 1997), alcohol problems (Marmorstein, 2009), adult depression (Fombonne *et al.*, 2001), suicide (Tuisku *et al.*, 2014) or economic outcomes (Smith and Smith, 2010). Finally, much of the evidence to date comes from predominantly female or female-only samples (Devries *et al.*, 2013; Tuisku *et al.*, 2014).

Against this background we use data from a longitudinal study of a New Zealand birth cohort, the Christchurch Health and Development Study, to examine the linkages between the extent of depression in adolescence (age 14-16 years) and a broad range of measures of mental health and psychosocial functioning at ages 30 and 35 years. The aims of the study were to:

1. Examine the associations between the extent of adolescent depression (14-16 years) and later mental health and psychosocial outcomes at 30 and 35 years.

2. Identify potential confounding factors and adjust the associations between the extent of adolescent depression and later outcomes for confounding.

3. Examine whether the associations between adolescent depression and later outcomes varied by gender.

Method

Participants

Participants were members of the Christchurch Health and Development Study (CHDS) birth cohort. The CHDS is a longitudinal study of 1,265 children born in the Christchurch (New Zealand) urban region over a 4-month period during 1977. This cohort has been studied on a total of 23 occasions from birth until age 35 years (Fergusson and Horwood, 2001, 2013). The present analysis is based upon a sample of 995 participants who were assessed for depression in adolescence (14-16 years) and also on adult psychosocial outcomes at 30 or 35 years. This sample represented 81% of the surviving cohort at age 30. All phases of the study have been subject to ethical approval by the Canterbury Regional Health and Disabilities Ethics Committee. All data were collected with the signed consent of the study participants.

Extent of adolescent depression (14-16 years)

At the 15 and 16 year assessments, cohort members and their parents were questioned separately about the young person's symptoms of major depression in the previous 12 months using the relevant sections of the self- and parent-report versions of the Diagnostic Interview Schedule for Children (DISC) (Costello *et al.*, 1982). Because versions of the DISC suitable for the assessment of DSM-III-R symptom criteria for major depression were not available the time the research was planned, the DISC items were supplemented by additional custom-written items for the assessment of DSM-III-R diagnostic criteria (Fergusson *et al.*, 1993, 1995). Using this information, it was possible to classify participants on the extent to which they met DSM-III-R diagnostic criteria for a major

depressive episode on the basis of both self- and parent-report at each age. A previous analysis had shown that an optimal method of classification of adolescent depression was based on a combination of self- and parent-report (Fergusson *et al.*, 1993), therefore the data were combined over the two informants and two assessments to derive a three-level classification reflecting the severity of adolescent depression over the period 14-16 years. This classification was: no depression, the young person experienced no depressive symptoms as recorded for both self- and parent-report (68.1% of the cohort); sub-threshold depression, the young person was reported to have at least one of the core symptoms of major depression (depressed or irritable mood, loss of interest/pleasure for two weeks or longer) but did not meet the diagnostic threshold for a major depressive episode on the basis of self- or parent-report (18.3% of the cohort); major depression, the young person met diagnostic criteria for a major depressive episode on the basis of either self- or parent-report (13.6% of the cohort).

Outcomes

At 30 and 35 years participants were assessed on a comprehensive interview that examined aspects of the individual's mental health and psychosocial functioning. Interviews typically lasted between 1.5-2.5 hours and were conducted by trained lay interviewers at a time and setting nominated by the participant. The following measures were used in the analysis.

Mental health outcomes

At ages 30 and 35 participants were questioned about their experience of the following mental health problems during the 12-months prior to the assessment.

Major depression and anxiety disorder. Participants were questioned about symptoms of major depression and a range of anxiety disorders (generalized anxiety disorder, panic disorder, agoraphobia, social phobia, specific phobia) in the previous 12 months. Questioning was based on the relevant components of the Composite International Diagnostic Interview (CIDI World Health

Organization, 1993) and Diagnostic and Statistical Manual of Mental Disorders 4th edition (DSM-IV) criteria (American Psychiatric Association, 1994). Using this information, dichotomous measures were constructed to reflect whether the participant met diagnostic criteria for a diagnosis of a major depressive episode and/or any anxiety disorder for the intervals: 29-30 and 34-35 years.

