Article

Psychological Rather Than Obstetric Factors are Associated With Postpartum Anxiety Symptoms in Mothers of Preterm Infants: Findings From Linear and Fuzzy-Set Qualitative Comparative Analyses

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Abstract

Background: Mothers of preterm infants are at increased risk of psychological distress during the postpartum period. Although obstetric variables such as gestational age, multiple birth, and postpartum timing have been associated with maternal anxiety, the role of psychological factors, particularly attachment insecurity and maternal guilt, remains insufficiently understood. This study aimed to examine the combined contribution of obstetric and psychological variables to postpartum anxiety symptoms among mothers of preterm infants.

Methods: A cross-sectional study was conducted with 48 mothers of preterm infants assessed between birth and 24 months postpartum (66.6% late preterm, 20.9% very preterm, 12.5% extremely preterm; 53.6% multiple births; 75% of infants required Neonatal Intensive Care Unit (NICU) admission). Participants completed measures of romantic attachment (Experiences in Close Relationships-Revised (ECR-R)), perinatal anxiety (Perinatal Anxiety Screening Scale (PASS)), and maternal guilt. Group comparisons, correlational analyses, and fuzzy-set qualitative comparative analysis (fsQCA) were performed to identify both linear associations and configurational pathways associated with high and low levels of postpartum anxiety.

Results: No significant differences in anxiety, attachment insecurity, or guilt were found according to degree of prematurity or singleton versus multiple birth. Correlational analyses showed that attachment anxiety was positively associated with total postpartum anxiety, fear, social anxiety, and perfectionism, whereas attachment avoidance was associated with total anxiety, social anxiety, and perfectionism. Maternal guilt was positively related to social anxiety and overall postpartum anxiety. fsQCA revealed that no single condition was necessary for elevated anxiety levels. However, configurations characterized by insecure attachment and maternal guilt consistently emerged as sufficient pathways to higher postpartum anxiety. In contrast, greater gestational age, lower attachment insecurity, and lower guilt were recurrent protective factors associated with lower anxiety symptomatology.

Conclusions: Psychological vulnerability factors, particularly insecure attachment and maternal guilt, appear to play a more prominent role than obstetric characteristics in explaining postpartum anxiety symptoms among mothers of preterm infants. These findings highlight the importance of incorporating early attachment- and guilt-focused psychological assessment and intervention strategies into perinatal and neonatal mental health care, particularly for mothers at increased psychological vulnerability.

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Keywords

postpartum anxiety symptoms; prematurity; maternal guilt; attachment; postpartum period

Introduction

The puerperium is a crucial phase requiring complex biopsychosocial adjustments as women transition into motherhood [1], spanning three clinically distinct stages: immediate (first 24 hours), early (days 2–10), and remote or late (days 11–42) [2]. Consistently, Raphael [3] introduced the concept of matrescence to describe the transition into motherhood, framing it as a pivotal biopsychosocial metamorphosis, encompassing far-reaching psychological, sociocultural, and existential reconfigurations [4]. Neurobiologically, the puerperium period triggers substantial and lifelong structural and functional neuroplasticity [5], with the transformative process extending until approximately the second year postpartum, when maternal identity achieves progressive consolidation [4,6]. The inherent challenges of this adaptation may heighten psychological fragility and increase the risk of mental health difficulties [7].

In this sense, anxiety disorders are the most prevalent mental health conditions worldwide [8], affecting approximately 17.4% of mothers during the perinatal period [9,10]. Postpartum anxiety symptoms may compromise maternal responsiveness to infants' emotional needs, foster hypervigilance and overprotective behaviors, frequently co-occurring with perinatal depression, amplifying its impact on both maternal and infant well-being [9,11–14].

The complexity of this period is intensified when childbirth occurs prematurely—defined by the World Health Organization [15] as delivery prior to 37 weeks of gestation and classified into moderate to late preterm (32–37 weeks), very preterm (28–31 weeks), and extremely preterm (under 28 weeks) [15]. The abrupt interruption of the gestational process raises concerns about infant viability, the physical trauma of emergency surgical interventions, and a more adverse symptomatic trajectory throughout the first postpartum year all of which contribute to a significantly heightened psychological burden in these mothers [1,16–20]. Postpartum anxiety symptoms appears inversely associated with gestational age, with earlier deliveries linked to greater maternal distress, partly due to heightened concerns regarding infant survival and medical vulnerability [21–23]. This distress is further intensified when neonates require Neonatal Intensive Care Unit (NICU) admission, an environment perceived as a traumatic stressor that prolongs hospitalization and exacerbates feelings of emotional anguish and social alienation [24–27].

While the puerperium is inherently a period of high stress, the transition remains multifaceted and influenced by parental attributes, situational contexts, and the infant's specific health profile [19]. In this context, pregnancy type also shapes the postpartum experience, as mothers of twins report significantly higher rates of depression, anxiety, and stress than mothers of singletons, reflecting increased psychological vulnerability resulting from the unique demands of multiple gestation [28,29].

Nevertheless, postpartum adjustment cannot be explained exclusively by non-modifiable obstetric and contextual variables, such as gestational age at birth, postpartum timing, or twin pregnancy [30,31]. Individual psychological characteristics, particularly attachment patterns and maternal guilt, may play a particularly relevant role in shaping how mothers perceive and cope with perinatal stressors, potentially influencing the intensity and manifestation of postpartum anxiety symptoms [30,32,33].

Attachment

Attachment represents the relational bond emerging from dyadic interactions, centered on the provision of safety, solace, and protection. According to Bowlby [34], early interactions with primary caregivers allow children to construct cognitive and behavioral frameworks, known as internal working models, that shape self-worth, the perceived availability of others, and interpersonal behavior throughout adulthood [35,36].

While Ainsworth *et al.* [37] initially identified secure, anxious and avoidant attachment styles, later research identified the disorganized typology [38], frequently observed in individuals with a history of trauma [35]. Broadly, secure attachment fosters a resilient and positive self-concept, whereas insecure typologies often lead to dysfunctional relational patterns. Avoidant individuals suppress intimacy to mitigate the risk of rejection, while anxious individuals display heightened emotionality and relational dependency. Lastly disorganized individuals oscillate between proximity-seeking and withdrawal [38].

In the context of motherhood, insecure attachment is associated with heightened parenting stress, diminished maternal self-efficacy, and compromised mother-infant bonding, while secure attachment serves as a protective factor that enhances a mother's capacity to manage distress and fulfill caregiving responsibilities [39–43]. These dynamics are particularly relevant in preterm populations,

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where lower gestational age is significantly correlated with a higher incidence of insecure attachment [44]. The NICU environment further complicates this relational development; factors such as physical barriers, invasive clinical interventions, and restricted maternal participation in routine care acts as systemic stressors that may undermine the early bonding process [45].

Maternal Guilt

Maternal anxiety across the peri- and postnatal periods is fundamentally intertwined with the construct of guilt [46], defined as the psychological distress arising from the belief that one's past thoughts or actions were inadequate [47,48]. Within the maternal context, guilt is often described as an omnipresent phenomenon [49] that frequently manifests as a perceived failure to embody the "ideal mother" archetype, leading to feelings of inadequacy driven by unrealistic cultural expectations [50].

