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SYSTEMATIC REVIEW

Cost-effectiveness of mental health interventions during and after pregnancy: A systematic review

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Abstract

Background: Mental health problems during and after pregnancy such as depression, anxiety, post-traumatic stress disorder (PTSD), or addiction are common and can have lifelong implications for both parents and offspring. This review investigates the cost-effectiveness of interventions tackling these problems, assesses the methodological quality of included studies, and indicates suggestions for further research.

Methods: Thirteen databases were searched for economic evaluations of interventions related to antenatal, perinatal, and postnatal mental health conditions, published between 2000 and September 2021, in high-income countries.

Results: Thirty-nine studies met all inclusion criteria. Interventions considered were screening programs, pharmacological treatments, and various forms of psychosocial and psychological support. Six studies reported that the intervention was cost-saving. Eighteen were cost-effective and seven likely to be cost-effective. Only six studies included health outcomes for the child; one study considered paternal health. The time horizon for which costs and consequences were considered was for most evaluations limited to 1 year (n = 18) or 2 years (n = 11) postpartum.

Conclusions: Given the importance of the subject, a relatively low number of studies have investigated the cost-effectiveness of interventions tackling mental health problems during and after pregnancy. The scant evidence available suggests good overall value for money. Likely, cost-effectiveness is underestimated as costly long-term consequences on offspring are systematically excluded. No evidence was found for several frequently occurring conditions. Further research is required to obtain reliable, long-term effectiveness data and to address the methodological challenges related to measuring all relevant health outcomes for all parties affected.

KEYWORDS
antenatal, perinatal and postnatal period, cost-effectiveness, mental health

1 | INTRODUCTION

Globally, an estimated 10% of pregnant and 13% of postnatal women experience a mental health disorder.[1] In the United Kingdom, the National Institute for Clinical Excellence (NICE) guidelines consider the following problems most relevant for antenatal and postnatal mental health: depression, anxiety disorders, eating disorders, drug-use and alcohol-use disorders, severe mental illness (such as psychosis, bipolar disorder, schizophrenia), and post-traumatic stress disorder (PTSD) following traumatic birth experiences.[2] Depression is recognized as the primary mental health condition with recent studies reporting prevalence rates of postpartum depression in mothers from 12%[3] up to 14%.[4] Prevalence estimates with regard to paternal depression approximate 10%.[5-8] However, other mental health disorders during and after pregnancy, both in mothers and in fathers, are also common but often overlooked. A prevalence rate of anxiety disorders in pregnant or postpartum women of 13% was reported in a large United States population-based study.[9] A Canadian study estimated PTSD after childbirth to prevail in 4%-17% of pregnant or postpartum women.[10] Pregnancy can furthermore be a catalyst for the start or remission of eating disorders.[11] Addiction is also a relevant problem, specifically when considering the high correlation of drug-use and alcohol-use disorders with other mental health conditions.

Mental health problems during and after pregnancy should be of particular concern to health policymakers because of the significant long-term health consequences on parents and their offspring. Parental mental illness not only increases the risk of adverse obstetrical outcomes but also affects parent-infant attachment and the cognitive, emotional, social, and behavioral development of the child, and its biological systems.[12-17] Therefore, antenatal, perinatal, and postnatal mental health conditions are expected to generate significant long-term costs to be borne by health systems later on. In the United Kingdom, Bauer et al. estimated the additional total lifetime costs of mother and child for perinatal depression to equal £75.728 per case, of which 69% relates to the child (fathers were not considered in this study).[18] As a consequence, effective prevention and treatment at an early stage is likely to be economically beneficial. Consensus on the general need and effectiveness of treatment is reflected in current clinical guidelines (in eg the United Kingdom, the United States, and Australia).[2,19,20]

In order to increase access to treatment within the available health care budget, policymakers do require not only proof of effectiveness but also evidence on the *cost-effectiveness* of interventions. This means assessing whether the costs of an intervention are worth the generated health benefit. For a better understanding, Table 1 provides an overview of key concepts and the different types of health economic analyses that are discussed throughout this paper. Previous reviews have summarized available evidence on the cost-effectiveness of preventing or treating maternal depression and anxiety during pregnancy.[21,22] However, there is no available overview of the state of knowledge of the broader scope of perinatal mental health conditions for both mother and father, which is the aim of this systematic review.

We aim to provide an up-to-date synthesis of current knowledge about the cost-effectiveness of prevention or treatment of mental health conditions in the antenatal, perinatal, and postnatal period. This objective was translated into specific inclusion criteria using the PICO framework (Table 2). A secondary objective was to review the methodological quality of available studies, with particular attention to how studies have dealt with the complicated nature of interventions linked to pregnancy and as a consequence the potentially lifelong effects on offspring.

2 | METHODS

2.1 | Search strategy and selection criteria

A systematic literature search was conducted in February 2021 and updated in September 2021, as prescribed by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[23] Electronic searches were performed on PubMed Central, Embase, Web of Science, APA PsycArticles (through ProQuest), CINAHL (through EBSCO), Cochrane, NHS EED, INAHTA, DARE, CADTH, HAS, PBAC, and CEA registry. Search terms included words related to (1) economic evaluation, health technology assessment, cost-effectiveness, and cost-benefit or cost-utility analysis; (2) mental health conditions related to depression, anxiety, eating disorders, drug-use and alcohol-use disorders, psychosis, bipolar disorder, schizophrenia, and PTSD; and (3) mothers and fathers before, during, and after pregnancy (Appendix 1). The search was not restricted by language.

The PICO framework was used as a guide to select and assess studies.[24] Included studies were all health economic evaluations of preventive (including screening) or curative interventions, for mothers or fathers during and up to 2 years after pregnancy, for the previously mentioned mental health conditions. The search was restricted to high-income countries, to ensure the comparison of evidence in similar health care contexts. Treatment outcomes were compared with no intervention, usual care, alternative interventions, or placebo. Only studies published from 2000 onward were

TABLE 1 Types of economic evaluation and key concepts in health economics[25]

Cost-effectiveness assessment		Assessing whether the costs of an intervention are worth the generated health benefit
Incremental cost-effectiveness ratio	ICER	The incremental costs of an intervention divided by the incremental health gain generated. The ICER represents the additional cost for one extra unit of health outcome and is typically used to assess cost-effectiveness.
Cost-utility analysis	CUA	The costs of an intervention are compared with the generated health outcomes in terms of *QALYs*. (The ICER is expressed in terms of costs per QALY.)
Quality-adjusted life-year	QALY	A generic measure of disease burden representing the time (in years) in a certain health state, adjusted for the quality of life (QoL) experienced in this health state. 1 QALY represents one life-year in perfect health.
Quality of life (weights)	QoL	A preference-based weight of a certain health state defined by two reference points: zero (= a state perceived equal to death) and 1 (= a state perceived equal to perfect health).
Cost-effectiveness analysis	CEA	The costs of an intervention are compared with the generated health outcomes in terms of relevant *natural units* to express treatment success. (The ICER is expressed in terms of costs per, eg cases of postpartum depression avoided.)
Cost-benefit analysis	CBA	The costs of an intervention are compared with the generated health outcomes in terms of *monetary units*. (Cost-effectiveness is calculated by considering the net benefit or the benefit-cost ratio of an intervention.)
Dominant intervention		The intervention is less costly and more effective than the alternative to which it is compared in the evaluation. (The intervention *dominates* the alternative.)

TABLE 2 PICO characteristics of the systematic review

Patients	pregnant women and fathers up to 24 months after delivery
Intervention	screening, prevention or treatment of depression, anxiety disorders, eating disorders, drug-use and alcohol-use disorders, severe mental illness (such as psychosis, bipolar disorder, and schizophrenia), and PTSD from traumatic birth
Comparator	alternative interventions, usual care, no intervention, or placebo
Outcome	partial or full economic evaluation

considered in order to exclude interventions that are less relevant for today's decision-makers.

Exclusion criteria were: studies describing only outcomes or only costs, effectiveness studies, or studies of which only posters were available. Gestational obesity was not considered a purely mental health condition as such and was therefore excluded if no related mental health condition was mentioned in the study description.

2.2 | Data extraction and quality assessment

After abstract selection, 66 full articles were reviewed assessing eligibility for inclusion. A data collection form was constructed, summarizing the background and design of the studies, cost-effectiveness results, quality assessment, and methodological limitations acknowledged by the study authors and the reviewers themselves. Studies excluded in the last review stage are listed in Appendix 2. Cost-effectiveness results were converted to 2019 euros (Appendix 3).

The methodological quality of the included studies was assessed by 2 authors (EV and JL), based on the 10-point checklist for assessing economic evaluations by Drummond et al.[25] Cases of disagreement on inclusion and quality assessment were resolved by discussion.

3 | RESULTS

3.1 | Study characteristics

In total, 39 studies met the inclusion criteria. Table 3 describes the characteristics of each study. The evaluated interventions were related to: anxiety and depression (n = 21),[26-46] smoking cessation (n = 12),[47-58] and substance abuse (n = 6).[59-64] No results were found for eating disorders, drug-use disorders other than tobacco, severe mental illnesses (such as psychosis, bipolar disorder, and schizophrenia), and PTSD from traumatic birth (Figure 1).

In terms of type of intervention, we identified four broad categories. *Psychosocial support* includes psychoeducation, home visits, mentorship, financial incentives, or supportive phone calls or text messages (n =

14).[26,31,35,40,43,47,48,51-53,55-57,62] Psychosocial support is based on the social environment, whereas *psychological support* departs from psychological methods such as cognitive behavioral therapy and interpersonal therapy (n = 7).[27,36,41,45,54,58,63,65] Some programs combine both types of support (n = 3).[39,49,59] Other categories are *pharmacological* interventions (treatment with medication) (n = 3)[32,50,64] and *screening programs* (n = 7).[28,30,34,38,45,46,60] Some interventions consisted of a mix of different categories (n = 5).[29,33,37,42,61] The comparator in the studies was primarily usual care (n = 27), consisting of, for example, smoking cessation programs or perinatal care as prescribed by local guidelines.[26,27,29,31,33-43,45,47-52,55,59] The study population consisted of pregnant women (n = 22),[26,33,39,44-58,60-62,64] postpartum women (n = 15),[27,29-32,34-38,40-43,63] or both (n = 1)[59]; one study focused on postpartum fathers.[28] No studies were found related to mental health in parents before or between pregnancies.

Studies were predominantly from the United Kingdom (n = 16)[29,34-39,41,45,47,48,50-52,56,63] and the United States (n = 14).[27,32,33,42,49,53-55,57-61,64]

The type of decision-maker considered in an economic evaluation determines the perspective adopted and hence which costs and consequences should be included. For example, travel costs might be relevant from a patient's perspective but not from the Ministry of Health's point of view.[25] The most commonly adopted perspective was that of a health care payer, considering only health care expenditure and excluding productivity losses or other economic costs (n = 23).[26,27,30,32,33,35,37,40-42,44-49,52,53,55,57,59-61] Eight studies combined a health care payer perspective with a social service perspective (including home help costs), and one considered both the health care payer and broader patient costs.[29] In one study, these three perspectives were combined.[43] A societal perspective, including productivity costs in addition to health care costs, was adopted in six studies.[28,31,54,58,62,64] Effectiveness data included in the studies originated from randomized controlled trials (RCTs),[26,27,31,33-35,39,45,48-50,52,53,55-57,63] clustered RCTs,[36,43] or cohort studies.[29,46,59] Seventeen studies were based on decision-analytic models populated with data from the scientific literature.[28,30,32,37,38,40-42,44,47,51,54,58,60-62,64]

The type of economic analysis differed between studies. Fifteen evaluations considered health outcomes in terms of quality-adjusted life-years (QALYs) in a cost-utility analysis (CUA).[26-28,30,32,34,38,40,41,44,45,51,55,58,61,64] QALYs are a generic measure of disease burden representing the time in a certain health state, adjusted for the quality of life (QoL) experienced in this health state.[25] Fifteen studies were identified as cost-effectiveness analyses (C EA)[29,31,33,35,36,39,46,47,49,50,53,54,56,57,62] as health outcomes were included in natural units. Seven studies reported incremental health gains both in QALYs (CUA) and in natural units (CEA).[36,37,42,43,48,52,63] Last, two studies considered both costs and outcomes in monetary terms in a cost-benefit analysis (CBA).[59,60] In almost all studies (n = 36), health outcomes for the mother were considered. Three studies did not include outcomes for the mother: Asper et al. considered screening for paternal depression,[28] Pollack et al. only included the number of sudden infant deaths (SIDs) because of gestational smoking,[54] and Thanh et al. considered the number of fetal alcohol spectrum disorder (FASD) cases in children.[62] In total, 6 studies included health outcomes related to the offspring in terms of: numbers of FASD cases,[60,62] number of SIDS averted,[54] and adverse birth outcomes.[51,58,64] Paternal health was once considered the main outcome in a study[28] and once included in the sensitivity analysis.[32]

The time horizon considered was for most evaluations limited up to 1 year (n = 18) or 2 years (+n = 11) postpartum. Ten studies also considered a period longer than 2 years, of which five considered a patient's lifetime health. In case the time horizon exceeded 1 year, the studies reported a discount rate for costs, outcomes, or both; only one study[60] did not report whether discounting was applied (Table 4).

