

Abortion, substance abuse and mental health in early adulthood: Thirteen-year longitudinal evidence from the United States

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Abstract

Objective: To examine the links between pregnancy outcomes (birth, abortion, or involuntary pregnancy loss) and mental health outcomes for US women during the transition into adulthood to determine the extent of increased risk, if any, associated with exposure to induced abortion.

Method: Panel data on pregnancy history and mental health history for a nationally representative cohort of 8005 women at (average) ages 15, 22, and 28 years from the National Longitudinal Study of Adolescent to Adult Health were examined for risk of depression, anxiety, suicidal ideation, alcohol abuse, drug abuse, cannabis abuse, and nicotine dependence by pregnancy outcome (birth, abortion, and involuntary pregnancy loss). Risk ratios were estimated for time-dynamic outcomes from population-averaged longitudinal logistic and Poisson regression models.

Results: After extensive adjustment for confounding, other pregnancy outcomes, and sociodemographic differences, abortion was consistently associated with increased risk of mental health disorder. Overall risk was elevated 45% (risk ratio, 1.45; 95% confidence interval, 1.30–1.62; $p < 0.0001$). Risk of mental health disorder with pregnancy loss was mixed, but also elevated 24% (risk ratio, 1.24; 95% confidence interval, 1.13–1.37; $p < 0.0001$) overall. Birth was weakly associated with reduced mental disorders. One-eleventh (8.7%; 95% confidence interval, 6.0–11.3) of the prevalence of mental disorders examined over the period were attributable to abortion.

Conclusion: Evidence from the United States confirms previous findings from Norway and New Zealand that, unlike other pregnancy outcomes, abortion is consistently associated with a moderate increase in risk of mental health disorders during late adolescence and early adulthood.

Keywords

Abortion, substance abuse, mental health, pregnancy outcomes, longitudinal data

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Background

Women aborting unintended pregnancies generally face improved prospects for education, employment, and income,¹ but evidence that their mental health is thereby improved has been elusive. The question is consequential for clinical practice and public health. At over 40 million per year worldwide, induced abortions are one of the most common medical procedures,² and most (63%) countries, rising to 9 in 10 developing countries (89%), justify the legal availability of abortion as physician-certified therapy for the woman's mental health³ (p. 25).

Uneven quality in earlier studies of this question led to sharply contested results, spurring improvements in study design, including the use of representative population samples;

controlling for confounders such as mental illness prior to pregnancy and rape or intimate partner violence (IPV) following the abortion; the use of standard, well-validated measures of mental health; and the adoption of appropriate comparison groups to isolate the effects of abortion from that of pregnancy. Despite claims to the contrary from psychiatric associations^{4,5} and abortion providers,⁶ evidence of psychological distress and

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mental disorders following abortion continues to accrue.⁷⁻⁹ Recent studies have tended to document a positive association between having an abortion and a range of difficulties, including post-traumatic stress disorder (PTSD),^{10,11} anxiety,^{12,13} suicidality,^{1,14} and substance abuse.¹⁵ The most persistent finding has been that of an association between abortion and subsequent indicators of depression,^{8,13,14,16-18} although others have produced weak or null results.^{19,20}

A 2008 American Psychological Association (APA)⁴ Task Force review of the literature found that

women obtain abortions within widely different personal, social, economic, religious, and cultural contexts that ... may lead to variability in women's psychological experiences to their particular abortion experience⁴ (p. 9). ... Some women experience beneficial outcomes, whereas others experience sadness, grief, and feelings of loss following the elective termination of a pregnancy. Some women experience clinically significant outcomes, such as depression or anxiety (p. 91).

The Task Force also noted, "Historical linkages between coercive abortion and sterilization practices and the eugenics movements may lead some poor women and women of color to feel ambivalent" and "women who belong to religious groups that oppose abortion on moral grounds, such as Evangelical Protestants or Catholics, may be more conflicted" about terminating an abortion.⁴ (p. 10) "For these reasons," the Task Force concluded, "global statements about the psychological impact of abortion on women can be misleading"⁴ (p. 9).

The Task Force review identified in the literature several specific factors that may be associated with greater distress following abortion, including abortion of a wanted pregnancy, abortion at lower gestational age, and having more children preabortion.^{4,21} Other mechanisms that have been proposed include stigma,²² risk-taking, and relational stress.²³

Four theoretical frameworks in this area of research have shaped understanding of the relation of abortion to mental distress, according to the Task Force. The Stress and Coping Perspective "views abortion as a potentially stressful life event" within the context of other life stressors. The analytical difficulty posed by this perspective is being able to isolate abortion from other related stressors. A second perspective proposes that abortion can be a uniquely traumatic experience resulting in a type of PTSD termed "post-abortion syndrome" (PAS), characterized by mental health problems as well as "grief, anger, shame, survival guilt and substance abuse" (p. 11).^{4,24} Evidence for this theory has been derived primarily from clinical samples, although population studies have found a small minority of women meeting criteria for PAS or post-abortion PTSD.^{21,25,26} A third theoretical perspective emphasizes the effects of Sociocultural Context, primarily stigma, in influencing psychological trauma relating to abortion, and a fourth emphasizes comorbidities or Co-occurring Risk Factors, such as a

pre-existing propensity to depression, as alternative explanations for distress following abortion. Although discourse between theoretical perspectives has sometimes been quite controversial, the Task Force suggests that the perspectives are not mutually exclusive, and their findings are largely complementary.