Suicidal ideation/attempt. Participants were questioned using custom-written survey items about whether they had ever thought about killing themselves or had attempted suicide in the previous 12 months and the frequency of such thoughts or attempts (Fergusson *et al.*, 2008). Using this information, participants were classified on a dichotomous measure reflecting whether they reported any suicidal ideation/attempt for the intervals: 29-30 and 34-35 years.

Substance abuse/dependence. Participants were questioned about problems associated with their use of alcohol or illicit drugs in the previous 12 months, using CIDI items to assess DSM-IV symptom criteria for abuse/dependence. Using this information, participants were classified on dichotomous measures reflecting whether they met diagnostic criteria for alcohol abuse/dependence or illicit substance abuse/dependence for the intervals: 29-30 and 34-35 years.

Any mental health problem. To provide an overall measure of the burden on mental health problems, the above measures of mental disorder and suicidal ideation/attempt were combined to classify participants as to whether they had experienced any mental health problems for the intervals: 29-30 and 34-35 years.

Education and economic circumstances

Degree attainment. At each assessment participants were questioned about their educational qualifications and any changes in these qualifications since the previous assessment. This information included whether the participant had attained a bachelor's or higher-level degree from a university or other tertiary institution by age 30 or 35.

Welfare dependence. Participants were questioned about any times when they received a government income-tested benefit of job seeker support, sole-parent support or a supported living

allowance for the interview periods of 29-30 years and 34-35 years. Using this information, responses were dichotomized into those who had and those who had not received a welfare benefit.

Net weekly personal income. At each assessment, participants were asked to report their usual weekly income from paid employment after tax and other deductions. Incomes reported in currencies other than New Zealand dollars were converted into New Zealand dollars using Purchasing Power Parities (Organisation for Economic Co-operation and Development (OECD), 2007), scaled to 2012 New Zealand dollar equivalents at age 35.

Partnership and family outcomes

Unintended pregnancies. Participants were asked the total number of times they had ever become pregnant, or got a partner pregnant (males). For each pregnancy reported, participants were questioned as to whether the pregnancy had been planned, that is, both partners were not using contraception with the intention of having a child. Using this information, responses were classified on dichotomous measures to reflect a history of any unintended pregnancy occurring before age 30 and 35 years.

Sole parenthood. At each assessment participants were asked about the presence of a cohabiting spouse/partner and whether they were parenting a dependent child who was living with them. Those who were parenting a dependent child in the absence of a cohabiting spouse/partner were classified as sole parents at each age.

Respondents who reported being in a romantic partner relationship at any time in the past 12 months (n=879 at age 30 and n=838 at age 35) were questioned on the following additional measures of partner relationship quality and intimate partner violence (IPV).

Relationship quality. Partner relationship quality was assessed using the 25-item Intimate Relations Scale (Braiker and Kelley, 1979). This scale measured two dimensions: positive partner relations (love and investment) and negative partner relations (ambiguity and conflict). Participants responded to each item using a 3-point scale (1=does not apply; 2=applies somewhat; 3=definitely

applies). For the purposes of the present analysis the ambiguity and conflict items were reverse scored and a total relationship quality score was constructed from an unweighted sum of the 25 items at each age. Internal consistency for both indices was good: α=0.90 at age 30; α=0.88 at age 35.

Intimate partner violence (IPV) perpetration and victimization. Participants were questioned about their experience of intimate partner violence (IPV) perpetration and victimization in the previous 12-months, using the Revised Conflict Tactics Scales (CTS2) (Straus *et al.*, 1996). Each scale comprised a series of 25 questions regarding the respondent's victimization by, or perpetration of, acts of verbal aggression, physical violence or threats ranging from incidents of minor verbal aggression through to severe physical assault. For the purposes of the present analysis two scale scores representing the extent of IPV victimization and IPV perpetration were constructed for each of the intervals 29-30 and 34-35 years based on a count of the number of different types of intimate partner aggression/violence reported by the participant. These scales were of moderate to good internal consistency: for IPV perpetration at age 30 α=0.74, 35 α=0.70; for victimization at age 30 α=0.79, 35 α=0.77.

Covariates

To assess the extent to which associations between adolescent depression and the mental health and psychosocial outcomes could be explained by the effects of confounding factors, a wide range of measures of family background, family functioning, child factors and comorbid mental health problems, were selected from the CHDS database. These factors were chosen as they were shown to be associated with adolescent depression and are described in Online Supplement 1.

