



“A Window of Opportunity”: Parenting and Addiction in the Context of Pregnancy

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Abstract

Purpose of Review Maternal prenatal substance use presents a multilevel risk to child development and parenting. Although parenting interventions are increasingly integrated into substance use treatment, prenatal parenting processes have not received equal attention within these interventions. This article aims to synthesize the evidence on the specific prenatal risk factors affecting the development of early parenting of substance-using mothers, as well as interventions focusing on those factors.

Recent Findings Both neurobiological and psychosocial risk factors affect the prenatal development of parenting in the context of maternal substance use. Maternal–fetal attachment, mentalization, self-regulation, and psychosocial risks are important in treatment and highly intertwined with abstinence. Although parenting interventions seem to be highly beneficial, most studies have not differentiated between pre- and postnatal interventions or described pregnancy-specific intervention elements.

Summary Due to the salience of pregnancy in treating substance-using parents, interventions should begin prenatally and include pregnancy-specific parenting focus. Further research on prenatal interventions is warranted.

Keywords Prenatal substance use · Addiction · Parenting · Pregnancy · Prenatal interventions · Maternal–fetal attachment

Introduction

Addiction during pregnancy poses a multilevel cumulative risk both to child development and to the development of parenting. Prenatal exposure to various legal and illegal substances has been robustly associated with problems in fetal growth, prematurity, and child health [1], with long-term consequences to self-regulation [2], mental health and

behavioral problems [3], and substance use [4] in the developing child.

In addition to the proximal, direct biophysiological exposure effects, a variety of distal, psychosocial risks intrinsic to maternal substance use also greatly impact both child development and parenting [5]. These risks include socio-economic problems, a lack of social support, being a single mother, or having a substance-using partner. Furthermore, mental health problems, including depression [6], post-traumatic stress disorder [7,••], and personality disorders, especially borderline personality disorder [8], are common among substance-using mothers. Finally, substance-using mothers typically have highly insecure and traumatic attachment histories [9], often characterized by repeated experiences of childhood maltreatment [10] and/or intimate partner violence in adulthood [11].

Early parent–child interaction is a central component mediating the cascade of proximal and distal risks to child development [12, 13]. Substance-using mothers often show pervasive problems in establishing sensitive interactions with their children [14] and display harsh, intrusive, or extremely withdrawn interaction patterns [15, 16], bordering

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on high risk for maltreatment and foster care placements [3, 17]. Parenting has gradually become one of the key targets of treatment for prenatally substance-using mothers [18].

Pregnancy has been described as a “window of opportunity,” featuring enhanced treatment motivation for substance-using mothers [19, 20]. There is also an increasing understanding of the role of pregnancy process in the development of parenting among substance-using mothers, with an emphasis on prenatal interventions targeting the maternal–fetal attachment bond as well as the maternal ability to reflect upon her baby, mothering, and her own attachment history [21, 22]. Furthermore, the roles of maternal prenatal stress and emotion regulation have been increasingly acknowledged as vital to prenatal substance use interventions [23, 24.●●●]. Thus, this review article focuses, first, on the prenatal development of parenting and the multiple, interconnected neurobiological and psychosocial factors potentially affecting parenting among substance-using mothers. These factors and their interplay with a mother’s pre- and postnatal substance use, parenting, and child development are illustrated in Fig. 1. Second, we review the existing literature on prenatal interventions targeting this complex myriad of distal and proximal risk factors crucial to the development of parenting, as displayed in Table 1.

Review of Specific Risk Factors Potentially Affecting Prenatal Parenting Among Substance-Using Mothers

The Neurobiological Risks of Maternal Substance Use on Prenatal Parenting

Prenatal substance use impairs maternal parenting capacities by dysregulating three neural–hormonal systems vital to parenting [25, 26, 27.●●●]. These systems include the maternal stress (glucocorticoid system), reward (dopamine),

and affiliation (oxytocin) systems. Addiction and stress are intertwined, often leading to “dual” exposure to both substances and prenatal toxic stress [26, 27.●●●]. Stressful events, especially parenting-related stress, also strongly trigger cravings and relapses [26], whereby prenatally distressed mothers are more likely to relapse [28, 29]. In terms of the reward system, substance-using mothers show blunted neural responses to positive cues from their infant in brain areas associated with rewards, suggesting that their reward circuits are co-opted by addiction instead of pleasure from the infant [26]. Finally, abnormalities in the maternal oxytocin system, a hormone crucial for high-quality maternal caregiving, associate with postnatal parenting problems [27.●●●]. Mothers with addiction may also show an impoverished neural discrimination of infant facial and vocal emotional cues at least postnatally [30], although research remains lacking on whether these deficits are already present during pregnancy. Such findings suggest global deficits in the neural, substance-related mechanisms of caregiving that should be targeted already during pregnancy by simultaneously supporting abstinence, emerging motherhood, and a relationship with the fetus.

