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Review article

An umbrella review of meta-analyses of interventions to improve maternal outcomes for teen mothers

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ABSTRACT

The purpose of this study was to perform an umbrella review of meta-analyses of intervention studies designed to improve outcomes of pregnant or parenting teenagers. An extensive search retrieved nine reports which provided 21 meta-analyses analyses. Data were extracted by two reviewers. Methodological quality was assessed using the AMSTAR Instrument.

Most effect sizes were small but high quality studies showed significant outcomes for reduced low birth weight (RR = 0.60), repeat pregnancies/births (OR = 0.47–0.62), maternal education (OR = 1.21–1.83), and maternal employment (OR = 1.26). Several parenting outcomes (parent-child teaching interaction post-intervention [SMD = −0.91] and at follow-up [SMD = −1.07], and parent-child relationship post-intervention [SMD = −0.71] and at follow-up [SMD = −0.90]) were significant, but sample sizes were very small. Many reports did not include moderator analyses.

Behavioral interventions offer limited resources and occur too late to mitigate the educational and social disparities that precede teen pregnancy. Future intervention research and policies that redress the social determinants of early childbearing are recommended.

In 2014, the birth rate for teens 15–19 years fell to a historic low (Hamilton, Martin, Osterman, Curtin, & Mathews, 2015). While this is good news, the U.S. rate exceeds that of all other developed countries and differs substantially by age groups, race/ethnicity, and states with New Mexico having the highest rate (47.5/1000) and New Hampshire the lowest (13.8/1000) (Ventura, Hamilton, & Matthews, 2014). Subsequent births to teen mothers are also of concern, with almost 1 in 6 teen mothers having a second birth before age 20 (Ventura et al., 2014).

Early childbearing is associated with adverse health and social outcomes for mothers and their children. Teen mothers have an increased risk of preterm delivery (Kawakita et al., 2016; Torvie, Callegari, Schiff, & Debiec, 2015) and postpartum hemorrhage (Torvie et al., 2015). Reduced education and employment prospects, increased welfare use, and single parenting are also attributed to young maternal age (Coyne & D'Onofrio, 2012; Ventura et al., 2014). Poor maternal outcomes, however, have been exaggerated by selection bias, inadequate comparison groups, and the failure to examine heterogeneity among teen mothers and to control for background factors that increase the risk of teen pregnancy and poor outcomes (Weed,

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Nicholson, & Farris, 2015). When researchers have employed relevant comparison groups or statistical controls to adjust for background factors, poor outcomes among teen mothers have been reduced or eliminated (Kearney & Levine, 2012; Sisson, 2012; Weed et al., 2015). The high public costs of early childbearing may also be exaggerated since no comparison was generated for older mothers with similar backgrounds (The National Campaign to Prevent Teen and Unplanned Pregnancy, 2013).

Interventions targeting pregnant and parenting teens were first developed in the 1970s in hopes of improving maternal-child outcomes and defraying public costs (Hofferth, 1987). As intervention studies have grown in number, narrative and systematic reviews have summarized the results (Hofferth, 1987; Hoyer, 1998; Lachance, Burrus, & Scott, 2012; Ruedinger & Cox, 2012; Whitaker et al., 2016). Early reviews included program evaluations that were not rigorously evaluated (Hofferth, 1987). More recent reviews document that interventions target a variety of maternal outcomes related to the pregnancy, birth, or postpartum periods. Interventions also vary in terms of their intensity, length, scope, location, background of interventionists, and mode of delivery. For example, interventions are delivered in schools, homes, health settings, or community sites, and by professionals, paraprofessionals, or volunteers. Some interventions are relatively short-term and involve few sessions while others provide numerous sessions over months or years. Depending on the outcome of interest, participants begin the intervention during pregnancy, after delivery, or one or two years post-birth. Interventions are typically delivered to the mother alone or to the mother-child dyad. The vast majority of interventions include multiple components (e.g., case management, parent support and training, access to services, health education, life skills training). Overall, reviewers conclude that the effects of interventions vary, with some producing worse outcomes relative to controls and others producing minimal or conflicting results. Methodological limitations (i.e., attrition, small sample sizes, missing information, the use of different metrics, and the lack of power) limit the assessment of intervention effects (Lachance et al., 2012).

While narrative and traditional reviews provide useful information on the state of the science, the conclusions are limited to a narrative summary of a count of the significant and nonsignificant studies and the variation between the studies. Because significance is affected by a number of things such as effect size (ES) and sample size, studies with moderate ES and small sample sizes may provide nonsignificant results. Thus, straight counting of significant and nonsignificant studies can provide misleading results.

Meta-analytic techniques overcome the limitations of narrative reviews by employing quantitative methods to compute a summary ES of similar primary studies (Borenstein, Higgins, Higgins, & Rothstein, 2009). To obtain the summary effect, the ES and variance for each study is computed and a weighted mean is obtained; more weight is assigned to studies that are more precise (Borenstein et al., 2009). Meta-analysis also allows researchers to examine moderator effects across interventions, participants, and design quality characteristics. In addition, meta-analysis allows examination of publication bias that potentially favors large, significant studies. When several meta-analyses on a particular topic are available, a critical summary, or umbrella review, of these reports is warranted (Ioannidis, 2009).

Meta-analyses of interventions for teen mothers have not been summarized into an umbrella review. An umbrella review permits conclusions across meta-analyses about the effects (referred to as meta-analytic results or effects) of interventions and provides guidance for future research, practice, and policy. The purpose of this study was to perform an umbrella review to summarize the meta-analyses of intervention studies designed to improve outcomes of pregnant or parenting teenagers.

1. Methods

We conducted this umbrella review using PRISMA guidelines as appropriate (Moher, Liberati, Tetzlaff, & Altman, 2009).

1.1. Eligibility criteria

Meta-analyses of interventions for pregnant and parenting teens were eligible. Meta-analyses were excluded if teen mothers comprised less than 70% of the total sample or if the focus was on teen mothers' children or teen fathers.

1.2. Information sources

Eleven electronic databases (PsycINFO, Ovid MEDLINE(R), CINAHL, ERIC, Scopus, Sociological Abstracts, Social Work Abstracts, Science Citation Index (Web of Science), Cochrane Library, ProQuest Dissertations & Theses, Campbell Collaboration Library of Systematic Reviews) were initially searched from October, 2012 to March, 2013 to retrieve published and unpublished studies that reported a meta-analysis of intervention studies. In May 2014, the same search strategy was re-executed in the 11 databases for publication years 2013–2014.