Debate on the question of distress following abortion was heightened in 2011 by two comprehensive reviews which offered contradictory assessments of the state of knowledge. Coleman, pooling effects from 22 studies in a meta-analysis, estimated an 81% increased risk of mental health problems for women having an abortion, concluding that the combined results "revealed a moderate to highly increased risk of mental health problems after abortion"²⁷ (p. 180). But a much more extensive but non-quantitative review by the United Kingdom's National Collaborating Center for Mental Health for the Academy of Medical Royal Colleges (AMRC) concluded that, when studies with weak design and quality were excluded, "The rates of mental health problems for women with unwanted pregnancy were the same whether they had an abortion or gave birth."⁵ (p. 8) This exchange was followed by a flurry of articles, reviews, and letters critical of the Coleman review,²⁸ the AMRC report,²⁹ or both.⁹

Research on the question of abortion and mental health has been limited by the use of retrospective cross-sectional data on fertility and mental health outcomes, in which the critical issue of time order is often unclear or obscured, and more effective, rigorous designs using longitudinal data have been called for.^{4,14} Many longitudinal studies designed to overcome this constraint have examined outcomes or measures at only a single point in time, which does not fully exploit the advantages of the longitudinal data,³⁰⁻³⁴ or have been limited by short follow-up periods, typically 5 years or less.^{16,20,35,36} Some of the strongest evidence to date has come from two longitudinal studies by Fergusson and Pedersen of women in New Zealand and Norway that followed cohorts from adolescence into their late 20s. Both found small but significant post-abortion increases in the risk of affective and addictive disorders, including depression, anxiety, suicidal ideation, and abuse of alcohol, marijuana, or other illicit drugs;^{15,37,38} however, comparable evidence from other countries has not been examined. This study aims to amend this lack by replicating the major features of these two studies, examining similar, strong longitudinal data from the United States.

Like these two prior studies, the present analysis is pursued within a stress and coping perspective, while also considering the influences of sociocultural context and comorbidities. The purpose is to either confirm or disconfirm the presence and extent of a net association of abortion with mental distress, employing stronger data and measures for the United States than has heretofore been the case. The scope of the study does not include the question of PAS or PTSD following abortion. The analysis therefore proceeds by addressing following progression of analytical questions:

(1) What associations between pregnancy outcomes and mental health are observed in this cohort of American women from age 15 to 29; and is there an identifiable association of mental distress with exposure to induced abortion within this set of observations? (2–4) To what extent is any abortion–mental health association modified by sociocultural context, life course developmental context (other pregnancy outcomes), or pre-existent or co-occurring risk factors as proposed in prior literature? These are addressed as separate, progressive questions.

Method

The National Longitudinal Study of Adolescent to Adult Health (Add Health), initiated in 1994 with funding from 18 federal agencies, was designed to be the largest and most extensive study of the health-related behaviors of US adolescents during the transition to adulthood. In 1995, researchers obtained extensive measures of behavior, attitudes, and well-being from in-home interviews with a nationally representative sample of 20,745 US adolescents (Wave I) selected from a school-based multistage cluster sampling frame stratified by region of country, urbanicity, school size, school type, and ethnicity.³⁹ After a 1-year follow-up at Wave II, 80.5% of the available original sample completed follow-up interviews both after 7 years (Wave III in 2001–2002) and after 13 years (Wave IV in 2008–2009), resulting in comprehensive longitudinal health measures for 15,608 individuals at mean ages of 15.1 years (standard deviation (SD), 1.74 years; range, 11–21 years) at Wave I (baseline), 22.0 years (SD, 1.77 years; range 18–28 years) at Wave III and 28.5 years (SD, 1.79 years; range, 24–34 years) at Wave IV (terminus). The final analytic sample for this study included 8005 female respondents with information on fertility history and mental health outcomes at all included Waves.

Sensitivity analyses have characterized non-response bias for health risk measures at Waves III and IV of Add Health as “negligible.”^{40,41} This study, moreover, employs longitudinal population weights designed to counteract any bias by adjusting for cross-Wave sample differences, thus providing a high degree of confidence that the Wave III and IV samples “adequately represent[] the same population surveyed at Wave I.”⁴¹ (p. 7)

This study examines seven mental health and substance abuse outcomes: depression, anxiety disorder, suicidal ideation, nicotine dependence, alcohol abuse, illicit drug abuse, and cannabis abuse. All outcome measures were time-dynamic, and conformed in most cases to the relevant *Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition* (DSM-IV) diagnostic criteria for each disorder. Depression was measured by the full Center for Epidemiologic Studies–Depression scale (CES-D)⁴² at Wave I ($\alpha=0.87$), and measures constructed by Add Health based on shortened versions and/or a reported diagnosis of depression at Waves III and IV. Anxiety was assessed at Wave

IV by a reported clinical diagnosis of anxiety disorder; at Wave I by a 7-item scale that combined questions about the frequency of the following symptoms: fearfulness, trouble relaxing, poor appetite, trouble falling asleep or staying asleep, moodiness, and frequent crying ($\alpha=0.72$); and at Wave III by a 4-item scale that measured the last three of these dimensions plus an item on inattentiveness ($\alpha=0.68$). Suicidal ideation at each Wave reflects those reporting that in the past 12 months, they had seriously thought of committing suicide. Nicotine dependence was assessed by the Fagerstrom scale, using scale totals constructed by Add Health.⁴³