Various environmental and obstetric factors further intensify this burden: the sense of being relegated by clinical staff, prolonged separation from the newborn, formula feeding, and undergoing a cesarean section have all been identified as significant contributors to heightened maternal guilt during the early postpartum period [32,51,52]. The clinical relevance of guilt is especially evident in the context of neonatal complications. Parents of extremely preterm infants frequently internalize responsibility for the preterm delivery, believing the outcome could have been prevented. Additionally, they often experience further distress related to their perceived level of involvement in neonatal intensive care, as well as guilt over perceived delays in seeking psychological support [53].

Theoretical Framework, Rationale and Research Objectives

While previous literature has independently examined the relationship between gestational age, twin pregnancy, postpartum timing, attachment styles, guilt, and postpartum anxiety symptoms [54,55], research integrating these variables within a single explanatory framework remains limited, particularly in studies focused exclusively on mothers of preterm infants, a population with distinct obstetric and emotional characteristics that may significantly shape the experience of postpartum anxiety symptoms. Furthermore, existing studies on the evolution of maternal psychological distress have primarily adopted linear approaches focused on symptom progression over time [56,57], rather than examining how obstetric and psychological variables may interact to shape anxiety levels [56,58].

Against this background, the present study aims to provide a comprehensive understanding of the factors associated with postpartum anxiety symptoms among mothers of preterm infants. Specifically, it examines how non-modifiable obstetric variables, such as gestational age, twin pregnancy, and postpartum timing, interact with psychological factors, including attachment styles and maternal guilt, in shaping maternal anxiety levels during the postpartum period. Three hypotheses were formulated: (H1) mothers of infants born at lower gestational ages, mothers of twins, and women assessed during earlier postpartum stages will report significantly higher levels of postpartum anxiety symptoms; (H2) insecure attachment styles and greater maternal guilt are expected to be positively associated with anxiety symptomatology, and (H3) the combined contribution of obstetric and psychological variables will significantly predict maternal anxiety levels, differentiating mothers with lower versus higher anxiety symptomatology.

Materials and Methods

Participants

To assemble the study sample, participants were required to meet the following inclusion criteria: (a) being of legal age (18 years or older); (b) having given birth to a preterm infant within the last two years; (c) having read and understood the information provided regarding the study procedures and the voluntary nature of participation; (d) having provided informed consent; and (e) having properly completed the questionnaires included in the battery.

A total of 552 responses were assessed for eligibility between March and April 2026. Of these, 301 were excluded because they did not meet the inclusion criteria (i.e., being aged 18 years or older, having given birth within the previous two years, having read the study information, providing informed consent, and completing the questionnaires). Of the remaining 251 participants, 203 were excluded because they had given birth to a full-term infant. The final analytical sample comprised 48 postpartum women who had given birth to a preterm infant, aged between 28 and 44 years (mean (M) = 36.06; standard deviation (SD) = 3.96).

Variables

The following sociodemographic and clinical variables of the participants and their infants were assessed us-

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ing an ad hoc record developed for this study: age, biological sex, marital status, history of perinatal loss, history of complications during pregnancy, childbirth and the postpartum period. Additionally, the type of delivery and gestational age, along with any neonatal complications, their nature, the duration of neonatal hospitalization was recorded.

The following psychological variables were also assessed: romantic attachment, postpartum anxiety symptoms, and guilt.

Instruments

Similarly, the following psychological variables were evaluated using the instruments described below. It should be noted that certain instruments utilized in this study required formal authorization, which was duly granted by the respective authors.

First, romantic attachment was assessed using the Experiences in Close Relationships-Revised (ECR-R) questionnaire [36] in its Spanish short-form version [59]. This 18-item self-report tool utilizes a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree) to assess two dimensions: attachment anxiety (9 items; e.g., fear of rejection) and attachment avoidance (9 items; e.g., discomfort with intimacy). Seven items are reverse scored to ensure data validity. The scores for attachment anxiety and attachment avoidance were computed as the M total score of the corresponding nine items, yielding a possible score range of 1 to 7 rather than 9 to 63. Higher scores indicate greater attachment insecurity. Participants focused on their romantic history over the last year or, alternatively, on general significant attachments. While Spanish validation reported robust reliability (α = 0.80 for anxiety; α = 0.86 for avoidance), the present study obtained Cronbach's alpha coefficients of 0.85 and 0.60 respectively.

Postpartum anxiety symptoms were assessed using the Perinatal Anxiety Screening Scale (PASS) [60], specifically the 27-item Spanish adaptation [61]. Although all participants were assessed during the postpartum period, the PASS is a validated measure of anxiety across the perinatal period and has been widely used in postpartum populations. This version excludes four original items deemed irrelevant during the cultural adaptation process. Participants rated symptoms on a 4-point Likert scale (0–3) across three subscales: worry and fears (0–24 points), perfectionism (0–21 points) and social/acute anxiety (0–36 points). Total scores were aggregated. Following Somerville *et al*. [60], a total score of $\geq$26 was considered indicative of clinically significant postpartum anxiety symptoms. This cutoff has also been retained in the Spanish validation [61]. The adapted scale previously demonstrated high internal consistency (α = 0.89); in the current sample, the Cronbach's α was 0.94.

Finally, maternal guilt was evaluated through four items designed drawing upon the framework established by Thivierge *et al.* [53] and the specific constructs intended for measurement. Participants responded using a 5-point Likert scale with the last item reverse-scored. Composite scores for the general Guilt factor range from 1 to 5, with higher values indicating more pronounced feelings of guilt. Similarly, maternal guilt was calculated as the M total score across the four items, resulting in a score range of 1 to 5. The exploratory factor analysis supported a unidimensional structure for the guilt measure. Sampling adequacy was acceptable (Kaiser-Meyer-Olkin test (KMO) = 0.68), and Bartlett's test of sphericity was significant, $\chi^2(6) = 50.64$, $p < 0.001$. A single factor emerged, accounting for 56.79% of the total variance, with factor loadings ranging from 0.41 to 0.88. Finally, reliability estimates proved satisfactory for the scale (α = 0.74), a commendable result considering the brief nature of the instrument [62].

Procedure

The research process commenced with participants completing a comprehensive survey battery hosted on the on the Universitat de València's LimeSurvey platform. This stage was preceded by the formal signing of informed consent and a rigorous review of the inclusion criteria. Participants were explicitly briefed on the study's primary objective: which are the configurational factors associated with postpartum anxiety symptoms in mothers of preterm infants.

Recruitment was facilitated through social media outreach, with a focus on Instagram. This involved strategic collaboration with support associations for first-time mothers and families of preterm infants (e.g., Pequeños Grandes Héroes). Additionally, maternal care specialists were engaged via social media to disseminate the survey link among their networks. All participating organizations and professionals received a detailed briefing regarding the study's scope.

Data were collected throughout 2026, under the formal oversight and prior approval of the Ethics Committee of the Universitat de València. The estimated completion time for the survey ranged from 10 to 25 minutes. Although no adverse psychological effects were anticipated by the researchers, participants were provided supplementary information and links to support organizations should they expe-

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rience emotional distress as a result of their participation.

Research Design

The present study employed an observational, cross-sectional, retrospective and correlational-explanatory design, utilizing a quantitative and comparative approach. As an observational study, all variables were measured in their natural context without experimental manipulation. The cross-sectional and retrospective nature of the design reflects data collection at a single time point, with certain measures assessing participant's prior experiences. Furthermore, the correlational-explanatory component of the design, focused on examining the interplay and associations among distinct psychological constructs. A quantitative framework was implemented, enabling the operationalization of psychological variables through statistical analysis of the resulting scores.