3.2 | Critical appraisal

The quality of the included studies varied, and recurring methodological challenges were identified. An overview of the quality assessment based on the 10-point checklist by Drummond et al. is included in Appendix 4. Two studies scored only three points[54,60]; these studies did not provide sufficient information to assess whether reported results conform guidelines. Nevertheless were these studies included because they were part of the scarce number of evaluations (n = 3) that considered a lifetime time horizon for both women and offspring. All other studies scored at least five points or more, with a median score of 8.

The most common shortcoming of studies was that not all relevant costs and consequences were included. Besides the generally short time horizon considered, no study included health outcomes for mother, father, and child altogether. Second, studies related to the same mental health condition expressed health effects in different outcome measures. Outcomes related to depression were, for example, considered in terms of the number of women no longer fulfilling diagnostic criteria (such as EPDS scale or SCID-II assessment), number of depression-free days, risk of depression outcomes, or SF-36 general health perception. This lack of uniformity between measures hampers cost-effectiveness comparisons, even for studies related to the same condition. Generally, QALYs are the preferred outcome unit to improve comparability of results across

TABLE 3 Study characteristics

Ref	Authors	Year	Title	Population
Anxiety and depression				
26	Turkstra et al.	2016	An economic evaluation alongside a randomised controlled trial on psycho-education counselling intervention offered by midwives to address women's fear of childbirth in Australia	Women with high scores on childbirth fear, n = 184 (91 intervention), second trimester of pregnancy, English, and 16 y or older
32	Eldar-Lissai et al.	2020	Cost-Effectiveness of Brexanolone Versus Selective Serotonin Reuptake Inhibitors for the Treatment of Postpartum Depression in the United States	Mothers with moderate-to-severe PPD, on average 16 wk postpartum, and age 28 (similar to BRX clinical trial patients)
27	Ammerman et al.	2017	Cost-effectiveness of In-Home Cognitive Behavioral Therapy for low-income depressed mothers participating in early childhood prevention programs	Low-income mothers enrolled in a home visiting program and diagnosed with major depressive disorder (MDD) (n = 93)
36	Morrell et al.	2009	Psychological interventions for postnatal depression: cluster randomised trial and economic evaluation. The PoNDER trial	Women registered with participating GP practices who became 36 wk pregnant during the recruitment phase of the trial, had a live baby, and were on a collaborating HV's caseload for 4 mo postnatal. 103 clusters in 29 primary care trusts, n = 4084
41	Stevenson et al.	2010	The Cost-Effectiveness of Group Cognitive Behavioral Therapy Compared with Routine Primary Care for Women with Postnatal Depression in the UK	Women with postnatal depression
45	Trevillion et al.	2020	An exploratory parallel-group randomised controlled trial of antenatal Guided Self-Help (plus usual care) versus usual care alone for pregnant women with depression: DAWN trial	Pregnant women older than 16, meeting criteria for DSM-IV depression on the structured clinical interview (n = 53, 26 intervention)
33	Grote et al.	2017	Incremental Benefit-Cost of MOMCare: Collaborative Care for Perinatal Depression Among Economically Disadvantaged Women	Socioeconomically disadvantaged women with antenatal depression with and without comorbid PTSD (n = 164) (women at 12-32 wk gestation scoring 10 or higher on the PHQ-9 or with a diagnosis of probable dysthymia)
39	Petrou et al.	2006	Cost-effectiveness of a preventive counselling and support package for postnatal depression	Women at high risk of developing postnatal depression: predictive index score ≥24, 26-28 wk of gestation (n = 151, 74 intervention)
29	Boath et al.	2003	When the cradle falls II: the cost-effectiveness of treating postnatal depression in a psychiatric day hospital compared with routine primary care	Women with postnatal depression (n = 60, 30 intervention)

Country	Intervention	Time	Condition	Type of intervention	Comparator
Aus	A midwife-led telephone psycho-education intervention for women fearful of birth (BELIEF)	Antenatal	Anxiety	Psychosocial support	Usual care
USA	Brexanolone injection for postpartum depression	Postnatal	Depression	Pharmacological	Treatment with selective serotonin reuptake inhibitors (SSRIs) for PPD
USA	In-home cognitive behavioral therapy (IH-CBT)	Postnatal	Depression	Psychological support	Usual care
UK	HV training in the assessment of postnatal women, combined with either cognitive behavioral approach (CBA) or person-centered approach (PCA) sessions for eligible women, plus the option of a selective serotonin reuptake inhibitor if indicated	Postnatal	Depression	Psychological support	Usual care
UK	Group cognitive behavioral therapy (1 session/wk for 8 wk, of 2 h, in groups of 4-6)	Postnatal	Depression	Psychological support	Usual care
UK	Guided self-help (GSH) modified for pregnancy plus usual care	Antenatal	Depression	Psychological support	Usual care
USA	A multicomponent collaborative care intervention: including evidence-based depression treatment and active measurement of outcomes and follow-up according to stepped-care principles	Antenatal	Depression	Psychological support and pharmacological	More intensive version of usual care (= MSS-plus)
UK	Counseling and specific support for mother-infant relationship: visit 35 and 37 wk antenatally to establish supportive relationship, then visits on days 3, 7, and 17 after delivery and then weekly up to 8 wk	Antenatal	Depression	Psychological/ psychosocial support	Usual care
UK	A specialist psychiatric Parent and Baby Day Unit (PBDU): individual, high intensity, customized treatment, existing of: counseling, group therapy, creative therapy, hobbies and activities, stress management, assertiveness training, yoga and relaxation, a group for parents and older children and pharmacotherapy	Postnatal	Depression	Psychological/ psychosocial support +pharmacological	Usual care

(Continues)

TABLE 3 (Continued)

Ref	Authors	Year	Title	Population
63	Barlow et al.	2019	A randomized controlled trial and economic evaluation of the Parents Under Pressure program for parents in substance abuse treatment	Parents receiving treatment for a drug or alcohol problem and are a primary caregiver of a child under the age of 2.5 y. (n = 100, 48 intervention)
31	Dukhovny et al.	2013	Prospective Economic Evaluation of a Peer Support Intervention for Prevention of Postpartum Depression among High-Risk Women in Ontario, Canada	Postpartum woman from seven health regions across Ontario, Canada (n = 610)
35	Morrell et al.	2000	Costs and effectiveness of community postnatal support workers: randomised controlled trial	Postnatal women aged 17 or older (n = 493)
40	Saing et al.	2018	Cost Effectiveness of a Community-Delivered Consultation to Improve Infant Sleep Problems and Maternal Well-Being	Mothers and infants (0-12 mo)
28	Asper et al.	2018	Screening fathers for postpartum depression can be cost-effective: An example from Sweden	Postpartum fathers, initial study: A questionnaire was sent to 8011 fathers of whom 3656 (46%) responded
30	Campbell et al.	2008	Screening for postnatal depression within the Well Child Tamariki Ora Framework	New mothers in New Zealand who have given birth in any 12-month period (regardless of number or previous children) (n = 56 635)
46	Chambers et al.	2021	The clinical performance and cost-effectiveness of two psychosocial assessment models in maternity care: The Perinatal Integrated Psychosocial Assessment study	Women attending their first antenatal visits (n = 3673 usual care, n = 3132 PIPA model)
34	Henderson et al.	2018	Cost-effectiveness of PoNDER health visitor training for mothers at lower risk of depression: findings on prevention of postnatal depression from a cluster-randomised controlled trial	Mothers with lower-risk status at 6 wk postnatal (n = 1459)
38	Paulden et al.	2009	Screening for postnatal depression in primary care: cost effectiveness analysis	A hypothetical population of women assessed for postnatal depression either by routine care only or supplemented by use of formal identification methods 6 wk postnatally
44	Premji et al.	2021	Maximizing maternal health and value for money in postpartum depression screening: a cost-effectiveness analysis using the All Our Families cohort and administrative data in Alberta, Canada	Women during second trimester of pregnancy (n = 2698, 87% screened)
42	Wilkinson et al.	2017	Screening for and Treating Postpartum Depression and Psychosis: A Cost-Effectiveness Analysis	Hypothetical cohort of 1000 pregnant women experiencing one live birth over a 2-y time horizon
37	NCCMH	2014	Case identification and assessment, psychological and psychosocial interventions for the prevention or treatment of mental health problems. In Antenatal and postnatal mental health: the NICE guideline on clinical management and service guidance (update)	Women with subthreshold/mild-to-moderate depression in the postnatal period

Country	Intervention	Time	Condition	Type of intervention	Comparator
UK	Intensive one-to-one parenting program (parents under pressure, PuP) to reduce child abuse potential by enhancing parental emotional regulation	Postnatal	Substance abuse	Psychological support	Usual care
Can	A volunteer telephone-based peer support intervention for prevention of PPD	Postnatal	Depression	Psychosocial support	Usual care
UK	Up to 10 home visits in the first postnatal month of up to 3-h duration by a community postnatal support worker	Postnatal	Depression	Psychosocial support	Usual care
Aus	A community-delivered consultation aimed at improving infant sleep and maternal well-being	Postnatal	Depression	Psychosocial support	Usual care
Sweden	Postpartum depression screening (EPDS screening) for fathers (1000 iterations)	Postnatal	Depression	Screening	No screening
New Zealand	Screening program for postnatal depression	Postnatal	Depression	Screening	No screening
AUS	Perinatal Integrated Psychosocial Assessment (PIPA)	Perinatal	Depression	Screening	Usual care
UK	Health visitor training to assess postnatal depression	Postnatal	Depression	Screening	Usual care
UK	Alternative screening methods of postnatal depression in primary care (might detect women that are not detected by routine care but also incorrectly identify women who were not depressed)	Postnatal	Depression	Screening	Usual care
Can	Postpartum depression screening	Postnatal	Depression	Screening	No screening
USA	Physicians screening for and treating postpartum depression and psychosis in partnership with a psychiatrist	Postnatal	Depression	Screening +psychological support	Usual care
UK	Different types of psychological and psychosocial interventions: facilitated self-help or listening visits	Postnatal	Depression	Screening +psychological/ psychosocial support	Usual care

(Continues)

TABLE 3 (Continued)