Statistical methods

Unadjusted associations. The first phase of the analysis examined the associations between the extent of adolescent depression (14-16 years) classified as none, sub-threshold depression and

major depression, and a series of mental health, educational, economic, partnership and family outcomes at 30 and 35 years. This analysis used the pooled repeated observations at ages 30 and 35 to obtain an estimate of the population-averaged associations between adolescent depression and the outcomes (Table 1). Linkages between adolescent depression and the outcomes were analyzed using a generalized estimating equation (GEE) modeling approach (Zeger and Liang, 1986) in which each outcome was modeled as a linear function of adolescent depression and age. These models were of the form:

$$F(Yit) = B0 + B1\ Xit + B2\ AGEit \qquad (EQ\ 1)$$

where Yit was the outcome for the ith participant in the time period t (t=30, 35 years), F was the appropriate link-function for the outcome (log odds for dichotomous outcomes, mean for continuous outcomes and log rate for count-based outcomes), Xit was the measure of adolescent depression (14-16 years) for each individual i at time t, AGEit was the age of the individual i at the time period t. In these models, the coefficient B1 provides an estimate of changes in the outcomes with changes in the adolescent depression measure Xit. The models permitted the repeated measures of each outcome for each individual to be correlated. To test the linearity assumption for the effect of adolescent depression, the fit of the linear GEE model for each outcome was compared to the fit of a model in which depression was treated as a categorical measure. These comparisons showed in all cases, a linear model provided an adequate fit to the observed data and no statistically significant departures from linearity were detected.

Identification of covariates. Associations between adolescent depression and potential confounders were then examined (Table 2). For ease of presentation all covariates were dichotomized to show the profile of family background, family functioning, child factors and comorbid mental health problems for each level of adolescent depression, and each association was tested for statistical significance using the Mantel-Haenszel chi square test for linear trend. However, in all subsequent analysis the covariates were scaled in their natural metric as described in

Online Supplement 1. The strength of each association was summarized by the correlation (*r*) between the measure of adolescent depression and the covariate scored in its natural metric.

Adjusting for covariates. The regression models in EQ 1 were extended to include the covariate factors identified in Table 2. The models were of the general form:

$$F(Yit) = B0 + B1\ Xit + B2\ AGEit + \Sigma\ Bk\ Zik \quad \text{(EQ 2)}$$

where Zik were the set of observed covariate factors for each individual i (Table 3). From the fitted models, adjusted effect size estimates for adolescent depression (odds ratios for dichotomous outcomes, incidence rate ratios for count outcomes, and associated 95% confidence intervals) were calculated in the usual manner e(B1±1.96 SE B1). For outcomes that were significantly associated with adolescent depression after covariate adjustment effect size estimates were supplemented by estimates of the population attributable risk percent (PAR%), which is the estimated reduction in the outcome rates if major depression (14-16 years) did not exist in the population. The PAR% was calculated with adolescent depression dichotomized into 0=no depression/sub-threshold depression and 1=major depression.

Gender interactions. To examine whether the associations between adolescent depression and outcomes varied between males and females the covariate adjusted models in EQ 2 were extended to include multiplicative gender x adolescent depression interactions.

All analyses were conducted using SAS® 9.3 (SAS Institute Inc, 2012) and Stata 12.0 (StataCorp, 2011) for Windows.

Sample size and sample bias. As noted above, the analysis is based on a sample of 995 participants (81% of the surviving cohort) assessed on adolescent depression and outcomes at age 30 or 35. Comparison of the analysis sample with remaining cohort members on socio-demographic factors assessed at birth, showed significant ($p<0.05$) tendencies for the analysis sample to under-represent children from socially disadvantaged families characterized by low maternal education, low socioeconomic status and single parenthood. To examine whether selection bias due to the

processes of sample attrition influenced the findings, the data were reanalyzed using the data-weighting method described by Carlin, Wolfe, Coffey, and Patton (1999). These analyses produced essentially identical conclusions to the reported analyses, suggesting that the findings were unlikely to have been influenced by selection bias.

