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Abortion-Related Mental Health Disorders at Mid-Life: Twenty-Year Longitudinal Evidence from the United States

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Abstract: *Background and Objectives.* To examine trends in the links between induced abortion and subsequent mental health problems for U.S. women approaching completed fertility. *Materials and Methods.* Panel data on a nationally-representative cohort of 3,842 ever-pregnant women assessed at mean ages of 15, 22, 28 and 37 years from the National Longitudinal Study of Adolescent to Adult Health (Add Health) were examined for pregnancy outcome-related mental health disorders, with extensive adjustment for confounders including sociodemographic differences, mental health history, and unwanted pregnancies. Outcomes were defined using published diagnostic criteria or validated index for depression, anxiety disorder, post-traumatic stress disorder (PTSD), and suicide ideation (affective problems); alcohol abuse, drug abuse, opioid abuse, and cannabis abuse (substance abuse problems); and summary counts of affective problems, substance abuse problems and total disorders. Results were adjusted for abortion under-reporting using cross-wave analysis. *Results.* The relative risk of mental health disorder with exposure to induced abortion followed an inverted "V" pattern as women aged to midlife, increasing from Wave III (age 22; IRR 1.41) to Wave IV (age 28; IRR 1.67), then dropping sharply by Wave V (age 37; IRR 1.20). The population attributable fraction of mental health disorder due to abortion dropped from 18.1% at Wave IV to 8.0% at Wave V. Unlike previous Waves, at Wave V mental health risk was more strongly reduced by exposure to childbirth (IRR 0.70, 95% CI .63, .78, $p < .001$). Reduced relative metrics at Wave V were not due to reduced prevalence of mental health disorders for ever-aborting women, which increased from Wave IV to Wave V by 1.7%, but increased much more, by 20.5%, for never-aborting women. *Conclusion.* At midlife approaching completed fertility, differential negative psychological outcomes for ever-aborting U.S. women remained elevated but reduced from younger ages.

Keywords: induced abortion; depression; suicidality; substance abuse; panel data; fertility surveys; nonresponse bias; National Longitudinal Study of Adolescent to Adult Health (Add Health)

1. Introduction

Rising from 56 million a year 73 million a year over the past decade, induced abortions are one of the most common and rapidly increasing medical procedures [1,2]. Although women aborting unwanted pregnancies may face improved economic prospects [3–5], evidence that their mental health is improved has been elusive. The question is important for clinical practice and public health, as most (63%) countries, rising to nine in ten developing countries (89%), justify the legal availability of abortion as physician-certified therapy for the woman's mental health [6].

Research findings on abortion and mental health have diverged sharply between studies finding psychological risks following abortion to be negligibly small and transient [7–12] and those finding them to be significant and persistent [4,13–20]. Some studies have found a positive association between having an abortion and a range of difficulties [15,21,22], including suicidality [4,17,23,24], depression [13,15,17,25–27], anxiety [28,13], and substance abuse [29,30]. Other studies have reported weak or null results on all these outcomes [7–9,11,31–33].

Competing reviews have vigorously critiqued the methodology of those on the other side of the divide ([21,34,35] see also [22,36–40]). The controversy has prompted successive methodological improvements, including insistence on population representative data; comparison samples;

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validated measures of mental disorder; substantial controls for prior medical history, confounding covariates and alternate pregnancy outcomes; and a preference for longitudinal cohort data with long term (at least 7 years) follow up [9,41].

Although some studies have reported transient short-term improvement in mood or affect akin to relief [42–44], no study has yet found general long-term improvement to women's mental health following abortion. A recent study of Finnish register data reported that pregnant adolescents under age 18 (but not under age 20) who had an abortion had slightly better long-term psychological outcomes than those who gave birth, however this finding was not statistically significant [45]. Representative cohort studies following women for at least a decade following abortion have all found increased risk of disorder relative to comparable women with no abortions or who gave birth [4,18,20,29,30,46].

A series of recent studies based on clinical samples of women not permitted to finalize a desired abortion for medical or legal reasons, known as the Turnaway Study [7,9,44], has claimed to provide strong evidence of minimal mental health disorders which avoids the serious problem of abortion concealment, which is estimated to typically exceed 50% in U.S. population data. However, this study design cannot examine the crucial difference in outcomes between women who choose to terminate a pregnancy by abortion and those who do not. The Discussion section addresses this issue further.

Some recent research has taken a step backwards with the appearance of studies that re-introduce some of the earlier errors of research in this area.[42] The author of a recent comprehensive review remarked that "astonishingly, pre-existing mental health problems are often underestimated or neglected" [39]. The use of longitudinal population samples has been largely displaced by recourse to studies marred by the use of unrepresentative clinical samples, small sample sizes, short follow-up term, and very high rates of attrition [7,47].

Improved research has focused on overcoming the limitations of retrospective cross-sectional fertility data in favor of rigorous longitudinal designs, which can more clearly establish the time order of cause and effect [48,17]. Most studies using longitudinal data, however, have only analyzed reported outcomes at a single wave, which does not make full use of the potential of the data to model temporal sequence [10,49,50,4,51,31]. Studies have also been limited by short follow-up periods following abortion, most often no more than five years [7–9,25,52,53]. Some of the strongest evidence to date has come from three longitudinal studies by Fergusson, Pedersen and Sullins of women in New Zealand, Norway and the United States that measured health outcomes and abortion status over at least three points in time from adolescence into the late 20s. All three studies found significant post-abortion increases in the risk of affective and addictive disorders, including depression, thoughts of suicide, anxiety, and abuse of illicit drugs, marijuana, or alcohol [18,20,29,46].

Substantial under-reporting has limited the usefulness of fertility surveys to assess the predictors and effects of pregnancy outcomes [54–56]. Recent analyses have estimated that in the data used for this study only about a third of abortions and three-fourths of births were reported [57,58], however the reported percent of abortion exposure, the metric used in this study, is much higher, ranging from 84 to 99% over Waves III-V [59]. The present study introduces an adjustment to correct for abortion non-response bias, which is discussed in the Method section.

The present study aims to replicate and improve upon the methodological strength of these prior studies, making use of similar, strong population panel data from the United States; longitudinal models that make use of information from all panels; and extensive covariate adjustment for demographic differences, pre-abortion mental health, unwanted pregnancy, and other confounders. The present study also introduces a non-response adjustment to correct for abortion concealment bias, and is the first to extend abortion and mental health surveillance for American women into midlife, close to the age of completed fertility.

2. Materials and Methods

The National Longitudinal Study of Adolescent 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 U.S. adolescents during the transition to adulthood. In 1995 researchers

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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 [60]. After a one-year follow-up at Wave II, available eligible Wave I respondents were contacted every seven years for follow-up in-home interviews. At Wave III in 2001-02, 15,197 of 19,600 eligible persons were interviewed, for a response rate of 77.5%; at Wave IV (2008-2009), 15,701 of 19,560, response rate of 80.3%. [61] Wave V (2016-2019) employed a multi-mode survey design yielding 12,297 cases, for which an effective response rate of 72% has been reported [62]. The final analytic sample for this study included 5,452 female respondents with information on fertility history and mental health outcomes on all four Waves, at mean ages of 15.5 years (95% CI 15.2, 15.7, range 11-21) at Wave I (baseline), 21.8 years (95% CI 21.6, 22.1, range 18-27) at Wave III, 28.3 years (95% CI 28.1, 28.6, range 24-34) at Wave IV, and 37.4 years (95% CI 37.2, 37.7, range 33-43) at Wave V (terminus).

2.1. Capturing Unreported Pregnancy Outcomes

As already noted, persistent under-reporting of abortions challenges the use of retrospective fertility surveys to study abortion and mental health for American women.[55,56]. Recent analyses by Tierney [58] and Lindberg et al. [57] have respectively estimated abortion capture at Add Health Wave IV at only 35% and 31%. For reasons presented in the Discussion section, these estimates may be too low [59]; however, the present study adopts Tierney's estimate as a parameter to correct for abortion non-response bias. The exact extent of under-reporting is unknown because non-compliance by local health departments on national abortion surveillance surveys is also high.

Complicating under-report estimates, the Add Health data contained many cross-wave inconsistencies in reports of pregnancies and pregnancy outcomes, including abortion. Wave III (mean age of 22) and Wave IV (mean age of 28) both included full pregnancy histories, including the outcome and year of each pregnancy. Discrepancies were not cross-checked at the Wave IV interview, and the reported pregnancies and pregnancy outcomes reported at the two interviews were not congruent. For comparable time periods, women who participated in both interviews generally reported more pregnancies at the earlier wave, suggesting that time to recall was a factor. For example, at Wave III 257 women who participated in both interviews reported that their first pregnancy occurred in 1996, but by Wave IV only 217 did so. The latter group (217) was not a subset of the earlier group (257), however. Of the latter group of 217, only 167 had reported a 1996 first pregnancy at Wave III. Moreover, fifty of the 217 women who reported a 1996 first pregnancy at Wave IV reported a different year for their first pregnancy at Wave III, ranging from 1992 to 2002; and 100 of 257 who reported a 1996 first pregnancy at Wave III reported a different first pregnancy year at Wave IV, ranging from 1992 to 2008. For both distributions the discrepancies were generally normally distributed around 1996, for which year the number of reported first pregnancies was lower at Wave IV than Wave III, suggesting that date recall error was also present. However, eighteen of the 257 women who at Wave III reported a 1996 first pregnancy subsequently reported at Wave IV that 1996 was the year of their second pregnancy. This suggests that, in these cases, the discrepancy could also be due to an unreported pregnancy at either wave.

Wave V also collected a pregnancy history restricted to the first six pregnancies ending in birth, supplemented by summary counts of abortions and other pregnancy losses, which introduced other incongruencies. A substantial number of pregnancies went unreported at Wave V, many of them related to miscarriages or abortions reported elsewhere at the Wave V interview or a previous interview at Waves I, III or IV. For example, of the 2,941 persons, both men and women, who at Wave V reported never being pregnant or having a pregnant partner, 436 (15%) had reported one or more pregnancies at Wave IV. An additional 28 reported a pregnancy at Wave III. A total of 319 ever-pregnant Wave V respondents (3.4% of ever-pregnant persons) reported more lifetime pregnancies at Wave IV (249 respondents; 140 men, 109 women) and/or Wave III (70 respondents; 38 men, 32 women) than at Wave 5. Of these, 149 (47%) reported one or more aborted pregnancies at Waves III, IV or V. Among ever-pregnant women, 132 (2.4%) reported more lifetime pregnancies at either

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Waves III or IV than at Wave 5, of whom 66 (50%) reported an aborted pregnancy or pregnancies at Waves III, IV or V.