Analysis

Data analysis was performed using SPSS statistics, version 28.0 (IBM Corp., Armonk, NY, USA) [63]. Fuzzy-set qualitative comparative analysis (fsQCA) [64] was computed for all study variables. First, continuous clinical and psychological variables were summarized using Ms and SDs, whereas categorical variables were described using frequencies and percentages. Differences in psychological outcomes by degree of prematurity and delivery type were examined using a one-way analysis of variance (ANOVA). Furthermore, Pearson correlation coefficients were calculated to assess the associations among attachment, gestational age, postpartum anxiety, and maternal guilt. Statistical significance was set at $p < 0.05$ for all tests.

An fsQCA was conducted using fsQCA 4.0 (developed by Charles C. Ragin and Sean Davey, Department of Sociology, University of California, Irvine, CA, USA) to investigate which combinations of conditions contribute to high puerperium anxiety, maternal guilt and anxiety-avoidant attachment. The conditions assessed included prematurity, gestational week at delivery, and the type of birth (singleton, twins, triplets or higher-order multiple birth). This methodological approach was considered appropriate given the study's objective to identify combinations of obstetric and psychological factors associated with postpartum anxiety symptoms rather than to estimate the independent contribution of isolated predictors. Unlike conventional linear models, fsQCA accommodates equifinality—the possibility that different combinations of conditions may lead to the same outcome—and causal asymmetry, in which the pathways leading to high postpartum anxiety are not necessarily the inverse of those leading to low postpartum anxiety. Both features are highly pertinent in the context of perinatal mental health [65].

Prior to analysis, all variables were calibrated into fuzzy-set scores following Woodside's [66] percentile-based procedure. The 10th, 50th and 90th percentiles of each variable's distribution served as anchors for full non-membership, the crossover point, and full membership, respectively. This calibration method was selected because the aim of the fsQCA was to identify relative configurational patterns within the observed sample rather than to classify participants according to clinical diagnostic thresholds. As a result, calibration reflected set membership within the observed sample rather than clinical status.

Necessary conditions were subsequently identified using a consistency threshold of 0.90 [67], while sufficiency was assessed with a threshold of 0.74 [68]. The sufficiency analysis relies on a truth table that systematically mapped all possible combinations of conditions and their empirical outcomes, from which complex, parsimonious, and intermediate solutions were derived. The intermediate solution was selected for interpretation, as it represents the most analytically balanced and theoretically interpretable option. Given the relatively small sample size, a frequency threshold of 1 was retained to avoid discarding potentially informative configurations, although this decision may increase the likelihood of identifying sample-specific solutions [67,68].

Solution quality was evaluated through four indicators: overall solutions coverage, reflecting the proportion of outcome cases accounted for by the solution as a whole; overall solution consistency, capturing the degree to which the solution fits a subset relation with the outcome; raw coverage, indicating the proportion of outcomes cases explained by each individual configuration; and unique coverage, quantifying the proportion of cases explained exclusively by a given configuration and not by any other. In line with Ragin [67], raw coverage was treated as the primary indicator of causal relevance.

Results

Descriptive Analysis of the Sample

The sample consisted predominantly of heterosexual women (91.7%), with the majority being married (39.6%). Regarding obstetric complications, 77.1% of the participants reported experiencing difficulties during delivery,

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with emergency cesarean section (29.2%) and scheduled cesarean section (10.4%) being the most frequently reported modes. Within this subgroup, emergency cesarean section was the most common mode of delivery (43.8%), followed by spontaneous vaginal birth (37.5%).

In terms of gestational complications, the most prevalent conditions were the combination of vomiting, prescribed rest and threatened miscarriage or preterm labor (8.3%), followed by the co-occurrence of bed rest, threatened miscarriage or preterm labor and hemorrhage (6.3%). During the postpartum period, approximately 60.4% of the sample reported at least one complication, with breastfeeding difficulties (8.3%) and the combination of pelvic floor dysfunction and breastfeeding difficulties (6.4%) being the most frequent.

Regarding neonatal outcomes, all infants in the sample were born preterm. Infants were further classified according to gestational age into late preterm [between 32 and 37 weeks of gestation (66.6%)], very preterm [between 28 and 31 weeks of gestation (20.9%)] and extremely preterm [under 28 weeks of gestation (12.5%)]. Of all deliveries, 56.3% were twin births, 41.7% were singleton births, and 2% were triplet or higher-order multiple births. In terms of neonatal health, 35.4% of the newborns experienced complications during delivery, predominantly of respiratory origin (20.8%), while 43.7% encountered complications during the postpartum period. Notably, 75% of the infants required admission to the NICU, with lengths of stay showing considerable variability, ranging from 1 to 93 days (M = 37.06; SD = 26.21). Detailed demographic and clinical data are presented in Table 1.

Descriptive Analysis of Psychological Variables

Overall, participants exhibited low levels of postpartum anxiety, insecure attachment and guilt. Nevertheless, 31.3% showed high levels of postpartum anxiety. Among insecure attachment dimensions, postpartum anxiety scores were slightly higher for postpartum anxiety than for avoidance scores. For postpartum anxiety subscales, the fear subscale yielded the highest M score compared to the other two subscales (M = 10.79). Complete descriptive statistics are reported in Table 2.

Between-Group Comparison: Late Preterm, Very Preterm and Extremely Preterm

To examine whether the degree of prematurity was associated with differences in maternal guilt, attachment insecurity or postpartum anxiety, a one-way ANOVA was conducted comparing late preterm (group 1, 32–37 weeks), very preterm (group 2, 28–31 weeks) and extremely preterm (group 3, under 28 weeks). A one-way ANOVA was conducted to compare maternal guilt, attachment insecurity, and postpartum anxiety across the three prematurity groups. No statistically significant between-group differences were observed for any study variable (Table 3). Effect sizes were generally trivial, with only attachment anxiety and perfectionism showing small effects.

Between-Group Comparison: Singleton Birth or Multiple Birth

Independent samples *t* tests were conducted to examine potential differences between groups, with Levene's test used to assess homogeneity of variance and Cohen's *d* calculated to evaluate the practical magnitude of the findings. Given the markedly limited representation of the "triplet or higher-order multiple" subgroup, which comprised only a single participant, this category was merged into the "twin" subgroup to form a broader "multiple birth" category. This methodological decision was adopted to avoid the statistical instability and interpretive limitations associated with analyzing a subgroup of such minimal size, thereby ensuring a more robust and meaningful basis for subsequent group comparisons. Following this reclassification, the final sample comprised 20 participants in the "singleton" subgroup and 28 participants in the "multiple birth" subgroup.

As shown in Table 3, gestational age was the only variable to differ significantly between groups, demonstrating a large effect size. No significant between-group differences were observed for the remaining psychological variables. Effect sizes for these variables were consistently small to negligible, indicating that the two groups were broadly comparable across the outcomes assessed.

Correlational Analyses

A Pearson correlation analysis was conducted to explore the bivariate associations among the study variables. Gestational age at birth and postpartum weeks were also included as descriptive timing variables to examine whether the psychological measures varied according to birth timing or the interval between delivery and assessment. The results are presented in Table 4. The pattern of correlations was notably differentiated in both the strength and distribution of associations across outcome measures.