Ref	Authors	Year	Title	Population
43	Ride et al.	2016	Preventing postnatal maternal mental health problems using a psychoeducational intervention: the cost-effectiveness of What Were We Thinking	English-speaking first-time mothers attending participating Maternal and Child Health Centres 6 mo postpartum (n = 362, 184 intervention)
Smoking cessation				
50	Essex et al.	2014	Cost-Effectiveness of Nicotine Patches for Smoking Cessation in Pregnancy: A Placebo Randomized Controlled Trial (SNAP)	Heavy-smoking pregnant women (n = 1050)
54	Pollack et al.	2001	Sudden Infant Death Syndrome, Maternal Smoking During Pregnancy, and the Cost-Effectiveness of Smoking Cessation Intervention	Birth cohort 1995 (self-reported smoking status mothers)
49	Dornelas et al.	2006	Efficacy and cost-effectiveness of a clinic-based counseling intervention tested in an ethnically diverse sample of pregnant smokers	Low income, predominantly Hispanic, pregnant patients in an urban prenatal clinic, ≤ 30 wk gestation, ≥ 18 y old (n = 105, 53 intervention)
58	Barcheller et al.	2021	Behavioral Smoking Cessation Counselling During Pregnancy A Cost-Effectiveness Analysis	Theoretical cohort of n = 285000 women
47	Bell et al.	2017	Evaluation of a complex healthcare intervention to increase smoking cessation in pregnant women: interrupted time series analysis with economic evaluation	n = 10 594 mothers smoking during pregnancy
48	Boyd et al.	2016	Are financial incentives cost-effective to support smoking cessation during pregnancy?	Pregnant women (n = 612), Markov model = 1000 women with mean age = 28 y
51	Jones et al.	2019	A dynamic, modifiable model for estimating cost-effectiveness of smoking cessation interventions in pregnancy: application to an RCT of self-help delivered by text message	Hypothetical cohort of 1000 singleton-pregnancy women who smoke
57	Mundt et al.	2021	Cost-effectiveness of stop smoking incentives for Medicaid-enrolled pregnant women	Medicaid-enrolled pregnant smoking women, mean gestation at enrollment = 15 wks (n = 1014 of which incentive group, n = 505)
52	Naughton et al.	2017	Large multi-centre pilot randomized controlled trial testing a low-cost, tailored, self-help smoking cessation text message intervention for pregnant smokers (MiQuit)	<25 wk gestation, smoked at least 1 daily cigarette, able to receive and understand English SMS texts (n = 407, n = 203 intervention)
53	Parker et al.	2006	Feasibility, cost, and cost-effectiveness of a telephone-based motivational intervention for underserved pregnant smokers	Women who have smoked at least one puff of a cigarette within the past 30 days, <26 wk pregnant, have access to a telephone and speak English or Spanish, n = 1065 randomized between 3 experimental groups (n = 358 intervention)

Country	Intervention	Time	Condition	Type of intervention	Comparator
Aus	What Were We Thinking, a psychoeducational intervention targeted at the partner relationship, management of infant behavior and parental fatigue	Postnatal	Depression, anxiety, and adjustment disorders	Psychosocial support	Usual care
UK	Nicotine patches for smoking cessation	Antenatal	Smoking cessation	Pharmacological	Usual care
USA	Prototypical smoking cessation programs (field of psychological support)	Antenatal	Smoking cessation	Psychological support	No intervention
USA	1.5-h counseling plus telephone follow-up delivered by a master's-prepared mental health counselor (bimonthly during pregnancy and monthly after delivery)	Antenatal	Smoking cessation	Psychological/ psychosocial support	Usual care
USA	Behavioral smoking cessation counseling	Perinatal	Smoking cessation	Psychological	Usual care
UK	A package of measures implemented in trusts and smoking cessation services, comprising skills training for health care and smoking cessation staff; universal carbon monoxide monitoring with routine opt-out referral for smoking cessation support provision of carbon monoxide monitors and supporting materials; and an explicit referral pathway and follow-up protocol	Antenatal	Smoking cessation	Psychosocial support	Usual care
UK	Financial incentives for smoking cessation in pregnancy	Antenatal	Smoking cessation	Psychosocial support	Usual care
UK	12-week program of tailored text messages	Antenatal	Smoking cessation	Psychosocial support	Usual care
USA	Financial incentives in the form of gift cards	Perinatal and postnatal	Smoking cessation	Psychosocial support	Lower incentive scheme
UK	12-wk program of individually tailored, automated, interactive, self-help smoking cessation text messages	Antenatal	Smoking cessation	Psychosocial support	Usual care
USA	A proactively provided telephone-based motivational smoking cessation intervention	Antenatal	Smoking cessation	Psychosocial support	Group 1: self-help quit kit, group 2: self-help quit kit +monetary incentive lottery

(Continues)

TABLE 3 (Continued)

Ref	Authors	Year	Title	Population
55	Ruger et al.	2008	Cost-effectiveness of motivational interviewing for smoking cessation and relapse prevention among low-income pregnant women: A randomized controlled trial	Low-income pregnant women recruited from multiple obstetrical sites in the Boston metropolitan area (n = 302) 2 groups: current smokers (smoking cessation: SC), and recent quitter within 3 mo (relapse prevention, RP)
56	Ussher et al.	2015	The London Exercise And Pregnant smokers (LEAP) trial: a randomised controlled trial of physical activity for smoking cessation in pregnancy with an economic evaluation	Women aged 16-50 y, between 10 and 24 wk gestation, currently smoking at least one cigarette per day, were smoking at least five cigarettes per day before pregnancy, prepared to quit smoking 1 wk after enrollment, and they could confirm that they were able to walk continuously for at least 15 min (n = 785)
Substance abuse				
61	Premkumar et al.	2019	Methadone, Buprenorphine, or Detoxification for Management of Perinatal Opioid Use Disorder (Detoxification = medically supervised withdrawal over 5 days to 16 wk with medications such as buprenorphine or clonidine)	Women with OUD after 16 wk of pregnancy (100.000 simulations)
64	Robin et al.	2021	Cost-effectiveness of buprenorphine vs. methadone for pregnant people with opioid use disorder	Theoretical cohort of n = 22,400 pregnant women
63	Barlow et al.	2019	A randomized controlled trial and economic evaluation of the Parents Under Pressure program for parents in substance abuse treatment	Parents receiving treatment for a drug or alcohol problem (opioid replacement treatment, relapse prevention, counseling) and were a primary caregiver of a child under the age of 2.5 y (n = 100, 48 intervention)
59	French et al.	2002	Benefit-cost analysis of addiction treatment in Arkansas: Specialty and standard residential programs for pregnant and parenting women	Pregnant and parenting substance abusers (most women entered these programs as self or criminal justice referrals.) (n = 85, 44 intervention)
62	Thanh et al.	2014	An Economic Evaluation of the Parent-Child Assistance Program for Preventing Fetal Alcohol Spectrum Disorder in Alberta, Canada	Women abusing substances and are pregnant up to 6 mo postpartum (n = 366, of which 161 alcohol abuse)
60	Gifford et al.	2010	Assessment of Benefits of a Universal Screen for Maternal Alcohol Use during Pregnancy	Pregnant women

disease categories. The QALY values in the included studies were, however, mainly based on secondary data, because of a lack of information on the QoL related to mental health during pregnancy for mothers, fathers, and offspring. This introduces a significant risk of bias as specific aspects related to pregnancy or the mother-child-(father) relationship are not included in the evaluation. For example, four studies[30,37,38,42] included QALY values based on the QoL experienced during general depression while studying pregnancy-related depression. Another challenge related to comparability of results is the difference between comparators. Even though the majority of studies (n = 27) considered the same comparator: usual care, general practices still vary per country, potentially affecting the generalizability of results.[22] Last, although most (n = 31) studies transparently discussed potential

Country	Intervention	Time	Condition	Type of intervention	Comparator
USA	Motivational interviewing (IM): 3 home visits (1 h) client-centered technique exploring perceptions and concerns about smoking, clarifies conflicting motivations, focuses on the social context in which women live, and provides support and skills of training	Antenatal	Smoking cessation	Psychosocial support	Usual care
UK	Physical activity +behavioral support (moderate-intensity exercise was prescribed according to age and current activity levels)	Antenatal	Smoking cessation	Psychosocial support	Behavioral support only
USA	Methadone, buprenorphine, or detoxification treatment for the management of opioid use disorder (OUD) during pregnancy	Antenatal	Substance abuse	Pharmacological and psychological support	Methadone, buprenorphine, or detoxification treatment
USA	Buprenorphine	Perinatal	Substance abuse (opioid use disorder)	Pharmacological	Methadone
UK	Intensive one-to-one parenting program (parents under pressure, PuP) with the goal of reducing child abuse potential by enhancing parental emotional regulation	Postnatal	Substance abuse	Psychological support	Usual care
USA	Speciality residential treatment: a comprehensive set of "wrap-around" services on site (up to 12 mo of stay)	Antenatal/ postnatal	Substance abuse	Psychological/ psychosocial support	Usual care
Can	Parent-Child Assistance Program: 3-y home visitation/harm reduction intervention to prevent alcohol exposed births (thereby births with fetal alcohol spectrum disorder)	Antenatal	Substance abuse	Psychosocial support	No intervention
USA	Universal meconium screening for maternal drinking during pregnancy (combined with 3 possible interventions)	Antenatal	Substance abuse	Screening	No intervention

uncertainty of cost-effectiveness results, robust sensitivity analyses were lacking. Two studies did not report any sensitivity analysis,[26,49] and six studies discussed uncertainty only to a limited extent.[33,39,56,57,60,63] Because the lack of reliable (long-term) data (for all parties affected) was generally recognized, exploring the specific impact of uncertainty on outcomes is indispensable.

Discussing the limitations of the studies, authors reported recurring topics possibly leading to biased results. Most frequently mentioned were the consideration of a limited time horizon[29,31,34,39,42,51,52,61] and a limited perspective of the study, which did not allow the inclusion of impacts on infants, family members, or broader effects on society.[29,30,33,34,38,39,44,60,62,63] Other risks of bias originate

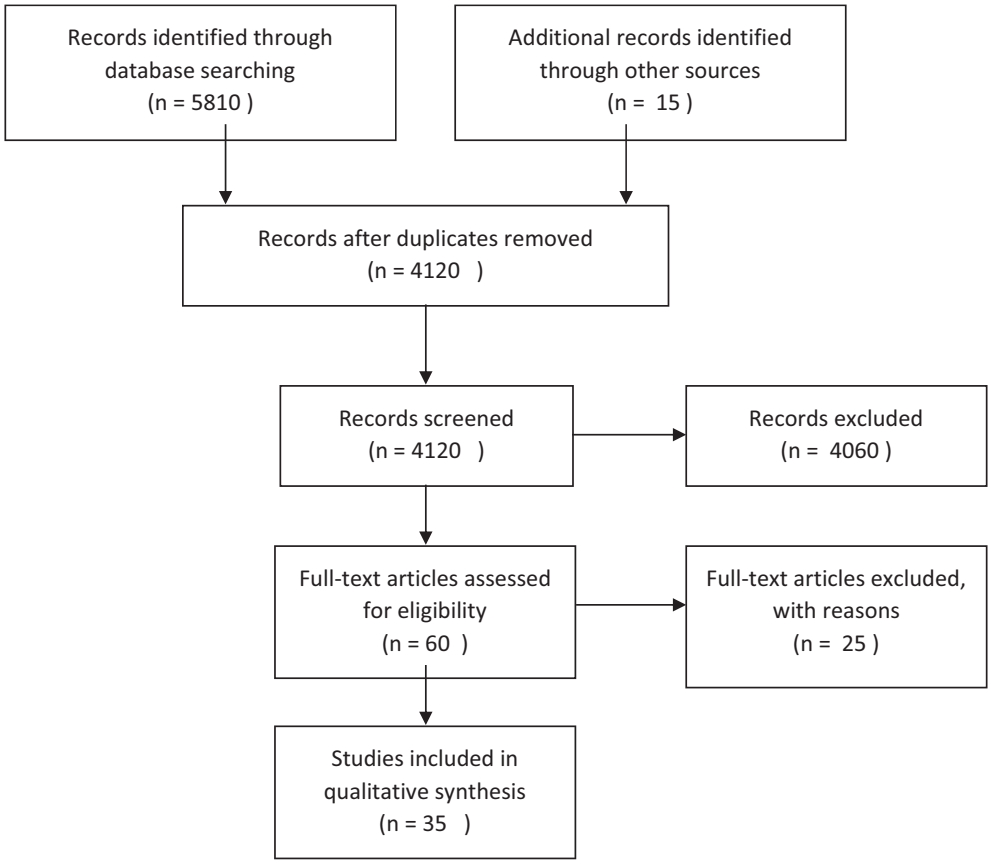

FIGURE 1 Study selection flow diagram

from self-reported results,[31,33,45,48,54,59,63] low compliance or follow-up rates,[26,33,50,52,53,59] or the use of QALY values that are not specifically related to the assessed condition.[30,32,37,38,40] In addition, nonrandomized data,[29,46,47,59] missing data,[47,59] and limited population size[29,45,55] were identified as factors possibly limiting reliability of clinical and health economic outcomes.