For the present study, cross-wave analysis systematically reconciled apparent undercounts at each wave with pregnancies and pregnancy outcomes reported at other waves. By this means, an additional 2,466 pregnancies (19.4%), 793 births (9.2%), 454 abortions (27.4%), and 184 other pregnancy losses (7.0%) were restored to individual waves, usually earlier ones, where they had not been reported. The larger proportion of unreported abortions and pregnancies, compared to birth and other pregnancy losses, may reflect concealment of abortions and related pregnancies. Unreported abortions recovered in this way also enabled estimation of abortion non-response bias for remaining estimated under-reporting, as described below in the Results section.

2.2. Measures

The present study examined eight mental health and substance abuse outcomes, imposing three demographic controls and 20 covariates. The variables are listed, with descriptive statistics, in Table 1. The description of most study variables has been previously reported in two prior studies [20,30]. The account that follows describes in detail only those variable definitions unique to the present study.

Table 1. Descriptive Characteristics for Full and Analysis Sample: Ever-Pregnant Women, by Abortion Status, Add Health Wave 5 (Population Weighted).

	Wave V Only N = 5745	Full N = 4526	Analysis N = 3852	Ever Abortion		Difference (T-test)		
				Yes N=2811 (23.8%)	No N=1041	W5-Full	Full-Analysis	Abortion Yes - No
Age (mean)	37.40	37.24	37.18	37.24	37.16	.14	.74	.51
College degree (%)	38.78	39.43	41.55	38.99	42.35	.81	.45	.23
Currently married (%)	63.06	64.32	65.51	50.92	70.06	.53	.56	.00
Race (%)								
Hispanic	11.26	9.71	9.15	10.69	8.67	.53	.79	.20
NH white	68.63	70.66	71.51	59.92	75.13	.63	.84	.00
NH black	15.91	15.80	15.35	23.17	12.91	.97	.88	.01
NH other	4.20	3.83	3.99	6.23	3.30	.76	.90	.03
Region of origin (%)								
1 – Northeast	16.07	15.57	9.15	20.91	13.63	.82	.92	.01
2 – Midwest	31.71	34.57	71.51	29.39	37.04	.44	.87	.01
3 – South	40.00	39.02	15.35	37.85	38.58	.75	.84	.84
4 – West	12.26	10.84	3.99	11.85	10.75	.35	.91	.58
Ever childbirth (%)	90.43	91.12	91.17	84.18	93.35	.45	.96	.00
Ever other pregnancy loss (%)	37.44	37.07	36.80	44.83	34.29	.82	.87	.00
Ever unwanted pregnancy (%)	59.61	58.07	57.51	95.33	45.71	.39	.78	.00
Outcomes (at Wave 5)								
Depression (%)	9.72	10.47	9.88	13.27	8.82	.71	.86	.00
Anxiety (%)	29.77	30.09	29.82	32.94	28.85	.84	.87	.15
PTSD (%)	8.69	8.22	7.79	8.32	7.62	.60	.65	.65

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Suicide ideation (%)	6.28	6.22	7.8	6.76	5.66	.92	.67	.36
Total number of above four affective disorders (0-4 scale mean)	.549	.546	.535	.611	.511	.93	.71	.048
Drug Abuse/Dependence (%)	2.56	2.70	2.79	4.52	2.25	.73	.85	.03
Alcohol Abuse/Dependence (%)	14.63	15.60	15.48	20.89	13.80	.31	.91	.00
Cannabis Abuse/Dependence (%)	7.05	7.11	6.98	11.50	5.57	.94	.89	.00
Opioid Abuse/Dependence (%)	12.19	12.42	12.60	14.84	11.90	.82	.86	.13
Total number of above 4 substance disorders	.364	.378	.379	.518	.335	.49	.99	.00
Total number of above 8 mental health disorders	.912	.924	.911	1.12	.846	.77	.77	.00

				Ever Abortion		Difference (T-test)		
	Wave V Only N = 5879	Full N = 4526	Analysis N = 3852	Yes N=2811	No N=1041	W5-Full	Full-Analysis	Abortion Yes - No
Covariates measured at Wave 1								
Family poverty (%)	9.92	11.8	11.3	10.8	11.5	.20	.76	.66
Trouble in school (scale mean)	0.972	0.984	0.971	1.08	0.938	.67	.63	.00
Self-esteem (scale mean)	4.031	4.027	4.032	4.023	4.035	.86	.85	.66
Pre-existing disorder symptoms prior to first pregnancy								
Depression (%)	11.89%	12.16%	12.13%	12.46%	12.02%	.81	.84	.79
Anxiety (%)	2.43%	2.34%	2.07%	2.22%	2.02%	.99	.59	.79
PTSD (%)	0.85%	0.85%	0.72%	0.47%	0.80%	.99	.65	.37
Suicide ideation (%)	14.80%	15.06%	14.76%	17.00%	14.07%	.81	.79	.11
Drug Abuse/Dependence (%)	3.36%	3.36%	3.46%	4.60%	3.23%	.99	.89	.11
Alcohol Abuse/Dependence (%)	9.50%	9.51%	8.72%	7.76%	9.02%	.99	.93	.37
Cannabis Abuse/Dependence (%)	1.17%	1.53%	1.60%	2.01%	1.47%	.43	.91	.33
Opioid Abuse/Dependence (%)	6.67%	6.67%	11.68%	9.55%	5.80%	.99	.94	.00

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Covariates measured at Wave 3								
Childhood parent physical abuse (%)	17.19	17.20	17.32	21.15	16.12	.99	.92	.02
Childhood parent sex abuse (%)	7.83	7.83	7.72	9.74	7.06	.99	.66	.19
Childhood parent verbal abuse (%)	52.07	52.05	51.75	59.59	49.20	.99	.86	.00
Covariates measured at Wave 5								
Number of times married	.955	.949	.963	.810	1.01	.84	.66	.00
Ever experienced forced sex (%)	16.84	16.47	15.98	17.98	15.36	.74	.67	.16
Covariates measured at all waves (Wave 5 value reported)								
Poverty income (%)	13.64	13.94	13.68	14.65	13.37	.83	.87	.47
Ever intimate partner violence (IPV)	15.38	15.47	15.22	20.65	13.53	.93	.84	.00

Tests report significance (p-value) of t-tests for equal means. "Wave V Only", cases with data at Waves I and V; "Full Sample", cases with data at Waves I, III, IV and V (all waves); "Analysis Sample", cases with complete data for all analysis variables at all waves.

The mental health outcomes examined were depression, anxiety disorder, post-traumatic stress disorder (PTSD), suicide ideation, alcohol abuse, illicit drug abuse, opioid abuse, and cannabis abuse. All outcome measures were time-dynamic, and conformed in most cases to the relevant DSM-IV diagnostic criteria for each disorder. Depression was measured by the full Center for Epidemiologic Studies-Depression scale (CES-D) [63] at Wave I and shortened versions and/or a reported diagnosis of depression at Waves III and IV. Because changes in affect were of interest in this study, I created comparable indicators of depressive symptoms in waves 1, 3, 4, and 5 by summing responses from the four CES-D items found in all four surveys. The items asked respondents how often in the past 7 days they could not shake the blues, were depressed, were sad, and were happy. (The item "You were happy" did not appear on the Wave 3 survey, so "You enjoyed life" was substituted.) The possible responses were "never or rarely (0),"sometimes (1)," "a lot of the time (2), "most of the time or all the time (3)," with a 0-12 range for four items.

Four and five item subsets of the CES-D have been found to be reliable instruments and highly correlated with the full 20-item scale [64–66]. On Add Health Wave I, the 4-item scale used in the present study correlated .87 with the almost full (19-item) scale. Alpha was slightly reduced but still acceptably strong, at .77 compared to .87 for the almost full scale. The cut-off to predict depression was set at 4, the closest match to the full scale cutoff of 16. At Wave I, the full scale predicted depression in 26.9% of females (95% CI 24.7, 29.2); the four-item scale predicted depression in 29.6% of females (95% CI 27.1, 32.2).

Unlike previous studies, the present study made use of a diagnosis history taken at Wave V to measure anxiety disorder and PTSD by self-reported diagnosis rather than assessment scales included in the interview. Diagnoses reported prior to previous survey waves were aggregated at the index wave, thus providing a more reliable metric for trend analysis. Wave V reports of diagnoses

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before Wave IV were reconciled with a similar history taken at Wave IV; only diagnoses consistently reported at both Waves were retained.

Alcohol abuse or problem drinking was assessed by three questions asked at all four Waves. Persons were assessed positive for problem drinking who fulfilled any of three criteria: had drunk every day in the past year; had 7 or more drinks on each occasion that they drank; or had drunk 5 or more drinks at a time (4 or more at Waves IV and V) at least once a week in the past year (binge drinking). Alpha for the three items at Waves I, III, IV and V respectively was .34, .57, .58, and .57.

Measures of pregnancies and pregnancy outcomes were time-dynamic and summative, compiled from retrospective accounts at each Wave. Pregnancies ending in miscarriage, stillbirth, ectopic pregnancy, or other pregnancy loss were combined into a single category of "involuntary pregnancy loss", resulting in pregnancy outcome categories of birth, abortion, and involuntary pregnancy loss. For each pregnancy, respondents were asked to respond yes or no to the question: "Thinking back to the time just before this pregnancy with {initials}, did you want to have a child then?" Women responding "yes" for any aborted pregnancy were coded as having experienced wanted pregnancy abortion, yielding analysis categories of never abortion, unwanted pregnancy abortion only, and ever wanted pregnancy abortion.