Results

Associations between adolescent depression and adult psychosocial outcomes

Table 1 shows the associations between the extent of adolescent depression (14-16 years) and a series of mental health, educational, economic, partnership and family outcomes pooled over assessments at 30 and 35 years. The source data for this table is shown in the Online Supplement 2. The associations were analyzed by fitting population-averaged regression models to the pooled data in which each outcome was modeled as a linear function of adolescent depression and age (see Methods). For each outcome Table 1 reports: the pooled rate or mean of the outcome for each level of adolescent depression; the estimated regression coefficient (B) for the effect of depression, with the corresponding standard error and test of statistical significance (p-value). The strength of each association is summarized by the correlation coefficient (*r*) relating adolescent depression and the outcome.

The results show the presence of statistically significant ($p<0.05$) linear associations between increasing severity of adolescent depression and higher rates of mental health problems (major depression, anxiety disorder, suicidal ideation/attempt, any mental health problem); reduced educational attainment and economic circumstances (lower rates of tertiary degree attainment, higher rates of welfare dependence, lower personal income); and more adverse partnership outcomes including unintended pregnancies, sole parenthood, lower relationship quality and higher levels of conflict and violence. However, there was no association between adolescent depression and the outcomes alcohol abuse/dependence ($p=0.897$) and illicit substance dependence/abuse

(p=0.091). In all cases the associations between adolescent depression and later mental health and psychosocial outcomes were small to small in magnitude ($|r| \leq 0.15$).

Insert Table 1

Identification of covariate factors

Table 2 shows the associations between adolescent depression and a series of measures of family background reflecting childhood family functioning, child characteristics assessed at or prior to 18 years and comorbid mental health problems 14-16 years (see Online Supplement 1 for a detailed description of these measures). The table shows the presence of significant (p<0.05) linear associations between adolescent depression and all covariate factors. Specifically, young people who experienced greater severity of depression in adolescence were more likely: to have come from families characterized by greater socioeconomic disadvantage (lower maternal education, poorer living standards) and family dysfunction (higher rates of parental adjustment problems, family instability, child abuse and family violence); to be female, with lower IQ, have poorer self-esteem, higher neuroticism and novelty seeking, poorer attachment to parents and have greater involvement with delinquent/substance using peers; and to have higher rates of comorbid mental health problems (anxiety disorders, suicidality, conduct/oppositional defiant disorder, attention deficit hyperactivity disorder, alcohol/ illicit substance abuse) in adolescence.

Insert Table 2

Adjustment for confounding

To take into account the potential confounding effects of the factors in Table 2, the regression models in Table 1 were extended to incorporate these factors as covariates (see Statistical methods). Table 3 summarizes the results of the analyses showing the covariate adjusted regression

coefficient, standard error and test of significance for the effect of adolescent depression on each outcome, and the covariates that were statistically significant in the adjusted model. For dichotomous and count outcomes the strength of the adjusted association is summarized by the odds ratio (OR) or incidence rate ratio (IRR) respectively and associated 95% confidence interval for a one step change on the adolescent depression scale, supplemented by an estimate of population attributable risk (PAR%) for those outcomes for which the adjusted association with adolescent depression remained statistically significant after covariate adjustment. Examination of the table shows that after covariate adjustment:

(a) There remained statistically significant (p<0.05) associations between the extent of adolescent depression and risks of major depression and any mental health problem and a marginally statistically significant association with anxiety disorders (p=0.051). For these outcomes the adjusted associations were OR=1.3 (depression) and OR=1.2 (any disorder and anxiety disorders), and estimates of PAR% suggested that adolescent depression accounted for between 4.8% to 8.9% of the rate of these disorders.

(b) There was also a significant (p=0.049) adjusted association between adolescent depression and intimate partner violence victimization: for this outcome the adjusted IRR was 1.1, and the estimated PAR was 2.0%.

(c) For all other education, economic, family and partnership outcomes the adjusted associations with adolescent depression were both small and statistically non-significant

(d) A wide range of covariate factors had statistically significant effects in the adjusted models. These factors spanned measures of childhood family socio-economic background and family functioning, child personal characteristics and behavior, peer affiliations and other mental health problems in adolescence that were co-morbid with adolescent depression.

Insert Table 3

Tests of gender interactions

To examine whether the effects of adolescent depression on later outcomes differed by gender, the covariate adjusted models reported in Table 3 were extended to include multiplicative tests of gender x adolescent depression interactions. This analysis showed statistically significant gender x adolescent depression interactions for two outcomes: unintended pregnancy (p=0.007) and IPV victimization (p=0.006). The nature of these interactions is explored in Figure 1, which shows the covariate adjusted rates of each outcome by the extent of adolescent depression estimated from the fitted models. The adjusted rates are shown separately for females and males. Figure 1 shows that, for females, increasing extent of adolescent depression was associated with increasing rates of unintended pregnancy and victimization; whereas for men, the associations were either much weaker or in the opposite direction.