1.3. Search strategy

The search strategy was developed with a medical librarian working with the first author. Truncated keywords included (teen* OR adolescen*) (pregnan* or mother* or parent*) and were combined with meta-analysis (and keyword variations). No publication date restrictions were applied; only articles published in English were accepted.

1.4. Study selection

A total of 592 records from the first search were exported into a citation manager program and duplicates were removed resulting in 443 records. The search was re-executed in May 2014 and 207 additional records were retrieved resulting in 138 records after duplicates were removed. Six additional records were identified through other resources. The first author screened the titles and abstracts of all 587 references; 568 were excluded. Nineteen full-text records were read; of these, 10 were excluded. Nine reports were included in the analysis (See Fig. 1).

1.5. Data abstraction

Key characteristics and data from the 9 reports were extracted, placed into tables, and reviewed by two reviewers. Disagreements on data extraction were settled by consensus with a third reviewer. Key characteristics and data extracted can be seen in the tables.

1.6. Assessment of quality

We evaluated the quality of the meta-analyses using the Assessment of Multiple Systematic Reviews (AMSTAR) Instrument (Shea et al., 2007, 2009). The instrument includes 11 items for evaluating the methodological rigor of systematic reviews/meta-analyses, including assessment of publication bias, conflict of interest, and comprehensiveness of the search strategy. Each item is scored 0 or 1, with a total score less than 4 indicating low quality, a score of 4–7 indicating moderate quality, and a score of 8–11 representing high quality. In addition, we developed a table to display the specifics of the quality assessment including risk of bias and indicated if a quality rating scale was used within each meta-analysis. Two reviewers independently coded the 9 studies; a third reviewer settled disagreements.

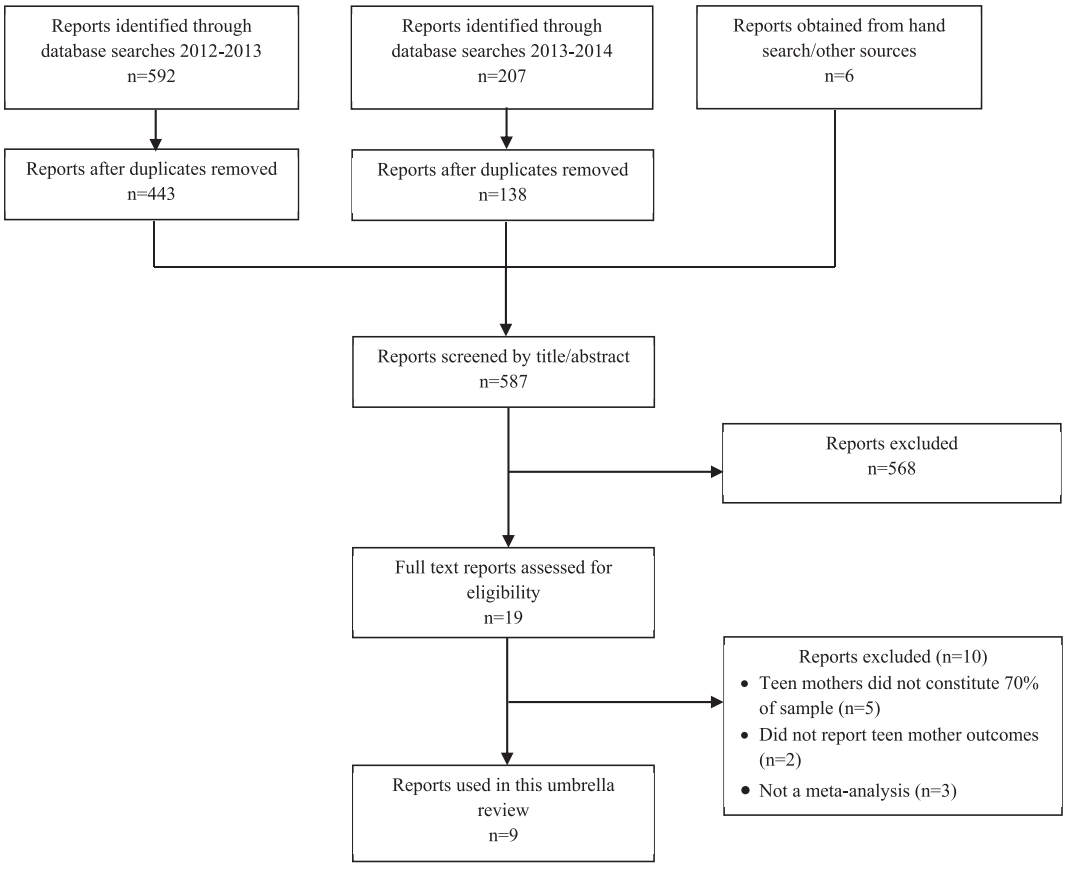

Fig. 1. Flow diagram of search process.

2. Results

2.1. Overview of meta-analyses

A total of 9 reports containing meta-analyses for 21 maternal outcomes were included in this review. One research team (Sukhato et al., 2015) addressed birth outcomes at delivery. Other researchers addressed teen mothers' educational attainment (Baytop, 2006; Steinka-Fry, Wilson, & Tanner-Smith, 2013) employment (Baytop, 2004), repeat pregnancies/births (Baytop, 2004; Corcoran & Pillai, 2007), depression (Ripper, 2014), and contraceptive use (Baytop, 2004). One team focused on parenting outcomes (Barlow et al., 2011). The number of primary studies (*s*) in the 9 reports varied from 2 to 30, with sample sizes ranging from 46 to 12,452 (See Table 1 for a list and description of the reports). We summarize the outcome ESs below. When fixed-effect and random-effect results were both reported in a meta-analysis, we present random effects because it assumes that the true effects are normally distributed (Borenstein et al., 2009).