To fully adjust for prior mental health history, all eight outcomes were entered at Wave I for women who had not yet become pregnant. Lagged values of all outcomes at any prior waves were also initially included in the analysis models, however these had little effect on model predictions and so were excluded to improve model fit.

Other covariates fitted included retrospective measures of childhood family conditions, including poverty status, parental education, and any physical, sexual or verbal abuse; conditions measured at baseline, including conduct problems and self-esteem; conditions measured at terminus, including educational attainment, lifetime rape victimization; and time-dynamic covariates measured at all four Waves, including unwanted pregnancy, poverty income, number of times married, and intimate partner violence (IPV) victimization. Detailed descriptions of these measures have been previously published. [20,30]

2.3. Study Design

The analysis proceeded by computing relative risk ratios for each association of pregnancy outcome and mental disorder using population-averaged longitudinal logistic regression models similar to the method described by Fergusson [67]. Incidence rate ratios for the total number of mental disorders were estimated from the corresponding poisson models. Model fit was assessed by the Archer-Hosmer-Lemeshow F-adjusted mean residual test [68]. Population attributable fractions were estimated from logistic models using the method developed by Greenland and Drescher[69] and Newson[70], which has been shown to provide less biased (and consistently smaller) estimates than that of Bruzzi [71,72]. Analyses were performed with Stata 13 statistical software, incorporating the complex design features of the survey following published guidelines [73]. Data use protocols were reviewed and approved as exempt under 45 CFR 46.104 by the Catholic University Institutional Review Board, Certificate FWA00004459, on August 16, 2021.

Two classes of models are presented, employing alternate comparison groups for ever-aborting women. The first class estimates the effects of exposure to abortion, comparing ever-aborting women with never-aborting women. This permits clear estimation of population effects, but somewhat oversimplifies risks. In a lifetime history analysis, abortion risks interact with those of other pregnancy outcomes, since most ever-aborting women also experience other pregnancies with different outcomes. In particular, abortion interacts explicitly with childbirth, which is, in most cases, the direct alternative to an abortion. The second class of models, therefore, estimates the effects of abortions compared to births, isolating pregnancies that end in either abortion or childbirth.

The analysis models adjusted for pre-existing distress, measured as the presence of each of the eight outcome variables at Wave 1 prior to any pregnancy; for exposure to unwanted pregnancy; and for other pregnancy outcomes by including all possible pregnancy outcomes (abortion, childbirth, or other pregnancy loss) in a single model.

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3. Results

3.1. Associations between Pregnancy Outcomes and Mental Health (15–35 Years)

Tables 2 and 3 report the relationships between pregnancy history and mental health measured at Waves I, III, IV and V at average ages of 15, 22, 29 and 35 years. Mental health outcomes examined in Table 2 include depression, anxiety disorder, post-traumatic stress disorder (PTSD), suicidal ideation, the sum of these four affective disorders. Table 3 examines alcohol abuse, illicit drug abuse, opioid abuse, cannabis abuse, the sum of these four substance abuse disorders, and the combined sum of the eight mental health problems presented in both Table 2 and Table 3. Pregnancy history was characterized by four dichotomous measures representing whether the women by the given age had experienced an abortion; a live birth; an involuntary pregnancy loss (miscarriage, stillbirth, ectopic pregnancy); or had never been pregnant. The tables report the prevalence of each mental health outcome at each wave and the pooled risk ratio (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 incidence rate ratio (IRR) for the total number of mental health problems.

Inspection of Tables 2 and 3 supports the following general observations about the associations between pregnancy outcome and mental health problems:

1) Exposure to induced abortion was uniformly associated with an increased rate of all eight mental health disorders, with ORs ranging from 1.21 to 1.79 for affective disorders and from 1.71 to 2.62 for substance abuse disorders. These trends are summarized in the facts that women exposed to abortion from ages 15 to 35 (on average) experienced summary rates of affective disorders 1.37 (95% CI 1.07, 1.76) times higher ($P < .05$) and summary rates of substance abuse disorders 1.75 (95% CI 1.53, 1.99) times higher ($P < .001$) than those not exposed to abortion. Overall rates of mental health disorders for ever-aborting women were 1.53 (95% CI 1.32, 1.76) times higher ($P < .001$) than those of never-aborting women.

Table 2. Prevalence and rates of affective disorders for women by pregnancy history, in percent: Add Health Waves I, III, IV and V cases with info for all waves (n at terminus=3,852 [columns 1-3, ever-pregnant women], n=5,456 [column 4, all women]).

	Abortion		Live Birth		Pregnancy Loss		Ever Pregnant	
	No	Yes	No	Yes	No	Yes	No	Yes
Depression								
Wave I	31.7	21.2	27.0	32.7	28.5	36.7	13.3	30.0 ***
Wave III	9.9	12.3	13.7	9.4 †	9.9	12.6	7.3	10.4 **
Wave IV	8.8	14.3 †	9.8	10.1	9.9	10.9	9.6	10.3
Wave V	9.1	15.3 **	16.1	10.1 †	9.5	12.5	9.6	10.7
Pooled OR	1.63 ** (1.14, 2.34)		.78 (.59, 1.05)		1.22 † (.98, 1.51)		1.32** (1.10-1.58)	
Anxiety disorder								
Wave I	6.5	4.9	9.7	2.2 †	6.5	4.2	2.8	5.1
Wave III	12.7	13.9	13.5	12.8	11.6	18.1 *	9.1	12.9 **
Wave IV	22.4	32.4 **	28.7	23.9	23.8	26.0	21.6	24.3
Wave V	29.1	33.8	30.8	30.2	28.3	33.5 *	31.1	30.4
Pooled OR	1.45 ** (1.09-1.91)		.88 (.72-1.07)		1.10 (.94-1.28)		1.08 (.95-1.24)	
PTSD								
Wave I	3.8	2.1	6.4	0.2 †	4.1	0 †	0.9	3.2
Wave III	3.9	3.0	2.3	4.1	3.2	5.2	1.7	3.5 **
Wave IV	5.6	8.7	4.2	6.7	5.4	8.7 †	4.7	6.3
Wave V	8.0	10.1	10.3	8.3	7.2	10.7 †	8.1	8.6

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Pooled OR	1.79 [1] (.92-3.46)		1.10 (.77-1.56)		1.43 [**] (1.10-1.85)		1.13 (.89-1.45)	
Suicidal ideation								
Wave I	21.0	12.6	22.1	16.4	19.0	22.1	16.2	19.4
Wave III	5.9	7.4	11.2	4.6 [**]	4.8	9.2 [*]	7.5	6.8
Wave IV	6.6	8.2	11.5	6.2 [*]	6.1	9.4 [1]	7.2	7.2
Wave V	6.0	7.0	11.1	5.8 [1]	5.5	7.3	9.7	6.5 [1]
Pooled OR	1.21 (.92-1.60)		.49 [***] (.36-.65)		1.41 [**] (1.09-1.82)		.85 [1] (.70-1.03)	
Number of affective problems (mean)								
Wave I	0.63	0.41 [1]	0.65	0.51	0.58	0.63	0.33	0.57 [***]
Wave III	0.32	0.37	0.41	0.31 [1]	0.30	0.45 [**]	0.25	0.34 [***]
Wave IV	0.43	0.64 [*]	0.54	0.47	0.45	0.55 [1]	0.43	0.48
Wave V	0.52	0.67 [1]	0.72	0.54 [*]	0.51	0.64 [*]	0.58	0.56
Pooled IRR	1.37 [*] (1.07-1.76)		.81 [**] (.70-.95)		1.12 [1] (1.00-1.27)		1.03 (.94-1.13)	
Unweighted sample size								
Wave I	255	93	198	150	302	46	5,010	443
Wave III	1,354	531	516	1,369	1,193	390	3,135	2,321
Wave IV	2,194	760	522	2,432	2,056	829	1,853	3,603
Wave V	2,811	1,041	353	3,499	2,431	1,421	820	4,636

Shown are population-weighted rates estimated from cases with coverage for all survey waves. Pregnancy outcome columns include only ever-pregnant women; "Ever Pregnant" compares these with never pregnant women. Sample sizes shown do not include outcome missing data. Numbers in parentheses report the 95% confidence interval. IRR, incident rate ratio; OR, odds ratio; CI, confidence interval; PTSD, post-traumatic stress disorder; Add Health, National Longitudinal Study of Adolescent to Adult Health. [1] $p < 0.10$; [*] $p < 0.05$; [**] $p < 0.01$; [***] $p < 0.001$. Pooled OR (IRR) shows wave-adjusted longitudinally-weighted population-averaged estimates over all waves from logistic (poisson) models.

Table 3. Prevalence and rates of substance abuse disorders for women by pregnancy history, in percent: Add Health Waves I, III, IV and V cases with info for all waves (n=3,852 [columns 1-3, ever-pregnant women], 5,456 [column 4, all women]).