Insert figure 1

Discussion

This study has examined associations between the extent of adolescent depression at age 14-16 and a series of mental health and psychosocial outcomes assessed at age 30 and 35 years. The findings of the study suggest a number of conclusions. First, at the bivariate level there was evidence of small but pervasive linear associations between severity of adolescent depression and the great majority of outcomes examined. Thus, young people who experienced depressive symptoms in adolescence were an at risk group for difficulties in later psychosocial functioning in mature adulthood. These difficulties were not confined to those who met diagnostic criteria for major depression in adolescence; those with sub-threshold symptoms were also at elevated risk.

To a large extent these associations appeared to reflect the social, family and individual context of adolescent depression, and statistical adjustment for a range of covariate factors correlated with adolescent depression substantially reduced that strength of these associations. After covariate adjustment there remained modest but significant or marginally significant associations between the extent of adolescent depression and rates of major depression, anxiety disorder, any mental health problem and IPV victimization. Estimates of attributable risk suggested adolescent depression accounted for between 2%-8.9% of the rates of these outcomes. These findings are broadly consistent with previous research linking adolescent depression with increased risks of mental health problems and victimization in young adulthood (Dunn and Goodyer, 2006; Fergusson *et al.*, 2005; Fergusson and Woodward, 2002; Fombonne *et al.*, 2001; Hammen *et al.*, 2013; Tuisku *et al.*, 2014; Weissman *et al.*, 1999a; Weissman *et al.*, 1999b). The study also showed that, with the exception of victimization, there was no evidence that adolescent depression was associated with other educational, economic, partnership or family outcomes after covariate adjustment; in general agreement with findings from previous studies (Devries *et al.*, 2013; Fergusson and Woodward, 2002; Hammen *et al.*, 2013; Kessler *et al.*, 1997; Lehrer *et al.*, 2006; Nduna *et al.*, 2010; Weissman *et al.*, 1999b).

An interesting finding of this research has been the differing partnership and family outcomes of adolescent depression for males and females. In particular, the findings showed evidence gender-specific responsivity such that increasing severity of adolescent depression was associated with increased rates of unintended pregnancy and IPV victimization for females but not for males. A number of explanations may be posited for these findings. First, a number of studies have linked adolescent depression in females to greater sexual risk-taking (more sexual partners, unprotected sex) which may in turn lead to unintended pregnancy, whereas for males depression may lead to fewer sexual partners and reduced risk of unintended pregnancy (Fergusson and Woodward, 2002; Hammen *et al.*, 2013; Kessler *et al.*, 1997; Lehrer *et al.*, 2006). Similarly, females

may be at increased risk for IPV victimization due to selection into maladaptive romantic relationships (Devries *et al.*, 2013; Hammen *et al.*, 2013; Nduna *et al.*, 2010).

The current study has a number of strengths including: greater length of follow-up than most studies; good sample retention; the inclusion of sub-threshold depressive symptoms; availability of a wide range of measures of adult psychosocial functioning; comprehensive control for potential confounding factors; and prospective assessment of all measures. However, the study is not without limitations. In particular the findings reported are of a birth cohort studied in a specific historical context, using self-report interview data, limited by the extent to which they can be generalized to other contexts.

While no claim can be made regarding adolescent depression causing later mental health problems on the basis of this study; it is possible that sub-threshold and major depression during adolescence creates a susceptibility to later mental health problems (Costello and Maughan, 2015; Fergusson *et al.*, 2005; Fergusson and Woodward, 2002; Hammen *et al.*, 2013) which may be familial in nature and influenced by the timing of the first episode (Weissman *et al.*, 1999b). Clinicians treating adolescents with depressive symptoms may need to consider this susceptibility as a marker for longer-term mental health problems that may help perpetuate further mental distress and disability in the long-term. Further, clinicians may also need to consider the implications of adolescent depression on later partnership and family outcomes for their female patients. Specifically, females who have experienced adolescent depression may enter parenthood under more adverse circumstances and also have more conflict and violence in their partnerships.