2.2. Birth outcomes

Sukhato et al. (2015) analyzed four birth outcomes across five randomized trials (RCTs) testing the effects of psychosocial interventions. These outcomes included low birth weight, preterm birth, mean birth weight, and mean gestational age at delivery for women less than 21 years of age. Psychosocial interventions were broadly designed to provide psychological or social support, to improve knowledge of maternal and fetal health, and to promote access to health care. The interventions were delivered across a wide variety of settings by health professionals and were compared to routine antenatal care. When primary studies were synthesized, psychosocial interventions reduced low birth weights ($s = 4$, pooled risk ratio [RR] = 0.60; 95% CI: 0.38, 0.92) and increased the mean birth weight by an average of 200.63 g ($s = 3$, 95% CI: 21.02, 380.25) for the intervention groups compared to the control groups. However, interventions did little to reduce the risk of preterm birth ($s = 4$, RR = 0.67; 95% CI: 0.42, 1.05) or to lengthen gestational age ($s = 2$, RR = 0.29; 95% CI: −0.43, 1.02). Of special note, the RCTs included in this report were conducted between 13 and 30 years ago; four RCTs were conducted in the U.S. and one was delivered to teen mothers across four Latin American countries. No moderator analyses were conducted (Anothaisintawee, personal communication, January 19, 2016).

2.3. Maternal education

The researchers of two reports synthesized interventions on maternal education (Baytop, 2006; Steinka-Fry et al., 2013). Baytop (2006) included enrollment in school or any alternative educational or vocational program as an indicator of maternal education. Baytop reported that the 15 randomized studies had an effect with an odds ratio (OR) of 1.21 (95% CI: 1.04, 1.41; $p = 0.01$) on improving teen mothers' education, but that these studies should not be combined because of substantial heterogeneity across them. As might be expected, Baytop reported a larger ES for 14 nonrandomized studies (OR = 2.55; 95% CI: 1.59, 4.09; $p < 0.001$). Combined, the ES of the 29 studies was an OR of 1.68 (95% CI: 1.37–2.06, $p < 0.001$).

Steinka-Fry et al. (2013) published their report seven years after Baytop and included 15 studies with outcome measures related to school enrollment and graduation/drop-out. Teen mothers who received the educational interventions were almost two times as likely to graduate from high school as those who did not receive the intervention (OR = 1.83; 95% CI: 1.54, 2.18). Steinka-Fry et al. noted that studies using nonrandomized or non-matched designs generally produced larger ESs than studies with randomized or matched designs but these results were not reported.

2.4. Subsequent pregnancies/births

In two reports, researchers examined the effects of interventions to reduce subsequent pregnancies/births (Baytop, 2004; Corcoran & Pillai, 2007). Baytop (2004) identified 30 primary intervention studies from 1970 to 2003. All but four had been published and most interventions were conducted in the 1980s and 1990s. Corcoran and Pillai (2007) retrieved 16 studies. Thus, Baytop retrieved twice the number of studies than Corcoran and Pillai for roughly the same time period. Baytop's greater yield was likely due to searching twice as many databases. For both reports, researchers employed extensive efforts to retrieve grey literature. All interventions were conducted in the U.S.

Across the 30 primary studies reporting on 32 programs, Baytop (2004) reported an OR of 0.62 (95% CI: 0.49, 0.79; $p < 0.001$); the randomized studies showed less effect (OR = 0.87; 95% CI: 0.75, 1.03; $p = 0.11$) while the nonrandomized studies showed a greater effect (OR = 0.40; 95% CI: 0.23, 0.71; $p = 0.002$). Baytop also stratified results of the randomized studies by a number of factors including timing of enrollment into the intervention (before or within 6 months of giving birth, or later), mean age of participants, length of follow-up (≤24 months; between 25 and 36 months; ≥42 months). (See Table 2). Primary study teams that enrolled teen mothers during pregnancy or within 6 months of the birth showed greater effects at reducing a repeat birth (OR = 0.64; 95% CI: 0.52, 0.80; $p < 0.001$) than study teams that enrolled teens later (OR = 1.08; 95% CI: 0.96, 1.21; $p = 0.201$). Also, interventions showed greater effects for 16–17 year olds (OR = 0.66; 95% CI: 0.51, 8.85; $p = 0.002$) than for 18 year olds (OR = 0.85; 95% CI: 0.85, 1.17; $p = 1.00$). Studies of poor quality were excluded in a series of sensitivity analyses.

Table 1
Overview of summary effects reported across the meta-analyses.

1st Author, (yr) of MA	Purpose	Outcomes	Effect size statistic (fixed/random effects)	# of studies	Sample size, *N*	Summary effect size, 95% CI, *p*	$Q_{(df)}$ or I^2 statistic CI, *p*
Barlow et al., 2011 [a]	To examine the effectiveness of programs in improving maternal psychosocial health and parenting	Appropriate developmental expectation of children, Post-I	Standardized mean difference (random)	2	70	0.17; −0.96, 1.30; $p = 0.77$	$I^2 = 81\%$; $p = 0.02$
		Lack of empathetic awareness, Post-I	Standardized mean difference (random)	2	69	0.02; −1.46, 1.50; $p = 0.98$	$I^2 = 89\%$; $p = 0.003$
		Non-belief in corporal punishment, Post-I	Standardized mean difference (fixed)	2	69	0.26; −0.22, 0.73; $p = 0.29$	$I^2 = 0\%$; $p = 0.5$
		Lack of parent-child role reversal, Post-I	Standardized mean difference (fixed)	2	70	0.09; −0.38, 0.56; $p = 0.71$	$I^2 = 0\%$; $p = 0.99$
		Parent-child teaching interaction, (parent subscale) Post-I	Standardized mean difference (fixed)	2	46	-0.91; −1.52, −0.30; $p = 0.004$	$I^2 = 0\%$; $p = 0.75$
		Parent-child teaching interaction, (parent subscale) FU	Standardized mean difference (fixed)	2	47	−1.07; −1.80, −0.34; $p = 0.004$	$I^2 = 95\%$; $p = 0.00001$
			Standardized mean difference (random)	2	47	−6.11; −16.99, 4.77; $p = 0.27$	$I^2 = 95\%$; $p = 0.00001$
		Parent-child relationship (parent interaction with child), Post-I	Standardized mean difference (fixed)	2	46	-0.71; −1.31, −0.11; $p = 0.02$	$I^2 = 0\%$; $p = 0.79$
		Parent-child relationship (parent-child teaching interaction, total score), FU	Standardized mean difference (fixed)	2	46	-0.90; −1.51, −0.30; $p = 0.004$	$I^2 = 0\%$; $p = 0.6$
Baytop, 2004	To examine the effectiveness of programs in reducing repeat teen pregnancy	Repeat teen pregnancy	Odds Ratio (fixed; random if statistical evidence of heterogeneity)	30 total	12,452	0.62; 0.49, 0.79; $p = < 0.001$	$I^2 = 184.59$
				18 random	9315	0.87; 0.75, 1.03; $p = 0.11$	$I^2 = 30.33$; $p = 0.02$
				14 non-random	3137	0.40; 0.23, 0.71; $p = 0.002$	$I^2 = 115.34$; $p < 0.001$
Baytop, 2004	To examine the effectiveness of programs in improving employment outcomes	Employment	Odds Ratio (fixed; random if statistical evidence of heterogeneity)	15 total	11,966	1.26; 1.06, 1.50; $p = 0.009$	$I^2 = 40.44$; $p < 0.001$
				8 random	10,371	1.14; 1.04, 1.28; $p = 0.04$	$I^2 = 10.22$; $p = 0.18$
				7 non-random	1595	1.73; 1.04, 2.89; $p = 0.04$	$I^2 = 23.74$; $p = 0.001$
Baytop, 2004	To examine the effectiveness of programs in improving contraceptive use	Contraceptive use	Odds Ratio (fixed; random if statistical evidence of heterogeneity)	3 random	NR	0.93; 0.66, 1.31	
				4 non-random	NR	3.47; 0.74, 16.26	
Baytop, 2006 (same results with Chapter 5 in Baytop, 2004)	To examine the effectiveness of programs in improving	Educational attainment	Odds Ratio (fixed; random if statistical evidence of heterogeneity)	29 total	11,445	1.68; 1.37, 2.06; $p < 0.001$	$I^2 = 133.78$; $p < 0.001$
				15 random	8488	1.21; 1.04, 1.41; $p = 0.01$	$I^2 = 26.59$; $p = 0.02$
				14 non-random	2957	2.55; 1.59, 4.09; $p < 0.001$	