Alcohol abuse, illicit drug abuse, and cannabis abuse explicitly reflected DSM-IV diagnostic indicators of dependence or abuse at Waves III and IV, using variables constructed by Add Health researchers based on several dozen specific questions about these abuses. For example, the in-home interview asked 16 questions about alcohol use and related problems, such as frequency of drinking and binge drinking, attempts to quit drinking, and presence and extent of symptoms of physical withdrawal when attempting to quit, whether and how often the respondent had experienced legal problems, problems with family and friends, or problems at work due to drinking, and other similar questions. Questions about when each of these problems occurred or began to occur were then used to compute measures presence and frequency of symptoms of alcohol abuse and dependence and of symptom clustering. From this information, the Add Health researchers created a summary measure, “DSM4 Lifetime Diagnosis of Alcohol Abuse or Dependence,” with classifications of “no abuse/dependence,” “DSM4 Abuse Diagnosis,” or “DSM Dependence,” with the latter further classified as being with physiological symptoms, with no physiological symptoms, or with clustering. From this variable, I created a dichotomous measure reporting any kind of abuse/dependence versus no abuse/dependence. Similar procedures were used to construct the measures of illicit drug abuse and cannabis abuse.

Substance abuse measures at Wave I were constructed following Sieving and colleagues, who have published a full description and construct validation.⁴⁴ Mental health and substance abuse outcomes at Wave III and IV excluded women reporting a completed pregnancy prior to Wave I ($n=130$).

Measures of pregnancies and pregnancy outcomes were time-dynamic and summative, compiled from retrospective accounts at each Wave. Excluding incomplete pregnancies at interview, pregnancy outcome options were birth, abortion, miscarriage, stillbirth, ectopic pregnancy, or other pregnancy loss. The latter four alternatives were combined, resulting in analysis categories of birth, abortion, and involuntary pregnancy loss.

The analysis proceeded by computing relative risk ratios (RRs) for each association of pregnancy outcome and mental disorder using population-averaged longitudinal logistic regression models similar to the method described by Ferguson

et al.³⁷ Incidence rate ratios (IRRs) for the total number of mental disorders were estimated from the corresponding Poisson models.

In these analyses, where both the dependent and independent variables are dichotomous, the ratios express the ratio of the odds on being in the indicated state of the dependent variable (e.g. depression) conditional on being in each state of the independent variable (e.g. having had an abortion), averaged (or pooled) over all time periods. Model fit was assessed by the Archer–Hosmer–Lemeshow F-adjusted mean residual test.⁴⁵ Population attributable fractions (PAFs) were estimated from logistic models using the method developed by Greenland and Drescher⁴⁶ and Newson,⁴⁷ which has been shown to provide less biased (and consistently smaller) estimates than that of Bruzzi et al.⁴⁸ and R ckinger et al.⁴⁹ Analyses were performed with Stata 13 statistical software, incorporating the design features of the survey following published guidelines.⁵⁰ Data use protocols were reviewed and approved by the Catholic University Institutional Review Board.

The analysis models examined a large number of covariate confounders proposed in prior studies using forward and backward elimination, after equalizing demographic differences in age (within Wave), race (Hispanic, White, Black, Asian, and other, following the US Census), and region of origin (northeast, southeast, northwest, southwest, following the US Census) by fitting these covariates in all models. Covariates not significant in any model were excluded. Covariates retained and fitted included retrospective measures of childhood family conditions, conditions measured at baseline, conditions measured at terminus, and time-dynamic covariates measured at all three Waves.

Significant childhood family conditions included *childhood family poverty status*, assessed by parent-reported participation in one or more of three means-tested government support programs, resulting in a single indicator of poverty status. Alpha is 0.69 for the three underlying items. *Parental education* reflected the attainment of a college degree by the more educated parent. *Parental physical, sexual or verbal abuse* in childhood was constructed from retrospective Wave IV questions that asked how often, before age 18, a parent or adult caregiver did “say things that really hurt your feelings or made you feel like you were not wanted or loved,” “hit you with a fist, kick you, or throw you onto the floor, into a wall, or down stairs,” or “touch you in a sexual way, force you to touch him or her in a sexual way, or force you to have sexual relations.” The reports of frequency were recorded into a single dichotomous variable reporting whether the respondent had ever experienced any of these abusive behaviors.

Retained covariates measured at baseline included *conduct problems in school*, reflecting the mean results of a 4-item scale (alpha=0.69) that included self-reported problems getting along with teachers or students, paying attention in school, or getting homework done. Items were measured

on a scale ranging from 0 (never) to 4 (every day). *Integration into the neighborhood* was summative scale of three yes–no items (alpha=0.59) asking whether the adolescent respondents know people in their neighborhood, talk with neighbors, or feel that their neighbors look out for each other. *Grade point average* measures self-reported school performance in English, mathematics, history, and science on a combined 4-point scale. *Neuroticism* was assessed using the scale developed by Young and Beaujean,⁵¹ based on the average of six Likertized items (alpha=0.86) that closely replicate content and scores from the NEO Personality Inventory–Revised (NEO-PI-R), with unidimensional factor structure and high internal consistency.