3.3 | Synthesis of cost-effectiveness results

Generally, cost-effectiveness is reported in terms of an *incremental cost-effectiveness ratio* (ICER), representing the incremental cost of the intervention for one extra unit of outcome (usually QALYs or specific effects such as depression-free days achieved). A *cost-saving* intervention is less costly and more (or equally) effective than the alternative. In this case, the intervention *dominates* and should, at least from an economic perspective, be adopted.[25] Seven studies dominated,[27,28,34,36,51,56,64] even though considerable statistical uncertainty was pointed out by two.[56,64] Alternatively, an intervention is cost-effective when the generated health gain is large enough to offset its additional costs, which was the case in sixteen studies.[29,30,32,33,37,40,42,44,46,48,49,52,55,57,58,62] French et al. did not report an ICER but significant clinical improvements and a positive net benefit, indicating cost-effectiveness.[59] Cost-effective or cost-saving ICERs were found for psychological/social support (n = 13), screening (n = 4), pharmacological (n = 2) or mixed (n = 4) programs for depression (n = 12), smoking cessation (n = 8), and substance abuse (n = 3), before (n = 13) and after (n = 10) birth. Seven studies reported potential cost-effectiveness, depending on the willingness to pay for the obtained health outcomes.[31,39,47,53,54,60,63] Five studies emphasized uncertainty related to results, and hence, more research is required.[26,43,45,50,61] Only three studies reported that the intervention was not cost-effective, also indicating potential reasons for this conclusion. Morrell et al. did not find an additional health benefit generated by a community postnatal support program in addition to usual care. This could, however, depend on the measure of health, as 75% of the intervention group did indicate that the support was better than expected.[35] Paulden et al. reported a lack of cost-effectiveness of screening for postnatal depression; this was mainly driven by the costs of managing false positives, indicating the importance of accurate

screening.[38] Last, Stevenson et al. concluded that group CBT for postnatal depression does not appear to be cost-effective (Table 5), but also here, uncertainty and the need for further research were emphasized.[41]

4 | DISCUSSION

This systematic review demonstrated that the evidence related to the cost-effectiveness of mental health interventions during and up to 2 years after pregnancy is, given the importance of this subject, all-in-all limited. A total of 39 studies were identified, published between 2000 and September 2021, considering anxiety, depression, smoking, or substance abuse. The majority of economic evaluations reported good value for money, even though results tend to be uncertain because of a lack of reliable data and difficulties of appropriately measuring all relevant health outcomes. These findings largely reflect challenges related to the underlying evidence base on effectiveness in the first place. Before the question of cost-effectiveness can be answered, more evidence is needed about the effectiveness of mental health programs in aspiring or young parents.

There were important gaps in the (cost-)effectiveness literature. First, although the evidence on perinatal depression is substantial, research on the broader range of mental health disorders is lacking even though the prevalence of these conditions during pregnancy is significant.[9,10,66-68] Second, no studies related to preconception mental health were found. Although this can be a delicate topic because of, for example, stigmatizing attitudes that can worsen mental disorders, preconception care offers an important window of opportunity to generate long-term health benefits.[68-71] Third, curative interventions that exclusively target paternal mental health are scarce, and as a consequence, so is rigorous research on this topic.[72-74] Fourth, the evidence on pharmaceutical interventions, including possible risks during pregnancy and lactation, is poor.[75-77] Furthermore, no study considered the co-occurrence of mental health conditions in couples and comorbidities and the implications on (cost-) effectiveness results. Incidence rates of paternal postpartum depression are, however, positively correlated with maternal depression, increasing from 1.2%-25.5% to 24%-50% when the mother experiences PND too.[7,8] In addition, significant relations between schizophrenia and alcohol use during pregnancy have been identified, but also smoking cessation, PTSD, anxiety, bipolar disorder, and eating disorders have been associated with depression.[4,67,78-83] These conditions cannot be treated in isolation from each other, and neither can cost-effectiveness be assessed. Finally, the importance of entangled risk factors such as the parent-infant relationship (eg, hostile behavior or domestic violence) is often overlooked. As these factors can be crucial for the behavioral outcomes of the child in the long term, additional parenting support might be required to ensure (cost-)effective results.[84-87]

Regarding the studies that were available, it is noteworthy that none of them considered health outcomes for mother, child, and father altogether, despite the potential long-term effects for each. Including *all* lifelong consequences is likely to increase cost-effectiveness significantly but requires long-term follow-up data for all parties affected.[88] Furthermore, health outcomes need to be captured in uniform outcome measures that allow meaningful comparisons of study results. For example, considering the incremental change in number of depression-free days does not allow inclusion of broader consequences such as future behavioral or cognitive problems of the child. In order to allow appropriate use of QALY values, further research is required to determine the QoL of mothers, children, and fathers in the specific context of mental health during and after pregnancy.

Our recommendations for further research can be summarized as follows. First, access to reliable data on the costs and effectiveness of mental health interventions in the long term, for mother, father, and child, need to be improved. Second, more research is required to identify appropriate measures of health that can capture all relevant health consequences of mental health interventions, for all parties affected. With regard to QALYs, QoL values need to be determined for the specific context of mental health in the antenatal, perinatal, and postnatal periods. Finally, a holistic approach is required that allows the consideration of related disorders and risk factors to increase accuracy of results.

This review has several strengths and limitations. To our knowledge, this is the first review that provides a comprehensive overview of the different health domains relevant for budget al.location decisions related to perinatal mental health care. Studies were identified based on a systematic process and were assessed according to the quality criteria proposed by Drummond et al. This assessment was used as a basis to identify fundamental methodological challenges of the included studies and to identify recommendations for future research.

However, despite our systematic search, some studies might not be included because they were not categorized under the searched mesh terms or did not include the specified search terms in the title or abstract. Second, although cost-effectiveness results were

TABLE 4 Design of included studies

Ref	Authors	Type of evaluation	Data source	Perspective	Health outcomes included	Health outcomes included for: Mother	Health outcomes included for: Child
Anxiety and depression							
26	Turkstra et al.	CUA	RCT	Health care	Health-related quality of life baseline and 6 wk postpartum (EQ-5D-3L)	v	
32	Eldar-Lissai et al.	CUA	Model	Health care (third-party payer perspective)	QALYs	v	v (0- to 4-y hospitalization but no utility loss, 5-12 y behavioral issues, 13- to 18-y depression)
27	Ammerman et al.	CUA	RCT +model	Health care	QALYs	v	
36	Morrell et al.	CEA	Cluster RCT/ model	Health care +social services	Proportion of at-risk women with a 6-month Edinburgh Postnatal Depression Scale (EPDS) score ≥12, QALY (SF-6D at 6 wk, and 6, 12, and 18 mo)	v	
41	Stevenson et al.	CUA	Model	Health care	QALYs (mapped EPDS scores)	v	
45	Trevillion et al.	CUA	RCT	Health care	QALYs based on SF-6D at baseline, 14 wk postrandomization and 3 mo postdelivery	v	
33	Grote et al.	CEA	RCT	Health care	Depression-free days (DFDs)	v	
39	Petrou et al.	CEA	RCT	Health care+social services	Duration of postnatal depression, SCID-II assessment 8 wk, 18 wk, 12 mo, and 18 mo postpartum	v	
29	Boath et al.	CEA	Prospective cohort study	Health care +broader patient costs	Women no longer fulfilling research diagnostic criteria for major or minor depressive disorder after 6 mo	v	
63	Barlow et al.	CEA/ CUA	RCT	Health care +social services	Child abuse potential, parental emotional regulation, QALYs (baseline, 6 and 12 mo) (if both parents had alcohol or drug problem primary caregiver was assessed)	v	
31	Dukhovny et al.	CEA	RCT +model	Societal	Edinburgh Postnatal Depression Scale (EPDS) score >12 at 12 wk postpartum	v	

Father	Costs included	Time horizon	Currency	Disc rate
	Self-reported visits to GP, midwives, obstetricians, nurse, home visits, ultrasound scans, hospital emergency department visits, hospital admissions (prebirth and postbirth), special care nursery, and mode of birth	Baseline until 6 wk postpartum	AUSD 2013	
v (in sensitivity analysis: risk of major depressive disorder)	Treatment costs +direct medical costs (from literature)	11-y base case (model up to 18 y)	$ 2018	3%
	Treatment costs +medical care	3 y	$ 2013	3%
	Health visitor training costs, primary analysis: costs of mother at 6 mo, further analysis: mother and baby costs at 12 mo	6 mo	£ 2003-2004	
	Costs of treatment (health worker*time)	12 mo	£ 2007-2008	
	Treatment costs, and health and social care costs	3 mo postdelivery	£ 2015-2016	
	Treatment costs +mental health services costs directly related to depression treatment	18 mo	$ 2013	No
	Intervention costs, all health and social care services (by interviewing women and diaries care practitioners—coupled to prices in literature) also for child	18 mo (after delivery)	£ 2000	Costs: 6%, effects 1,5%
	Medication, cost of transport, childcare, opportunity costs of women: loss of employment, house work, leisure time	6 mo	£ 1992-1993	6%
(v)	Program costs, hospital, community health and social services, legal services, and costs borne by parents	12 mo	£ 2016	
	Direct medical and program costs to the health care system, costs absorbed by all of the stakeholders, including childcare and household help, missed work, and the opportunity cost of volunteer time	First 12 wk postpartum	CAD 2011	

(Continues)

TABLE 4 (Continued)

Ref	Authors	Type of evaluation	Data source	Perspective	Health outcomes included	Health outcomes included for: Mother	Health outcomes included for: Child
35	Morell et al.	CEA	RCT	Health care	Short form-36 (SF-36) general health perception domain measured at 6 wk (costs and outcomes compared at 6 wk and 6 mo after delivery)	v	
40	Saing et al.	CUA	Model	Health care	EPDS scores mapped to published utility scores -> QALYs, interruption free-nights	v	
28	Asper et al.	CUA	Model	Societal	QALYs (health utilities related to depression for fathers)		
30	Campbell et al.	CUA	Model	Health care	(1) the number of mothers with resolved PND (who are not depressed at end point), (2) the number of PND cases detected, and (3) maternal quality-adjusted life-years (QALY). (screening 6 wk and 4 mo postpartum)	v	
46	Chambers et al.	CEA	Prospective cohort study	Health care	Rate of true positives and false positives (after additional screening by midwife)	v	
34	Henderson et al.	CUA	RCT +model	Health care +social services	QALYs +risk of depression outcomes at follow-up as a secondary outcome	v	
38	Paulden et al.	CUA	Model based on systematic review	Health care +social services	QALYs	v	
44	Premji et al.	CUA	Model	Health care	QALYs sf-6 d	v	
42	Wilkinson et al.	CEA/ CUA	Model	Health care	Number of remissions and QALYs	v	
37	NCCMH	CEA/CUA	Model (based on guideline meta-analyses)	Health care	(1) Number of women who improved and did not relapse at the end of 1-year follow-up. (2) Number of quality-adjusted life-years (QALYs) gained at the end of 1-year follow-up.	v	
43	Ride et al.	CEA/CUA	Clustered RCT +model	Health care +social services +patient costs	The 30-day prevalence of depression, anxiety and adjustment disorders, and quality-adjusted life-years (QALYs)	v	
Smoking cessation							
50	Essex et al.	CEA	RCT	Health care +social services	Biochemically validated smoking cessation	v	