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Table 1 (*continued*)

1st Author, (yr) of MA	Purpose	Outcomes	Effect size statistic (fixed/random effects)	# of studies	Sample size, *N*	Summary effect size, 95% CI, *p*	$Q_{(df)}$ or I^2 statistic CI, *p*
	educational outcomes						$I^2 = 87.41$; $p < 0.001$
Corcoran & Pillai, 2007	To examine the effectiveness of programs in reducing repeat teen pregnancy	Repeat teen pregnancy @ 19 mo	Odds Ratio (fixed)	16	8200	0.79; 0.68, 0.93; $p = 0.004$	$Q_{(15)} = 57.04$
			Odds Ratio (random)	16	8200	0.474; 0.32, 0.70; $p = 0.000$	
		Repeat teen pregnancy @ 31 mo	Odds Ratio (fixed)	8	NR	0.74; 0.61, 0.92; $p = 0.005$	$Q_{(6)} = 18.2$
			Odds Ratio (random)	8	NR	0.66; 0.43, 1.02; $p = 0.06$	
Ripper, 2014	To examine the effectiveness of interventions in reducing depression in teen mothers	Decreased depression		9	1741	0.21; 0.12, 0.30; $p = .000$	
Steinka-Fry et al., 2013	To examine the effectiveness of programs in improving educational outcomes	Graduation	Odds ratio (random)	*15*	NR	1.83; 1.54, 2.18	$QE = 211$
		Enrollment outcome	Odds ratio (random)	*15*	NR	1.55; 1.15, 2.09	$QE = 35$
Sukhato et al.,2015	To examine the effectiveness of psychosocial interventions on birth outcomes in pregnant teens	Low birth weight	Pooled Risk Ratio (fixed)	4	847	0.60; 0.38, 0.92	$I^2 = 0.0\%$, $p = 0.614$
		Preterm birth	Pooled Risk Ratio (fixed)	4	684	0.67; 0.42, 1.05	$I^2 = 0.0\%$, $p = 0.495$
		Birth weight (in grams)	Unstandardized mean difference (random)	3	322	200.63; 21.02, 380.25	$I^2 = 66.8\%$, $p = 0.049$
		Gestational age at delivery	Unstandardized mean difference (random)	2	199	0.29; −0.43, 1.02	$I^2 = 33.2\%$, $p = 0.221$

Notes: ES: Effect size; CI: confidence interval; Post-I: post-intervention; FU: follow-up; *QE* – weighted sum of squares heterogeneity statistic; I^2 = the percentage of total variability; NR = not reported.

[a] For these analyses, minus effect sizes reflect outcomes that favor the intervention groups.

Table 2
Moderator results reported across the meta-analyses.