The Psychosocial Risks of Maternal Substance Use on Prenatal Parenting

The core psychological task of pregnancy is to develop maternal–fetal attachment, an increasingly intensive affective bond towards an unborn child, while simultaneously beginning to recognize the child as a separate person [31]. This process is also accompanied by the development of prenatal representations, that is, cognitive–emotional information-processing models of the unborn baby and oneself as a mother [32]. This forms the basis for a maternal identity and the relationship to the baby [33, 34]. During pregnancy, a shift occurs towards a new behavioral–motivational system, namely, a caregiving system [35], with a specific focus

Fig. 1 Neurobiological and psychosocial risk factors and pathways for maternal pre- and postnatal substance use, parenting, and child development

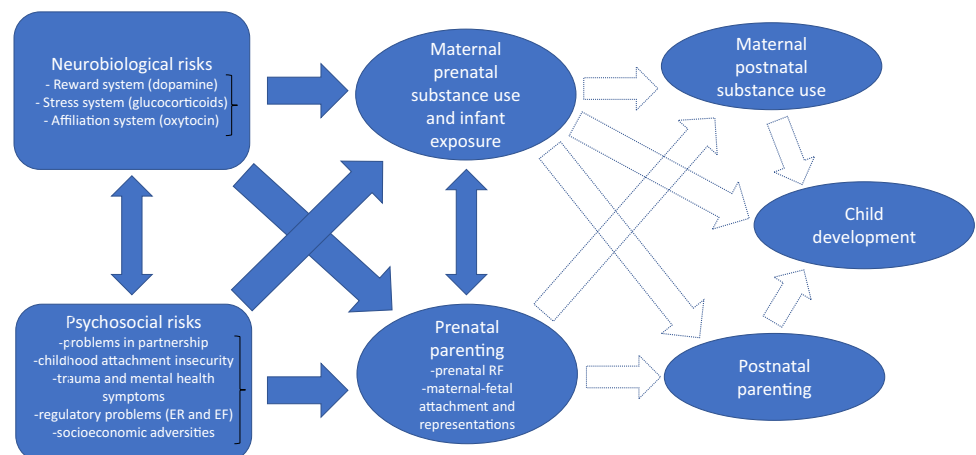


Table 1 A summary of studies about prenatal interventions for substance-using mothers

<i>Author(s) (year)</i>	<i>Article type</i>	<i>Study sample and design</i>	<i>Intervention(s) and their main components</i>	<i>Main results</i>	<i>Pre- or postnatal</i>
Review articles					
Neger & Printz [65]	Review article	21 outcome studies of dual parenting and substance use interventions targeting parents, 31 studies (24 cohort studies, 3 quasi-experimental studies, and 4 RCTs) with integrated substance use interventions	Different integrated interventions focusing on both substance use and parenting	Dual interventions are effective in improving substance use and parenting	Mostly postnatal interventions
Niccols et al. [66]; Niccols et al. [67]	Two review articles	31 studies (24 cohort studies, and 4 RCTs) with integrated substance use interventions	Different integrated substance use interventions including on-site pregnancy-, parenting-, or child-related services	Infants of mothers in integrated treatment showed better development and growth than the infants of untreated mothers, and greater improvement in emotional and behavioral functioning than the infants of mothers in nonintegrated interventions Integrated interventions were effective in improving parenting skills	Mostly postnatal interventions
Ashley et al. [68]	Review article	38 studies (7 RCTs, and 31 non-RCTs) on women-only substance use interventions	Interventions including women-specific components: child care, prenatal care, women-only programs, supplemental services, and workshops that address women-focused topics, mental health programming, and comprehensive programming	Providing women-specific services associated positively with treatment completion, the length of stay, decreased substance use and mental health symptoms, improved birth outcomes, employment, self-reported health status, and HIV risk reduction	Mostly postnatal interventions
Calhoun, Conner, Miller & Messina [70]	Review article	4 RCTs of interventions targeting either substance-using parents or their children together with parent(s)	Interventions aimed at substance-using parents with or without their children, aimed at enhancing family functioning and parenting	Interventions that focus on improving parenting practices and family functioning may be effective in reducing problems in children affected by parental substance abuse	Only postnatal interventions, some with older children

Table 1 (continued)