The two attachment dimensions (anxiety and avoidance) showed a strong positive correlation with each other. Attachment anxiety was significantly associated with the

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total postpartum anxiety total score, as well as with the social anxiety, fear and perfectionism subscales. Attachment avoidance followed a partially overlapping pattern, correlating significantly with the postpartum anxiety total score, perfectionism and social anxiety, though its link to fear did not reach statistical significance.

The total postpartum anxiety score demonstrated strong correlations with all three subscales, with the highest correlation observed for fear, followed by social anxiety and perfectionism. Substantial intercorrelations were also found among the subscales themselves: between fear and perfectionism, social anxiety and fear, and perfectionism and social anxiety.

Guilt was significantly associated with both social anxiety and the total postpartum anxiety total score. Neither gestational age nor time elapsed since delivery showed significant independent correlations with any of the postpartum anxiety subscales or attachment variables when examined independently.

Predictive Analysis: fsQCA Analysis of Necessary Conditions

Necessity analysis were conducted separately for high and low levels of each outcome with results presented in Table 5. No condition reached the 0.90 consistency threshold required to be considered necessary [67], indicating that no single variable functioned as an indispensable prerequisite for any of the outcomes under investigation.

Sufficient Conditions

The sufficient configurations for both the presence and absence of each outcome are displayed in Table 6, using a frequency cutoff of 1 and consistency cutoffs ranged from 0.80 to 0.84. The truth table consistency cutoff was set at 0.803922. Due to the logical minimization procedure implemented in fsQCA, individual intermediate configurations may occasionally exhibit consistency values marginally below the initial truth table threshold. For each outcome three distinct configurations were identified. Solution coverage values ranged from 0.50 to 0.83, while solution consistency values varied from 0.75 to 0.84, indicating satisfactory model fit across all analyses.

When examining sufficient conditions for elevated outcomes, attachment-related difficulties proved to be the most pervasive element. Avoidant attachment appeared in every configuration leading to high postpartum anxiety (overall coverage = 0.58), while both anxious and avoidant attachment jointly appeared across all configurations for high perfectionism (overall coverage = 0.52) and high social anxiety (overall coverage = 0.50). For high fear (overall coverage = 0.64), guilt was the sole condition shared by all three configurations, indicating its role as a quasi-necessary contributor. Obstetric variables such as singleton delivery and the puerperal period were present in select configurations only, differentiating specific causal paths rather than defining a common core.

Turning to sufficient conditions for lower outcome levels, the number of gestational weeks functioned as a consistently recurring protective factor, featuring in every configuration for both low social anxiety (overall coverage = 0.83) and low perfectionism (overall coverage = 0.71). Notably, the second configuration for low perfectionism had the highest unique coverage in the entire analysis (0.31). Pathways to low postpartum anxiety (overall coverage = 0.67) and low fear (overall coverage = 0.68) were broadly defined by the absence of attachment insecurity and guilt, with specific obstetric circumstances further distinguishing individual routes.

The findings underscore the configurational and asymmetric logic inherent to fsQCA: the configurations that produce high levels of a given outcome bear little resemblance to those producing its absence. While insecure attachment combined with guilt forms the nucleus of pathways toward worse perinatal mental health, adaptive outcomes are instead characterized by adequate gestational development and the absence of attachment-related vulnerabilities. A summary of the main findings is presented in Fig. 1.

Discussion

The present study investigates the roles of both obstetric and psychological variables—including gestational age, birth type, postpartum timing, attachment style, and maternal guilt—in relation to postpartum anxiety symptoms among mothers of preterm infants. The findings provide preliminary evidence that psychological vulnerability factors, particularly insecure attachment and maternal guilt, may play a more prominent role than obstetric characteristics in shaping postpartum anxiety symptoms among mothers of preterm infants. Nevertheless, the results should be interpreted with caution given the exploratory nature of the study, the limited sample size and the moderate coverage values.

The first hypothesis posited that mothers of more preterm infants, mothers of multiples, and women assessed

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Table 1. Descriptive statistics of sociodemographic and clinical variables (n = 48).

Variables	n	%
Sexual orientation		
Heterosexual	44	91.7%
Homosexual	1	2.1%
Bisexual	3	6.3%
Marital status		
Single	1	2.1%
Married	19	39.6%
Other	28	58.3%
Difficulties during delivery		
No difficulties	11	22.9%
Emergency cesarean section	14	29.2%
Scheduled cesarean section	5	10.4%
Induction	2	4.2%
Other	16	33.3%
Gestational complications		
No complications	10	20.8%
Vomiting, prescribed rest and threatened miscarriage or preterm labor	4	8.3%
Bed rest, threatened miscarriage or preterm labor and hemorrhage	3	6.3%
Hypertension	2	4.2%
Other	29	60.4%
Complications during postpartum period		
No complications	19	39.6%
Breastfeeding difficulties	4	8.3%
Pelvic floor dysfunction and breastfeeding difficulties	3	6.3%
Other	22	45.8%
Preterm newborn		
Late preterm	32	66.6%
Very preterm	10	20.9%
Extreme preterm	6	12.5%
Gestational type		
Singleton	20	41.7%
Twin	27	56.3%
Triplet or higher-order multiple	1	2%
Delivery type		
Spontaneous vaginal delivery	18	37.5%
Emergency cesarean delivery	21	43.8%
Elective cesarean delivery	9	18.7%
Newborns complications during delivery		
No complications	31	64.6%
Respiratory	10	20.8%
Other	7	14.6%
Newborn postpartum complications		
No complications	27	56.3%
Respiratory	4	8.3%
Respiratory + cardiac	2	4.2%
Respiratory + digestive	2	4.2%
Others	13	27.1%
Admission to the NICU		
Admission	36	75.0%
Non admission	12	25.0%

Values are presented as n (%). For obstetric and neonatal complication variables, multiple responses were permitted; therefore, category frequencies do not necessarily sum to the total sample size. NICU, Neonatal Intensive Care Unit.

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Table 2. Descriptive analysis of the psychological variables.

Psychological variables		M	SD	Min.	Max.	P10	P50	P90
Attachment	Anxiety	2.94	1.47	1.00	6.33	1.22	2.67	5.23
	Avoidance	2.51	1.07	1.00	4.89	1.21	2.67	4.06
Anxiety	Postpartum anxiety	19.43	13.96	1.00	52.00	2.90	18.50	37.80
	Perfectionism	4.37	3.51	0.00	10.00	0.00	4.50	9.00
	Social anxiety	4.27	5.98	0.00	24.00	0.00	2.00	10.80
	Fear	10.79	6.25	0.00	20.00	2.00	11.00	20.00
Guilt	Guilt	2.25	1.11	1.00	5.00	1.00	2.17	3.77

M, mean; SD, standard deviation; Min., minimum; Max., maximum; P10, percentile 10; P50, percentile 50; P90, percentile 90.

Table 3. Descriptive statistics, M comparisons and effect sizes for the study variables.