Financial Support

This research was funded by grants from the Health Research Council of New Zealand (HRC 11/792), the National Child Health Research Foundation, the Canterbury Medical Research Foundation and the New Zealand Lottery Grants Board.

Declaration of Interest

None

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Table 1. *Unadjusted associations between adolescent depression (14-16 years) and a series of mental health and psychosocial outcomes pooled over assessments at 30 and 35 years*

Outcome	Adolescent depression (14-16 years)			*r*	B (S.E.)	*p*
	None	Sub-threshold	Major depression			
Mental health						
Major depression						
Pooled %	9.0	14.6	21.5	0.14	0.516 (0.097)	<0.001
Pooled *N*	1240	330	251			
Anxiety disorder						
Pooled %	11.1	15.8	26.3	0.15	0.510 (0.094)	<0.001
Pooled *N*	1240	330	251			
Suicidal ideation/attempt						
Pooled %	1.9	4.2	6.8	0.15	0.692 (0.177)	<0.001
Pooled *N*	1240	330	251			
Alcohol abuse/dependence						
Pooled %	8.6	10.6	8.0	0.00	0.011 (0.128)	0.934
Pooled *N*	1240	330	251			
Illicit substance abuse/dependence						
Pooled %	4.3	7.3	7.8	0.05	0.265 (0.156)	0.091
Pooled *N*	1240	330	251			
Any mental health problem						
Pooled %	25.8	35.8	44.2	0.15	0.423 (0.077)	<0.001
Pooled *N*	1240	330	251			
Education and economic circumstances						
Degree attainment						
Pooled %	33.3	23.9	19.8	-0.11	-0.362 (0.106)	0.001
Pooled *N*	1291	351	262			
Welfare dependence						
Pooled %	7.8	10.3	21.1	0.14	0.551 (0.114)	<0.001
Pooled *N*	1240	330	251			

Net weekly personal income (NZD)						
Pooled mean (S.D.)	821.8 (605.9)	676.5 (523.9)	590.2 (596.0)	-0.15	-125.1 (24.1)	<0.001
Pooled *N*	1237	329	251			
Partnership and family outcomes						
Any unintended pregnancies						
Pooled %	37.3	46.3	56.2	0.14	0.400 (0.089)	<0.001
Pooled *N*	1240	330	251			
Sole parenthood						
Pooled %	4.8	7.0	13.1	0.11	0.526 (0.132)	<0.001
Pooled *N*	1240	330	251			
Relationship quality[a]						
Pooled mean (S.D.)	28.1 (6.7)	27.3 (7.5)	26.8 (8.0)	-0.07	-0.674 (0.272)	0.013
Pooled *N*	1085	288	222			
Perpetration of intimate partner violence[a]						
Pooled mean (S.D.)	2.0 (1.8)	2.2 (1.9)	2.5 (2.1)	0.09	0.112 (0.026)	<0.001
Pooled *N*	1086	288	222			
Victim of intimate partner violence[a]						
Pooled mean (S.D.)	2.2 (2.1)	2.4 (2.4)	2.9 (2.6)	0.10	0.122 (0.024)	<0.001
Pooled *N*	1086	288	222			

S.E., standard error; S.D., standard deviation; NZD, New Zealand dollars.

[a] Analysis restricted to respondents in any romantic partnership over the previous 12 months at 30 and 35 years who also had information on adolescent depression at 14-16 years (n=1596).

Table 2. *Associations between potential covariate factors and adolescent depression 14-16 years*