Author(s) (year)	Article type	Study sample and design	Intervention(s) and their main components	Main results	Pre- or postnatal
Milligan et al. (2011)	Meta-analysis	10 studies on integrated interventions with infant outcome data	Integrated interventions targeting parenting and substance use	Compared to untreated families, infants of mothers in integrated treatment had better growth, fewer birth complications, and less exposure Compared to families in nonintegrated treatments, infants were less often premature and mothers attended more prenatal visits	Prenatal interventions with postnatal outcomes
Prenatal parenting support interventions					
Black et al. [72]	Empirical study	An RCT among 60 substance-using women (31 in the intervention group and 29 in the comparison group)	Parenting support intervention: primary care in a multidisciplinary clinic, biweekly visits by a nurse from pregnancy to 18 months	Intervention specifically improved parenting, with some marginally significant positive effects on child health	From prenatal to 18 months
McMurtrie, Rosenberg, Kerker, Kan & Graham [73]	Empirical study	A study among 192 crack cocaine using adults entering a treatment service during 1990–1994, 101 of whom were long-term clients (mean stay, 100 days)	Parenting support intervention: an inpatient, PACE intervention	Fetal exposure and birth outcomes improved for infants whose families received the long-term PACE intervention (over 42 days)	Most started the intervention during pregnancy
Grossmann et al. (2019)	Empirical study	A naturalistic implementation study in NICU on improving nonmedical care of 287 infants with NAS	Parenting support intervention: prenatal counseling supported parents to be present for their infants during NAS treatment, in addition to a more comprehensive medical treatment model	The new treatment model greatly decreased the length of hospital stay, morphine use, and financial costs of treating infants with NAS	Parental counseling was conducted prenatally, although the intervention was mainly postnatal
Attachment- and mentalizing-based interventions					
Suchman et al. [75]	Empirical study	An RCT among 87 mothers and their infants or young children, randomly assigned to mentalization-based MIO intervention or psychoeducation	Attachment/mentalizing-based intervention: a 12-week individual therapy MIO intervention to improve maternal emotion regulation and promote secure attachment and a positive mother-child interaction	Mothers in the MIO intervention showed a higher RF capacity and their children had more secure and less disorganized attachments than controls	Postnatal intervention

Table 1 (continued)

Author(s) (year)	Article type	Study sample and design	Intervention(s) and their main components	Main results	Pre- or postnatal
Slade et al. [76]	Empirical study	An RCT among 156 non-substance-using mothers, 77 in the intervention group (mentalization-based MTB intervention) and 79 controls receiving pre- and postnatal care as usual	Attachment/mentalizing-based intervention: MTB, an intensive, interdisciplin-ary home visit intervention, including help with parent-ing, trauma, and mental health as well as practical issues Intervention is based on infant–parent psychotherapy, adult psychotherapy, family/ couple counseling, and support for the mother to experience, explore, and a move towards resolving the impact of trauma	Mothers in MTB showed a higher increase in RF and their children had more secure and less disorganized attachments than controls	From pregnancy to the child’s second birthday
Pajulo, Pajulo, Jussila, & Ekholm [22], Jussila, Ekholm & Pajulo (2020); Jussila, Pajulo & Ekholm (2019)	A description of the interven-tion protocol Two empirical studies	An RCT among 90 substance-using mothers (46 in the intervention group and 44 in the control group)	Attachment/mentalizing-based intervention: a pregnancy-specific mental-ization-based intervention aiming to improve maternal RF and prenatal attachment via an interactive ultrasound consultation and a preg-nancy diary	Attending an ultrasound was higher for the intervention group, and viewing the fetus was touching to the mothers No effects on self-reported parenting, psychological distress, fetal drug expo-sure, and perinatal child outcomes	Prenatal intervention
Self-regulation-based interventions Milligan, Usher & Urbanoski (2017)	A description of the theo-retical model of integrated substance use intervention and a qualitative study	6 client focus groups ($n = 50$) were conducted to explore client perspectives on integrated treatment and characteristics of the therapeutic relationship they found most/least helpful using qualitative methods (thematic analysis)	Self-regulation-based inter-vention model: substance use intervention framework with a focus on client emo-tion regulation and executive functioning and counselor behaviors that support those	Results showed that specific counselor behaviors support client emotion regulation and executive functioning in substance use treatment	Pre- and postnatal intervention
Body-oriented interventions					

Table 1 (continued)

Author(s) (year)	Article type	Study sample and design	Intervention(s) and their main components	Main results	Pre- or postnatal
Short et al. (2017)	Empirical study	A pre-post-test design among 59 mothers enrolled in treatment for substance use disorder	Self-regulation/body-oriented parenting intervention: a 12-week mindfulness-based MBP program was added to the treatment of mothers with substance use disorder	Intervention decreased both general and parenting stress	Pre- or postnatal: participants were between 28 weeks gestation and 36 months postpartum
Gannon, Mackenzie, Hands, Short & Abatemarco (2019)	Empirical study	A pre-post-test design among 120 parenting women enrolled in an opioid treatment program	Self-regulation/body-oriented, trauma-informed parenting intervention: a trauma-informed model of the RE-AIM framework was applied to the 12-week MBP intervention in a drug treatment program, which targets stress regulation, parenting, and dyadic attachment between the mother and child	The intervention was feasible and improved parenting from pre- to post-test	Pre- or postnatal: participants were between 28 weeks gestation and 36 months postpartum
Trauma- and mental health-informed treatment models					
Bosk, Paris, Hanson, Ruisard & Suchman (2019)	A description of new interventions for substance-using parents and their children	Describes four new comprehensive intervention models for treating substance-using mothers and their children	Trauma-informed, mentalization- and self-regulation-based intervention in residential care: C.A.R.E. model: trauma-informed elements are combined with residential care lasting for at least 6 months; comprises group, substance use, and trauma counseling as well as psychotherapy (CPP) that target parenting, substance use, trauma, RF, and emotion regulation	No effectiveness results yet: clinicians using the model have noticed changes in their clients' self-efficacy, trauma symptoms, anxiety, depression, and sleep disturbances	Prenatal or postnatal (up to a 5-year-old child)
Inpatient or residential treatment					
Lester & Twomey [92]	Review article	Eight residential or outpatient studies on pregnant and parenting mothers with substance use disorders	Residential care/comprehensive interventions: various comprehensive residential and outpatient treatment models for substance-using women, some with a home visit component	Residential and other intensive comprehensive interventions may improve practical life, reduce substance use, and increase parenting skills	Prenatal and postnatal interventions