Respondents’ *educational attainment* at terminus was a dichotomous indicator of college degree or higher versus less than college degree. *Rape victimization* reflected the yes/no answer to the question “Have you ever been forced to have any type of sexual activity against your will?” Respondents were directed to exclude experiences with a parent or adult caregiver. Current *relationship satisfaction* reflected responses on a 5-point response scale—strongly agree, agree, neutral, disagree, and strongly disagree—to seven statements: “I am satisfied with the way we handle our problems and disagreements,” “I am satisfied with the way we handle family finances,” “We enjoy doing even ordinary day-to-day things together,” “My partner listens to me when I need someone to talk to,” “My partner expresses love and affection to me,” “I am satisfied with our sex life,” and “I trust my partner to be faithful to me.” Alpha for the seven items is 0.89. Any disagreement was coded 0, neutrality or agreement was coded 1, and the items were combined into a 7-point summative scale of satisfaction.

Time-dynamic measures, with information at all three included Waves, were available for respondent’s *income*, *marital status*, and *IPV* victimization in the past year. IPV was assessed at Waves III and IV by questions that asked how often the respondent’s partner had “threatened you with violence, pushed or shoved you, or thrown something at you that could hurt,” “slapped, hit or kicked you,” “made you have sexual relations when you didn’t want to,” or the respondent had sustained “an injury, such as a sprain, bruise, or cut because of a fight with [your partner].” At Wave IV, these questions asked about experiences in the past year, and at Wave III, for each lifetime sex partner. After exploring continuous measures, these were expressed as dichotomous indicators of poverty level income, married or not, and having experienced any physical or sexual IPV.

Results

Associations between pregnancy outcomes and mental health (15–29 years)

Supplementary Table 1 shows the relationships between pregnancy history and mental health measured at Waves I,

Table 1. Adjusted relative risk (OR) (95% CI) of mental health disorders for women by pregnancy history: Add Health Waves I, III, and IV (n=4519 (columns 1–3, ever-pregnant women), 6677 (column 4, all women)).

	Abortion	Live birth	Pregnancy loss	Ever pregnant
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Depression	1.30 (1.09–1.56)	0.72 (0.60–0.85)	1.38 (1.17–1.62)	1.27 (1.13–1.42)
Anxiety disorder	1.23 (0.97–1.55)	0.86 (0.69–1.06)	1.24 (1.00–1.54)	0.89 (0.77–1.03)
Suicidal ideation	1.69 (1.28–2.22)	0.43 (0.34–0.56)	1.36 (1.04–1.78)	1.00 (0.84–1.19)
Alcohol abuse/dependence	2.10 (1.72–2.56)	0.47 (0.38–0.57)	0.84 (0.68–1.03)	0.71 (0.62–0.81)
Illicit drug abuse/dependence	3.25 (2.48–4.26)	0.49 (0.38–0.65)	1.20 (0.91–1.59)	1.37 (1.13–1.66)
Nicotine dependence	1.72 (1.38–2.15)	1.66 (1.33–2.08)	1.42 (1.17–1.74)	1.65 (1.43–1.90)
Cannabis abuse/dependence	2.51 (1.98–3.19)	0.73 (0.57–0.93)	1.04 (0.81–1.34)	1.06 (0.90–1.24)
Number of mental health problems	1.54 (1.42–1.68)***	0.81 (0.74–0.88)***	1.16 (1.06–1.26)**	1.04 (0.98–1.11)

OR: odds ratio; CI: confidence interval; Add Health: National Longitudinal Study of Adolescent to Adult Health.

Numbers in parentheses report the 95% CI. All models are adjusted for age (within panels), race, parent education, childhood poverty status, and region of origin. Sample size is reduced and (n) varies slightly by model due to missing data. Column 4 shows all women (n=6677).

*p<0.10; **p<0.05; ***p<0.01; ****p<0.001.

III, and IV at average ages of 15, 22, and 29 years. Mental health outcomes include depression, anxiety disorder, suicidal ideation, alcohol dependence, illicit drug dependence, nicotine dependence, cannabis abuse, and a count of the total number of above mental health problems. Pregnancy history is characterized by four dichotomous measures representing whether the women by the given age had experienced an abortion, a live birth, a pregnancy loss (miscarriage, still-birth, ectopic pregnancy), or had never been pregnant. The table reports the percentage of women manifesting each mental disorder within each category of pregnancy history, and the pooled RR between each measure of pregnancy history and each mental health outcome, estimated by the odds ratio (OR) for individual mental health outcomes and by the IRR for the total number of mental health problems.

The RRs are estimated from time-dynamic random-effects regression models in the method described by Fergusson et al.³⁷ and also employed in Tables 1 and 2 and Supplementary Tables 2 and 3.

The associations between pregnancy outcome and mental health problems shown in Supplementary Table 1 can be summarized in the following general observations:

1. Exposure to induced abortion was consistently associated with increased rate of most mental disorders, with ORs ranging from 1.02 to 2.83. This trend is summarized in the fact that women exposed to abortion from ages 15 to 29 (on average) experienced overall rates of mental health problems 1.34 (95% confidence interval (CI), 1.22–1.47) times higher than those not exposed to abortion (p<0.001).
2. Exposure to live birth was consistently associated with reduced rates of mental disorders, with ORs ranging from 0.96 to 0.39. This trend is summarized in the fact that women giving birth from ages 15 to 29 experienced overall rates of mental health problems

0.66 (95% CI, 0.61–0.72) times lower than those not giving birth.