	Abortion		Live Birth		Pregnancy Loss		Ever Pregnant	
	No	Yes	No	Yes	No	Yes	No	Yes
Alcohol abuse								
Wave I	16.6	15.8	21.4	10.8 [*]	16.3	17.3	8.3	14.9[**]
Wave III	10.4	21.6 [***]	22.1	9.8 [***]	11.6	16.0	17.2	12.6[***]
Wave IV	7.3	12.8 [**]	14.7	7.5 [***]	8.3	9.1	13.9	8.6 [***]
Wave V	14.2	20.4 [**]	17.9	15.5	16.3	14.9	15.2	16.0
Pooled OR	1.71 [***] (1.39-2.10)		.54 [***] (.44-.67)		.97 (.79-1.20)		.74 (.64-.85) [***]	
Illicit drug abuse								
Wave I	7.5	12.5	11.4	5.0 [1]	8.6	7.3	3.6	7.6 [*]
Wave III	2.9	10.6 [***]	12.5	2.0 [***]	3.6	7.2 [1]	5.8	4.4 [1]
Wave IV	4.0	9.7 [**]	8.4	4.7 [1]	5.1	5.6	3.2	5.2 [**]
Wave V	2.5	4.5 [*]	6.1	2.7 [1]	2.6	3.7	2.5	2.9
Pooled OR	2.62 [***] (1.91-3.59)		.35 [***] (.25-.48)		1.30 (.92-1.84)		1.09 (.87-1.37)	

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Opioid Abuse								
Wave I	14.2	18.2	22.1	6.9 **	14.5	17.8	7.1	15.2 ***
Wave III	20.7	34.4 ***	35.5	19.8 ***	20.8	26.8 [1]	23.5	24.1
Wave IV	10.8	22.9 ***	24.0	11.7 ***	13.9	12.4	15.3	13.7
Wave V	12.4	14.7	16.2	12.7	12.2	14.4	10.9	12.7
Pooled OR	1.74 *** (1.44-2.10)		.49 *** (.40-.61)		1.09 (.90-1.32)		1.00 (.88-1.15)	
Cannabis abuse								
Wave I	3.1	9.4	7.6	0.6 **	4.6	3.0	1.7	3.9*
Wave III	3.6	10.9 ***	11.1	3.3 ***	4.6	6.2	4.8	5.6
Wave IV	4.5	7.2 [1]	8.6	4.4 *	4.3	6.9 [1]	5.3	5.5
Wave V	5.9	11.5 ***	9.2	7.1	6.7	8.2	9.6	7.3
Pooled OR	2.38 *** (1.75-3.24)		.49 *** (.36-.67)		1.17 (.87-1.58)		.84 (.66-1.08)	
Number of substance abuse problems								
Wave I	0.41	0.56	0.63	0.23 ***	0.44	0.45	0.21	0.42***
Wave III	0.38	0.77***	0.81	0.35 ***	0.41	0.56 *	0.51	0.47
Wave IV	0.27	0.53***	0.56	0.28 ***	0.32	0.34	0.38	0.33
Wave V	0.35	0.51***	0.49	0.38 [1]	0.38	0.41	0.38	0.39
Pooled IRR	1.75 *** (1.53-1.99)		.55 *** (.48-.62)		1.05 (.92-1.20)		.87 ** (.79-.95)	
Number of mental health problems								
Wave I	1.04	0.97	1.28	0.75 ***	1.02	1.08	0.54	0.99***
Wave III	0.70	1.14 ***	1.23	0.65 ***	0.70	1.02 ***	0.76	0.80
Wave IV	0.70	1.16 ***	1.10	0.75 ***	0.77	0.89 [1]	0.81	0.81
Wave V	0.87	1.17 ***	1.20	0.92 *	0.88	1.05 *	0.97	0.95
Pooled IRR	1.53 *** (1.32-1.76)		.66 *** (.59-.74)		1.08 (.97-1.20)		.93 * (.86-.99)	
Unweighted sample size								
Wave I	255	93	198	150	302	46	5,010	443
Wave III	1,354	531	516	1,369	1,193	390	3,135	2,321
Wave IV	2,194	760	522	2,432	2,056	829	1,853	3,603
Wave V	2,811	1,041	353	3,499	2,431	1,421	820	4,636

Shown are population-weighted rates estimated from cases with coverage for all survey waves. Pregnancy outcome columns include only ever-pregnant women; "Ever Pregnant" compares these with never pregnant women. Sample sizes shown do not include outcome missing data. Numbers in parentheses report the 95% confidence interval. IRR, incident rate ratio; OR, odds ratio; CI, confidence interval; PTSD, post-traumatic stress disorder; Add Health, National Longitudinal Study of Adolescent to Adult Health. [1] $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Pooled OR (IRR) shows wave-adjusted longitudinally-weighted population-averaged estimates over all waves from logistic (poisson) models.

2) Exposure to live birth was consistently associated with reduced rates of seven of the eight mental health disorders, with ORs ranging from .49 to 1.12 for affective disorders and from .34 to .53 for substance abuse disorders. These trends are summarized in the facts that women exposed to childbirth from ages 15 to 35 (on average) experienced summary rates of affective disorders .81 (95% CI .70, .95) times lower (P < .01) and summary rates of substance abuse disorders .55 (95% CI .48, .62) times lower (P < .001) than those not exposed to childbirth. Overall rates of mental health disorders for women exposed to childbirth were .66 (95% CI .59, .74) times lower (P < .001) than those of women not exposed to childbirth.

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3) Exposure to involuntary pregnancy loss was weakly associated with higher rates of affective disorders, with ORs ranging from 1.09 to 1.43, but was not consistently associated with substance abuse disorders, with ORs ranging from .97 to 1.30, all with confidence intervals that spanned unity. These trends are summarized in the facts that women exposed to pregnancy loss experienced summary rates of affective disorders 1.12 (95% CI 1.00, 1.27) times higher (P < .10) and summary rates of substance abuse disorders not statistically different (OR 1.05, 95% CI .92, 1.20) than those of women who had not experienced involuntary pregnancy loss. This lack of consistent association is summarized in the fact that the overall rate of mental health problems for women experiencing pregnancy loss, at 1.08 (95% CI .97, 1.20), was not statistically distinguishable from the rate for women who had not experienced pregnancy loss.

4) Exposure to pregnancy at all was weakly and inconsistently associated with reduced mental health problems by age 37. Ever-pregnant women experienced 1.32 (95% CI 1.10, 1.58) times higher rates of depression than those who had never been pregnant (P < .01). This was the only disorder that was significantly elevated with pregnancy. Alcohol abuse was significantly reduced (OR .74, 95% CI .64, 85, P < .001) and suicide ideation weakly reduced (OR .85, 95% CI .70, 1.03, P < .10). The confidence intervals for the five remaining individual mental health disorders all spanned unity, indicating no clearly discernible association. The summary rate of substance abuse disorders for ever-pregnant women was .87 (95% CI .79, .95) times lower (P < .01) than for women who had never been pregnant, but there was no difference in summary affective disorders (OR 1.03, 95% CI .94, 1.13). The overall association of pregnancy with mental health disorders was negative but small (OR .93, 95% CI .86, .99, P < .05).

3.2. Adjustment for Demographic Differences, Interactions, Covariates and Unwanted Pregnancy

The results in Tables 2 and 3 do not account for multiple background differences and covariates which previous research has found to affect the associations of pregnancy outcomes with mental health. Table 4 addresses this consideration, presenting RR/IRR estimates for abortion and birth under four increasingly restrictive sets of covariate adjustments. Column A adjusts each pregnancy outcome (abortion, birth, or involuntary pregnancy loss) for lifetime exposure to the other two possible pregnancy outcomes. This adjustment slightly moderated (moved toward 1.0) the RR/IRR for each pregnancy outcome, reducing the range of ORs for mental health disorders with abortion from 1.21-2.62 in Tables n2 and n3 to 1.06-2.17 in Table 4, column A, and increasing the range of ORs with childbirth (excluding the anomalous PTSD) from .35-.88 to .45-.90. Column B adds adjustments for demographic differences, which tended to heighten (moved away from 1.0) the estimated RR/IRRs with abortion and birth compared to column A. Column C includes extensive additional adjustments for prior distress and comorbidities, which tended to moderate the RR/IRRs, more strongly for abortion than for childbirth. From column B to column C, the IRR for summary mental health disorders with abortion was reduced from 1.48 to 1.35, or roughly by 27% toward unity, and was increased with birth from .69 to .72, or roughly by 10% toward unity, indicating that about a quarter of the distress observed with abortion and a tenth of the benefit associated with childbirth was due to the presence or absence of prior distress and comorbidities.

Table 4. Relative risk (RR/IRR) (95% CI) of mental health disorders with exposure to induced abortion and childbirth, showing the effect of successive adjustment for A) other pregnancy outcomes, B) demography, C) prior or comorbid distress and D) unwanted pregnancy: Add Health Waves I, III, IV and V (n=3,852).

	Ever Abortion				Ever Childbirth			
	A	B	C	D	A	B	C	D
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)

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Depression	1.61* (1.09, 2.29)	1.65* (1.08, 2.53)	1.46* (1.06, 2.01)	1.32 (.93, 1.87)	.90[1] (.64, 1.27)	.70* (.50, .98)	.72[1] (.52, 1.01)	.68* (.48, .95)
Anxiety disorder	1.41* (1.07, 1.88)	1.58** (1.19, 2.10)	1.43** (1.12, 1.83)	1.38* (1.05, 1.82)	.90 (.74, 1.09)	.83[1] (.68, 1.02)	.88 (.71, 1.10)	.86 (.69, 1.08)
PTSD	1.77[1] (.92, 3.41)	1.78[1] (.95, 3.35)	1.49[1] (.95, 2.36)	1.58[1] (.96, 2.62)	1.19 (.84, 1.70)	1.02 (.71, 1.48)	1.03 (.70, 1.52)	1.07 (.71, 1.60)
Suicidal ideation	1.06 (.79, 1.43)	1.08 (.80, 1.45)	.93 (.68, 1.29)	.82 (.57, 1.16)	.54*** (.39, .74)	.50*** (.36, .70)	.53*** (.38, .74)	.49*** (.34, .69)
Number of above 4 affective disorders	1.34* (1.03, 1.73)	1.38* (1.08, 1.78)	1.23** (1.06, 1.42)	1.18* (1.01, 1.38)	.86[1] (.73, 1.01)	.80** (.68, .93)	.83** (.73, .95)	.81** (.71, .93)
Alcohol abuse	1.54*** (1.24, 1.91)	1.54*** (1.23, 1.93)	1.45** (1.16, 1.82)	1.36* (1.06, 1.75)	.59*** (.47, .74)	.60*** (.47, .76)	.62*** (.48, .79)	.59*** (.46, .77)
Illicit drug abuse	2.17*** (1.55, 3.05)	2.11*** (1.47, 3.04)	1.91** (1.33, 2.76)	1.51* (1.00, 2.28)	.45*** (.32, .64)	.46*** (.31, .68)	.48** (.31, .74)	.42*** (.27, .65)
Opioid Abuse	1.57*** (1.28, 1.93)	1.65*** (1.33, 2.03)	1.53*** (1.23, 1.89)	1.42** (1.14, 1.77)	.57*** (.45, .72)	.54*** (.43, .69)	.55*** (.44, .70)	.54*** (.43, .68)
Cannabis abuse	2.12*** (1.52, 2.94)	2.06*** (1.46, 2.89)	1.95*** (1.40, 2.71)	1.78** (1.22, 2.60)	.61** (.44, .85)	.55** (.39, .79)	.56** (.39, .82)	.54** (.36, .79)
Number of above 4 substance abuse disorders	1.58*** (1.38, 1.82)	1.55*** (1.34, 1.79)	1.49*** (1.30, 1.71)	1.41*** (1.21, 1.63)	.61*** (.53, .70)	.59*** (.51, .69)	.63*** (.54, .73)	.61*** (.53, .71)
Number of above 8 mental health disorders	1.45*** (1.25, 1.69)	1.48*** (1.27, 1.73)	1.35*** (1.22, 1.51)	1.29*** (1.14, 1.45)	.72*** (.64, .81)	.69*** (.61, .77)	.72*** (.65, .80)	.70*** (.63, 1.09)