Covariate	Adolescent depression (14-16 years)			*r*	*p*
	None (n=678)	Sub-threshold (n=182)	Major depression (n=135)		
Family background					
Mother lacked formal educational qualifications at birth of child %	46.2	54.4	60.0	-0.11	<0.001
Lowest quartile averaged family living standards (1-10 years) %	43.6	49.5	65.2	-0.14	<0.001
Family functioning					
Parental illicit substance use (11 years) %	22.4	28.9	31.5	0.08	0.010
Parental history of alcohol problems (15 years) %	9.1	12.8	25.9	0.17	<0.001
Parental history of criminality (15 years) %	9.4	17.8	26.7	0.18	<0.001
Parental history of depression/anxiety (15 years) %	25.5	37.2	42.2	0.14	<0.001
Any interparental violence (<16 years) %	40.9	47.1	56.9	0.17	<0.001
Any change of parents (0-16 years) %	31.7	50.6	58.5	0.24	<0.001
Child factors					
Gender (Female) %	44.5	56.0	70.4	0.18	<0.001
Lowest quartile IQ (8-9 years) %	23.9	23.1	42.2	-0.09	<0.001
Lowest quartile self-esteem (15 years) %	22.4	30.8	49.6	-0.29	<0.001
Lowest quartile parental attachment (15 years) %	22.7	30.8	48.9	-0.28	<0.001
Regular/Severe physical punishment (<16 years) %	15.4	13.9	34.1	0.17	<0.001
Any sexual abuse (<16 years) %	8.9	15.0	34.1	0.25	<0.001
Highest quartile neuroticism (14 years) %	18.4	27.3	41.7	0.22	<0.001
Highest quartile novelty seeking (16 years) %	23.7	36.4	29.7	0.11	0.014
Any involvement with deviant peers (14-16 years)%	46.6	58.6	70.9	0.17	<0.001
Comorbid mental health problems (14-16 years)					
Anxiety disorder %	10.8	21.7	45.5	0.31	<0.001
Suicidality %	8.3	17.1	43.3	0.32	<0.001
Conduct/oppositional defiant disorder %	11.5	22.2	35.1	0.22	<0.001

Attention deficit hyperactivity disorder %	4.9	6.7	15.7	0.14	<0.001
Alcohol abuse %	6.7	15.0	23.9	0.20	<0.001
Illicit substance abuse %	2.3	4.4	12.7	0.17	<0.001

Table 3. *Associations between the extent of adolescent depression (14-16 years) and mental health and psychosocial outcomes pooled over observations at 30 and 35 years, after adjustment for confounding factors*

Outcome	B (S.E.)	OR/IRR (95% CI)	*p*	Significant covariates[b]	PAR %[c]
Mental health problems[a]					
Major depression	0.251 (0.118)	1.3 (1.0-1.6)	0.034	1,2	6.9
Anxiety disorder	0.223 (0.115)	1.2 (1.0-1.6)	0.051	2-4	8.9
Suicidal ideation/attempt	0.354 (0.223)	1.4 (0.9-2.2)	0.113	1,2,5-7	-
Any mental health problem	0.188 (0.092)	1.2 (1.0-1.4)	0.041	1,3,6,12	4.8
Education and economic circumstances					
Degree attainment	-0.071 (0.149)	0.9 (0.7-1.2)	0.633	3,6-8,13-15	-
Welfare dependence	0.192 (0.147)	1.2 (0.9-1.6)	0.190	-	-
Net weekly personal income (NZD)	-37.5 (24.8)	-	0.131	3,4,13,15	-
Partnership and family outcomes					
Unintended pregnancy	0.016 (0.110)	1.0 (0.8-1.3)	0.885	2,6,10,14,15	-
Sole parenthood	0.029 (0.161)	1.0 (0.8-1.4)	0.857	3,6,7,13,15	-
Relationship quality	-0.200 (0.305)	-	0.512	7,16,17	-
Intimate partner violence perpetration	0.032 (0.031)	1.0 (1.0-1.1)	0.298	2,5-7,11	-

Intimate partner violence victimisation	0.057 (0.029)	1.1 (1.0-1.1)	0.049	2,3,5-7,13,14	2.0

Note. S.E.= standard error; OR=odds ratio; IRR=incidence rate ratio; CI=confidence interval; PAR%=population attributable risk percent; NZD=New Zealand dollars.

[a] The outcome alcohol abuse/dependence and illicit substance abuse/dependence were excluded from the covariate adjusted analysis because of the non-significant association with adolescent depression in Table 1.

[b] Statistically significant ($p<0.05$) covariates: 1=parental history of illicit substance use (11 years); 2=childhood physical punishment (<16 years); 3=gender; 4=self-esteem (15 years); 5=childhood sexual abuse (<16 years); 6= novelty seeking (16 years); 7=adolescent conduct/oppositional defiant disorder (14-16 years); 8=maternal educational attainment; 9=parental history of offending (15 years); 10=involvement with deviant peers (14-16 years); 11=adolescent substance use (14-16 years); 12=neuroticism (14 years); 13=averaged standard of living in childhood (0-10 years); 14=number of changes of parents (<16 years); 15=child cognitive ability (8-9 years); 16=parental history of alcohol problems; 17= parental attachment (15 years).