Father	Costs included	Time horizon	Currency	Disc rate
	Costs of visits, GP contacts and prescriptions, hospital contacts ≥ medical care	6 mo	£ 1996	
	Consultation, training, residential stay, and health care resource costs	16 mo	AUSD 2014- 2015	5% for QALYs
v	Screening costs, and direct and indirect costs related to depression (antidepressants, productivity losses	Lifetime	€ 2016	3%
	Annual cost of implementing a routine screening program for PND: social support, psychological therapy, combination of antidepressants and psychological therapy	12 mo	New Zealand dollars 2006-2007	
	Time of screening midwives, staff, and clinicians	12 mo	AUSD 2017	
	HV training, ongoing clinical supervision; HV contacts; infant immunizations; GP contacts; prescriptions for all conditions; social worker contacts; admissions to mother and baby psychiatric units; and other mental health contacts	6 mo	£ 2003-2004	
	Cost of screening, subsequent treatment, and incorrect diagnosis (national reference costs)	1 y	£ 2006-2007	
	Screening, treatment, and health care costs	2 y	CAD 2019	
	Treatment costs and health care costs related to depression	2 y	$ 2014	3%
	Treatment costs, and health and social care costs for mother-infant dyad. (deterministic costing)	1 y after initiation treatment	£ 2013-2014	
	Health care, early childhood and social service costs + participant's out-of-pocket costs	6 mo	AUSD 2013-2014	
	Treatment costs+medical care	7 mo	£ 2009-2010	

(Continues)

TABLE 4 (Continued)

Ref	Authors	Type of evaluation	Data source	Perspective	Health outcomes included	Health outcomes included for	
						Mother	Child
54	Pollack et al.	CEA	Model	Societal	SIDS deaths averted, life-years saved		v
49	Dornelas et al.	CEA	RCT	Health care	Self-reported smoking abstinence for the previous 7 days (at end of pregnancy and 6 mo postpartum) confirmed by a carbon monoxide reading	v	
58	Bacheller et al.	CUA	Model	Societal	Maternal and neonatal outcomes +QALYs	v	v
47	Bell et al.	CEA	Model	Health care	Probability of quitting smoking during pregnancy	v	
48	Boyd et al.	CEA/ CUA	RCT/ model	Health care	Number of quitters/ QALYs	v	
51	Jones et al.	CUA	Economics of Smoking in Pregnancy (ESIP) model, estimates the lifetime cost-effectiveness of smoking cessation interventions in pregnancy applied to an RCT	Health care +social services	Costs of treating disease burdens, adverse birth outcomes, life-years and QALYs	v	v
57	Mundt et al.	CEA	RCT/model	Health care	Number of quitters	v	
52	Naughton et al.	CEA	RCT	Health care	Quit rate (+7 measures of smoking cessation)	v	
53	Parker et al.	CEA	RCT (smokers not randomized between call groups)	Health care (agency practitioner)	Quit rate (7 days of abstinence) assessment at 32 wk and 6 wk and 6 mo postpartum (self-report controlled by urine sample)	v	
55	Ruger et al.	CUA	RCT	Health care	(1) smoking cessation and relapse prevention, biochemically verified. (responses at baseline, 1 mo after intervention and 6 mo postpartum (2) infant: birth weight and postdelivery status (3) QALYs, life-years	v	
56	Ussher et al.	CEA	RCT (Leap trial)	Health care +social services	Biochemically validated abstinence from smoking between a quit date and the end of pregnancy	v	

Father	Costs included	Time horizon	Currency	Disc rate
		1 y (number of deaths+ extrapolation lifetime for life-years)	$ 1998	5%
	Costs of training mental health counselors and health care practitioners, counseling time, telephone time, clerical staff time	6 mo postpartum	$ 2002	
	Counseling costs +long-term outcome costs (stillbirth, smoking, preterm delivery)	Lifetime	$ 2020	3%
	Training of staff, investment in equipment, consumables, and changes in workload	5 y (for costs, data only 4 mo after intervention)	£ 2013	1.5%
	Direct costs to NHS/ model also includes LT costs: postbirth hospitalization costs +LT cost of treating smoking-related diseases	34-38 wk pregnancy / model = lifetime, considering relapse up to 8-y post quit	£ 2013	3.50%
	Antenatal care, perinatal care, delivery, neonatal care, treatment costs of lifetime morbidities (NHS reference costs +literature)	Women's and offspring lifetime (up to 100 y)	£ 2014-2015	3.5%
	Incentives, services, and staff and medication costs	6 mo postpartum	$ 2020	
	Intervention costs	>25 wk gestation up to 36 wk gestation	£ 2014-2015	
	Intervention costs	6 mo	$ 2006 (assumed)	
	Patient time, net resource costs: 1. intervention costs; 2. cost savings for neonatal intensive care, chronic medical conditions, and acute conditions during the first year of life; and 3. cost savings for maternal health care (cardiovascular and lung diseases)	6 mo postpartum	$ 1997	3% for QALYs
	Intervention cost +costs of caring for each woman and her infant during the period between randomization and the immediate postnatal period (in terms of expected annual cost)	Up to 9 mo (10-24 wk) gestation up to 10 wk postpartum	£ 2012-2013	

(Continues)

TABLE 4 (Continued)

Ref	Authors	Type of evaluation	Data source	Perspective	Health outcomes included	Health outcomes included for	
						Mother	Child
Substance abuse							
61	Premkumar et al.	CUA	Model	Health care	QALYs (maternal perspective: maternal health +maternal disutilities related to neonatal health state)	v	
64	Robin et al.	CUA	Model	Societal	Maternal and neonatal outcomes in terms of QALYs	v	v
63	Barlow et al.	CEA/ CUA	RCT	Health care +social services	Child abuse potential, parental emotional regulation, QALYs (baseline, 6 and 12 mo) (if both parents had alcohol or drug problem primary caregiver was assessed)	v	
59	French et al.	CBA	Nonrandomized effectiveness study +model	Health care	$ equivalent of quality-adjusted life-day related to substance abuse, psychiatric status. Selected variables from the Addiction Severity Index (ASI) converted into monetary equivalents, self-reported at treatment entry and 6 mo post discharge	v	
62	Thanh et al.	CEA	Decision-analytic modeling	Societal	Number of FASD cases avoided		v
60	Gifford et al.	CBA	Model	Health care	FASD cases prevented (in terms of costs)	v	v

expressed in 2019 euros, cost data are health system–specific and study results should be compared and interpreted with caution.[89] Last, the time horizon of the literature search was limited to 2000-2021, entailing the risk that certain pioneering studies (at a methodological level) were omitted.

4.1 | Conclusions

Mental health conditions are common during and after pregnancy, including long-term health consequences for mother, father, and child. Although guidelines generally recommend prevention and treatment of mental health conditions during this period, in many domains access to evidence-based care remains limited. This systematic review brings together cost-effectiveness evidence related to interventions targeting a broad range of mental health conditions during and after pregnancy. Overall, given the importance of this subject, there were relatively few studies available. The majority of studies was found to be cost-effective. Yet, these studies mostly illustrate a need for further research because of limited reliable long-term effectiveness data, or methodological challenges related to measuring all relevant health outcomes. Because of these challenges, it is likely that existing results systematically underestimate real-world cost-effectiveness, as long-term costs of suboptimal child development in the first years of life will be substantial.

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Father	Costs included	Time horizon	Currency	Disc rate
	Treatment costs, medical care costs including neonatal care (related to health)	26 wk	$ 2017	
	Drug and health care costs	Lifetime	$ 2020	3% for QALYs
(v)	Program costs, hospital, community health and social services, legal services, and costs borne by parents	12 mo	£ 2016	
	Reimbursed costs of treatment	6 mo	$ 1998	
	Cost of intervention compared with lifetime cost of case FASD	3 y	CAD 2013	5%
	Medical, education, social services, and out-of-pocket costs	Lifetime per child and per woman	$ 2006	? not mentioned

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TABLE 5 Cost-effectiveness results

Ref	Authors	Type of economic evaluation	Incremental health gain	Incremental costs	ICER
Anxiety and depression					
26	Turkstra et al.	CEA	(−) 0.024 (EQ-5D-3L level)	−€66	€2,758 (cost per 0.1-point improvement on EQ-5D-3L)
32	Eldar-Lissai et al.	CUA	0.286 QALYs (0.25 mother, 0.036 child)	€21,776	€76,074 (and €48,940 for women with severe PPD)
27	Ammerman et al.	CUA	0.07 QALYs	−€1.50	The intervention dominates
36	Morrell et al.	CUA	At-risk women: 0.003 QALY, all women: 0.002 QALY	At-risk women 6 mo: -€48,505 (nonsign.), all women: -€27,865	(not reported)
41	Stevenson et al.	CUA	0.032 QALY	€1908 per women	€59,099/ QALY gained (base case) €45,870/ QALY (PSA incorporating stochastic values)
45	Trevillion et al.	CUA	No significant difference in QALYs	No significant difference in QALYs	€8850 (of which €448 intervention)
33	Grote et al.	CEA	With comorbid PTSD: 68 more DFDs major depression alone: 13 more DFDs	With comorbid PTSD: €1008 major depression alone: €897	With comorbid PTSD: €15 per DFD major depression alone: €69 per DFD
39	Petrou et al.	CEA	−0.49 mo less depressed on average (nonsign)	€293 (nonsign)	€63 per month of postnatal depression avoided
29	Boath et al.	CEA	14 less women depressed	€46,830	€3345 per successfully treated woman

Key conclusion	Sensitivity analysis/ key determinants outcomes	Quality/ bias considerations
The intervention did not increase costs; however, it might be cost-effective for those women with very high childbirth fear	The probability that the intervention was more effective was 12%, whereas the probability that the intervention was less costly was 58% (no sensitivity analysis)	Follow-up retention rate of 54%, only public hospitals, self-reported patient data
BRX is a cost-effective therapy compared with SSRIs for treating women with PPD in the United States	Probabilistic sensitivity analysis	ADHD used as a proxy for behavioral difficulties of child because of lack of appropriate utility values. Key factor is duration of treatment: 4-wk model yields ICER of $5 million, 18 y: $60 000
IH-CBT is a more cost-effective treatment for low-income, depressed mothers than current standards of practice. (driven by reduction in expected depression days)	Results were most sensitive to: transition from remission to MDD, transition from MDD to remission, cost of MDD medications	Relatively small number of mothers, located in the same region. Constant transition probabilities from remission to MDD were assumed, limited follow-up window
HV intervention was highly likely to be cost-effective compared with the control. There was no difference in outcomes between the CBA and the PCA groups	Calculation of CEACs, modeling of missing data: 30% missing	Three issues were noted: the impact of missing data, the applied clustering, and costing method and data were not normally distributed; hence, parametric tests were possibly biased
Group CBT is unlikely to be cost-effective based on used assumptions	Considerable uncertainty in the model parameters (probabilistic sensitivity analysis)	No data available to compare group CBT with CBT, unknown role of concurrent medication, only one RCT was used to populate efficacy data
€7723 per ALY	GSH was cheaper but less effective on average than usual care alone, the probability of being cost-effective compared with usual care is around 50% at a threshold of £20 000–£30 000 per QALY. Results remain uncertain	Results based on the secondary analysis using EQ-5D-5L-based QALYs, and results of the sensitivity analyses did not alter the significance of outcomes
Women with comorbid PTSD: MOMCare intervention was more effective than MSS-Plus; major depression alone: similar improvement in both treatment conditions	Limited sensitivity analysis: correction for missing data and skewed distribution of costs	No inclusion of observational measures of the mother-child relationship or a standardized assessment of child development. Mental health service use was self-reported, and there was possible bias because of missing follow-up data
At a willingness-to-pay (WTP) threshold of £1000 per month of postnatal depression avoided, the probability of cost-effectiveness is 0.71 (likely to be cost-effective even at low WTP)	Univariate analysis, nonparametric bootstrapping for CE acceptability curves and alternative WTP thresholds, broad confidence intervals (CI)	A broader, societal perspective would allow the consideration of direct nonmedical costs (eg, travel and childcare costs), indirect costs (eg, lost productivity), and intangible costs (eg, costs of fear, pain, and suffering). Limited time horizon, no preference-based outcome measure. Characteristics of declined population were not reported
The treatment should be recommended to health care decision-makers	Results were sensitive to inclusion of primary care contacts and costs of medication	Initial study dates from 1992 to 1993, low number of participants, uncertainty because of a lack of spontaneous recovery rates estimates. Infant health is not considered by source study, limited time horizon: use of services extended beyond this period. Nonrandomized data