3. Exposure to pregnancy loss was not consistently associated with either higher or lower rates of mental health problems, with ORs for individual mental health problems ranging from 0.88 to 1.46. The associations of pregnancy loss with affective disorders were stronger than with substance abuse disorders; the OR CIs for all four of the latter, but none of the former, spanned unity. This lack of consistent association is summarized in the fact that the overall rate of mental health problems for women experiencing pregnancy loss, at 1.04 (95% CI, 0.95–1.13), was not significantly different than the rate for women who had not experienced pregnancy loss (p>0.40).
4. Exposure to pregnancy at all also had inconsistent or mixed associations with mental health problems, with ORs higher for depression, alcohol abuse, illicit drug abuse, and nicotine dependence, but lower for anxiety disorder, suicidal ideation, and cannabis abuse. The joint result of these conflicting trends, however, was that women ever pregnant experienced overall net rates of mental health problems 0.89 (95% CI, 0.85–0.94) times lower than those never having been pregnant (p<0.001).

Adjustment for demographic differences, interactions, and covariates

The results in Supplementary Table 1 do not account for background demographic or socioeconomic differences which may affect the associations with mental health. Table 1 addresses this consideration, showing the pooled RRs for each pregnancy outcome with mental disorders after equalizing models for sociodemographic differences by fitting covariates for respondents' age, race, region of origin, parent education,

Table 2. Adjusted relative risk (OR) (95% CI) of mental health disorders for ever-pregnant women by pregnancy history, controlling for covariates and other pregnancy outcomes: Add Health Waves I, III and IV (n=3152).

	Abortion	Live birth	Pregnancy loss	Significant covariates (p<0.05)	PAF for abortion
	OR (95% CI)	OR (95% CI)	OR (95% CI)		
Depression	1.54 (1.17 to 2.03)	1.04 (0.79 to 1.37)	1.50 (1.19 to 1.89)	3 to 6, 15 to 17	5.8 (2.0 to 9.5)
Anxiety disorder	1.49 (1.07 to 2.08)	1.14 (0.84 to 1.56)	1.39 (1.04 to 1.86)	1, 4, 5, 15, 16	6.6 (0.7 to 12.2)
Suicidal ideation	1.40 (0.89 to 2.19)	0.52 (0.35 to 0.79)	1.64 (1.14 to 2.35)	1, 6, 15, 16	7.2 (-3.0 to 16.4)
Alcohol abuse/dependence	1.51 (1.15 to 2.00)	0.61 (0.45 to 0.82)	0.85 (0.65 to 1.10)	1, 11, 14, 15, 18, 19	7.7 (2.3 to 12.7)
Illicit drug abuse/dependence	3.02 (2.07 to 4.39)	0.46 (0.30 to 0.70)	1.38 (0.94 to 2.02)	8, 10, 11, 14, 16 to 18, 20	25.6 (16.2 to 34.0)
Nicotine dependence	1.58 (1.13 to 2.22)	1.06 (0.78 to 1.46)	1.32 (0.98 to 1.77)	9, 15 to 18, 20	5.6 (1.3 to 9.7)
Cannabis abuse/dependence	2.30 (1.62 to 3.26)	0.88 (0.62 to 1.25)	1.29 (0.93 to 1.80)	10, 13, 16, 19, 20	17.9 (10.0 to 25.2)
Number of mental health problems	1.45 (1.30 to 1.62)****	0.86 (0.76 to 0.96)**	1.24 (1.13 to 1.37)****	1 to 5, 8, 9, 11, 15 to 17, 19, 20	8.7 (6.0 to 11.3)

OR: odds ratio; CI: confidence interval; Add Health: National Longitudinal Study of Adolescent to Adult Health; PAF: population attributable fraction. Shown are population-weighted and population-averaged panel regression estimates, derived from Poisson models for number of mental health outcomes and from logistic models for all other outcomes. All models are adjusted for sociodemographic variables: age (within panels), race, parent education, childhood poverty status, and region of origin. Numbers in parentheses report the 95% CI. All models are adjusted for the following demographic variables: age (within panel), race, parent education, childhood poverty status, and region of origin. Covariates fitted—childhood conditions: 1=childhood physical abuse, 2=childhood sexual abuse, 3=childhood verbal abuse; at Wave I (average age 15): 4=depression, 5=anxiety, 6=suicidal ideation, 7=alcohol abuse, 8=drug abuse, 9=nicotine dependence, 10=cannabis abuse, 11=conduct problems in school, 12=neuroticism, 13=neighborhood integration, 14=grade point average (gpa); at Wave IV (average age 28): 15=ever raped, 16=relationship satisfaction, 17=educational attainment; time-dynamic: 18=respondent poverty income, 19=marital status, 20=intimate partner violence.

*p<0.10; **p<0.05; ***p<0.01; ****p<0.001.

Table 3. Adjusted relative risk (IRR) (95% CI) of mental health disorders for abortion under various alternative analyses and constraints: Ever-pregnant women, Add Health Waves I, III, and IV (n=3152).