Table 1 (continued)

Author(s) (year)	Article type	Study sample and design	Intervention(s) and their main components	Main results	Pre- or postnatal
McComish et al. (2003)	Empirical study	39 women in residential treatment: mood and parenting attitudes measured pretreatment, every 3 months until the end of treatment, and at 6-month follow-up	Residential care/comprehensive interventions: family-focused care targeting substance use, mental health, parenting, and child development	Psychosocial status and parenting attitudes improved in long-term residential treatment It also provided an opportunity to support child development	Postnatal (children < 3 years old)
Pajulo (2006); Pajulo (2012)	Description of an RF-based treatment model in residential care Empirical study	A pre-post-test design among 34 mothers in residential treatment for substance use	Residential care/comprehensive interventions: integrated support of maternal substance use, parenting, mental health problems, peer support, and practical help Focus on maternal RF	Maternal RF increased during residential treatment, and a lower postnatal RF predicted substance use relapses and foster care placements	Pre- and postnatal treatment
Paris (2015)	Empirical study	A pre-post-test design among 66 substance-using mothers in treatment with BRIGHT intervention model	Residential care/comprehensive interventions: BRIGHT is a treatment module that can be used in residential or outpatient care contexts It aims to address substance use, parenting, maternal mental health and emotion regulation, RF, and child development It also utilizes CPP	Women with the highest levels of distress showed a significant decrease in mental health symptoms and an increase in RF as a result of the intervention	Pre- or postnatal treatment
Vazquez & Bergin [96.●●]	Empirical study	A pre-post-test measure among 100 substance-using pregnant mothers in inpatient care	Residential care/comprehensive interventions: a 90-day residential intervention that includes individual therapy and psychoeducation, parenting education, substance use treatment, and case management	Participants showed a greater sense of competence in parenting, fewer feelings of isolation, and lower depression scores post-treatment	Prenatal treatment lasting into the postnatal period

Table 1 (continued)

Author(s) (year)	Article type	Study sample and design	Intervention(s) and their main components	Main results	Pre- or postnatal
Myra et al. [98], Myra et al. [21]	Two qualitative studies	8 in-depth interviews of mothers in involuntary treatment were analyzed qualitatively Focus group interviews among 40 therapists providing both voluntary and involuntary substance use treatments analyzed qualitatively	Involuntary treatment: involuntary residential treatment, focus on attachment to the unborn child, and remaining abstinent	Most mothers in the study enrolled in involuntary treatment because they felt otherwise powerless to remain abstinent during pregnancy The intervention specifically supported attachment to the fetus	Prenatal

CPP child–parent psychotherapy, *MBP* mindfulness-based parenting, *MIO* Mothering from the Inside Out, *MTB* Minding the Baby, *NAS* neonatal abstinence syndrome, *NICU* neonatal intensive care unit, *PACE* Parent and Child Enrichment, *RCT* randomized control trial, *RF* reflective functioning

on attachment to and protection of the baby. Stern's [34] concept of the "motherhood constellation" characterizes a mother's gradual development of the capacity to fully concentrate on the infant's needs and temporarily set aside other facets of her life. This process may be particularly difficult for mothers with addiction who are neurobiologically and psychologically motivated to preoccupation with substance use instead of the infant [26]. During pregnancy, mothers also reformulate their pre-existing representations of their partner to encompass fatherhood and being part of a family triad [34, 36.●●]. Mothers with addiction are often single parents or experience difficulties with their partner, such as a partner's substance use or intimate partner violence [5, 11], making prenatal representational processes more vulnerable. Mothers with addiction have indeed found to show more negative representations of their partner during pregnancy [37].

The mental and physical changes accompanying pregnancy often activate deeply embodied memories of one's childhood attachment to their own parents, which serve as the building blocks for one's own maternal identity [33, 34]. Since adverse childhood experiences are common in substance-using mothers [9], this process is inherently more complex and may lead to harmfully empty, narrow, or idealized view instead of a realistic maternal identity [37].

Maternal–fetal attachment and a mother's prenatal representations are important because they provide the basis for actual postnatal mother–infant interactions and child attachment [38.●●●, 39], possibly even predicting a risk for foster care [40]. More negative or unrealistic representations during pregnancy risk disturbing the quality of the postnatal relationship among substance-using mothers [37, 41], potentially translating into hostile, intrusive, or disengaged patterns of parenting. The role of the maternal–fetal relationship is also intertwined with prenatal substance exposure: mothers with a stronger attachment to their unborn child are also more likely to remain abstinent during pregnancy [42].