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TABLE 5 (Continued)

Ref	Authors	Type of economic evaluation	Incremental health gain	Incremental costs	ICER
60	Barlow et al.	CEA/CUA	0.07 QALYs or 2.376 improvement on the Risk Abuse Scale from the Brief Child Abuse Potential Inventory (BCAP)	€2647	€36,391 per QALY or €1072 per unit of improvement in BCAP
31	Dukhovny et al.	CEA	11% absolute risk reduction in PPD in the peer support group	€739	€6622 per case of PPD averted (50% probability)
35	Morell et al.	CEA	No difference in SF-36 scores	No difference except for costs supports worker service	/
40	Saing et al.	CUA	0.017 QALYs	€37	€2171/QALY
28	Asper et al.	CUA	0.03 QALYs	−€ 1118	Base case analysis resulted in a negative ICER (€–37.266)
30	Campbell et al.	CUA	616 QALYs	€ 1,248,822	€2027 per QALY gained
46	Chambers et al.	CEA	True-positive rate: +0.035, false-positive rate: −0.128	true positives: -€0.13, false positives: -€0.37	true positives: -€2, false positives: -€2,9
34	Henderson et al.	CUA	0.002 QALY	−€ 114	-€4884/QALY
38	Paulden et al.	CUA	EPDS cut point 16:0.0006 QALY	€32	EDPS at a cut point of 16: €53,806/QALY compared with routine care only. ICER all other strategies: €65.358 to €356.667/QALY
44	Premji et al.	CUA	0.0021 QALYs	0.0021 QALYs	€29
42	Wilkinson et al.	CEA/CUA	21.43 QALYs or 29 more healthy women	€713 per woman	€7698 per remission, €10,477 per QALY

Key conclusion	Sensitivity analysis/ key determinants outcomes	Quality/ bias considerations
The probability that the program is cost-effective was ~51.8% if decision-makers are willing to pay £1000 for a unit improvement in BCAP. Significant improvements in emotional regulation, and measures of mood and borderline psychopathology	Scenario analysis (limited discussion), further research is needed	ICER in terms of QALYs does not capture effects on child. The primary outcome measure was the parent report of child abuse potential. There is likely to be variability in the quality and nature of the community-based addiction services supporting parents
The costs are within the range for other accepted interventions for this population	Results were sensitive to the health region costs to implement the program and opportunity costs of family/friend, partner time off work	Effectiveness measure (EPDS) score is a screening tool and not diagnostic. Limited time horizon, possible recall bias questionnaire
No health benefit of additional home visits compared with traditional community midwifery visiting as measured by the SF-36, "no savings" to the NHS: mean difference in total costs was €281	Limited sensitivity analysis/ discussion of uncertainty	RCT from 1996 to 1997, 79% response rate, SF-36 likely too insensitive to detect changes (more than 75% found the support better than expected)
Infant sleep consultations are cost-effective and led to improvements in quality of life through a reduction in postnatal depression	Univariate and probabilistic sensitivity analyses, model was most sensitive to probability of overnight residential stays and baseline EPDS mean score	Utility mapping was based on other study: different postnatal population. Costs are self-reported. Costs of treating postnatal depression were not included
Program dominates the no-screening program	70% probability of being cost-effective, results were sensitive to variables of QALYs for the depressed fathers, probabilities of remission in treatment and no treatment groups, start age and productivity losses	Study is based on only secondary data—further research required. Screening costs were assumed to be equal to cost of nurses' time (excluding administration and training costs). Possible overestimation productivity loss based on human capital approach
Introducing formalized screening for PND appears to represent good value for money	Univariate and multivariate sensitivity analyses, results depend on treatment uptake and subsidy level GP	Out-of-pocket costs and broader social impact were not included. Base case assumes 100% treatment uptake (unrealistic). Utility values related to a general population with depression using antidepressants
PIPA model was cost-saving and more effective at eliminating false positives and identifying "at-risk" women	PSA conducted, great degree of uncertainty in outcomes (large CIs)	Not randomized cohorts in different years, only intermediate outcomes (and costs) included
PoNDER HV training was highly cost-effective in preventing symptoms of PND in a population of lower-risk women	Multivariate sensitivity analysis, impact of the intervention appears to have been relatively uniform over the whole of the lower-risk sample	Included costs were limited to health and social care services, not included: longer-term adverse effects on child development and costs, employment-related productivity losses
Probability that no formal identification strategy was cost-effective was 88% (59%) at a cost-effectiveness threshold of £20 000 (£30 000) per QALY	Cost of managing incorrectly identified depression (false-positive result) was an important driver of the model	Probability that depression is detected and utility weights were based on values for "moderate depression" in general. Whooley questions not considered in base case because of lack of data. Family members were not considered, insufficient data for subgroup analysis
€13,666 per QALY	Screening is a favorable strategy, resulting in 11% more cases being diagnosed annually relative to not screening	With 100% attending referral, the ICER fell to €8113 per QALY. Probabilistic analysis, model most sensitive to % of women receiving pharmaceutical/mixed treatment
Screening for and treating postpartum depression is a cost-effective intervention	Results were robust in both the deterministic and probabilistic sensitivity analyses of input parameters	Limited time horizon to capture all relevant outcomes, variety of data sources (some before the year 2000)

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TABLE 5 (Continued)

Ref	Authors	Type of economic evaluation	Incremental health gain	Incremental costs	ICER
37	NCCMH	CEA/CUA	Whooley questions followed by EPDS: 0.113 QALYs	€ 5628	ICER of Whooley questions followed by EPDS versus Whooley questions followed by PHQ-9: €49,696/QALY (which is above threshold)
43	Ride et al.	CEA/CUA	Complete case: 1.77 percentage point lower prevalence of depression, anxiety and adjustment disorders and +0.007 QALYs, multiple imputation of missing data: 0.33 pp and +0.006 QALYs	€148 per participant; with imputation of missing data: €137	€20/ QALY
Smoking cessation					
50	Essex et al.	CEA	1.8% quit rate (nonsign)	€110	€5967 per additional quitter
54	Pollack et al.	CEA	108 SIDS deaths averted	€49 per participant	€231,091 per SIDS death averted
49	Bacheller et al.	CUA	1050 QALYs	€74 million	€70,800 per QALY
58	Dornelas et al.	CEA	Incremental quit rate at end of pregnancy = 18.7	€56 per patient	€298 per quitter at end of pregnancy
47	Bell et al.	CEA	Increased quitting rate: 1.81	€34 per additional delivery	€1045 per additional quit
48	Boyd et al.	CEA/CUA	trial: 0.14 quit rate lifetime: 0.036 QALY	trial: €172 lifetime: €19	€1231 per quitter Lifetime model: €519/QALY
51	Jones et al.	CUA	0.04 QALYs	€-41	Dominant: €-1036 per QALY
57	Mundt et al.	CEA	5.5% increase in 6 mo postbirth biochemically confirmed tobacco abstinence	€182 per participant	€3952 per additional woman tobacco abstinent at 6 mo postbirth

Key conclusion	Sensitivity analysis/ key determinants outcomes	Quality/ bias considerations
The use of formal identification comprises a cost-effective strategy when compared to standard care case identification	Threshold sensitivity analyses showed that the results were sensitive to the diagnostic characteristics of formal case identification tools and consultation time required to administer case identification tool	Because of lack of available evidence, several estimates used in the economic model were based on single studies and where necessary supplemented by the GDG expert opinion. Utility values for general depression were used
Neither costs nor outcomes were statistically significantly different	Probabilistic sensitivity and scenario analysis, there was considerable uncertainty surrounding the effectiveness of the intervention (55% prob. of being CE at a threshold of $A 55.000/QALY)	The cluster-randomized nature of the trial and small but non-negligible intracluster correlation coefficient for QALYs may also have reduced the ability to detect an effect of the intervention on QALYs in this trial
Because of high levels of statistical uncertainty, it was hard to determine the cost-effectiveness of NRT in this population	Sensitivity analysis including only singleton births yielded an ICER of €5033 per quitter	Low compliance: only 7.2% of women in the NRT group and 2.8% in the placebo arm used trial patches for longer than 1 mo
Prenatal smoking cessation programs are estimated to cost less than $11.000 per life-year. Typical prenatal smoking cessation programs are highly cost-effective but have limited impact on the population incidence of SIDS	No sensitivity analysis, only CIs were reported	Self-reported smoking data, postnatal maternal smoking or household members not considered. Impact of race/ethnicity not considered. Only SIDS was considered, no other benefits of smoking cessation such as reduced incidence of low birthweight, maternal complications in pregnancy, childhood asthma, lung cancer, and cardiovascular disease
The intervention is cost-effective and leads to fewer adverse neonatal outcomes	Intervention was CE at probabilities of smoking cessation >11.6% or cost of the intervention < $475.21	Simplified model assumptions, long-term downstream effects of smoking not included
Intervention is cost-effective and is most effective early in pregnancy and for women under age 25	(missing)	Nongeneralizable population (specific segment: overall smoking rate was very high), 68% attendance rate counseling (these people were still contacted and still had similar quit rates)
The intervention was associated with a significant increase in rates of quitting by delivery	(limited)	Routinely collected data from different sources, some had high levels of missing data and were nonrandomized or observational
Financial incentives (shopping vouchers) for smoking cessation in pregnancy are highly cost-effective	Probabilistic sensitivity analysis indicates uncertainty of results related to relapse after birth	Risk of untruthful reporting
Intervention was very likely to be cost-effective in the longer term and to generate health care savings. Greatest benefit comes from long-term perspective, which was not included in original analysis	probabilistic sensitivity analysis	The initial evaluation of MiQuit found nonsignificant effectiveness results. RCT with only short-term results. Trial did not collect pregnancy outcomes and ended at 36 wk of gestation. Smoking of household members was not included. Potential underestimation of long-term abstinence because success of quitting increases per attempt (but was kept constant)
Financial incentives are cost-effective for socioeconomically disadvantaged pregnant women who smoke	(limited)	Pregnancy and infant health outcomes not included

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TABLE 5 (Continued)