Variable	M (SD)			F/*t*	df	*p*	η^2/d
Comparisons among three groups (one-way ANOVA)							
	Late preterm (n = 32)	Very preterm (n = 10)	Extremely preterm (n = 6)	F			
Guilt	2.30 (1.21)	2.23 (0.98)	2.00 (0.82)	0.18	2	0.834	0.008
Attachment anxiety	2.93 (1.45)	3.40 (1.76)	2.26 (0.90)	1.14	2	0.329	0.048
Attachment avoidance	2.51 (0.96)	2.72 (1.22)	2.20 (1.51)	0.43	2	0.654	0.019
Postpartum anxiety total score	19.00 (14.52)	21.20 (13.81)	18.83 (13.17)	0.10	2	0.908	0.004
Perfectionism	4.13 (3.51)	5.70 (3.30)	3.50 (3.89)	0.98	2	0.384	0.042
Social anxiety	4.56 (6.53)	4.20 (5.77)	2.83 (3.13)	0.21	2	0.816	0.009
Fear	10.31 (6.37)	11.30 (6.09)	12.50 (6.60)	0.34	2	0.713	0.015
Comparisons between two groups (independent-samples *t* tests)							
	Singleton birth (n = 20)	Multiple birth (n = 28)		*t*			
Gestational age[a]	30.80 (3.61)	33.82 (2.21)	—	–3.33	29.10	0.002	–1.05
Attachment anxiety	2.84 (1.68)	3.02 (1.33)	—	−0.40	46	0.700	–0.12
Attachment avoidance	2.39 (1.25)	2.61 (0.94)	—	−0.69	46	0.514	–0.20
Postpartum anxiety total score	20.75 (15.88)	18.50 (12.63)	—	0.55	46	0.587	0.16
Perfectionism	4.20 (3.52)	4.50 (3.56)	—	–0.29	46	0.774	–0.09
Social anxiety	4.85 (6.66)	3.86 (5.54)	—	0.56	46	0.577	0.17
Fear	11.70 (7.12)	10.14 (5.59)	—	0.85	46	0.401	0.25

ANOVA, analysis of variance; M, mean; SD, standard deviation; F, F ratio; *t*, *t* statistic; df, degrees of freedom. [a] Given the violation of the homogeneity of variance assumption (Levene's test, $p = 0.004$), Welch's correction was applied throughout.

Table 4. Correlational analysis.

Item	1	2	3	4	5	6	7	8	9
1	1								
2	0.685**	1							
3	0.424**	0.322*	1						
4	0.297*	0.322*	0.825**	1					
5	0.475**	0.388**	0.888**	0.603**	1				
6	0.326*	0.167	0.920**	0.705**	0.688**	1			
7	0.249	0.293	0.339*	0.284	0.358*	0.256	1		
8	0.087	0.057	0.006	–0.030	0.114	–0.078	0.079	1	
9	–0.011	–0.005	-0.081	–0.011	–0.120	–0.058	0.003	–0.417**	1

*$p \leq 0.05$; **$p \leq 0.01$; 1 = attachment anxiety; 2 = attachment avoidance; 3 = postpartum anxiety total score scale; 4 = perfectionism factor; 5 = social anxiety factor; 6 = fear factor; 7 = guilt; 8 = gestational week; 9 = postpartum weeks.

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Table 5. Analysis of necessary conditions to explain high and low levels of postpartum anxiety.

Condition	High levels of postpartum anxiety		Low levels of postpartum anxiety		High levels of perfectionism		Low levels of perfectionism		High levels of social anxiety		Low levels of social anxiety		High levels of fear		Low levels of fear	
	Cons.	Cov.	Cons.	Cov.	Cons.	Cov.	Cons.	Cov.	Cons.	Cov.	Cons.	Cov.	Cons.	Cov.	Cons.	Cov.
Singleton delivery	0.42	0.49	0.40	0.51	0.40	0.47	0.42	0.52	0.45	0.48	0.38	0.52	0.44	0.52	0.39	0.47
~Singleton delivery	0.57	0.47	0.59	0.52	0.59	0.49	0.57	0.50	0.54	0.41	0.61	0.58	0.55	0.46	0.61	0.53
Gestational weeks	0.63	0.57	0.62	0.61	0.59	0.55	0.64	0.62	0.63	0.52	0.58	0.61	0.62	0.57	0.65	0.62
~Gestational weeks	0.57	0.58	0.56	0.62	0.59	0.61	0.53	0.58	0.54	0.50	0.55	0.65	0.59	0.62	0.56	0.60
Puerperium period	0.54	0.54	0.59	0.64	0.54	0.56	0.57	0.61	0.54	0.50	0.57	0.66	0.55	0.57	0.60	0.63
~Puerperium period	0.64	0.59	0.58	0.58	0.62	0.58	0.59	0.57	0.63	0.54	0.57	0.61	0.64	0.61	0.60	0.58
Attachment anxiety	0.67	0.67	0.48	0.52	0.65	0.67	0.49	0.52	0.67	0.62	0.47	0.55	0.66	0.68	0.50	0.53
~Attachment anxiety	0.53	0.48	0.70	0.70	0.53	0.50	0.69	0.68	0.52	0.44	0.68	0.72	0.55	0.51	0.70	0.68
Attachment avoidance	0.58	0.64	0.46	0.55	0.60	0.68	0.44	0.51	0.58	0.59	0.45	0.58	0.57	0.64	0.49	0.57
~Attachment avoidance	0.59	0.50	0.70	0.64	0.56	0.49	0.72	0.66	0.58	0.45	0.68	0.67	0.61	0.54	0.70	0.63
Guilt	0.70	0.67	0.50	0.52	0.71	0.69	0.49	0.50	0.71	0.63	0.49	0.55	0.70	0.69	0.53	0.54
~Guilt	0.50	0.48	0.68	0.71	0.48	0.47	0.70	0.71	0.48	0.43	0.67	0.75	0.53	0.52	0.69	0.70

Cons., consistency; Cov., coverage; ~, absence of the condition.

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Table 6. Synthesis of the main sufficient conditions.

Frequency cutoff: 1	High levels of postpartum anxiety (Consistency cutoff: 0.80)			Low levels of postpartum anxiety (Consistency cutoff: 0.84)			High levels of perfectionism (Consistency cutoff: 0.80)			Low levels of perfectionism (Consistency cutoff: 0.83)			High levels of social anxiety (Consistency cutoff: 0.80)			Low levels of social anxiety (Consistency cutoff: 0.80)			High levels of fear (Consistency cutoff: 0.82)			Low levels of fear (Consistency cutoff: 0.83)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Singleton delivery						●			○			●	○	●	●	○		●				○		
Gestational weeks		○	○	○	○	○	○	○		●		●	●	○		○	●			○	○	○	○	○
Puerperium period	○		○				○		○				●		○				○	○			○	○
Attachment anxiety	●	●		○	○	○	●	●	●	○	○			●	●	○	○	○	●		●	○		○
Attachment avoidance	●	●	●	○		○	●	●	●	○				●	●	○	○	○			●			○
Guilt	●	○	●	○	○	○		○		○	○	○	●		●		○	○	●	●	○	○	○	○
Raw coverage	0.29	0.25	0.22	0.36	0.38	0.22	0.24	0.24	0.23	0.35	0.58	0.17	0.22	0.17	0.15	0.28	0.29	0.25	0.36	0.29	0.25	0.24	0.26	0.22
Unique coverage	0.04	0.08	0.00	0.15	0.15	0.17	0.04	0.05	0.05	0.03	0.31	0.04	0.13	0.06	0.04	0.08	0.02	0.01	0.02	0.02	0.08	0.01	0.05	0.04
Consistency	0.85	0.84	0.85	0.91	0.89	0.88	0.87	0.81	0.78	0.90	0.85	0.93	0.82	0.88	0.86	0.80	0.83	0.87	0.87	0.84	0.86	0.86	0.85	0.94
Overall consistency	0.79			0.84			0.79			0.83			0.81			0.75			0.82			0.76		
Overall coverage	0.58			0.67			0.52			0.71			0.50			0.83			0.64			0.68		

●, indicates the presence of a condition; ○, indicates the absence of a condition; blank cells, not relevant condition for pathway.