Maternal mentalization, operationalized as reflective functioning (RF), refers to her capacity to be curious and reflect upon emotions, experiences, thoughts, and intentions underlying behaviors and reactions, both her own and her child's. This capacity is considered a crucial determinant of maternal interactive behavior [43, 44]. Parental RF is the caregiving-related capacity that mediates the effects of one's childhood attachment experiences on one's own parenting behaviors [44, 45]. Traumatic or insecure childhood attachment often hinders the mother's full capacity to use RF to make sense of an infant's cues and respond to them appropriately. Berthelot and colleagues [46.●●] demonstrated that low maternal prenatal RF mediated the effects of childhood maltreatment on her prenatal mental health problems. Furthermore, a higher prenatal RF associates with a stronger sense of parenting competence experienced prenatally, and more intensive and

positive maternal–fetal attachment among high-risk mothers [46.●●, 47.●●]. On average, substance-using mothers display a weak RF already during pregnancy [48, 49]. Prenatal level of RF has been found to predict both the quality of postnatal mother–infant interaction and the probability of abstinence in follow-up among substance-using mothers [48, 50].

The Role of Prenatal Emotions and Regulation During Pregnancy

Emotion regulation (ER) refers to “the extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to accomplish one’s goals” [51]. Thus, ER is vital to regulating distress and crucial in providing a parental regulatory capacity for infant distress. Deficits in ER often arise from trauma and mental health problems common among substance-using mothers. Substance use can be conceptualized as a deviant form of ER when more adaptive strategies are lacking [52, 53].

Pregnancy is a highly ambivalent period for substance-using mothers, simultaneously characterized by hope and motivation for change, but also by an increased vulnerability and emotional turmoil. Pregnancy-related activation of traumatic or adverse childhood memories, in conjunction with attempts to stop using substances, often lead to heightened distress and dysregulated negative emotions [9, 54] as well as intense feelings of guilt [55]. To help relieve this distress, prenatal interventions should also help women to identify new means of ER instead of substance use.

ER is also highly associated with the cognitive form of self-regulation, namely, executive functioning (EF) [56, 57]. Both capacities are also vital to maternal parenting [58] and associate with RF capacity [59, 60]. A recent study documented problems in EF among substance-using mothers [61]. EF implies the higher-order cognitive processes supporting effective problem-solving and goal-directed behavior [23], including the core functions of cognitive flexibility, working memory, and inhibitory control, as well as higher-order functions such as planning and self-monitoring [62]. EF may also greatly affect the flexibility and planning needed in parenting, as well as concrete problem-solving related to practical issues such as education or housing often relevant to mothers with addiction. ER and EF deficits are also central to both the initiation and maintenance of substance use [53, 63]. They should thus be jointly targeted in treatment, starting from pregnancy.

Review of Prenatal Interventions for Substance-Using Mothers

Table 1 summarizes studies about prenatal parenting interventions for substance-using mothers. For more than a decade, researchers have argued for early interventions specifically tailored to the needs and problems of parents with addiction, together with their children [48, 64]. Consensus exists that these families need comprehensive and integrated services comprising support for adverse life conditions, medical and psychosocial aid to treat addiction, and help for early parenting and developing attachment with their baby already prenatally [65–67]. In addition, maternal psychosocial needs should be addressed. For instance, a review of 38 women’s substance abuse treatment studies found that more positive treatment outcomes associated with the provision of practical issues such as prenatal care and childcare [68]. In the development of these services, trauma and mental health knowledge should be utilized [69.●●].

Most previous studies have focused on postnatal substance use interventions. In a review of 21 postnatal outcome studies of integrated treatment models [65], most decreased substance use and parenting problems. A review of randomized control trials [70] indicated that substance use interventions that improve parenting practices and family functioning may also positively affect child development.

A meta-analysis by Milligan and colleagues [71] showed that the children of mothers in prenatal integrated services had less physical exposure effects related to fetal growth, prematurity, and birth complications than the children of untreated substance-using mothers. Mothers in integrated substance use interventions showed higher prenatal care attendance and lower rates of preterm births than those attending nonintegrated substance use interventions. Similarly, Niccols et al. [66, 67] indicated in their two review articles of pre- and postnatal interventions that, while all substance use interventions enhanced child growth and physical development, integrated rather than nonintegrated interventions were effective for child behavioral and social emotional functioning as well as for increasing parenting skills. However, most previous reviews have not differentiated between pre- and postnatally initiated interventions or the interventions they describe have not included a parenting component specifically tailored to pregnancy. Furthermore, the core components of prenatal substance use interventions have not been described. Here, we thus aimed to delineate these core intervention components, supplemented with the theoretical framework presented above emphasizing the various neurobiological and psychosocial risk factors affecting both pre- and postnatal parenting.