Shown are population-weighted and -averaged panel regression estimates, derived from poisson models for number of mental health outcomes and from logistic models for all other outcomes. Numbers in parentheses report the 95% confidence interval. Numbers in parentheses report the 95% confidence interval. RR, risk ratio; IRR, incident rate ratio; OR, odds ratio; CI, confidence interval; PTSD, post-traumatic stress disorders; Add Health, National Longitudinal Study of Adolescent to Adult Health. [1] $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. The sample size (N) was time-dynamic by wave and is reported in Tables 2 and 3. RR/IRRs were adjusted as follows: Column A, abortion, birth, or involuntary pregnancy loss; Column B, age, race, region of origin, educational attainment, poverty income, marriage, survey wave, and everything in column A; Column C, childhood poverty status, childhood physical abuse, childhood sexual abuse, childhood verbal abuse; at Wave I (average age 15), self-esteem, conduct problems in school; at Wave V (average age 37), ever raped; time-dynamic, ever experienced intimate partner violence; symptoms of all 8 disorders prior to the first pregnancy; and everything in column B; Column D, unwanted pregnancy, and everything in column C.

Column D adds only a single additional covariate, exposure to unwanted pregnancy, which strongly moderated the risk of 7 of the 8 mental health disorders with abortion. From column C to

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column D, the IRR for summary mental health disorders was reduced from 1.35 to 1.29, or about by 17% toward unity. This difference may be interpreted to indicate that about a sixth of the perceived mental health problems with abortion are attributable, not to the abortion, but to an unwanted pregnancy that prompted the abortion. Unwanted pregnancy associated with birth unexpectedly did not moderate, but increased, the reduction in mental health problems observed with childbirth, although the effect was small.

In sum, the adjustments presented in Table 4 substantially moderated, but did not fully account for, the associations of mental health disorders with abortion. Full adjustment (column D) reduced the overall summary IRR for abortion from 1.45 (95% CI 1.52, 1.69; P < .001) to 1.29 (95% CI 1.14, 1.45, P < .001), or by about 36% from unity. Depression, which was no longer significantly associated with abortion after full adjustment, and suicide ideation, which was never significantly associated but which reversed with adjustment from a predicted positive to a predicted negative association with abortion, may be exceptions to the overall trend. However, none of the significant RR/IRRs of mental health disorders with abortion or childbirth in Table 2 or Table 3's unadjusted models were rendered non-significant in the fully adjusted covariate models shown in Table 4, column D. After adjustment for confounders and covariates, exposure to abortion remained generally positively associated with mental health disorders.

Table 5 presents the fully adjusted model showing all three pregnancy outcomes.

The results can be compared to those of a prior study using similar models at Wave IV, which found IRRs for total number of mental health problems to be with exposure to abortion 1.45 (95% CI 1.30, 1.62), with exposure to childbirth .86 (95% CI .76, .96), and with exposure to involuntary pregnancy loss 1.24 (95% CI 1.13, 1.37).[20] Ten years later for the same women the risks were very different. Involuntary pregnancy loss was no longer associated with any mental health disorder (IRR 1.00 95% CI .92, 1.09). The risk of higher pathology with abortion had dropped by 16 points, from 1.45 at Wave IV to 1.29 at Wave V. The risk of lower pathology with childbirth had also dropped by 16 points, from .86 at Wave IV to .70 at Wave V. As these women approached the end of their fertile years, incompleted pregnancies, both voluntary and involuntary, became less salient to their mental health, but completed pregnancies resulting in children became more salient. Abortion and childbirth moved in tandem, as the decreased risk of mental health problems with abortion was exactly offset by the increased protective effect of childbirth. Just as abortion and childbirth are reciprocal outcomes, in that an abortion, by definition, prevents the birth of a child, it appears that at near completed fertility abortion and childbearing had reciprocal harmful and protective associations with these women's mental health.

Table 5 also reports the significant covariates associated with each mental health disorder. IPV was associated with all disorders except drug abuse, educational attainment with all disorders except suicide ideation. Childhood verbal abuse; conduct problems in school at Wave I, age 15 on average; ever experiencing rape; and ever experiencing intimate partner violence (IPV) were associated with all affective disorders. Only educational attainment was associated with all substance abuse disorders. All of the affective disorders, but none of the substance abuse disorders, were associated with adolescent experience of the disorder prior to pregnancy. Drug abuse and cannabis abuse were associated with adolescent anxiety disorder, however, and drug abuse was associated with adolescent cannabis abuse. Alcohol abuse and opioid dependence prior to the first pregnancy were not significant predictors in any model, but together improved model fit and so were retained as covariates. A full analysis of the predictors of the associations of pregnancy outcomes with mental health disorders is beyond the scope of the present paper.

Table 6 models the reciprocity of abortion and childbirth, focusing on the question whether the abortion of one or more pregnancies is associated with greater subsequent mental health disorders compared to bringing the pregnancies to term. The reference category for the OR/IRRs in this table is restricted to never-aborting women who had given birth. Just as the risks of mental health disorders were generally increased with abortion but lowered with childbirth in the exposure models (Table 5), the RR/IRRs comparing abortion and birth (Table 6) were consistently higher than for abortion exposure alone (Table 5). Women who reported ever having an abortion were at 1.42 times (95% CI

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1.26, 1.59) higher risk (P < .001) of mental health disorders than women who reported having only births, with no abortions. Like the exposure models, risks were higher for substance abuse disorders (1.64, 95% CI 1.43, 1.88, P < .001) than for affective disorders (1.24, 95% CI 1.06, 1.45, P < .01). The predicted risk of suicide ideation with abortion, negative (.82) in Table 5, was slightly positive (1.07) in Table 6, reflecting the fact that the corresponding exposure risk with birth was even more strongly negative (.49) in Table 5.

Table 5. Relative risk (RR/IRR) (95% CI) of mental health disorders with exposure to induced abortion, childbirth, and other pregnancy loss, adjusted for covariates and other pregnancy outcomes: Add Health Waves I, III, IV, and V (n = 3852).

	Abortion	Abortion (unadjusted for under-reports)	Childbirth	Pregnancy Loss	Significant covariates
	Adj. OR (95% CI)	Adj. OR (95% CI)	Adj. OR (95% CI)	Adj. OR (95% CI)	
Depression	1.32 (.93, 1.87)	1.43* (1.03, 1.99)	.68* (.48, .95)	1.05 (.85, 1.29)	4,5,6,13,14,15,16,17,19
Anxiety disorder	1.38* (1.05, 1.82)	1.27[1] (.99, 1.62)	.86 (.69, 1.08)	1.00 (.84, 1.18)	4,6,13,14,15,16,19
PTSD	1.58[1] (.96, 2.62)	1.64* (1.02, 2.65)	1.07 (.71, 1.60)	1.18 (.90, 1.55)	2,3,4,7,14,15,16,17,19
Suicidal ideation	.82 (.57, 1.16)	.92 (.65, 1.29)	.49*** (.34, .69)	1.17 (.91, 1.51)	4,5,6,7,8,14,15,17,18,19
Sum of above four affective disorders	1.18* (1.01, 1.38)	1.18* (1.02, 1.37)	.81** (.71, .93)	1.02 (.92, 1.12)	2,3,4,5,6,7,9,13,14,15,16,17,19
Alcohol abuse/dependence	1.36* (1.06, 1.75)	1.43** (1.11, 1.82)	.59*** (.46, .77)	.93 (.75, 1.14)	1,16,18,19
Illicit drug abuse/ dependence	1.51* (1.00, 2.28)	1.82** (1.20, 2.75)	.42*** (.27, .65)	1.16 (.83, 1.63)	4,6,12,15,16,18
Opioid dependence	1.42** (1.14, 1.77)	1.56*** (1.23, 1.97)	.54*** (.43, .68)	.97 (.80, 1.17)	14,16,18,19
Cannabis abuse/ dependence	1.78** (1.22, 2.60)	1.58* (1.08, 2.29)	.54** (.36, .79)	1.04 (.77, 1.41)	6,8,14,15,16,17,19
Sum of above four substance use disorders	1.41*** (1.21, 1.63)	1.46*** (1.25, 1.69)	.61*** (.53, .71)	.98 (.87, 1.11)	6,14,15,16,17,18,19
Sum of above eight mental health problems	1.29*** (1.14, 1.45)	1.32*** (1.18, 1.47)	.70*** (.63, .78)	1.00 (.92, 1.09)	2,4,5,6,7,14,15,16,17,18,19

Shown are population-weighted and -averaged panel regression estimates, derived from poisson models for number of mental health outcomes and from logistic models for all other outcomes. Numbers in parentheses report the 95% confidence interval. Numbers in parentheses report the 95% confidence interval. RR, risk ratio; IRR, incident rate ratio; OR, odds ratio; CI, confidence interval; PTSD, post-traumatic stress disorders; Add Health, National Longitudinal Study of Adolescent to Adult Health. [1] p < 0.10; * p < 0.05; ** p < 0.01; ***p < 0.001. The sample size (N) was time-dynamic by wave and is reported in Tables 2 and 3. All models were adjusted for all pregnancy outcomes, unwanted pregnancy, age, race, region of origin, survey wave, and for the following covariates: childhood conditions: 1=childhood poverty status, 2=childhood physical abuse, 3=childhood sexual abuse, 4=childhood verbal abuse; disorder symptoms prior to first abortion: 5=depression, 6=anxiety, 7=PTSD, 8=suicidal ideation, 9=alcohol abuse, 10=drug abuse, 11=opioid abuse, 12=cannabis abuse; at Wave I (average age 15): 13=self-esteem; 14=conduct problems in school; at Wave V (average age 37): 15=ever raped, 16=educational attainment; and time-dynamic: 17=respondent poverty income; 18=times married; 19=ever experienced intimate partner violence (IPV).