Author, year outcome variable	Moderators	Type of moderator	Effect size	Confidence interval/Heterogeneity: Q	Heterogeneity statistics between group: Q_B
Baytop, 2004; Repeat pregnancy, randomized studies	Setting: Clinic ($k = 4$)	Categorical	OR = 0.66	CI: 0.32, 1.35, $p = 0.26$ $Q_E = 6.95$, $p = 0.07$	$Q_B = 6.39$, $p = 0.05$
	Setting: Community ($k = 9$)	Categorical	OR = 1.04	CI: 0.92, 1.17, $p = 0.60$ $Q_E = 5.98$, $p = 0.65$	
	Setting: Home ($k = 5$)	Categorical	OR = 0.75	CI: 0.51, 1.10, $p = 0.15$ $Q_E = 11.01$, $p = 0.03$	
Baytop, 2004; Repeat pregnancy, randomized studies	Intervention assigned to controls: None ($k = 11$)	Categorical	OR = 0.88	CI: 0.74, 1.04, $p = 0.13$ $Q_E = 13.69$, $p = 0.19$	$Q_B = 1.67$, $p > 0.1$
	Intervention assigned to controls: Some intervention ($k = 7$)		OR = 0.86	CI: 0.61, 1.20 $Q_E = 14.97$, $p = 0.02$	
Baytop, 2004; Repeat pregnancy, randomized studies	Length of Follow-up: ≤24 months ($k = 9$)	Categorical	OR = 0.76	CI: 0.53, 1.07, $p = 0.12$ $Q_E = 15.66$, $p = 0.05$	$Q_B = 0.79$, $p < 0.1$
	Length of Follow-up: 25-36 months ($k = 2$)		OR = 1.03	CI: 0.78, 1.36; $p = 0.82$ $Q_E = 0.15$, $p = 0.70$	
	Length of Follow-up: ≥42 months ($k = 7$)		OR = 0.90	CI: 0.72, 1.12, $p = 0.34$ $Q_E = 13.73$, $p = 0.03$	
Baytop, 2004; Repeat pregnancy, randomized studies	Baseline differences: Favors intervention ($k = 2$)	Categorical	OR = 0.77	CI: 0.49, 1.23, $p = 0.28$ $Q_E = 0.98$, $p = 0.323$	
	Baseline differences: Favors controls ($k = 5$)		OR = 0.87	CI: 0.58, 1.30, $p = 0.49$ $Q_E = 9.54$, $p = 0.49$	
	Baseline differences: No baseline differences ($k = 8$)		OR = 0.88	CI: 0.70, 1.11; $p = 0.29$ $Q_E = 15.53$, $p = 0.03$	
Baytop, 2004; Repeat pregnancy, randomized studies	Timing of enrollment: before or within 6 months after delivery ($k = 11$)	Categorical	OR = 0.64	CI: 0.52, 0.80, $p < 0.001$ $Q_E = 8.17$, $p = 0.61$	$Q_B = 17.25$, $p < 0.001$
	Timing of enrollment: Enrolled after delivery ($k = 7$)		OR = 1.08	CI: 0.96, 1.21, $p = 0.201$ $Q_E = 4.91$, $p = 0.56$	
Baytop, 2004; Repeat pregnancy, randomized studies	Intervention approach: Teen mother only ($k = 10$)	Categorical	OR = 1.04	CI: 0.91, 1.19, $p = 0.53$ $Q_E = 5.82$, $p = 0.758$	$Q_B = 3.77$, $p = 0.05$
	Intervention approach: Two-generational & Family ($k = 8$)		OR = 0.63	CI: 0.43, 0.91, $p = 0.015$ $Q_E = 20.74$, $p = 0.004$	
Baytop, 2004; Repeat pregnancy, randomized studies	Race: <80% Black ($k = 11$)	Categorical	OR = 0.99	CI: 0.87, 1.13, $p = 0.91$ $Q_E = 10.66$, $p = 0.38$	$Q_B = 2.05$, $p > 0.1$
	Race: ≥ 80% Black ($k = 7$)		OR = 0.71	CI: 0.45, 1.10, $p = 0.13$ $Q_E = 17.62$, $p = 0.007$	
Baytop, 2004; Repeat pregnancy, randomized studies	Mean age: <18 yrs old ($k = 10$)	Categorical	OR = 0.66	CI: 0.51, 0.85, $p = 0.002$ $Q_E = 7.92$, $p = 0.54$	$Q_B = 9.70$, $p < 0.01$
	Mean age: 18 yrs old ($k = 8$)		OR = 1.00	CI: 0.85, 1.17, $p = 1.00$ $Q_E = 12.71$, $p = 0.08$	

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Table 2 (*continued*)

Author, year outcome variable	Moderators	Type of moderator	Effect size	Confidence interval/Heterogeneity: Q	Heterogeneity statistics between group: Q_B
Baytop, 2004; Repeat pregnancy, randomized studies	Use of case management only ($k = 10$)	Categorical	OR = 1.03	CI: 0.91, 1.20[a], $p = 0.68$ $Q_E = 8.46$, $p = 0.49$	$Q_B = 4.21$, $p = 0.05$
	Without case management ($k = 8$)		OR = 0.71	CI: 0.49, 1.01, $p = 0.06$ $Q_E = 17.66$, $p = 0.01$	
Corcoran & Pillai, 2007; Subsequent pregnancy	African-American vs	Categorical, Mixed effects	OR = 0.56	CI: 0.36, 0.87	$Q_B = 0.93$, $p = 0.334$
	Not AA		OR = 0.38	CI: 0.20, 0.72	
	Low SES vs.		OR = 0.68	CI: 0.47, 0.98	$Q_B = 5.38$, $p = 0.020$
	Not low SES		OR = 0.26	CI: 0.12, 0.53	
	Comprehensive Program vs		OR = 0.40	CI: 0.19, 0.82	$Q_B = 25$, $p = 0.618$
	Not Comprehensive		OR = 0.50	CI: 0.29, 0.85	
	Quality scores to explain heterogeneity	Continuous, meta-regression	Slope 0.25 Intercept −2.17	CI: 0.05, 0.45; z = 2.47; $p = 0.01$ CI: −3.40, −0.95 z = −3.48; $p = 0.00$	
	Multiservice package	Categorical, meta-regression	OR = 1.61	CI: 1.41, 1.83	
	Attendance monitoring + contingencies		OR = 1.99	CI: 1.65, 2.40	
	Random assignment (1 = yes)	Meta-regression	$b = -1.12$	CI: −1.97, −0.26, $p < 0.05$	
	Matched groups design (1 = yes)		$b = -1.57$	CI: −2.53, −0.62, $p < 0.05$	
	Attrition (%)		$b = -0.37$	CI: −2.09, 1.35	
	Mean group equivalence OR		$b = -0.11$	CI: −0.78, 0.56	
	Adjusted data for OR (1 = yes)		$b = 0.39$	CI: −0.31, 1.08	
	Independent evaluator (1–4)		$b = -0.34$	CI: −0.71, 0.03, $p < 0.10$	
	Percentage white		$b = -0.03$	CI: −1.09, 1.03	
	Average age		$b = -0.08$	CI: −0.50, 0.33	
	Program duration (in weeks)		$b = -0.00$	CI: −0.01, 0.00	
	Hours of service/week		$b = 0.01$	CI: −0.01, 0.03	
	Implementation quality (1–3)		$b = 0.53$	CI: 0.24, 0.83, $p < 0.05$	

b = Unstandardized regression coefficient; OR = odds ratio; Q_E = weighted sum of squares heterogeneity statistic; Q_B = heterogeneity statistics between group.
No moderator analyses presented in Barlow et al. (2011), Baytop (2006), Ripper (2014 and Sukhato et al. (2015).
[a] This CI was recalculated with data from the report to address an apparent error.