Prenatal parenting support interventions were initially developed in the 1990s largely in response to the

crack cocaine epidemic. These interventions usually have a rather broad and practical focus [72], aiming to create positive changes in caregiving and a child's home environment, as well as to prevent child neglect and abuse. Parental ability to mobilize social support is emphasized, including family and other social networks as well as professional help. McMurtrie and colleagues [73] found that the infants of long-term clients of the Parent and Child Enrichment (PACE) intervention had greater mean birth weight and less intrauterine growth retardation than infants in comparison groups. Fetal exposure to cocaine decreased dramatically among women enrolled for 42 or more days during their pregnancy. In addition, the home visit intervention run by Black and colleagues [72] decreased maternal drug use and improved parenting quality more than a comparison treatment without home visits. A more recent example of such an intervention was described by Grossmann and colleagues [74], where prenatal counseling for mothers with addiction was used as a part of a comprehensive medical intervention to improve hospital care for infants with neonatal abstinence syndrome (NAS). Counseling aimed to empower mothers in their important roles to be present and provide comfort to their infants as much as possible during NAS treatment. A comprehensive intervention was found to decrease the length and costs of hospital stays for infants and to reduce their need for morphine.

Attachment- and mentalizing-based interventions focus on improving the mother–child attachment relationship. Such interventions concurrently target the behavioral level, including maternal interactive behaviors, and the representational level, including the maternal pre- or postnatal representations of the baby and parenting as well as maternal RF. In relation to interactive behavior, mothers receive multilevel support in the interpretation of and response to their infant's interaction signals (that is, being sensitive). Different from behavioral guidance alone, increased curiosity towards the child's experiences and more accurate interpretations of a child's interaction signals are considered key mechanisms of improving the parent–child interaction [64]. Postnatal or combined pre- and postnatal attachment- and mentalizing-based interventions [75, 76] have shown some promising results towards improving maternal RF, the mother–child interaction, and a child's secure attachment among high-risk families.

Thus far, only a few studies have explored the effect of attachment- or mentalizing-based interventions during pregnancy. Pajulo and colleagues report in a series of papers on their recent innovative prenatal intervention study [22, 77.●●●, 78.●●●], where three four-dimensional interactive ultrasound sessions were offered to the intervention group during the third trimester of pregnancy. The model was based on pioneering work regarding an ultrasound

consultation method developed by Boukydis and colleagues [79, 80], but with an added RF focus. The model aimed to increase maternal curiosity and interest in fetal development and foster a perspective helping the mother recognize her own experiences while watching the fetus and prompting her to think about becoming a mother to this particular child. This intervention also included a new pregnancy diary, with sections, for example, focused on gradually developing fetal capacities and personal characteristics week-by-week, mentalization of the baby and parenthood, and reflecting upon the pregnancy experience [22, 81]. The efficacy of the intervention was tested using a randomized control trial design in a maternity outpatient clinic specializing in the follow-up of substance-using mothers in collaboration with child welfare agencies. The intervention was well accepted, with an especially high attendance rate during the ultrasound sessions. Watching fetal facial features was self-reported by the mothers as particularly impressive. However, no statistically significant group differences were found in the outcomes explored and with the methodology used: self-reported prenatal mentalization and psychological distress, hospital record–based fetal drug exposure, and perinatal child outcome [77.●●●, 78.●●●].

Self-regulation-based intervention models are presented here as their own category, given their specific role for maternal emotion dysregulation during pregnancy, as described earlier. These models emphasize the role of the underlying affective and cognitive regulatory processes in parenting and addiction. For instance, Suchman et al. [64] suggested that mothers first need support in their own emotion regulation before they can facilitate their child's developing self-regulation. As such, Milligan et al. [23] developed a comprehensive theoretical framework and treatment model, using self-regulation as depicted by emotion regulation (ER) and executive functioning (EF) as key target concepts. In their qualitative study using focus group interviews, they extracted specific counselor behaviors that explicitly supported ER (e.g., a nonjudgmental attitude and empathic listening) and EF (e.g., the simplification of procedures, action-oriented and goal-directed support, and parent coaching adapted to the maternal learning style).

Body-oriented interventions can be considered a specific type of self-regulation-based intervention and may benefit traumatized and substance-using mothers [82, 83]. Given that pregnancy and parenting a young infant are strongly embodied experiences, and emotion regulation has physiological components, body-oriented interventions may also be important during pregnancy. Thus far, only a few studies have incorporated body-oriented therapeutic modalities into the treatment of substance-using mothers, with none specifically tailored to pregnancy alone. Mindfulness-based interventions have proved feasible and effective among pregnant and parenting mothers of 0- to 3-year-old children attending

drug treatment programs, ultimately improving parenting and dyadic attachment [84, ●●] and decreasing both general and parenting-related stress [85].

Trauma- and mental health-informed treatment models are theoretically close to attachment- and self-regulation models and are often used in combination with them. A mother's complex, early-life history of attachment trauma, such as experiences of abuse and neglect, may biologically and behaviorally dysregulate her parenting capacity [86, 87]. Until recently, substance use disorder interventions have rarely been trauma-informed or included concurrent treatment for mental health disorders [88, 89], although both trauma activation and mental health issues may emerge when the mother abstains from substance use during pregnancy. Trauma-informed care emphasizes trustworthiness and openness throughout the entire treatment process, including elements of client safety, peer support, collaboration, cultural sensitivity, and empowerment of the client [90, 91]. This approach also alleviates the stigmatization of substance-using individuals who, instead of being regarded as "deficient" or "unmotivated," are now considered from the perspective of having unresolved trauma. For example, the C.A.R.E model combines trauma-informed treatment elements pre- and postnatally for mothers in residential care for substance use [69, ●●]. Clinicians using the model have observed changes in their clients' self-efficacy, trauma symptoms, anxiety, depression, and sleep disturbances [69, ●●].