Ref	Authors	Type of economic evaluation	Incremental health gain	Incremental costs	ICER
52	Naughton et al.	CEA/CUA	Incremental quit rate = 3.46%	€5	€144 per quitter based on lifetime utility gain values: €75 per QALY
53	Parker et al.	CEA/CBA	3 calls: 38 quitters, no call: 5 quitters	3 calls: €2829 no call: €123	Reported effectiveness-to -cost ratio: 1: €74 for 3 calls
55	Ruger et al.	CUA	Smoking cessation: −0.04 QALYs, relapse prevention: 0.49 QALYs	€340	Smoking cessation: MI is more costly but less effective relapse prevention: €949/LY saved and €701/QALY saved
56	Ussher et al.	CEA	1.3% incremental quit rate, 0.76 expected annual quitters	€-2253 (expected annual cost) or €-39 per participant	Not calculated, intervention dominates alternatives
Substance abuse					
61	Premkumar et al.	CUA	Buprenorphine: - Methadone: −0.23 Detoxification: 0.13	Buprenorphine: - Methadone: €6448 Detoxification: €17,237	Methadone and detoxification are dominated
64	Robin et al.	CUA	558 QALYs	€121.5 million	Methadone is dominated
63	Barlow et al.	CEA/CUA	0.07 QALYs or 2376 improvement on the Risk Abuse Scale from the Brief Child Abuse Potential Inventory (BCAP)	€2647	€36,391 per QALY or €1072 per unit of improvement in BCAP
59	French et al.	CBA	€17,150 (Specialty relative to standard)	Specialty: €8821 per client standard: €1611 per client	Per client net benefit €18,820 for specialty, €8881 standard. Benefit-cost ratio: 3.1 specialty and 6.5 standard
62	Thanh et al.	CEA	31 prevented FASD cases	€62,650	NMB = €24.4 million
60	Gifford et al.	CBA	Benefits from preventing FASD births range between €30.7 and €37.3 billion	Total costs of screening and treatment for all positive tests range between €0.31 and 4.26 billion	Potential financial savings range from €6 to €97 for every €1 spent on screening and treatment

Key conclusion	Sensitivity analysis/ key determinants outcomes	Quality/ bias considerations
Probability of MiQuit being cost-effective was 96.5% (at a threshold of £10.000)	As only 34% of those setting a quit date achieve longer-term abstinence, the cost per quitter, inflated accordingly, is probably closer to €650	High dropout rate (adjusted conservatively by assuming that all dropouts were still smoking), short time horizon
Telephone counseling is a potentially cost-effective approach to help a low-income, underserved population of pregnant women quit smoking	Results were tested for: exclusion of the no-call group, changes in price and covariates	Low number of urine samples collected: 114 first visit, 113 third trimester, and 23 after 6 mo postpartum. 46% of participants received all 3 calls
Among low-income pregnant women, MI helps prevent relapse at relatively low cost, and may be cost-saving when net medical cost savings are considered	Including savings in maternal lifetime medical costs in sensitivity analyses resulted in cost savings for MI for relapse prevention compared with UC	Specific patient subgroup (low income), long-term morbidity and mortality data for children were not included, sample size was limited
Physical activity seems cost-effective but results are uncertain	Considerable statistical uncertainty, limited sensitivity analysis (no adjustment for quit rates)	Low attendance may have affected efficacy, intervention contamination might have occurred in the control group (insufficient difference in PA between two groups). Participants seem to overestimate self-reported PA levels
Initiation of buprenorphine was the dominant strategy	Nonetheless, buprenorphine was not found to be cost-effective in almost one of three of simulations suggesting limited robustness of the model—further research is needed	Long-term developmental outcomes of the offspring associated with each of the strategies remains unknown, and there are limited data focusing on adherence in the postpartum period for women using methadone or buprenorphine, and no data for detoxification
Buprenorphine is cost-saving and reduces neonatal morbidity and mortality	61% probability of being CE, impactful parameters: probability of neonatal opioid withdrawal syndrome, discontinuing buprenorphine, preterm birth, and stillbirth	Only self-reported data during pregnancy, high dropout rates, comparator is not no-intervention
The probability that the program is cost-effective was ~51.8% if decision-makers are willing to pay £1000 for a unit improvement in BCAP. Significant improvements in emotional regulation, and measures of mood and borderline psychopathology	Scenario analysis (limited discussion), further research is needed	ICER in terms of QALYs does not capture effects on child. The primary outcome measure was the parent report of child abuse potential. There is likely to be variability in the quality and nature of the community-based addiction services supporting parents
Both specialty and standard clients showed significant clinical improvements and positive net benefits resulting from treatment	Economic benefits were not distributed evenly over different outcome categories. No statistical significance of total benefit or net benefit	Nonrandomized field study, patients receiving specialized treatment had more severe issues: samples differed at baseline. Unknown reliability and validity of interview instrument. Missing data: drop rate #cases = 32%, low follow-up rate (56%), self-reported data, selection bias (substance abusers that voluntarily seek treatment)
The program is cost-effective, and the net monetary benefit is significant	Increasing the use of contraceptives had a significant impact on the outcomes	Benefits from reduction in unemployment, welfare income dependence, and potential drug abuse were not included (results likely underestimated)
Universal meconium analysis of newborns and subsequent intervention could be cost-effective to reduce the incidence of FAS and FASD	Sensitivity analysis was conducted to test result for social drinkers instead of binge drinkers (sensitivity of 80%)	Costs of intervention after screening not included, economic values most likely underestimate full impact of FASD, psychological burden—quality of life not included, costs based on literature past 20 y

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APPENDIX 1

Search strategy (Overview of 3 main search strategies that were adapted for every specific database.)

1. PUBMED

Pregnancy

Postpartum[tiab] OR post-partum[tiab] OR postnatal[tiab] OR post-natal[tiab] OR perinatal[tiab] OR peri-natal[tiab] OR antepartum[tiab] OR ante-partum[tiab] OR antenatal[tiab] OR ante-natal[tiab] OR pregnan*[tiab] OR gestation [tiab] OR father*[tiab] OR paternal[tiab] OR matern*[tiab] OR mother*[tiab] OR parent* [tiab] OR "Birth Interval"[tiab] OR "Birth Spacing" [tiab] OR "Birth Spacings"[tiab] OR "Interpregnancy"[tiab] OR

"Pregnancy"[Mesh] OR "Maternal Health Services"[Mesh] OR "Pregnant Women"[Mesh] OR "Parents"[Mesh] OR "Postpartum Period"[Mesh] OR "Birth Intervals"[Mesh]

Cost-effectiveness

Economic-evaluation[tiab] OR economic-analys*[tiab] OR cost-effective*[tiab] OR costeffective*[tiab] OR cost-benefit*[tiab] OR cost-utilit*[tiab] OR cost-and-benefit*[tiab] OR costs-and-benefit*[tiab] OR benefit-and-cost*[tiab] OR benefits-and-cost*[tiab] OR "cost efficiency"[tiab] OR "Health Technology Assessment"[tiab] OR

"Cost-Benefit Analysis"[Mesh]

Mental health

depress*[tiab] OR anxi*[tiab] OR "mental health"[tiab] OR "mental disorder"[tiab] OR eating-disorder*[tiab] OR anorexia[tiab] OR bulimia[tiab] OR smoking[tiab] OR (substance[tiab] AND (abuse*[tiab] OR addiction[tiab] OR dependence[tiab])) OR ((drug*[tiab] AND (abuse*[tiab] OR addiction[tiab] OR dependence[tiab]) OR psycho*[tiab] bipolar[tiab] OR schizophren*[tiab] OR PTSD[tiab] OR Post-Traumatic[tiab] OR posttraumatic[tiab] OR stress[tiab] OR

"Mental Disorders"[Mesh] OR "Smoking Cessation"[Mesh]

2. EMBASE

Pregnancy

postpartum:ti,ab,kw OR 'post partum':ti,ab,kw OR postnatal:ti,ab,kw OR 'post natal':ti,ab,kw OR perinatal:ti,ab,kw OR 'peri natal':ti,ab,kw OR antepartum:ti,ab,kw OR 'ante partum':ti,ab,kw OR antenatal:ti,ab,kw OR 'ante natal':ti,ab,kw OR pregnan*:ti,ab,kw OR gestation:ti,ab,kw OR father*:ti,ab,kw OR paternal:ti,ab,kw OR matern*:ti,ab,kw OR mother*:ti,ab,kw OR parent*:ti,ab,kw OR 'birth Interval':ti,ab,kw OR 'birth Spacing':ti,ab,kw OR 'birth Spacings':ti,ab,kw OR 'interpregnancy':ti,ab,kw OR

'pregnancy'/exp OR 'perinatal period'/exp OR 'parent'/exp OR 'pregnant woman'/exp OR 'perinatal care'/exp

Cost-benefit

'Economic evaluation':ti,ab,kw OR 'economic analys*':ti,ab,kw OR 'cost effective*':ti,ab,kw OR costeffective*:ti,ab,kw OR 'cost benefit*':ti,ab,kw OR 'cost utilit*':ti,ab,kw OR 'cost and benefit*':ti,ab,kw OR 'costs and benefit*':ti,ab,kw OR 'benefit and cost*':ti,ab,kw OR 'benefits and cost*':ti,ab,kw OR 'cost efficiency':ti,ab,kw OR 'Health Technology Assessment':ti,ab,kw OR

'economic evaluation'/exp

Mental health

'depression':ti,ab,kw OR 'anxi*':ti,ab,kw OR 'mental health':ti,ab,kw OR 'mental disorder':ti,ab,kw OR 'eating disorder':ti,ab,kw OR anorexia:ti,ab,kw OR *bulimia:ti,ab,kw OR smoking:ti,ab,kw OR ((substance:ti,ab,kw OR alcohol:ti,ab,kw) AND (abuse*:ti,ab,kw OR addiction:ti,ab,kw OR dependence:ti,ab,kw)) OR ((drug*:ti,ab,kw OR tobacco:ti,ab,kw OR nicotine:ti,ab,kw OR amphetamine:ti,ab,kw OR cocaine:ti,ab,kw OR marijuana:ti,ab,kw OR narcotic*:ti,ab,kw) AND (abuse*:ti,ab,kw OR addiction:ti,ab,kw OR dependence:ti,ab,kw)) OR psycho*:ti,ab,kw bipolar:ti,ab,kw OR schizophren*:ti,ab,kw OR PTSD:ti,ab,kw OR 'Post Traumatic':ti,ab,kw OR posttraumatic:ti,ab,kw OR stress:ti,ab,kw OR

'mental disease'/de OR 'perinatal depression'/exp OR 'anxiety disorder'/exp OR 'drug abuse'/exp OR 'substance abuse'/exp OR 'substance use'/exp OR 'psychosis'/exp OR 'bipolar disorder'/exp OR 'schizophrenia'/exp OR 'smoking cessation'/exp OR 'eating disorder'/exp OR 'psychological well-being'/exp OR 'mood disorder'/exp

3. WOS CORE COLLECTION

Pregnancy

TS=(postpartum OR "post partum" OR postnatal OR "post natal" OR perinatal OR "peri natal" OR antepartum OR "ante partum" OR antenatal OR "ante natal" OR pregnan* OR gestation OR father* OR paternal OR matern* OR mother* OR parent* OR "birth Interval" OR "birth Spacing" OR "birth Spacings" OR "interpregnancy")

Cost-benefit

"Economic evaluation" OR "economic analys*" OR "cost effective*" OR costeffective* OR "cost benefit*" OR "cost utilit*" OR "cost and benefit*" OR "costs and benefit*" OR "benefit and cost*" OR "benefits and cost*" OR "cost efficiency" OR "Health Technology Assessment"

Mental health

"depression " OR "anxi* " OR "mental health " OR "mental disorder " OR "eating disorder " OR anorexia OR *bulimia OR smoking OR ((substance OR alcohol) AND (abuse* OR addiction OR dependence)) OR ((drug* OR tobacco OR nicotine OR amphetamine OR cocaine OR marijuana OR narcotic*) AND (abuse* OR addiction OR dependence)) OR psycho* OR bipolar OR schizophren* OR PTSD OR "Post Traumatic " OR posttraumatic OR stress