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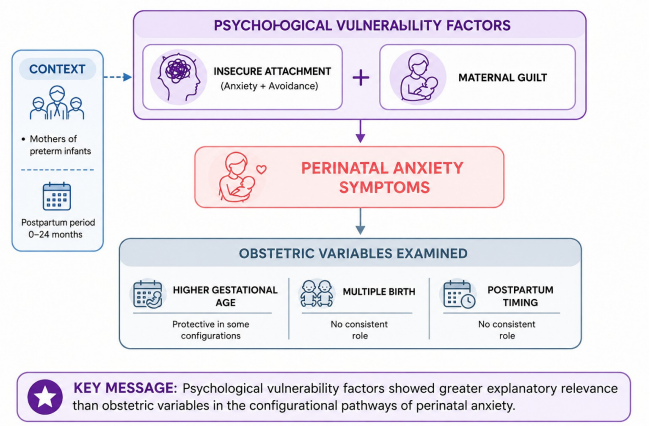

Fig. 1. Summary of the main findings. Visual summary of the main findings. Psychological vulnerability factors, particularly insecure attachment and maternal guilt, showed greater explanatory relevance than obstetric variables in the configurational pathways associated with postpartum anxiety symptoms among mothers of preterm infants. The figure summarizes the main findings and does not represent statistical effect sizes.

earlier in the postpartum period would report significantly higher levels of postpartum anxiety symptoms. The results do not support this hypothesis in its linear form, since no statistically significant differences in any psychological variable were observed across prematurity groups, a finding that diverges from previous literature describing an inverse relationship between gestational age and maternal psychological distress [21]. Prior research suggests that the psychological impact of extreme prematurity may, in some cases, be attenuated by intensive clinical teams involvement and greater specialist support availability during NICU admission [26,27], potentially explaining the similar anxiety profiles observed in this sample across different levels of prematurity.

Regarding the comparison between singleton and multiple births, gestational age was the only variable to significantly differentiate the groups, with a large effect size, confirming that mothers of twins delivered at substantially lower gestational ages. However, none of the psychological variables differed between groups, suggesting that multiple gestation per se may not constitute an independent risk factor for postpartum anxiety symptoms [28,29]. This raises the possibility that the influence of multiple gestation may be mediated or moderated by more proximal psychological characteristics. Consistent with this notion, neither gestational age nor time elapsed since delivery correlated independently with any postpartum anxiety indicator, suggesting that their effects on maternal well-being may not be direct and emerges through interaction with other contextual and psychological factors [30,31], a hypothesis that warrants systematic examination in future research with larger samples. Additionally, variables not assessed in this study may further account for this pattern, including parity [given that primiparous women face a particularly pronounced identity disruption in the transition to motherhood [69]], prior perinatal loss, whose emotional consequences can remain active well into subsequent postpartum periods [70], and the quality of dyadic coping within the couple, which has been shown to buffer or amplify the psychological weight of adverse obstetric experiences [69].

The second hypothesis proposed that insecure attachment styles and greater maternal guilt would be positively associated with anxious symptomatology, received empirical support from the correlational analyses. However, the cross-sectional nature of the design limits the conclusions that can be drawn regarding directionality.

Attachment anxiety was significantly associated with total postpartum anxiety, social anxiety and perfectionism, while attachment avoidance showed a partially overlapping pattern, correlating significantly with total anxiety, perfectionism, and social anxiety. These findings align with adult attachment theory [34] and with studies linking insecure attachment to increased psychopathological vulnerability, lower parental self-efficacy, and difficulties in emotional regulation during the postpartum period [39–41]. Notably, attachment anxiety demonstrated a slightly broader network of associations than avoidance, including a significant relationship with fear, the most representative subscale of postpartum anxiety in this sample—possibly reflecting the hypervigilance and heightened threat sensitivity characteristic of the anxious-preoccupied attachment profile [36]. Nevertheless, this interpretation merits careful consideration considering the limited statistical power afforded by the present

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sample size.

Maternal guilt, while displaying a more selective pattern than attachment, was associated with both social anxiety and total postpartum anxiety. This influence, concentrated primarily in the interpersonal domain of anxiety, is consistent with the conceptualization of guilt as a relational construct rooted in the perception of having failed to meet external expectations [49]. In the context of prematurity, guilt may be further intensified by the internalization of responsibility for the preterm birth and by experiences of early separation from the neonate during NICU hospitalization [53], though the extent to which these specific mechanisms drove the observed associations cannot be determined from the present data.

Also noteworthy is the strong internal coherence of the postpartum anxiety scale, with fear emerging as the most representative dimension. This structure is consistent with prior validation work on the PASS [60] and is tentatively suggests a shared transdiagnostic process underlying the different domains of postpartum anxiety symptoms [9]; nonetheless this interpretation would require confirmation in larger and more diverse samples.

The third hypothesis proposed that the combined contribution of obstetric and psychological variables would significantly predict higher levels of maternal anxiety. The fsQCA results are broadly consistent with this hypothesis and offer a more nuanced picture of potential causal complexity than conventional linear methods could provide [65]; however, the preliminary nature of these findings, given that no condition reached the threshold for necessity and coverage values were only moderate, should be kept in mind throughout.

The analysis of necessary conditions indicated that no single variable constituted an indispensable prerequisite for high postpartum anxiety symptoms, indicating that the phenomenon may be equifinal: different combinations of conditions could potentially produce the same anxious outcome. This pattern is consistent with the heterogeneity of risk profiles documented in the perinatal literature [30] and tentatively points to the possibility that maternal psychological vulnerability may be more relevant than obstetric circumstances in explaining postpartum anxiety symptoms among mothers of preterm infants, a hypothesis that future investigations drawing on larger, more representative samples will be better positioned to examine with the necessary statistical rigor.

The sufficiency analysis showed that perinatal mental health difficulties may not emerge from single isolated variables but from combinations in which prior psychological vulnerability intensifies obstetric stress, which would be in line with multifactorial accounts of perinatal psychopathology [7,56,58]. Insecure attachment emerged as the structurally recurrent condition across all outcomes, often co-occurring with guilt and a briefer postpartum duration, a combination that represented the most frequent explanatory configuration across the models. In the case of fear, guilt operated as a particularly prominent condition across all three configurations, a pattern that may reflect the widespread tendency toward self-blame reported by mothers of preterm [70].

The social anxiety model introduced birth multiplicity as a relevant differentiating factor: multiple gestation, together with guilt and extended gestational duration, characterized the primary risk profile, while singleton births accounted for risk in the remaining configurations. This pattern raises the possibility that caring for more than one preterm neonate may amplify the interpersonal dimension of anxiety in ways that linear approaches are less able to detect [28,29], though replication in larger samples is needed before firmer conclusions can be drawn. On the protective side, gestational weeks emerged as the most recurrent buffer across configurations associated with low social anxiety and low perfectionism, suggesting adequate gestational maturation as a protective factor with implications that may extend beyond strictly neonatal outcomes [71].