	OR/IRR (95% CI)	PAF (95% CI)
Number of mental health problems	1.45 (1.30–1.62)****	8.7 (6.0–11.3)
Number of affective disorders	1.33 (1.12–1.56)****	6.2 (2.4–9.8)
Number of substance abuse disorders	1.53 (1.32–1.77)****	10.7 (6.9–14.4)
Number of mental health problems (fixed effects)	1.38 (1.15–1.65)****	–
Lagged mental health disorders	1.38 (1.24–1.54)****	7.7 (5.1–10.3)
Lagged affective disorders	1.47 (1.31–1.64)****	8.9 (6.1–11.5)
Lagged substance abuse disorders	1.42 (1.27–1.58)****	8.4 (5.7–11.0)
Number of abortions (1–4)	1.23 (1.16–1.30)****	8.7 (6.1–11.2)
Age at first abortion (years)		
<20	1.62 (1.41–1.85)****	32.2 (25.0–38.7)
≥20	1.51 (1.30–1.75)****	7.5 (5.5–9.6)
Lagged pregnancy outcomes (years)		
1	1.53 (1.35–1.73)****	8.8 (6.2–14.4)
2	1.49 (1.31–1.70)****	9.9 (6.5–13.2)
3	1.50 (1.30–1.73)****	10.1 (6.3–13.7)
4	1.45 (1.25–1.67)****	9.1 (5.4–12.7)
5	1.49 (1.27–1.74)****	9.9 (5.8–13.8)

OR: odds ratio; IRR: incidence rate ratio; CI: confidence interval; PAF: population attributable fraction; Add Health: National Longitudinal Study of Adolescent to Adult Health.

Shown are population-weighted and population-averaged panel regression estimates derived from Poisson models adjusted as described in Table 2. Numbers in parentheses report the 95% confidence interval.

*p<0.10; **p<0.05; ***p<0.01; ****p<0.001.

and childhood poverty status. Adjusting for these ascribed characteristics generally increases the association of pregnancy outcomes with mental health problems. To avoid problems with multiple significance tests, in Tables 1 and 2 and Supplementary Tables 2 and 3, significance is assessed only for summary models predicting the total number of mental health problems. Every RR in Table 1 is elevated compared to the corresponding RR in Supplementary Table 1, with the exception of marginal reductions in the association of pregnancy loss with depression, anxiety, and alcohol abuse. The overall rate of association with mental disorders is therefore increased for abortion (1.54; 95% CI, 1.42–1.68; $p < 0.001$) and pregnancy loss (1.16; 95% CI, 1.06–1.26; $p < 0.05$), but decreased for live birth (0.81; 95% CI, 0.74–0.88; $p < 0.001$) and having ever been pregnant (1.04; 95% CI, 0.98–1.11; $p > 0.30$). The latter two RRs were both below unity in Supplementary Table 1.

Table 1 and Supplementary Table 1 counterfactually treat each pregnancy outcome as an independent exposure, without considering possible interactions among the different pregnancy outcomes. The results shown in Supplementary Table 2 address this issue by adjusting each pregnancy outcome for the presence of other pregnancy outcomes, in addition to the sociodemographic adjustments already imposed. This adjustment moderates most mental health disorder associations with abortion slightly. The RRs for abortion in Supplementary Table 2 range from 1.23 to 3.04, down from 1.23 to 3.25 in Table 1, but the mean number of mental health problems associated with abortion, at 1.54 (95% CI, 1.41–1.67), is unchanged and is significant at $p < 0.0001$. Adjusting for other pregnancy outcomes consistently elevates the associations with birth, and tends to reduce associations with affective disorder, but increase them for substance abuse disorders, in the presence of pregnancy loss.

Tables 2 and 3 and Supplementary Table 3 present models with covariates and constraints pertinent to the relation of abortion to mental health, which is the focus of this study. Table 2 and Supplementary Table 3 adjust for 20 covariate conditions that have been posed as confounders of the abortion-mental health association. Measures of physical abuse, sexual abuse, or verbal abuse in childhood assess the effect of early abuse. At adolescence, school conduct and grade point average, as well as integration into the neighborhood, are often associated with substance abuse, as is neuroticism with emotional distress. The state of the seven independent variables at Wave I are also fit, to test claims that these may render spurious the observed association of subsequent abortion and mental distress. Relationship satisfaction at Wave IV and IPV measured at all three waves adjust for positive and negative characteristics of the respondent's intimate relationships. Having ever been raped at Wave IV assesses related violent victimization. Covariates for educational attainment by Wave IV and for poverty status and marital status at all three waves control for differences in respondent socioeconomic status. Unlike the dependent variables and regressors, which are measured repeatedly at all three waves

of the data, covariates may be measured at either a single wave or multiple waves; the wave of measurement for each covariate is reported in the table notes. Significant covariates for each mental health outcome are reported in the tables.

The significant covariates do have a broad effect on the associations of pregnancy outcome with mental disorder, but the effect is mixed, with very little net effect on the overall number of mental health problems. With respect to abortion, the risk of depression, anxiety disorder, illicit drug dependence, and cannabis abuse is increased by considering the covariates, while that of suicidal ideation and dependence on alcohol and nicotine is reduced. The predicted RR for the number of mental health problems is increased slightly, to 1.46 (95% CI, 1.32–1.62; significant at $p < 0.0001$) from 1.34 in Supplementary Table 1.