APPENDIX 2

Full-text articles excluded

Title	Year	Author	Reason
Cost-benefit analysis of varenicline vs. Existing smoking cessation strategies in pregnant women	2010	Barnard et al.	Poster
Lifetime costs of perinatal anxiety and depression	2016	Bauer et al.	Does not consider interventions (only economic impact of perinatal anxiety and depression)
Perinatal depression and child development: exploring the economic consequences from a South London cohort	2015	Bauer et al.	No economic evaluation
The clinical effectiveness, cost-effectiveness and acceptability of community-based interventions aimed at improving or maintaining quality of life in children of parents with serious mental illness: a systematic review	2014	Bee et al.	No economic evaluation

APPENDIX 2 (Continued)

Title	Year	Author	Reason
The cost-effectiveness of screening tools used in the diagnosis of foetal alcohol spectrum disorder: a modelled analysis	2019	Berrigan et al.	Only newborn screening is evaluated
An experimental evaluation of the benefits and costs of providing fertility information to adolescents and emerging adults	2018	Boivin et al.	Not directly related to mental health condition. no economic evaluation
Mums 4 Mums: structured telephone peer support for women experiencing postnatal depression. Pilot and exploratory RCT of its clinical and cost effectiveness	2011	Caramlau et al.	Study protocol
Relapse prevention in UK Stop Smoking Services: current practice, systematic reviews of effectiveness and cost-effectiveness analysis	2010	Coleman et al.	No specific evaluation for pregnant smokers
The SNAP trial: a randomised placebo-controlled trial of nicotine replacement therapy in pregnancy--clinical effectiveness and safety until 2 y after delivery, with economic evaluation	2014	Cooper et al.	Same evaluation as included study of Essex et al.
243: The cost-effectiveness of counselling interventions for young women at-risk of perinatal depression	2020	Franta et al.	Poster
Early start a cost-beneficial perinatal substance abuse program	2012	Goler et al.	No economic evaluation (cost savings calculated)
A culturally tailored intervention to reduce risk of alcohol-exposed pregnancies in American Indian communities: rationale, design, and methods	2021	Hanson et al.	Study protocol
The cost-effectiveness of parent-child interaction therapy: examining standard, intensive, and group adaptations	2021	Hare et al.	Young children are older than our target group
Improving infant sleep and maternal mental health: a cluster randomised trial	2007	Hiscock et al.	No economic evaluation
A model for cost-effectiveness analyses of smoking cessation interventions applied to a Quit-and-Win contest for mothers of small children	2005	Johansson et al.	Preschool children (not within 2 y after birth)
Comparing the acceptability, clinical-, and cost-effectiveness of mental health E-screening to paper-based screening in pregnant women: a randomized, parallel-group, superiority trial	2015	Kingston et al.	Poster
Training health visitors in cognitive behavioural and person-centred approaches for depression in postnatal women as part of a cluster randomised trial and economic evaluation in primary care: the PoNDER trial	2011	Morell et al.	No economic evaluation
Effectiveness and cost-effectiveness of an electronic mindfulness-based intervention (eMBI) on maternal mental health during pregnancy: the mindmom study protocol for a randomized controlled clinical trial	2020	Müller et al.	Study protocol
Postpartum depression screening in Alberta, Canada: a cost effectiveness analysis using administrative data	2017	Premji et al.	Poster
Setting the boundaries for economic evaluation: investigating time horizon and family effects in the case of postnatal depression	2018	Ride et al.	No specific intervention evaluated
Lithium use during pregnancy for bipolar disorder: a cost-effectiveness analysis	2020	Saito	Poster
Group cognitive behavioural therapy for postnatal depression: a systematic review of clinical effectiveness, cost-effectiveness and value of information analyses	2010	Stevenson et al.	Same study as other paper of Stevenson et al. 2010

(Continues)

APPENDIX 2 (Continued)

Title	Year	Author	Reason
The benefits of family action: an economic assessment of the potential benefits from family action interventions for women at risk of perinatal depression	2014	Taylor et al.	No economic evaluation
A cost effectiveness analysis of midwife psycho-education for fearful pregnant women - a health system perspective for the antenatal period	2017	Toohill et al.	Same data as the study of Turkstra et al. (Turkstra et al. was preferred because of the use of outcomes in terms of health-related quality of life)
Cost-utility analysis of a one-time supervisor telephone contact at 6-wk post-partum to prevent extended sick leave following maternity leave in The Netherlands: results of an economic evaluation alongside a randomized controlled trial	2011	Uegaki et al.	Not directly related to one of the specific defined mental health conditions
Costs of a motivational enhancement therapy coupled with cognitive behavioral therapy versus brief advice for pregnant substance users	2014	Xu	No economic evaluation (only cost analysis)

APPENDIX 3

INFLATION AND CURRENCY CONVERSION

Reported costs were first adjusted to a target price year using the OECD Consumer Price Indices,[90] in order to take into account general inflation in the country of the study. If two base years were reported, the average of both annual rates was calculated. If no price year was reported, the year the study was reported to be "received" was considered. Second, these price year–adjusted costs were converted to euros based on purchasing power parities.[91]

Author	Country	Currency-price year	CPI in price year (2015 = 100) [1]	CPI 2019	PPP
Ammerman et al.	USA	$ 2013	98.3	107.9	1
Asper et al.	Sweden	€ 2013	100.2	105	0.7
Bacheller et al.	USA	$ 2020	109.2	107.9	1
Barlow et al.	UK	£ 2016	101	107.8	0.7
Bell et al.	UK	£ 2013	98.2	107.8	0.7
Boath et al.	UK	£ 1992-1993	62.7	107.8	0.7
Boyd et al.	UK	£ 2013	98.2	107.8	0.7
Campbell et al.	New Zealand	NZD 2006-2007	84.3	105.8	1.5
Chambers et al.	AUS	AUSD 2020	107.8	106.9	1.4
Dornelas et al.	USA	$ 2002	75.9	107.9	1
Dukhovny et al.	Can	CAD 2011	94.7	107.4	1.2
Eldar-Lissai et al.	USA	$ 2018	105.9	107.9	1
Essex et al.	UK	£2009-2010	89	107.8	0.7
French et al.	USA	$1998	68.8	107.9	1
Gifford et al.	USA	$2006	85.1	107.9	1
Grote et al.	USA	$ 2013	98.3	107.9	1
Henderson et al.	UK	£2003-2004	77.25	107.8	0.7
Jones et al.	UK	£ 2014-2015	99.8	107.8	0.7
Morell et al.	UK	£ 1996	68.5	107.8	0.7
Morrell et al.	UK	£ 2003-2004	77.25	107.8	0.7

APPENDIX 3 (Continued)

Author	Country	Currency-price year	CPI in price year (2015 = 100) [1]	CPI 2019	PPP
Mundt et al.	USA	$ 2020	109.2	107.9	1
Naughton et al.	UK	£ 2014-2015	99.8	107.8	0.7
NCCMH	UK	£ 2013-2014	98.9	107.8	0.7
Parker et al.	USA	$ 2006 (assumed)	85.1	107.9	1
Paulden et al.	UK	£2006-2007	82.35	107.8	0.7
Petrou et al.	UK	£ 2000	73.4	107.8	0.7
Pollack et al.	USA	$ 1998	68.8	107.9	1
Premji et al.	Can	CAD 2019	107.4	107.4	1.2
Premkumar et al.		$ 2017	103.4	107.9	1
Ride et al.	AUS	AUSD 2013-2014	97.3	106.9	1.4
Robin et al.	USA	$ 2020	109.2	107.9	1
Ruger et al.	USA	$ 1997	67.7	107.9	1
Saing et al.	Aus	AUSD 2014- 2015	99.25	106.9	1.4
Stevenson et al.	UK	£ 2007- 2008	84.75	107.8	0.7
Thanh et al.	Can	CAD 2013	97	107.4	1.2
Trevillion et al.	UK	£ 2015-2016	100.5	107.8	0.7
Turkstra et al.	Aus	AUSD 2013	96.1	106.9	1.4
Ussher et al.	UK	£ 2012-2013	97.1	107.8	0.7
Wilkinson et al.	USA	$ 2014	99.9	107.9	1

APPENDIX 4

QUALITY ASSESSMENT

Study	Was a well-defined question posed in answerable form?	Was a comprehensive description of the competing alternatives given?	Was the effectiveness of the programs or services established?	Were all the important and relevant costs and consequences for each alternative identified?	Were costs and consequences measured accurately in appropriate physical units before valuation?	Were costs and consequences valued credibly?	Were costs and consequences adjusted for differential timing?	Was an incremental analysis of costs and consequences performed?	Was uncertainty in the estimated of costs and consequences adequately characterized?	Did the presentation and discussion of study results include all issues of concern to users?	Total score (on a scale from 0 to 10)
Barlow et al.	1	0	1	0	1	0	1	1	0	0	5
Ammerman et al.	1	1	1	0	1	1	1	1	1	1	9
Asper et al.	1	1	0	0	1	1	1	1	1	1	8
Bacheller et al.	1	1	1	0	1	1	1	1	1	1	9
Bell et al.	0	0	1	1	1	1	1	1	1	0	7
Boath et al.	1	1	0	0	1	1	1	1	1	1	8
Boyd et al.	1	1	1	0	1	1	1	1	1	1	9
Campbell et al.	1	1	1	0	1	0	1	1	1	0	7

(Continues)

Study	Was a well-defined question posed in answerable form?	Was a comprehensive description of the competing alternatives given?	Was the effectiveness of the programs or services established?	Were all the important and relevant costs and consequences for each alternative identified?	Were costs and consequences measured accurately in appropriate physical units before valuation?	Were costs and consequences valued credibly?	Were costs and consequences adjusted for differential timing?	Was an incremental analysis of costs and consequences performed?	Was uncertainty in the estimated of costs and consequences adequately characterized?	Did the presentation and discussion of study results include all issues of concern to users?	Total score (on a scale from 0 to 10)
Chambers et al.	1	1	1	0	1	1	1	1	1	1	9
Dornelas et al.	1	1	1	0	1	0	1	1	0	0	6
Dukhovny et al.	1	1	1	0	1	1	1	1	1	1	9
Eldar-Lissai et al.	1	1	1	0	1	0	1	1	1	1	8
Essex et al.	1	1	0	0	1	1	1	1	1	0	7
French et al.	1	1	1	0	1	0	1	1	1	1	8
Gifford et al.	1	1	0	0	1	0	0	0	0	0	3
Grote et al.	1	1	1	0	1	1	1	1	1	1	9
Henderson et al.	1	0	1	0	1	1	1	1	1	1	8
Jones et al.	1	1	1	0	0	1	1	1	1	1	8
Morell et al.	1	1	1	0	0	0	1	1	0	0	5
Morrell et al. (2009)	1	0	1	0	1	1	1	1	1	1	8
Mundt et al.	1	1	0	0	1	0	1	1	0	1	6
Naughton et al.	1	1	1	0	1	1	1	1	1	1	9
NCCMH	1	1	1	0	0	0	1	1	1	1	7
Parker et al.	1	1	1	0	0	1	1	0	1	1	7
Paulden et al.	1	1	0	0	0	0	1	1	1	1	6
Petrou et al.	1	1	1	0	1	1	1	1	1	1	9
Pollack et al.	0	0	0	0	1	0	1	1	0	0	3
Premji et al.	1	1	1	0	1	1	1	1	1	1	9
Premkumar et al.	1	1	1	0	1	1	1	1	1	1	9
Ride et al.	1	0	1	0	1	1	1	1	1	1	8
Robin et al.	1	1	0	0	1	1	1	1	1	1	8
Ruger et al.	1	1	0	0	1	1	1	1	1	1	8
Saing et al.	1	1	0	0	0	0	0	1	1	1	5
Stevenson et al.	1	1	1	0	0	1	1	1	1	1	8
Thanh et al.	1	1	1	0	1	1	1	1	1	1	9
Trevellion et al.	1	1	1	0	1	1	1	1	1	0	8
Turkstra et al.	0	0	1	0	1	1	1	1	1	0	6
Ussher et al.	1	1	1	0	1	1	1	1	0	0	7
Wilkinson et al.	1	1	0	0	1	0	1	1	1	1	7