Finally, the conditions sufficient for elevated postpartum anxiety did not constitute a simple reversal of those associated with its absence, an asymmetry that would go undetected within variable-centered analytical frameworks and that, if replicated, would highlight a distinctive contribution of configurational methods to the understanding of perinatal psychopathology. Taken together, the findings of this study are best understood as preliminary and hypothesis-generating, providing a useful foundation for future research rather than definitive conclusions.

Limitations

Despite the contributions, several limitations of this study should be considered when interpreting the findings and evaluating their generalizability.

First, the sample size is small (n = 48), which limits the statistical power of the analyses and may have prevented the detection of group differences that would be significant in larger samples. To facilitate a more comprehensive interpretation of the findings, effect sizes were systematically reported alongside significance tests through-

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out the manuscript, allowing the magnitude of the observed differences to be evaluated independently of statistical significance, in line with current methodological recommendations. This is particularly relevant in the between-group variance analyses, where the effect sizes observed for some variables (notably attachment anxiety and perfectionism) suggest that clinically meaningful trends may exist but remained statistically undetected given the modest sample, although it should be acknowledged that mothers of preterm infants represent an inherently difficult population to access and recruit. This limitation is especially relevant for comparisons according to prematurity severity, as the extremely preterm group comprised only six participants. Consequently, the absence of statistically significant differences should not be interpreted as evidence that prematurity severity is unrelated to maternal anxiety, but rather as findings requiring confirmation in larger, more balanced samples.

Although fsQCA is particularly well suited to examining configurational relationships in relatively small samples and complements conventional linear approaches by identifying multiple pathways leading to the same outcome, the present sample nevertheless requires cautious interpretation of the configurational findings. Accordingly, the identified configurations should be regarded as exploratory and hypothesis-generating and should be replicated in larger independent samples. Accordingly, the configurational findings should be interpreted as exploratory and should be replicated in larger independent samples. Future studies using larger samples should examine the robustness of the identified configurations by testing alternative calibration anchors and consistency thresholds to determine the stability and reproducibility of the solutions.

Second, the cross-sectional design precludes causal inference and does not allow the temporal evolution of anxious symptomatology to be tracked. Although the study was prospective, data were collected at a single time point and postpartum duration varied widely among participants (from days to two years), so the potential influence of timing-related confounders cannot be excluded. This temporal heterogeneity is not without consequence, as maternal psychological well-being varies substantially across the distinct stages of the puerperium and anxious symptomatology tends to attenuate as the postpartum period progresses [6]. The aggregation of participants across such an extended postpartum window may therefore have obscured stage-specific patterns that a longitudinal design incorporating repeated assessments at predetermined time points would have been better positioned to detect.

Third, recruitment through social media and peer support associations introduces a meaningful selection bias that may also help account for the globally low scores observed across psychological variables. Women who participated voluntarily likely represent a non-representative subgroup of the broader preterm mother population; one with greater engagement with community resources, better access to psychological support, and a greater willingness to reflect on their emotional experience. Furthermore, given that data collection extended up to two years postpartum, a substantial proportion of the sample had already moved into larger stages of the puerperium, during which anxious symptomatology tends to naturally diminish over time [56]. Notably, despite this general pattern, the fear subscale consistently yielded the highest scores within the postpartum anxiety measure, aligning with prior research identifying concerns about neonatal viability and health as the most salient expression of maternal psychological distress in the context of prematurity [17,18].

Fourth, maternal guilt was assessed using a brief four-item measure developed ad hoc and adapted from the conceptual framework proposed by Thivierge *et al.* [53]. Although exploratory factor analysis supported a unidimensional structure and internal consistency was acceptable, the psychometric evaluation of this measure remains preliminary. Given the limited sample size, confirmatory factor analysis and more comprehensive validation procedures could not be conducted. Consequently, findings involving maternal guilt should be interpreted with appropriate caution. Moreover, the use of an ad hoc measure limits direct comparability with studies employing standardized instruments. To our knowledge, there is currently no well-validated instrument specifically designed to assess maternal guilt in the context of prematurity, highlighting the need for future research to develop and validate dedicated measures. Such work should include expert content validation (e.g., Delphi methodology), larger samples allowing both exploratory and confirmatory factor analyses, and the assessment of convergent, discriminant, and predictive validity. A further limitation concerns the internal consistency of the attachment avoidance subscale of the ECR-R, which yielded a Cronbach's alpha of 0.60. Although slightly below the conventional benchmark of 0.70, Hair *et al.* [62] note that coefficients close to 0.60 may be acceptable in exploratory research. Nevertheless, findings involving attachment avoidance should be interpreted with caution. Importantly, attachment avoidance did not emerge as a necessary condition in any of the identified fsQCA configurations, suggesting that its impact on the overall conclusions is likely to be limited.

Fifth, several potentially relevant confounding variables were not accounted for in this study. Factors such as

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previous psychiatric history, depressive symptomatology, perceived social support, parity, NICU admission, neonatal complications, prior perinatal loss and type of delivery were either not assessed or not incorporated into the analytical framework as covariates, despite their documented associations with maternal anxiety [17,18,72,73]. This omission introduces uncertainty regarding the extent to which the observed associations between attachment, guilt and postpartum anxiety reflect genuine psychological pathways rather than the confounding influence of these clinical characteristics. Future research should incorporate these variables analytically to more accurately disentangle the unique contribution of psychological vulnerability factors to maternal anxiety in the context of preterm birth.

An additional limitation pertains to the marked reduction from the initial pool of responses to the final analytical sample. Of the 552 responses assessed for eligibility, 301 did not meet the inclusion criteria, while 203 eligible participants had given birth to a full-term infant rather than a preterm infant, resulting in a final sample of 48 mothers of preterm infants. Although this recruitment process ensured that the sample closely matched the study objectives, the small sample size and the possibility of selection bias may limit the generalizability of the findings. Future studies should prioritize targeted recruitment strategies—such as direct clinical sampling within neonatal units or collaboration with hospital registries—to ensure the assembly of larger and more representative samples of this population.

Finally, the exclusively female, quantitative sample represents an additional constraint. While maternal perspectives are central to the research questions, the experiences of fathers and other primary caregivers, whose well-being in the context of preterm birth is equally worthy of investigation, are not represented. Incorporating qualitative data and a broader family-systems perspective would considerably enrich the understanding of the phenomenon.

Clinical and Practical Implications

Despite these limitations, the findings carry meaningful implications for psychological care in perinatal and neonatal settings. Although gestational age, birth type and postpartum timing are non-modifiable once birth has occurred, their inclusion serves a clinically relevant purpose: identifying mothers at elevated contextual risk while recognizing that this risk is not deterministic. The key finding is that these obstetric variables do not predict postpartum anxiety symptoms in isolation, their impact appears to be activated by modifiable psychological factors, particularly insecure attachment and maternal guilt. Non-modifiable obstetric characteristics can thus serve as screening triggers alerting clinicians to the need for psychological assessment, while intervention efforts should target the psychological variables that mediate their effects and that, unlike obstetric circumstances, are amenable to change. Because attachment representations generally predate pregnancy and remain relatively stable over time, psychological screening could ideally begin during pregnancy—or even during preconception care in women at increased obstetric risk—allowing preventive interventions before postpartum anxiety becomes clinically established.