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Table 6. Relative risk (RR/IRR) (95% CI) of mental health disorders with abortion relative to childbirth for ever-pregnant women, adjusted for covariates and other pregnancy outcomes: Add Health Waves I, III, IV, and V (n = 3852).

	Ever Abortion	Ever Abortion – Waves 1-4 only	Only Unwanted Pregnancy Abortions	Ever Wanted Pregnancy Abortion
	Adj. OR (95% CI)	Adj. OR (95% CI)	Adj. OR (95% CI)	Adj. OR (95% CI)
Depression	1.47* (1.05, 2.06)	1.59* (1.04, 2.44)	1.35 (.91, 2.00)	2.15** (1.32, 3.48)
Anxiety disorder	1.44** (1.10, 1.88)	1.97** (1.32, 2.94)	1.43* (1.07, 1.91)	1.50 (.92, 2.43)
PTSD	1.58[1] (.96, 2.59)	2.58* (1.20, 5.56)	1.71[1] (.99, 2.96)	.99* (.40, 2.49)
Suicide ideation	1.07 (.79, 1.47)	1.28 (.89, 1.85)	.97 (.69, 1.36)	1.67[1] (.96, 2.93)
Sum of above four affective disorders	1.24** (1.06, 1.57)	1.48*** (1.20, 1.83)	1.22* (1.03, 1.45)	1.35* (1.05, 1.72)
Alcohol abuse/dependence	1.62*** (1.28, 2.04)	1.98*** (1.44, 2.74)	1.68*** (1.31, 2.16)	1.36 (.86, 2.14)
Illicit drug abuse/dependence	2.16*** (1.50, 3.11)	2.66*** (1.67, 4.26)	2.34* (1.58, 3.45)	1.46 (.67, 3.18)
Opioid abuse/dependence	1.75*** (1.43, 2.15)	2.20*** (1.71, 2.83)	1.83* (1.46, 2.29)	1.47[1] (.98, 2.18)
Cannabis abuse/dependence	2.15*** (1.52, 3.05)	2.78*** (1.74, 4.43)	2.32*** (1.59, 3.38)	1.40 (.72, 2.73)
Sum of above four substance use disorders	1.64*** (1.43, 1.88)	1.96*** (1.66, 2.33)	1.71*** (1.48, 1.98)	1.34* (1.02, 1.77)
Sum of above eight mental health problems	1.42*** (1.26, 1.59)	1.73*** (1.49, 2.01)	1.43*** (1.26, 1.61)	1.36** (1.10, 1.66)

Reference category is births only, no abortions. Shown are population-weighted and -averaged panel regression estimates, derived from poisson models for number of mental health outcomes and from logistic models for all other outcomes, adjusted as described in Table 5. The reference category is only births, no abortions. Numbers in parentheses report the 95% confidence interval. RR, risk ratio; IRR, incident rate ratio; OR, odds ratio; CI, confidence interval; PTSD, post-traumatic stress disorders; Add Health, National Longitudinal Study of Adolescent to Adult Health. [1] $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. The sample size (N) was time-dynamic by wave and is reported in Tables 2 and 3.

The results shown in Table 4 are also comparable to a prior study using similar models at Wave IV, which found the IRR for total mental health problems with abortion relative to childbirth to be 1.74 (95% CI 1.55, 1.96, P < .001),[30] compared to the IRR of 1.42 reported in Table 6. The second column of Table 6 presents the current models restricted to Waves 1-4, which yields an IRR for summary disorders, 1.73 (95% CI 1.49, 2.01, P < .001), almost identical to the previous findings. Comparison of the first two columns of Table 6 shows that from Wave IV to Wave V the association of abortion relative to childbirth with mental health disorders uniformly diminished. All risks were higher at Wave IV than at Wave V. As women in this longitudinal sample aged from their late 20s to their mid-30s, mental health risks with abortion consistently and broadly declined, for every disorder and for the total number of affective, substance abuse and overall disorders. The largest percentage decrease (remembering that no association is indicated by 1.0, not zero) was for suicide ideation risk, which dropped by 75.0% (from 1.28 to 1.07); the smallest was for depression, which dropped by 20.3%

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(from 1.59 to 1.47). Substance abuse risks dropped less, and more consistently, from a low of 30.1% for drug abuse to a high of 37.5% for opioid abuse. The IRR for total affective disorders was reduced by 50% (from 1.48 to 1.24) and for substance abuse disorders by 33% (from 1.96 to 1.64); the IRR for the sum of all 8 mental health disorders dropped by 42%. In sum, just as the Wave IV to Wave V exposure risks with abortion and childbirth had declined, so the reciprocal effects of abortion relative to childbirth had also declined.

The structure of mental health risk with abortion presented in Table 6 was similar to that of Table 5. In all analyses, the risk of substance abuse disorders with abortion was higher than for affective disorders, risk of suicide ideation was not significantly associated with abortion, and risk of illicit drug abuse was most strongly associated with abortion. Abortion relative to childbirth (Table 6) rather than all-non-aborting women (Table 5) increased the IRR for total substance abuse disorders by 56%, from 1.41 in Table 5 to 1.64 in Table 6, but increased the IRR for total affective disorders by only 33%, from 1.18 to 1.24, reflecting the fact that exposure to childbirth reduced substance abuse risk more strongly than it did risk of affective disorders.

PTSD risk was unusual in that it was positively associated with exposure to both abortion and birth, and thus was unreduced in Table 6. Suicide ideation risk, on the other hand, was negatively associated with abortion exposure, but even more strongly with childbirth exposure, and thus was also unreduced in Table 6.

About one in six (16.2%, 95% CI 12.7, 20.4) ever-aborting women reported having aborted a pregnancy which they wanted to bring to term. Prior research through Add Health Wave IV found such wanted pregnancy abortions to be associated with higher affective disorders but no difference in substance abuse disorders, compared to abortions only of unwanted pregnancies.[30] The third and fourth columns of Table 6 show that by Wave V wanted pregnancy abortions, compared to abortions of unwanted pregnancies, remained associated with higher risk of affective disorder, but were now associated with significantly lower risk of substance abuse disorder.

3.3. Abortion Under-Reporting

The analytical models in this study made use of pregnancy and pregnancy outcome counts that were corrected for abortions, births and pregnancies that were initially unreported at one or more waves. Table 5 reports the results for abortion exposure using uncorrected counts which exclude the initially unreported pregnancies or pregnancy outcomes. Abortion under-reporting appeared to generally bias the estimates of mental health disorders upwards in these data, but the effect was small and inconsistent. The corrected counts yielded lower RRs for 6 of the 8 individual disorders, a lower IRR for summary substance abuse disorders, but no difference for summary affective disorders. The magnitude of the two downward biased disorders—anxiety disorder and cannabis abuse—was as large or larger than the upward biases of the remaining disorders. Indeed, the counter-trend downward bias for cannabis abuse was larger than the upward bias for any other substance abuse disorder, or any other disorder examined. Concealment did not change the structure of the relative magnitude of the ORs to each other. Reliance on the uncorrected rather than the corrected summary IRRs would make no difference to any of the inferences of this study regarding reported abortions.

The negative bias for unreported abortions may have a much stronger effect on estimates for all abortions, however, due to the prospect of substantial additional abortion non-reports. As already noted, previous research has calculated that only 35% of independently estimated U.S. abortions were reported on Wave IV of Add Health.[58] Applying that estimate to Wave V, the corrections for single-wave under-reports increased abortion capture by another 11%, to 46% of the estimated total number of abortions. If the level of reduction in mental health disorder risks of the discovered under-reports was roughly similar to that of the remaining projected under-reports, unbiased estimates of population risks adjusted for under-reporting can be derived from the IRRs for the reported abortions. Table 7 presents the analysis. To better estimate population effects, the exposure models were used, with coefficients carried out to 5 or 6 significant digits, rather than the models of abortion relative to birth, the coefficients of which refer only to birth-eligible pregnancies, not all pregnancies. The Corrected column for abortion exposure in Table 7 restates the summary IRRs from Table 5,

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which used both reported and recovered, initially unreported abortions. The Uncorrected column presents IRRs from the same models, but without including the unreported abortions in the analysis sample. The change in IRRs between the uncorrected and corrected models was then linearly interpolated to reflect the inclusion of an additional 2,849 unreported abortions, comprising all remaining estimated unreported abortions. A similar procedure was followed to project the population attributable fraction (PAF) of each group of disorders due to abortion exposure. It was not possible to estimate the uncertainty of the interpolated numbers. The resulting risk ratios and percents, presented in the Projected columns, estimate the population risk and prevalence of mental health disorders associated with abortion after accounting for all unreported abortions.

Table 7. Incident-rate ratios (IRR) and population attributable fractions of mental health disorders with exposure to induced abortion, adjusted for other pregnancy outcomes, covariates, and abortion under-reporting: Add Health Waves I, III, IV and V cases with information for all waves (n at terminus=3,852).

	Abortion Exposure			Population Attributable Fraction		
	Uncorrected Adj. IRR (95% CI)	Corrected Adj. IRR (95% CI)	Projected Adj. IRR (Estimated)	Uncorrected Percent (95% CI)	Corrected Percent (95% CI)	Projected Percent (95% CI)
Sum of affective disorders	1.18268* (1.02, 1.37)	1.179071* (1.00, 1.38)	1.17	3.9* (0.3, 7.3)	4.4[1] (, 0.1, 8.6)	6.0
Sum of substance abuse disorders	1.45581*** (1.25, 1.69)	1.406338*** (1.21, 1.63)	1.25	9.8*** (5.7, 13.6)	10.0*** (5.5, 14.3)	10.6
Sum of eight mental health problems	1.316357*** (1.18, 1.47)	1.288433*** (1.14, 1.45)	1.20	6.7*** (3.9, 9.3)	7.0*** (3.6, 10.3)	8.0
Number (%) of abortions reported	1846 (35%)	2425 (46%)	5274 (100%)			

Shown are population-weighted and -averaged panel regression estimates, derived from poisson models for number of mental health outcomes and from logistic models for all other outcomes, adjusted as described in Table 5. Numbers in parentheses report the 95% confidence interval. IRR, incidence rate ratio; "CI", confidence interval; "Add Health", National Longitudinal Study of Adolescent to Adult Health. [1] $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Uncorrected coefficients were estimated from the count of abortions reported at each wave. Corrected coefficients were estimated from the count of abortions at each wave corrected with discrepant abortions reported at other waves. Projected coefficients were interpolated from uncorrected and corrected models to correct for the total number of estimated unreported abortions.