Most of the approaches described above include several shared components which are specifically embedded together in more comprehensive treatment programs. *Inpatient or residential treatment* can be employed to treat mothers with severe substance use disorders, representing the most comprehensive and multifocus treatment models for pregnant women, usually extending into the postpartum period. Residential treatment has proved effective in terms of abstinence, employment, psychological distress, parenting, and criminal problems [92]. Moreover, such programs have the possibility of focusing on multiple issues simultaneously: substance use, general parenting skills, reinforcing parent-child attachment, psychoeducation, practical support, and the relevant therapeutic and medical care [48, 93].

BRIGHT, an attachment- and trauma-focused intervention that can be used in residential settings, is based on evidence-based child-parent psychotherapy (CPP) treatment [94]. Substance abuse treatment and concrete assistance with daily life problems are additional essential components of BRIGHT. Child development is supported through developmental guidance and the use of activities such as play and physical contact. Enhancing maternal RF and ER are also included in BRIGHT. Women with the highest distress have shown a significant decrease in mental health symptoms and an improved RF as a result of this intervention [95].

Vazquez and Bergin [96, ●●] described their 90-day inpatient intervention program for substance-using pregnant women. In addition to more traditional treatment elements (e.g., psychoeducation, sobriety classes, medically assisted detox, and case management), mothers received a combination of parenting education and an individual therapeutic program. The intervention reduced parenting stress, isolation, and depressive symptoms, and increased parenting competence.

Pajulo and colleagues [48, 97] described "Holding tight," the residential national treatment model, which has been under continuous development in Finland since the late 1990s for mothers with a severe substance use disorder. The program simultaneously targets parenting and substance use from pregnancy onwards, emphasizing increasing maternal RF and the quality of the mother-child relationship in everyday interaction situations. Parenting support is also offered in separate group meetings, promoting peer support, individual counseling, and through daily-life practical assistance. Referral to mental health treatment, help in managing the authorities (e.g., social services, legal issues), daily chores, and enhancing social networks may also be addressed based on individual's needs. In the first evaluation [48], parental mentalization capacity was found to increase during the intervention from pregnancy to postpartum. In addition, mothers with a higher RF at the end of the residential treatment period relapsed less frequently during the 2-year follow-up period and were more likely to retain custody of their child. Currently, we (the authors of this paper) are carrying out a new evaluation of the entire Finnish "Holding tight" program, focusing on parenting, mentalization, and ER.

One specific form of residential care is *involuntary treatment*. Norway is the only European country with legislation allowing for the involuntary treatment of pregnant mothers with addiction in cases where voluntary treatment is insufficient to safeguard fetal health. Mothers themselves often seek this type of treatment since they feel powerless to abstain [98]. Maternal-fetal attachment has been found to improve in both voluntary and involuntary treatment contexts, interestingly, perhaps more so during involuntary care [21]. According to a qualitative study, viewing a fetal ultrasound was experienced as quite important for mothers in involuntary treatment, allowing them to emotionally attach to the unborn child [98].

Conclusions

During the past 30 years, the development of intervention models has evolved from general parenting support and skills training into more specific attachment-based interventions that promote maternal reflective functioning, emotion regulation, and recovery from trauma and mental health

problems. Similarly, there has been a trend from previously fragmented services targeting either substance use or parenting into more effective integrated, multiservice “one-stop shop” treatment models that better serve the multiple biomedical and psychosocial needs of these mothers [99].

While many countries provide these types of comprehensive services, Meixner et al. [99] in their review stated that services remain too heterogeneous, with programs designed to match community needs and resources, whereas program evaluations and the dissemination of findings about best practices largely remain lacking. More comprehensive theoretical models are therefore needed to guide these perinatal services. This article attempts to delineate the most crucial components in the care related to prenatal substance use and parenting.

Given the increased understanding of pregnancy processes, treatment programs increasingly encompass the prenatal period, while often comprehensively extending into the postnatal period. Although precious few intervention studies have clearly differentiated whether certain treatment elements are particularly important or helpful during pregnancy, there have been a few promising attempts [22].

Supporting maternal–fetal attachment represents a crucial component in most modern, pregnancy-focused substance use interventions. Essentially, pregnancies are often unplanned, and substance-using mothers may be biologically and psychologically motivated by addiction rather than motherhood, thereby hindering the development of maternal–fetal attachment and other pregnancy processes. A higher maternal RF is suggested to serve as an important route towards a stronger maternal–fetal attachment.

However, little scientific evidence exists regarding how precisely and how effectively different elements and routes affect substance-using pregnant women’s situations and parenting. Randomized control trial studies are rare in the field. Although such studies would provide the most rigorous evidence of effectiveness, it is often not ethically or practically possible to conduct them in these vulnerable, high-risk populations. Some new, innovative assessment methods have also been applied in the field of prenatal substance use. For instance, *ecological momentary assessment* [7.●●] enables multiple daily-life assessments, thus providing a way to measure the flow of temporal associations between different risks and protective factors related to prenatal substance use, parenting, and their interventions.