Corcoran and Pillai (2007) did not conduct separate analyses for the randomized and non-randomized studies. Rather, they calculated ESs based on follow-up periods. The first follow-up period for the full sample ($S = 16$) occurred on average 19.3 months after the intervention; the second follow-up period was an average of 31 months post intervention, ($s = 8$). Compared to the comparison or control groups, the intervention groups' ES was an OR of 0.47 (95% CI: 0.32, 0.70, $p = 0.000$) at 19.3 months which disappeared by 31 months (OR = 0.66; 95% CI: 0.43, 1.02, p = 0.06). Researchers also showed less effect in preventing subsequent births among lower income (OR = 0.68; 95% CI: 0.47, 0.98) versus higher income teens (OR = 0.26; 95% CI: 0.12, 0.53).

2.5. Maternal use of contraception

Baytop (2004) conducted an analysis of programs to improve teen mothers' contraceptive use and included three randomized and four nonrandomized studies. Primary studies included a measure of contraceptive behavior among teen mothers who self-reported being sexually active. The measure included questions about contraceptive practice at every intercourse, at last intercourse, used regularly, or used over the study period. Baytop concluded that interventions in the three randomized studies had no effect on teen mothers' use of contraceptive methods (OR = 0.93; 95% CI: 0.66, 1.31). While not significant, the four nonrandomized studies showed that intervention effects were over three times that of comparison groups (OR = 3.47; 95% CI: 0.74, 16.26).

2.6. Maternal employment

Baytop (2004) studied the effects of interventions to improve teen mothers' employment status. Employment as an outcome included any type or length of employment. Eight randomized and seven nonrandomized studies were retrieved and synthesized. These 15 studies effected employment by an OR of 1.26 (95% CI: 1.06, 1.50, $p = 0.009$) but Baytop suggested that this pooled estimate was meaningless because of the significant heterogeneity across studies ($p < 0.001$). An even smaller effect was found when the randomized studies were analyzed separately (OR = 1.14, 95% CI: 1.04, 1.28, p = 0.04); a larger effect was found for the nonrandomized studies (OR = 1.73, 95% CI: 1.04, 2.89, p = 0.04).

2.7. Maternal depression

Ripper (2014) examined the effects of non-pharmacological interventions to decrease depression in teen mothers. Nine studies were retrieved from searching two databases; 13 interventions were included in these nine studies. Heterogeneity among these programs was common, and only two studies explicitly targeted depression and recruited teens based on depression scores at baseline. Studies were restricted to U.S. programs with teen mothers aged 13–18 years that were published between 2003 and 2013. Ripper standardized the mean depression score for each intervention and determined a small ES of 0.21 (95% CI: 0.12, 0.30, p = 0.000).

2.8. Parenting outcomes

Barlow et al., 2011 examined the effects of interventions on eight parenting outcomes. Primary studies were included if they were short-term home visiting programs (less than 20 weeks) to improve teens' parenting attitudes, beliefs, competence, and interactions with the child. A wide range of instruments was used across the primary studies. Only two eligible studies were identified for each of the eight outcomes. Interventions were ineffective for four parenting variables: appropriate developmental expectations of children, lack of empathic awareness, non-belief in corporal punishment, and lack of parent-child role reversal. Interventions were positive and significant for two other parenting variables: the standardized mean difference (SMD) was −1.07 (negative ES favors the intervention) for *parent-child teaching interaction* at follow-up (95% CI: −1.8, −0.34; p = 0.004 and for *parent child relationship* post-intervention (SMD = −0.71, 95% CI: −1.31, −0.11, $p = 0.02$) and at follow-up (SMD = −0.90, 95% CI: −1.51, −0.30, $p = 0.004$).

2.9. Quality of the included meta-analyses

Using the AMSTAR guidelines described earlier, two meta-analyses were of low-quality, one was of moderate quality, and six were of high quality (see Table 4). Authors for six of the meta-analyses searched at least 9 databases to identify primary studies, and with only one exception, two or more coders extracted data from the eligible studies. In all but two cases, researchers used a tool to assess the quality of the primary studies. Seven of the nine researchers tested for publication bias, with bias suggested in five of the seven (see Table 3).

3. Discussion

The primary purpose of this umbrella review was to summarize the meta-analytic reports on the effects of interventions for teen mothers. Primary studies regarding mothers' educational attainment and delay of subsequent births were synthesized in two reports. The magnitude of the ES in both educational reports varied from small (Baytop, 2006) to moderate

(Steinka-Fry et al., 2013). Differences in search strategies, search years, analytical techniques, and cohort differences may also have contributed to the difference in magnitude of the two MAs. The majority of teen mothers were African American with a mean age of 17 years in Baytop's (2006) study while teens in the Steinka-Fry et al. (2013) study were slightly older (mean age 18 years) and were ethnically and racially diverse. As expected, non-randomized studies were found to have greater effects than randomized studies, and studies with higher implementation quality showed greater effects than those with lower quality.

Analyses of the interventions to delay subsequent births showed minimal or small effects (Baytop, 2004; Corcoran & Pillai, 2007). Both research teams employed different approaches to stratify results. Baytop (2004) reported that programs which enrolled teen mothers (by random assignment only) during pregnancy or within 6 months of the birth showed greater effects on reducing a repeat birth than interventions that enrolled teens later. RCTs that included teens with a mean age less than 18

Table 3
Findings of AMSTAR quality check list.

Items	Barlow et al., 2011	Baytop, 2004	Baytop, 2004	Baytop, 2004	Baytop, 2006	Corcoran & Pillai, 2007	Ripper, 2014	Steinka-Fry et al., 2013	Sukhato et al.,2015
	9 MA	1 MA	1 MA	1 MA	1 MA	2 MA	1 MA	2 MA	4 MA
1. Was an "a priori" design provided?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Was there duplicate study selection and data extraction?	Yes	Yes	Yes	Yes	Yes	Can't answer	No	Yes	Yes
3. Was a comprehensive literature review performed?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Was the status of publication (i.e. grey literature) used as an inclusion criterion?	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
5. Was a list of studies (included and excluded) provided?	Yes	No	No	No	No	No	No	No	Yes
6. Were the characteristics of the included studies provided?	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
7. Was the scientific quality of the included studies assessed and documented?	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes
8. Was the scientific quality of the included studies used appropriately in formulating conclusions?	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes
9. Were the methods used to combine the findings of studies appropriate?	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
10. Was the likelihood of publication bias assessed?	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
11. Was conflict of interest stated?	No	No	No	No	No	No	No	No	No
Total mark	9	9	9	4	9	8	2	7	9

Note: Total AMSTAR quality range is 0–11.