Consistent with the suggestion of previous research,[10] adjustment by interpolation for all estimated unreported abortions resulted in reduced IRRs, very slightly for affective disorders but more strongly for substance abuse disorders and thus for total disorders. However, all summary IRRs for mental health disorders with abortion remained strongly positive after adjustment for all unreported abortions.

The population attributable fractions (PAFs) compared actual model outcomes with conditional outcomes which set the number of abortions to zero. At Wave 5, 8.0 percent of total mental health disorders was attributable to abortion exposure, a number which combined 6.0 percent of affective disorders and 10.6 percent of substance abuse disorders. Put another way, in a hypothetical world in which no pregnancies ended in induced abortion, ever-pregnant women's mental health problems at age 37, on average, would be an estimated 8 percent lower than was observed. Although the summary risk ratios diminished with increased capture of unreported abortions, from 1.32 to 1.20, the corresponding PAFs increased, from 6.7 to 8.0, since including the non-reports substantially increased the number of abortions, and hence abortion-related distress, in the model.

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Table 8 extends the adjustment for under-reporting to Waves III and IV. Abortion concealment was highest at wave 3, when correction for unreported abortions increased abortion capture to 57% (not shown), than at wave 4 (45%, not shown) or wave 5 (46%). At all waves, substance abuse disorders were more highly associated with abortion than were affective disorders. From waves 3 to 5, the IRRs and PAFs followed an inverted "V" pattern, lower at ages 22 and 35, but higher at age 28. Like the corresponding risk ratios presented in Table 6, the PAFs for mental health disorders with abortion were much higher when the sample was 7 years younger. The change was substantial. The PAF for all 8 mental health disorders attributable to abortion rose from 10.6% at age 22 to 18.1% at age 28, then dropped sharply to 8.0% by age 37.

Table 8. Incident-rate ratios (IRR) and population attributable fractions (PAFs) of numbers of mental health disorders with exposure to induced abortion, corrected for estimated abortion under-reporting: Add Health Waves I, III, IV and V cases with information for all waves (n at terminus=3,852).

	Projected IRRs			Projected PAFs		
	Wave III Adj. IRR	Wave IV Adj. IRR	Wave V Adj. IRR	Wave III Percent	Wave IV Percent	Wave V Percent
Sum of affective disorders	1.16	1.58	1.17	4.2	14.2	6.0
Sum of substance use disorders	1.67	1.75	1.25	16.7	22.2	10.6
Sum of eight mental health problems	1.41	1.67	1.20	10.6	18.1	8.0

Shown are population-weighted and -averaged panel poisson regression estimates, projected from known under-report bias to correct for all estimated unreported abortions. Models were adjusted as described in Table 5. IRR, incident-rate ratio; PAF, population attributable fraction; "CI", confidence interval; "Add Health", National Longitudinal Study of Adolescent to Adult Health. [1] $p < 0.10$; [*] $p < 0.05$; [**] $p < 0.01$; [***] $p < 0.001$. The sample size (N) was time-dynamic by wave and is reported in Supplemental Tables 1–2.

Although the PAF magnitude was larger for substance abuse disorders, the relative rise and decline was larger for affective disorders, which from wave 4 to wave 5 dropped by 58% (from 14.2 to 6.0) compared to substance abuse disorders, which dropped by 52% (from 22.2 to 10.6). After adjusting for all abortion under-reporting, at all waves the risk of mental health disorders remained positive associated with abortion.

3.4. Prevalence of Abortion-Related Disorders

To better interpret these trends, Table 9 presents the unadjusted population prevalence of the three summary measures of mental health disorders, comparing four overlapping groups at Add Health Waves I (age 15), III (age 22), IV (age 28) and V (age 37): all women, ever-pregnant women, ever-pregnant not-aborting women and ever-aborting women. The latter two categories correspond to the risk ratio comparison groups in Table 6.

Table 9 suggests that teen-aged abortion provided some affective relief. At Wave I, the mean number of affective disorders was lower among ever-aborting women than among ever-pregnant but non-aborting women. That relationship reversed by age 22 (Wave III), when the prevalence of multiple affective disorders among ever-aborting women exceeded that of ever-pregnant non-aborting women, which persisted in subsequent waves. Beginning at Wave III, affective disorders increased monotonically for both ever-pregnant non-aborting and ever-aborting women, but at different rates. Most of the increase occurred earlier (from Wave III to Wave IV) among ever-aborting women, but later (from Wave IV to Wave V) among ever-pregnant non-aborting women. The reduction in the risk ratio for affective disorders with abortion from Wave IV to Wave V, therefore,

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does not reflect a reduction in affective disorders among ever-aborting women but a larger increase in affective disorders among ever-pregnant non-aborting women.

Substance abuse disorders followed a contrasting pattern. Summary substance abuse disorders were increased with teen-aged abortion, as ever-aborting women experienced a higher number of substance abuse disorders than did ever-pregnant non-aborting women at Wave I. Substance abuse disorders then rose sharply by Wave III and declined through Waves IV and V among ever-aborting women, but followed the opposite pattern, dropping by Wave III then rising through Waves IV and V, among ever-pregnant non-aborting women. The Wave IV-Wave V decline in risk ratio for abortion-related substance abuse disorders, therefore, reflects both a drop in prevalence among ever-aborting women and a rise in prevalence among ever-pregnant non-aborting women.

Table 9. Mean number of eight mental health disorders, by wave, comparing all women, ever-pregnant women and ever-aborting women: Add Health Waves I, III, IV and V.

	Ever Abortion			
	I	III	IV	V
Number of 8 possible mental health disorders	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
All women	.58 (.53, .63)	.78 (.72, .84)	.81 (.75, .87)	.96 (.89, 1.02)
Ever-pregnant women	.99 (.84, 1.14)	.80 (.72, .88)	.81 (.74, .88)	.95 (.89, 1.02)
Ever-pregnant non, aborting women	1.01 (.84, 1.19)	.71 (.62, .80)	.70 (.63, .76)	.88 (.81, .94)
Ever-aborting women	.90 (.60, 1.20)	1.12 (.96, 1.27)	1.16 (1.01, 1.32)	1.18 (1.03, 1.33)
Number of 4 possible affective disorders				
All women	.35 (.32, .38)	.29 (.26, .32)	.47 (.43, .50)	.57 (.52, .61)
Ever-pregnant women	.57 (.47, .68)	.34 (.29, .38)	.48 (.43, .53)	.56 (.52, .61)
Ever-pregnant non-aborting women	.61 (.50, .72)	.32 (.27, .37)	.43 (.39, .48)	.52 (.48, .57)
Ever-aborting women	.43 (.23, .62)	.38 (.30, .46)	.63 (.50, .77)	.68 (.55, .82)
Number of 4 possible substance abuse disorders				
All women	.23 (.19, .26)	.49 (.46, .53)	.35 (.31, .38)	.39 (.36, .42)
Ever-pregnant women	.42 (.32, .52)	.47 (.42, .52)	.33 (.29, .36)	.39 (.36, .42)
Ever-pregnant non-aborting women	.41 (.29, .53)	.39 (.34, .44)	.27 (.23, .30)	.35 (.32, .39)
Ever-aborting women	.47 (.28, .67)	.74 (.62, .85)	.53 (.45, .61)	.50 (.44, .56)
Sample size (n)				
All women	5293	5214	5316	5167
Ever-pregnant women	430	2209	3507	4381

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Ever-pregnant non-aborting women	316	1585	2590	3173
Ever-aborting women	114	624	917	1208

Shown are population-weighted means for women with information for all survey waves. Numbers in parentheses report the 95% confidence interval. Item-missing data reduced some cell sizes; the largest reduction was 3%. "CI", confidence interval; "Add Health", National Longitudinal Study of Adolescent to Adult Health.[1] $^{\cdot}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

3.5. Sensitivity Analysis: Fixed Effects

To test model fit and comprehensiveness, IRRs for the three summary measures were estimated from fixed effects poisson models for comparison to the population averaged IRRs presented in Table 6. The results are reported in Table 10. The fixed effects calculations were not consistent with survey design weighting and variance, so were not optimal for the main study models. The comparison population averaged IRRs in Table 10 were computed from unweighted data, and thus differ slightly from those reported in Table 6. For the fixed effects models, all constant covariates were dropped by design; dynamic covariates were also dropped for substance abuse and summary mental health problems.

Table 10. Incident-rate ratios (IRR) of mental health disorders with exposure to induced abortion, comparing population averaged and fixed effects estimates: Add Health Waves I, III, IV, and V, cases with information for all waves (n at terminus=3,852).

Percent abortion vs birth	Ever abortion		
Mental Health Problems	Population Averaged	Fixed Effects	Hausman p-value
	IRR (95% CI)	IRR (95% CI)	
Sum of four affective disorders	1.18** (1.07, 1.30)	1.20 (.90, 1.60)	.21
Sum of four substance abuse disorders	1.66*** (1.50, 1.84)	1.47** (1.10, 1.95)	.14
Sum of eight mental health problems	1.38*** (1.29, 1.48)	1.32** (1.08, 1.62)	.15

Shown are population-weighted and -averaged panel poisson regression estimates, adjusted as described in Table 5. Numbers in parentheses report the 95% confidence interval. IRR, incident-rate ratio; C", confidence interval; Add Health, National Longitudinal Study of Adolescent to Adult Health.[1] $^{\cdot}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$. The sample size (N) was time-dynamic by wave and is reported in Tables 2 and 3.