Additional new avenues may include incorporating body-oriented therapies such as mindfulness to prenatal interventions in order to reduce stress and provide a space for developing motherhood [84.●●]. Maternal substance use disorder is often associated with a history of unresolved trauma, where body-oriented interventions as well as general trauma-informed care are particularly important. Furthermore, work with other high-risk populations has suggested

that interventions relying on experiential elements that support the pregnancy process, such as stroking the baby in the womb, singing, or talking to them, may benefit the mother–infant relationship [100, 101.●●]. Yet, research among substance-using mothers remains lacking.

New digital, technology-assisted treatment models may also show promise. While Hai and colleagues [102] in their review found that digitally based interventions (e.g., games or virtual reality technologies) were not necessarily effective among substance-using women, little is known regarding if such interventions could be helpful as part of more comprehensive interventions. To our knowledge, digital interventions have not yet been specifically developed for pregnancy or for parenting among substance-using mothers and therefore their utility as part of prenatal interventions remains unclear. Such tools may serve to replace the mother’s reward system with pleasure related to the baby instead of substances. Virtual treatments have already proved successful for other trauma patients [103.●●] and may be useful among pregnant substance-using mothers in the treatment of both trauma symptoms and parenting.

Pregnancy should be viewed as a crucial phase in the emerging mother–child relationship, with services designed for high-risk mothers starting as early as possible during pregnancy. Identifying mothers in need is, however, challenging, since pregnant mothers are often especially reluctant to disclose their substance use to healthcare providers, and adopt harmful strategies to avoid detection, such as isolation and missing prenatal appointments [104, 105]. Substance-using mothers often fear stigmatization, losing custody of their child, or are reluctant to leave other family members in order to attend treatment. Furthermore, practical issues, such as a lack of childcare and transportation, constitute obstacles to treatment access [106.●●].

Opportunities to receive treatment without automatic penalties should be more easily available as well as better access to comprehensive, multilevel care [106.●●, 107]. Services need to be continuum-based such that mothers receive care from the same providers from pregnancy through the postnatal period, in order to establish trusting, secure relationships. Due to the highly complex nature and recurring relapse risks inherent in substance use, early pre- and postnatal treatments also need to feature a long-term focus, taking into account the mother, child, and possible partner as well as others in their family and social networks, and establishing careful plans for follow-up and monitoring.

Moreover, focusing on fathers has been notoriously insufficient in the research concerning parenting interventions for substance-using mothers [108], probably because many mothers are single or the fathers themselves have substance use disorders and may not always be motivated for treatment. However, fathers participating in substance use treatment have reported mostly positive attitudes

towards parenting interventions [109]. Even considering legal addictions, such as nicotine, few interventions involve fathers, despite the fact that fathers' participation has proved helpful for mothers in quitting smoking during pregnancy. Huizink et al. [110] and Neger and Printz [65] suggested that the involvement of significant others in interventions may also help maintain the beneficial changes following the end of an intervention. Many substance-using individuals become isolated after reaching abstinence, since many of their previous networks may have consisted of others also using substances. Support from a peer group and in finding community resources may be particularly useful. Peer support may also help individuals to cope with the guilt inherent in maternal substance use.

The psychosocial and medical realities of these women should always be kept in mind when designing interventions. Parenting interventions alone may not lead to reduced substance use. Furthermore, general parenting interventions may not suffice for this special high-risk population, but they need tailored interventions that also address their unique psychosocial and mental health needs [111,••]. Despite the importance of resolving trauma and attachment issues, practical realities such as housing-, poverty-, and unemployment-related issues should always be equally addressed.

In summary, we suggest that both prenatal inpatient and outpatient interventions should include multidisciplinary and multifaceted help addressing the medical follow-up of pregnancy and child development, need for substitution medication, practical daily-life help, psychological treatment for substance use, including comorbid mental health problems, and support on the developing maternal–fetal attachment. The maternal–fetal relationship can be supported, for example, through group or individual activities helping mothers to connect with the baby in the womb, such as singing or touching the belly, viewing the baby via an ultrasound, or reflecting upon pregnancy or the baby through writing or talking. The baby may be viewed as an active agent in helping mothers to remain abstinent. Mindfulness, yoga, or other body-oriented interventions should be considered in an effort to ameliorate trauma symptoms and ER problems typical among these mothers. Such interventions could potentially prevent fetal exposure to prenatal stress, as well as provide new ways to regulate emotions without substances. The entire family, and extended family, could be included in treatment. Furthermore, treatments should always continue long enough from pregnancy until the postpartum period (and beyond), including long-term support or periodic follow-up of maternal well-being and child development, preferably in the context of reliable, long-term relationships with the same practitioner(s). This treatment continuum lies at the

core of trauma-informed care for vulnerable mothers with insecure attachment histories and substance use disorders.

Declarations

Conflict of Interest The authors declare no competing interests.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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