Inspection of the CIs clearly demonstrates the consistency, compared to the alternative pregnancy outcomes shown, of the association of abortion with mental health disorders. The predicted risk of every disorder with abortion is positive, with a CI that does not span unity. By contrast, although predicted risk is also positive for 6 of the 7 disorders with pregnancy loss, the CI includes the null association (1.0) for 5 of the 7 disorders. Within the limits of uncertainty, pregnancy loss may have no association with any substance abuse disorder examined. Birth consistently reduces risk, but 3 of its corresponding CIs also include unity. Only abortion elevates risk with confidence of prediction for every disorder examined.

Table 2 presents longitudinal models that adjust for all covariates and other pregnancy outcomes, that is, all possible confounding factors identified in this analysis. Risks of mental disorder with birth and pregnancy loss are mixed, with most CIs including null association. By contrast, induced abortion remains positively associated with every measure of mental health disorder, with 6 of the 7 related CIs excluding null association. The RR for the number of mental health problems with abortion, at 1.45 (95% CI, 1.30–1.62; significant at $p < 0.0001$), is almost unchanged from Supplementary Table 3. In the presence of all confounding factors examined in this analysis, abortion, unlike the other pregnancy outcome alternatives, remains positively and persistently associated with increased risk of mental health disorder.

Table 2 also presents PAF estimates, expressed as the percent of prevalence of each disorder that is due to exposure to abortion. The mental health problems included in this analysis would be reduced by an estimated 10.4% (95% CI, 7.6–13.2) overall if abortions did not occur. This fraction is lower for affective disorders, ranging from 6.0 to 6.8%, but rises to as high as 27% for illicit drug abuse and 19% for cannabis abuse.

Alternative analyses and constraints

The models in Table 3 explore various alternative analyses that elaborate or provide context for the findings regarding

abortion, which is the focus of this study. The models in this table fit the covariates and adjustments for other pregnancy outcomes included in Table 2. Looking at affective and substance abuse disorders separately, the risk of affective disorders, at 33% elevated risk, is lower than that for substance abuse disorders, at 53% elevated risk.

When fitted using the corresponding fixed-effects model, the summary RR for abortion of 1.45 shown in Table 2 is reduced by 5%, to 1.38 (95% CI, 1.15–1.65), but is still strong and significant at $p < 0.001$. This model provides a stringent test of possible confounding factors, since the fixed effects model uses only within-person variation to estimate the association. Put differently, this model controls for all unobserved or unmeasured variance that may covary with abortion and/or mental health.⁵² The statistically significant elevated RR estimated by this model therefore expresses the finding that abortion is associated with elevated risk of mental disorder, net of all possible confounding factors present in the data.

Models including lagged measures of disorders provide an additional method of controlling for prior mental health conditions, by fitting the measure of each disorder at the prior wave in the prediction of the current risk of mental disorder due to abortion. In the presence of these controls, risk was reduced slightly, by the same amount as for the fixed effects model, to 1.38 (95% CI, 1.24–1.54; significant at $p < 0.001$), indicating in another way that risk due to abortion cannot be reduced to the confounding effects of prior mental disorder. There is little difference between the effect of prior wave substance abuse and prior wave affective disorders.

Risk increases by a factor of 1.23 for each abortion up to the first four abortions. (Women reported up to 17 abortions, but all abortions above four were collapsed so as not to exert undue outlier influence.) In line with prior literature, risk of mental disorder is higher (1.62) for teenage women who have abortions, compared to women over age 20 (1.51). The proportion of mental disorders associated with abortion is much higher, at 32% compared to 8%, for women under 20. The bottom five lines in Table 3 report models in which pregnancy outcomes are retrospectively measured at 1–5 years prior to the measures of mental disorder. The RRs tend to decline slightly with increasing lag, but the effect overall is small, resulting in RRs ranging from 1.45 to 1.53. Despite these adjustments, all the RRs for mental disorders in the presence of abortion in these data are substantial and highly significant at $p < 0.0001$.

Discussion

The results of this analysis are remarkably similar to those of the two earlier longitudinal studies, by Pedersen¹⁵ and by Fergusson et al.,³⁷ which this study has attempted to replicate in a general sense. Fergusson et al.,³⁷ employing similar models and covariate adjustments, found a 1.37 RR (compared to 1.55 in this study) for number of mental health

problems, after examining comparable longitudinal data for a cohort of 500 New Zealand women from ages 15 to 30. Pedersen,¹⁵ using longitudinal measures but not panel models, found similar risks of substance abuse in a cohort of Norwegian women at age 27 by abortion history since age 15. Fergusson et al.³⁷ argued that his findings supported a middle position between claims that “abortion has large and devastating effects on the mental health of women” and claims that “it is without any mental health effects,” concluding that “abortion is likely to be a stressful and traumatic life event” for some women. (p. 450). The similarity of results among these three studies and this study is notable given the very different cultural, social, and legal contexts examined. Allott may be correct when he avers, on the basis of similar findings, that “while most cultures have slowly come to consider abortion as a normal and acceptable part of women’s health care, the real psychological effects that aborting one’s child has on a mother can never be completely avoided.”

The models presented here are the first to specify causal time order for the effect of abortion on women’s mental well-being through repeated measures using American data. The findings generally confirm the trend of research in this area, which has been to document more clear and persistent harm with the increasing use of methods that more clearly distinguish cause and effect. In particular, the ORs and PAFs reported by Mota using retrospective data from Canada with comparable controls are very similar to those of this study. Mota et al.,¹⁴ for example, reported ORs for depression, suicidal ideation, and drug dependence of 1.51, 1.59 and 3.87 (here 1.45, 1.54, and 3.60), and PAFs for drug dependence of 23.2 (here 27.4) and for any mood disorder of 6.0 (here 6.2) (p. 243, Table 1).