[c] PAR%= population attributable risk percent. This value was calculated on adolescent depression (14-16 years) dichotomized into two groups of: no/subthreshold depression (n=860) and major depression (n=135). PAR% is only reported for outcomes having a statistically significant association with adolescent depression after adjustment for confounding.

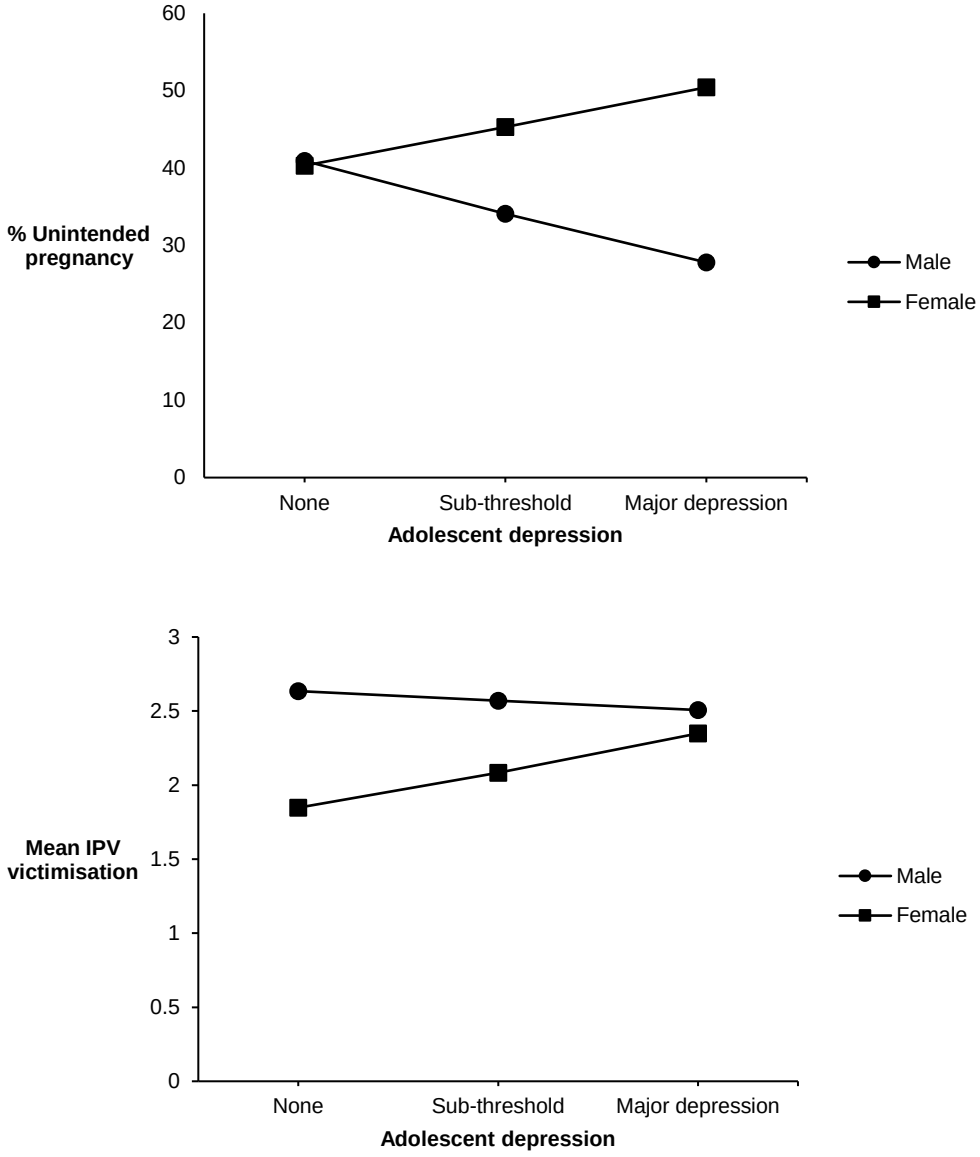

Figure 1. Adjusted associations between the extent of adolescent depression (14-16 years) and rates of (a) unintended pregnancy and (b) intimate partner violence victimization, pooled over assessments at age 30, 35 years, by gender.