For all three measures, the random and fixed effects results were similar in sign and magnitude. The Hausman test for each comparison was not significant, indicating an absence of systematic bias in the population averaged models. Since the fixed effects models fit all unobserved variance, the similarity of the random and fixed effects results also indicate that the random model covariates are free of significant missing variable bias, confirming that the covariates included in the population averaged models sufficiently represented the pertinent variation in the data.

4. Discussion

At midlife, up to 20 years post-abortion, the association of mental health disorders with abortion exposure for American women can be characterized by both decline and persistence. At the Add Health Wave 5 interview, when sample participants averaged age 37, the risk of increased mental health disorders due to abortion had dropped sharply from the levels reported by the same women

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7 years earlier. Women who reported having had one or more abortions also reported 1.4 times more mental health disorders, down from 1.7 times at Wave IV, than comparable women reporting only births, with no abortions. The trend of decline was universal: the risk of every disorder examined, and the sum of all eight disorders, dropped in magnitude from Wave 4 to Wave 5.

The reduction in risk, however, was primarily due not to reduced prevalence of mental health disorders among women who had had abortions, but to increased prevalence among women who had not had abortions. Affective disorders—depression, anxiety, PTSD and suicidality—increased from Wave IV to Wave V among ever-aborting women, but increased more strongly among ever-pregnant non-aborting women. Substance abuse disorders—alcohol abuse, drug abuse, opioid abuse, and marijuana abuse—dropped slightly among ever-aborting women, but also increased more strongly among ever-pregnant non-aborting women. Even after reduction, moreover, the risk of mental health disorders associated with abortion remained significantly positive at Wave V.

The models presented here and in two previous studies are the first to specify causal time order through repeated measures for the effect of abortion on American women's mental well-being. The previous studies examined abortion and mental health through Add Health Wave IV, when sample participants were in their late 20s; the present study extends the examination into their mid-30s. The findings generally confirm one trend of research in this area, which has been to document increased distress with longer follow-up periods, at least in excess of ten years [18,29,46]. Fergusson et al. reported a 30-year follow-up period, longer than the present study, however this period was from birth to age 30.

The present study, extending for a longer time over the adult life course than any previous study of American women, is the first to find that distress associated with abortion increased substantially but then declined. The peak and decline pattern appears more likely related to life course developments, in which the differentiation of mental health outcomes due to abortion declines over time, than to the resolution of particular distresses. Ever-aborting women, regardless of when their abortions occurred, underwent an aggregate process of increase and decline in the differential risk of mental health disorder, that looks more like maturation than recovery. The differential risk was resolved as much by increased distress among never-aborting women as it was by reduced distress among ever-aborting women. Recourse to abortion, this suggests, does not operate primarily as an efficient cause of harm, but precipitates relative harm through changes in the life course.

Perhaps the most obvious life course change abortion brings to American women is to displace the birth of a child. Exposure to childbirth, as Table 4 documents, was consistently protective for mental health disorders, just as abortion was consistently predictive of such disorders. A full operationalization of the harm of abortion should include the lost benefit of childbirth, a kind of opportunity cost that may be more powerful and persistent than any direct effect of abortion exposure itself. An attempt has been made in this study to model the effect of abortion compared to childbirth, finding that risk ratios are thereby increased, but much more extensive and refined analysis is needed to examine this dynamic more clearly.

The questions of abortion and mental health examined in the present study are largely orthogonal to those posed by the much-cited Turnaway Study, which compares women who obtained an abortion with those who wanted an abortion but were denied one due to gestational age limits. The Study's validity has been called into question due to high sample attrition, as much as 80% at five years, and the refusal of its authors to release their data for public scrutiny [9,38,44] Notwithstanding these methodological objections, the present findings, which show higher long-term life course psychological distress for women who had abortions, are not incompatible with the Turnaway Study's conclusion, that post-abortion negative psychological outcomes "are not a product of the abortion procedure itself"[47]. In contrast to the present study, the Turnaway research design does not include any women who elected not to have an abortion; does not represent all ever-pregnant or even all ever-aborting women; and considers only the effect of a single abortion, not all lifetime abortions and births. Consistent with the present study, some of the strongest factors influencing emotional state following abortion completion or denial, Turnaway research has found, are related to the personal and social disposition of the abortion decision, e.g., "abortion stigma" and

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"decisional rightness," rather than the abortion procedure itself. As the Turnaway researchers have begun to examine longer follow-up time, moreover, they are discovering factors "pointing to a possible mechanism behind later emergent or persistent post-abortion negative emotions" [47].

More generally, the present findings support what the APA has termed a "common risk factors" perspective, rather than a "stress and trauma" perspective, to account for post-abortion mental health outcomes [74]. The latter proposes that the abortion experience traumatizes women, leaving psychological scars in its wake; the former that abortion is associated with a complex of other life factors that together may precipitate reduced flourishing. The two perspectives are not mutually exclusive; both may account for different parts of post-abortion mental health outcomes. Jalanko et al., for example, noting that psychiatric distress began to increase only after five years following teenage abortions, observed that "teenaged induced abortion itself does not cause mental health disorders" in a traumatic sense, but rather "represents a part of a larger phenomenon, likely to include other hardships and circumstances these women face in their lives," consistent with the common factors perspective [45].

The present study also found that affective problems were temporarily reduced, not increased, following early teen-aged abortions (see Table 9), contrary to the prediction of the trauma perspective, but confirmed the strong association of abortion with unwanted pregnancy (see Table 1), for which distress is well documented, which argues for the common factors approach. This study's finding that by the late 30s in age PTSD and suicidality effects are weak and have declined substantially over time also suggests that trauma is not a persistent result of abortion for most women.

However, the expectation by some that a comprehensive consideration of common risk factors would render the association of mental health with abortion spurious [75] has not been borne out in this study. Even after reduction due to extensive adjustment for other common risk factors (Table 4), adjusted for under-reporting (Table 8) and even in fixed effects models, which control for all unobserved confounders (Table 10), the risk of mental health disorders following abortion is significantly elevated, and was even more highly elevated earlier in the life course.

More importantly, the risk factor model has not yet considered the possibility that the availability of abortion may dynamically interact with other risk factors in complex ways. There is strong evidence, for example, that abortion availability has suppressed the attainment marriage [76,77], which is strongly associated with higher mental health and life satisfaction for women, by enabling men to avoid presumptive marriage commitment in the event of unexpected pregnancy out of wedlock. The present study found that that, at average age 37, the marriage rate among ever-aborting women (51%) was significantly lower than that of never-aborting women (70%), which may confirm this prediction. Similar social feedback mechanisms with abortion may also increase unwanted pregnancies, both by moral hazard with respect to contraception and by reducing the probability of welcoming an unexpected pregnancy. Social exchange theory predicts that if abortion mitigates the negative effects of unwanted pregnancy, it thereby encourages more unwanted pregnancies to occur. The resulting increased social harm counteracts, and may even entirely offset, any individual advantages from recourse to abortion. Abortion may also suppress total fertility—in this study ever-aborting women were less likely to have ever given birth and more likely to have experienced involuntary pregnancy loss (Table 1)—and lead to greater nulliparity, which is also associated with lower life satisfaction. In the multiple factors that affect women's mental health at midlife, abortion cannot be assumed to be only a dependent variable. A full assessment of the effect of abortion on women's mental health should include examination of the dynamic interaction of abortion with other risk factors.

These findings are limited in several ways. The study measures were self-reported, susceptible to bias and imprecision. Although it is reasonable to interpret an influence of prior abortion on subsequent mental health from these findings, no observational study can establish causation beyond a preponderance of the evidence. Likewise, despite extensive confounding adjustments and confirmation of the findings from fixed effects models, which control for unmeasured confounders, it is possible that the mental health outcomes at terminus were due to unmeasured influence rather

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than abortion. Finally, although this study found that abortion non-response bias was small for affective disorders, and corrected for what bias was discovered, the misreporting of abortions remains an unknown limitation on the findings.

5. Conclusion

The moderate and declining level of psychological harm associated with abortion found in this study lies between ideologically driven claims that abortion is devastatingly harmful to all or most women, on the one hand, or that it is never or seldom harmful to any women, on the other hand. Following one or more induced abortions, a representative cohort of ever-pregnant American women faced elevated risks of affective distress and problem substance abuse behaviors in their late 20s which declined as they neared the completion of their fertile years. At midlife, abortion accounted for eight percent of mental health disorders for these women.

Whether harm from abortion is large or small should not distract us from the more consequential fact that it is not psychologically beneficial at a population level. The most common justification of abortion on grounds of mental health in American legislative debates and medical care is that abortion is "health care", that is, it assumes that procuring an abortion will typically benefit a woman's psychological and life outcomes more than will bringing the pregnancy to term. Several studies, like the present one, have indeed found evidence of short-term affective relief with abortion, but which is then displaced by higher long-term mental health risks. This is a "benefit" like that of smoking or psychotropic drug use, which may have something to do with the high correlation of these behaviors with abortion. To my knowledge, no study has yet found a sustained or consistent psychological benefit for women from induced abortion such as would justify a perception of therapeutic benefit. The only literature review that has examined the question concluded: "There is no available evidence to suggest that abortion has therapeutic effects in reducing the mental health risks of unwanted/unintended pregnancy" [22]. In the present study, the only pregnancy outcome that did bring such a therapeutic benefit was childbirth, and the benefit of childbirth was stronger at midlife than at earlier ages. Thus, for those whose goal is evidence-based medicine and medical policy, it should be of concern that there is to date no evidence to support much of current American policy or medical practice regarding induced abortion.

These findings support Fergusson's recommendation that before prescribing or recommending an abortion, physicians should more strictly scrutinize the evidence that the pregnancy poses a risk to the woman's mental health [22]. American women considering abortion should be informed that beyond temporary feelings of relief, the intervention brings no known psychological benefit, and has been found more likely than not to be troubling for American women, some more and some less, in the long term. Clinical mental health intake for ever-pregnant women should attempt to determine exposure to abortion and support therapeutic or behavioral interventions for women experiencing distress associated with abortion in relation to other pregnancy risk factors.

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