The results of this study, derived from repeated measures with extensive covariate controls, offer some of the strongest evidence to date that the association of abortion with subsequent mental distress is not merely contingent but is indeed causal. Several features of the analysis reinforce this conclusion. First, elevated risk of mental disorder with abortion was remarkably consistent: unlike other pregnancy outcomes, every RR estimated for abortion was above unity, and almost all were statistically significant. Second, the associations of abortion with mental disorder were robust in the presence of extensive confounding adjustments: from demographic controls to covariates to other pregnancy outcomes, the summary RR for mental health problems with abortion varied by only 0.02. Moreover, when estimated with the corresponding fixed effects model, which is unbiased with respect to all missing covariates, the RR for abortion was still substantially elevated and statistically significant. Third, time order was modeled by lagged models that ensured that pregnancy outcomes preceded the measures of mental disorder by up to 5 years, with only small effects on the overall RRs, which remained highly significant. Fourth, the effect of repeated abortions was substantially additive, reinforcing the view that distress is associated with

the abortions themselves, and not merely with accompanying conditions that may also be associated with the propensity to have an abortion. Fifth, the analysis included the full range of comparison groups related to fertility outcomes: birth, pregnancy loss, and women who were never pregnant. Of the four groups, which comprise all the logically possible outcomes to pregnancy, only abortion was consistently associated with higher risk of mental disorder.

These findings are limited in several ways. Most importantly, although it is reasonable to interpret an influence of prior abortion on subsequent mental health from these findings, no non-experimental study can establish causation beyond a preponderance of the evidence. Likewise, although the fact that virtually all confounders proposed in prior studies have been included, and that fixed effects models, which control for unmeasured confounders, have confirmed the findings, renders it unlikely, it is always possible that the mental health outcomes at terminus may be due to unmeasured influence rather than abortion. Outcome measures, moreover, are self-reported, may not be optimally consistent or precise, and pregnancy wantedness was not considered. Differential under-reporting of abortion, often as high as 50% on national fertility surveys,⁵³ may also be present. However, Add Health used a computer-assisted anonymous data collection method which is known to reduce under-reporting,⁵⁴ and as yet no reports of significant under-reporting of abortion by particular demographic groups on Add Health have been published.⁵⁵ At Wave IV, 31.6% (95% CI, 27–36) of ever-aborting women reported only one abortion and 68.4% reported multiple abortions, amounts almost identical to the age-matched proportions (33.1% for a single prior abortion and 66.9% for multiple abortions) in the same year on Guttmacher Institute's⁵⁶ abortion clinic survey, which has minimal abortion concealment, suggesting that under-reporting of abortions on Add Health is also minimal.

Conclusion

These findings contribute to the growing body of evidence that supports the claim that exposure to abortion among women facing pregnancy is implicated in higher rates of mental distress. As far as repeated longitudinal measures can establish, the effect of abortion appears to be causal and independent of confounding associations. The overall level of distress, accounting for about a tenth of mental disorders for women in their late 20s, may be characterized as moderate, but it is not trivial. Ideological claims that all abortions are psychologically devastating, or that abortion has no ill effect on mental health, are both inconsistent with these findings.

To date, the evaluation of abortion by British and American psychological associations has not adequately acknowledged the persistent findings of harm, and ideologically influenced discussions of abortion in the scholarly literature continue to mislead readers about the risks of induced abortion. Moreover, as Fergusson has pointed out, the

premise of expanded access to abortion is the expectation of therapeutic benefit, not merely the absence of harm. To date, although some studies have minimized the risk of distress following abortion, not a single study has documented mental health benefits for women from the practice of induced abortion.

The absence of reduced distress following abortion may have implications for American jurisprudence, which currently precludes the prohibition of abortion after fetal viability when it is deemed medically necessary for the preservation of the health, including the mental health, of the mother⁵⁷ (paras 164–165), and justifies permitting abortions before viability on the grounds, in part, that “the mother who carried a child to full term is subject to anxieties, to physical constraints, to pain ...”⁵⁸ (p. 10) The assumed premise of these arguments is that procuring an abortion will result in less anxiety, constraint, pain, and mental distress than will bringing a pregnancy to term. This study contributes strong evidence from American women to the research consensus that that premise is without basis in evidence.

This study reinforces two patient care initiatives proposed in prior literature on this topic. As already noted, this study's findings are congruent with those of similar prior studies by Fergusson and Pedersen, respectively, of women in New Zealand and Norway. The American cultural and legal context for abortion is similar to and thus moderates between that of both of these other countries. In America, up to the point of fetal viability, there are few restrictions on abortion, as in Norway; past that point of viability, abortion is permitted only with medical certification, as in New Zealand. For American women seeking abortions after fetal viability, therefore, the present findings lend support to Fergusson's recommendation for stricter, evidence-based psychiatric scrutiny that the pregnancy poses harm to the woman's health. Prior to viability, this study's conclusion support Pedersen's recommendation that “women who terminate a pregnancy would probably benefit from post-abortion counseling.”

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Data sharing statement

Information on how to obtain the Add Health data files used in this study is available on the Add Health website (<http://www.cpc.unc.edu/addhealth>).

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

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Informed consent

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