Table 4
Selected quality characteristics across the meta-analyses.

Author, year	Search terms listed	Range of years	# Data bases	# of Coders	Inclusion/ exclusion criteria	Quality rating scale	Publication Bias Tested
Barlow et al., 2011	Yes	No restriction through May, 2010	12	2, 3rd for bias disagreements	Yes	yes	Overall poor quality with many threats to internal validity and significant risk of bias
Baytop, 2004 Repeat teen pregnancy	Yes	1970–2003	10	2	Yes	Yes	Begg's & Egger's tests both significant suggesting bias; negative studies may exist that were not retrieved
Baytop, 2004 Employment	Yes	1970–2003	11	2	Yes	Yes	Begg's & Egger's tests not significant, bias unlikely
Baytop, 2004 Contraceptive use	Yes	1970–2003	9	2	Yes	Yes	Data not available
Baytop, 2006 Educational attainment	Yes	1970–2003	11	2	Yes	Yes	Begg's & Egger's tests both significant; bias may exist
Corcoran & Pillai, 2007	Yes	1970–2004	5	3	Yes	Yes	Rothenberg Fail-safe N, not serious
Ripper, 2014	Yes	2003–2013	2	NR	Yes	No	No
Steinka-Fry et al., 2013	No, published elsewhere	1985–2010	10	6	Yes	No	Peters' regression test of small study effects not significant; no clear evidence of bias
Sukhato et al., 2015	Yes	No restriction to May 2015	4	3	yes	yes	Egger Test & funnel plot: Bias: in low birth weight unlikely, in preterm birth likely.

Egger's = Egger's regression test; Begg's = Begg's adjusted rank correlation; NR = Not reported.

years also showed greater effects than interventions that enrolled teens with a mean age of 18 years. Corcoran and Pillai (2007) reported that interventions showed greater effects in preventing subsequent births among higher income versus lower income teens. Both teams concurred that no one approach was more effective than others in reducing subsequent births. The one report on employment (Baytop, 2004) found a small intervention effect based on 8 randomized studies and a moderate effect among the 7 non-randomized studies.

Reports addressing parenting outcomes included few primary studies and lacked key information (Barlow et al., 2011) Although researchers conducted extensive searches and included grey literature, most of these reports included only two primary studies. In some cases, narrow search strategies may have circumscribed the retrieval of relevant studies. Ripper's (2014) analysis on interventions to reduce depression showed a small effect but had a low quality rating. Sample sizes were small and studies were heterogeneous.

3.1. Strengths and limitations

Our umbrella review is based on a systematic review of meta-analyses of interventions to improve outcomes for teen mothers. While we followed established guidelines for conducting this review, an umbrella review of meta-analyses is only as good as the quality of the studies reviewed and the comprehensiveness of the data reported. Although six of the nine meta-analyses were judged to be of high quality using the AMSTAR guidelines (Shea et al., 2009), the majority did not include moderator effects of participant characteristics such as age, ethnicity, immigrant status, or family background. These data were often missing in the primary studies, which is a significant issue for synthesizing scientific findings (Ioannidis, 2009). Attrition is identified as a significant issue in interventions with teen mothers (Pinto-Foltz, Logsdon, & Derrick, 2011; South-Paul et al., 2014) but was rarely examined as a moderator in the meta-analyses. Future researchers should examine the effects of moderators on the results of their study. Also, the majority of reports were based on a small number of studies; 50% of the reports combined two studies only, and 61.91% of the reports included fewer than 5 studies. A serious limitation of the meta-analyses included in this review is that dissimilar interventions were combined so that a pooled estimate may have little meaning (Borenstein et al., 2009). Teen mothers are notably heterogeneous on socio-cultural factors, and it is the rare intervention study (Mistry et al., 2016) that examines heterogeneity to predict which sub-groups of teen mothers derive greater benefit from an intervention.

The results of these reports may also be of questionable relevance for contemporary U.S. teen mothers for the following reasons: interventions delivered in other countries were included in some reports (Barlow et al., 2011; Sukhato et al., 2015); teen mothers as a group have become more disadvantaged over time (Driscoll, 2014); and secular and policy changes have occurred since many of the primary studies were conducted, as described below.

3.2. Secular and policy changes

Primary studies included in these reports have spanned the last five decades. Major social, economic, and policy changes over this period have altered the context of early childbearing and must be considered when interpreting the results of this umbrella review for contemporary teen mothers. As described below, contemporary teen mothers were born into a set of family and socioeconomic circumstances that differ in important ways from their predecessors.

Although teen mothering has long been a marker of social disadvantage, contemporary teen mothers are more disadvantaged than earlier cohorts (Driscoll, 2014). By comparing U.S. teen mothers to their predecessors (and to older mothers) with five-year birth cohorts, Driscoll (2014) concluded that teen mothers' prospects have worsened since the 1970s. The rise in single mothering is a significant factor in teen mothers' worsening economic plight. In addition, interventions conducted before the 1990s typically targeted African American teen mothers. Latina teen mothers are increasingly included, but undocumented immigrants are prohibited from accessing health care and education, making these mothers particularly vulnerable in the U.S. (Toomey et al., 2014).

The effects of programs may be increasingly blunted by teen mothers' higher levels of disadvantage, psychological distress, and childhood adversities (Mollborn & Morningstar, 2009; SmithBattle & Freed, 2016). Teen mothers increasingly grow up in family and neighborhood contexts that expose them to material hardships, family instability, chronic stress, and violence (Easterbrooks, Chaudhuri, Bartlett, & Copeman, 2011; Mollborn, Lawrence, James-Hawkins, & Fomby, 2014; Noll, Shenk, & Putnam, 2009). Chronic stress and multiple traumas predispose mothers to mental health conditions (Felitti & Anda, 2010) and poor outcomes at mid-life (Hillis et al., 2004; Shern, Blanch, & Steverman, 2016). Mental health conditions compromise the mother-child relationship (Seng et al., 2013) and mothers' ability to engage in services. As a result, the most vulnerable teen mothers are the most likely to drop out of programs (Ingoldsby, 2010). Attrition was noted as a significant problem in the reports that we reviewed.