Furthermore, the prominent role of insecure attachment across the risk configurations identified by the fsQCA suggests that systematic screening for adult attachment style should be integrated into perinatal psychological assessment protocols, particularly for mothers of preterm neonates. Currently, psychological assessment in neonatal units tends to focus on anxiety and depression symptoms, often overlooking the relational dimensions that underlie maternal vulnerability [44,45]. Incorporating brief attachment screening tools, such as the one used in this study, could facilitate the early identification of mothers who may benefit from targeted preventive psychological interventions, rather than relying solely on symptom-based assessment once anxiety has already developed.

In the same vein, the relevance of maternal guilt points to the value of interventions that explicitly address the cognitive restructuring of responsibility attributions related to preterm birth. Brief cognitive-behavioral or compassion-based approaches, tailored to the postpartum context in prematurity, could prove effective in reducing both guilt and associated postpartum anxiety [32,49]. Likewise, attachment-informed interventions aimed at strengthening emotional security, promoting reflective functioning, and fostering more adaptive relational patterns may be particularly appropriate for mothers presenting insecure attachment profiles.

Importantly, addressing attachment insecurity and maternal guilt may not only reduce postpartum anxiety but also strengthen maternal confidence, facilitate early mother-infant bonding, and promote more adaptive parent–infant interactions. These broader relational benefits are particularly relevant following preterm birth, where early disruptions in the transition to parenthood may compromise both maternal well-being and the quality of early caregiving.

The finding that an earlier postpartum period amplifies risk in the presence of insecure attachment and guilt reinforces the importance of initiating psychological support early, ideally during NICU admission. Family-integrated

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care programs, which promote active parental involvement in neonatal care, skin-to-skin contact, and psychological accompaniment during hospitalization, have demonstrated effectiveness in both improving maternal well-being and in fostering early bonding [24,26,27], though their degree of implementation across Spanish neonatal units remains uneven [44]. The present findings strengthen the theoretical basis for these programs and underscore their relevance for mothers with insecure attachment profiles or elevated guilt. In general, these findings support a more personalized approach to perinatal psychological care, in which intervention intensity and content are tailored according to individual psychological vulnerability profiles rather than obstetric characteristics alone.

Finally, the specific risk profile identified for social anxiety, in which multiple gestation, guilt, and longer gestational duration converge as the dominant configuration, suggests that mothers of preterm twins constitute a subgroup warranting differentiated clinical attention. The unique demands of multiple preterm caregiving may give rise to a particular form of social isolation and pressure to embody the ideal mother, specifically amplifying the interpersonal dimension of postpartum anxiety [28,29]. Peer support groups and psychoeducation addressing the genuine challenges of multiple preterm caregiving could serve as valuable complementary resources for this subgroup [74].

Future Research Directions

The findings and limitations of this study open several lines of inquiry that could extend and deepen the understanding of postpartum anxiety in mothers of preterm infants.

Most immediately, replication in larger samples and with recruitment strategies that minimize selection bias, such as clinical sampling in neonatal units or collaboration with hospital registries, is a clear priority. Greater sample sizes would not only improve statistical power in comparative analyses but also allow more precise modeling of within-group variability across prematurity levels and enable the examination of interactions between obstetric and psychological variables through regression or structural equation modeling.

Longitudinal designs incorporating repeated measurements at key postpartum time points, such as six weeks, three months, six months, and one year, would also be a significant methodological advance. Such designs would make it possible to trace the temporal trajectory of maternal anxiety and identify the windows during which insecure attachment and guilt exert the greatest influence, as well as to distinguish transient from chronic symptomatology, a distinction with direct implications for intervention planning [56,57].

Future work would also benefit from examining potential mediating and moderating variables not included in the present study, such as perceived social support, relationship quality, and early adverse experiences. These variables have been shown to interact with attachment and guilt in shaping psychological responses to perinatal stress [35,52], and their inclusion would considerably refine the explanatory models.

At the methodological level, the development and validation of a guilt scale specifically designed for the context of prematurity represents an identified need. Guilt in mothers of preterm infants has distinctive features, centered on perceived responsibility for the early birth, the experience of NICU separation, and the disruption of the expected transition into motherhood, that justify a dedicated, psychometrically validated instrument [53].

Future studies should also examine the mother-infant dyad as the unit of analysis, incorporating indicators of infant development and exploring how maternal anxiety, as mediated by attachment and guilt, influences early interaction quality. The literature has established that postpartum anxiety compromises maternal sensitivity and the quality of early dyadic exchanges [11,12,14], yet the specific pathways through which maternal insecure attachment and guilt modulate these effects in preterm contexts remain poorly understood.

Lastly, incorporating paternal perspectives and a broader family-systems lens would provide a more complete picture of the emotional ecology of the postpartum period in prematurity [1,19]. The systematic exclusion of fathers from studies of this kind represents a persistent gap in literature that future research should actively work to address.

Conclusions

The present study offers preliminary evidence suggesting that postpartum anxiety among mothers of preterm infants does not follow a single, linear causal pathway but rather emerge from the interplay of psychological and obstetric factors acting in combination. Insecure attachment and maternal guilt appeared as more influential than obstetric variables such as degree of prematurity or birth type,

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whose impact on maternal mental health may be activated and amplified in the absence of preexisting psychological vulnerability, though this interpretation should be regarded as hypothesis-generating given the exploratory nature of the design and the moderate solution coverage values obtained. The application of fsQCA proved particularly well-suited to capturing this causal complexity, revealing differentiated risk profiles that appear to hinge on the specific configuration of conditions each mother presents, rather than on any single factor in isolation.

From a clinical standpoint, and bearing in mind the preliminary nature of these findings, the results underscore the value of incorporating the assessment of adult attachment and maternal guilt into psychological care protocols within neonatal units, with particular attention to the earliest stages of the postpartum period. Interventions designed to simultaneously address responsibility attributions surrounding preterm birth, support the development of early mother-infant bonding, and accompany mothers as they consolidate their maternal identity may prove especially effective in this population, though their effectiveness in this specific context remains to be established through future intervention research.

Availability of Data and Materials

The datasets generated and/or analysed during the current study are not publicly available due to ethical and privacy considerations. However, anonymized data may be made available by the corresponding author upon reasonable request and subject to approval by the principal investigator and compliance with applicable ethical requirements.

Author Contributions

LLT conceived and designed the study, coordinated the research project, supervised data collection, managed and curated the database, conducted statistical analyses, interpreted the findings, drafted the manuscript, and critically revised subsequent versions of the paper. LM contributed to the study design, participant recruitment, data collection, and preparation of the initial version of the manuscript. AS contributed to data analysis, interpretation of the findings, manuscript writing, and critical revision of the manuscript. All authors contributed to the revision of the manuscript and approved the final version for publication. All authors participated fully in the work, took public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or completeness of any part of the work were appropriately investigated and resolved.

Ethics Approval and Consent to Participate

Informed electronic consent was obtained from all participants prior to their participation in the study. The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of the Universitat de València [approval number: 2025-PSILOG-4284745].

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Conflict of Interest

The authors declare no conflict of interest.

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