The context of early motherhood has changed in other ways that may also limit the relevance of the meta-analyses reviewed here. Researchers who targeted repeat pregnancies and contraceptive use included studies from the early 1980s (Baytop, 2004; Corcoran & Pillai, 2007), and did not address changes in the availability and effectiveness of contraception over the last several decades or changes in abortion policies. Again, their results have limited utility for contemporary teen mothers. Several policies are relevant to this issue. Although teens gained access to confidential and low-cost family planning services with the passage of Title X in 1970 (Vamos, Daley, Perrin, Buhi, & Mahan, 2012), gaps in coverage remained substantial for teens far from urban centers. These gaps have narrowed as Medicaid expansion and changes in insurance coverage have improved teen access to contraception (Miller, Graefe, & De Jong, 2013). The last decade has also witnessed the promotion of long-acting reversible contraception (LARC) for teens which are shown to be more effective than other birth control methods in reducing teen births and abortions when provided at no cost (Baldwin & Edelman, 2013; Dodson, Gray, & Burke, 2012). LARC methods have also reduced subsequent births among teen mothers (Wilson, Fowler, & Koo, 2013). Although LARC methods are not routinely offered in the U.S because of cost, their use in teenagers is now recommended by professional groups (Ott & Sucato, 2014), and Medicaid expansion and other funding streams are providing LARC at low-cost to teens (Ricketts, Klingler, & Schwalberg, 2014). While these changes potentially reduce repeat births, restrictions to abortion, including parental notification laws, mandatory waiting periods, and lack of Medicaid funding (Kearney & Levine, 2015) could potentially increase repeat births.

Meta-analyses on educational attainment (Baytop, 2006; Steinka-Fry et al., 2013) and employment (Baytop, 2004) included interventions that were conducted prior to the 1996 passage of welfare reform. This legislation required that teen mothers live at home and attend secondary school to receive cash assistance. Although there is some evidence that teen mothers experienced worse outcomes post welfare reform (Lee, 2009), it is also the case that full-time employment by teen mothers in low-paying service positions has increased since the 1970s (Driscoll, 2014). Neither Baytop (2006) or Steinka-Fry et al. (2013) excluded primary studies conducted prior to 1996.

Educational discrimination of teen mothers continued long after the passage of Title IX prohibited the exclusion of pregnant and parenting teens from public schools in 1972 (McLaughlin, 2014; Pillow, 2004). Baytop's (2006) report included studies from 1970 through 2003 whereas Steinka-Fry et al. (2013) referred to the questionable relevance of early studies and excluded those conducted prior to 1985. Similar concerns may be raised regarding the Steinka-Fry report since educational interventions over a 30 year period were pooled.

In summary, teen mothers in the U.S. have become increasingly disadvantaged (Driscoll, 2014), and it is likely that their greater disadvantage may blunt the effects of more recent interventions. Complicating matters further, educational and welfare policies, along with advances in contraceptive technology, may have altered teen mothers' reproductive, educational, and employment outcomes. Yet few of the researchers conducting the reports we reviewed excluded studies that predated relevant policy changes. Of equal concern, researchers and policy makers tend to overlook the childhood disadvantage and adversities that precede teen mothering (Weed et al., 2015). Studies suggest that background factors, not young maternal age, are largely responsible for poor maternal-child outcomes (Weed et al., 2015). As Weatherley (1991) noted decades ago, programs are often too weak and behavioral interventions are too ambitious to make a large difference in outcomes, at least without also redressing the social inequalities and childhood adversities that course through teen mothers' lives before they become pregnant.

3.3. Recommendations

Future researchers studying behavioral interventions should consider the methodological limitations of primary studies (Lachance et al., 2012; Whitaker et al., 2016) that make it difficult to compare, synthesize, and generalize interventions to subgroups of teen mothers. Future meta-analysts should consider pooling only studies with similar intervention characteristics or at a minimum examine intervention characteristics as moderators. Inclusion criteria for meta-analysis of interventions must be carefully considered in light of social and policy changes to assure that results are relevant for the current context.

This umbrella review is consistent with other reviews suggesting that most downstream behavioral interventions have a small effect on improving outcomes for teen mothers (Whitaker et al., 2016). Behavioral interventions—no matter how well designed, implemented, and evaluated— offer too little and occur too late to mitigate the childhood adversities and educational and social disadvantage that contribute to poor maternal outcomes. Writing more than 30 years ago, Weatherley (1991) concluded that there is no "quick fix" or "magic bullet" for improving teen mothers' lives. This statement carries even more weight today in light of teen mothers' greater disadvantage (Driscoll, 2014), widening inequalities in the U.S. (Marmot, 2015; Pickett & Wilkinson, 2015; Pickett, Mookhenjee, & Wilkinson, 2005), and growing evidence that teen mothers do about as well on a range of outcomes as older mothers from similar backgrounds (Weed et al., 2015). We agree with Weatherley (1991) that effective (and ineffective) programs benefit some participants, "but cannot be expected to compensate for the disadvantages of poverty, racial separatism, and limited vocational opportunities. Such programs should be considered an important component of a more comprehensive public policy response to adolescent childbearing." (p. 24). The Healthy Teen Network identifies legislative and policy changes upstream to strengthen the health and development of young families (Kahn & Reeg, 2008). Investigating outcomes related to these and other policy interventions are needed.

Meta-analysis is a popular and powerful tool for addressing the effects of interventions when there are multiple studies testing similar interventions; the technique also allows evaluation of heterogeneity to address complex social phenomena. Critical realist approaches provide a viable alternative as exemplified by a recent review of interventions to reduce repeat pregnancies/births among teen mothers (Whitaker et al., 2016).

4. Conclusion

In an era committed to evidence-based practice, the results of this umbrella review offer a chastened view of the effects of interventions for improving outcomes for teen mothers. While the majority of meta-analyses included in this review were of high quality, most had a small effect. Because several reports included international studies and studies conducted decades ago, their results may have limited relevance for contemporary practice and policy. The limitations of the reports and the primary studies also made it impossible to address what types of interventions may be effective for sub-groups of teen mothers. Given the evidence that contemporary teen mothers are more disadvantaged than earlier cohorts, behavioral interventions are unlikely to repair the childhood disadvantage and widening social inequities that contribute to teen births *and* poor maternal outcomes. Interventions that are well-designed and tailored to contemporary teen mothers are needed but "quick fixes" and "silver bullets" are unlikely to reverse the long shadow of inequality and discrimination. Coming to terms with the limitations of downstream efforts should prod us to move upstream to reverse the social inequalities that undermine the health, education, and long term development of teen mothers.

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