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Children's Behavioral Development in Correlation with Post-Partum Mental Health During Pandemic Period

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Highlights

What are the main findings?

- Preschoolers born to mothers with postpartum depressive symptoms showed lower internalizing and total problem scores after the pandemic compared with those assessed in the peak of the pandemic.
- The proportion of children within the CBCL clinical range decreased in the post-pandemic cohort.

What is the implication of the main finding?

- Suggests a partial emotional–behavioral recovery following pandemic-related stress exposure.
- May help pediatricians identify unusual behaviors in children born during the pandemic and consider early supportive interventions.

Abstract

Background/Objectives: Maternal post-partum mood alterations and the COVID-19 pandemic are recognized risk factors for children's socioemotional difficulties. This study aims to assess behavioral outcomes in preschool children born to mothers previously screened for post-partum depression (EPDS >9), comparing cohorts evaluated during and after the pandemic through the Child Behavior Checklist (CBCL 1½–5). **Methods**: A retrospective observational study was conducted on a sample of 52 children aged 1.5-3 years, whose mothers had previously been screened with Edinburgh Post-natal Depression Scale (EPDS) for another project. Two cohorts were defined by the birth date (during pandemic: Jan 2022-April2022 ; post-pandemic: October 2023-November 2023). Primary outcomes were CBCL T-scores in correlation with EPDS scores, the secondary outcome was the correlation with pandemic period. Group differences were tested using appropriate parametric (t-test) or non-parametric (Mann–Whitney U) tests for continuous data, and χ^2 or Fisher's exact tests for categorical data. Sensitivity analyses confirmed robustness. **Results**: Children assessed in the post-pandemic period showed significantly lower internalizing and Total Problems T-scores compared to those assessed during the pandemic, while Externalizing problems T-scores remained similar. The proportion of children in clinical CBCL range decreased in post-pandemic period. **Conclusions**: Findings suggest a partial post-pandemic improvement in emotional-behavioral functioning among

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children. Such results may help raise pediatricians' awareness of unusual demeanors or subtle behavioral cues in children born during the pandemic.

Keywords: socioemotional development; preschool children; child behavior checklist; postpartum depression; maternal mood; pandemic; behavioral outcomes; pediatric awareness

1. Introduction

Early childhood, particularly the first 1000 days of life of children, is a period of heightened neuroplasticity during which multiple environmental factors can shape socio-emotional development [1,2]. Within these environmental factors maternal mood disorders during the post-partum period seems to be one of the most influential in shaping socioemotional and behavioral outcomes, in fact a stable caregiving environment and stable mother-infant interactions are able to promote adaptive self-regulation and resilience, whereas early exposure to stressor can compromise later mental health [3].

Among recent global stressors, the COVID-19 pandemic has profoundly threatened the psychological environment of families with young children. Although it was initially deemed as a public health crisis, going on with the restriction imposed by the period, the pandemic slowly became source for mental health problems, and it has therefore been recognized as a psychosocial event that caused significant stress, social isolation and disruption of caregiving routines [4]. During this challenging period, parents – especially mothers in the post-partum period – experienced an increase of psychological stress [5]. Several studies reported that the pandemic context, rather than infection itself, significantly influenced the emotional wellbeing of caregivers and the socioemotional adjustment of their children [6,7]. In fact, the loss of social networks, closure of early childhood services, and limitations on physical contact caused by the pandemic induced an alteration of normal children development, amplifying daily stressors and reducing opportunities for stimulation and social learning during a critical phase of childhood [8].

In addition to its direct impact on children's development, confirmed in literature, data collected at our institution (Fondazione Policlinico Universitario Agostino Gemelli IRCCS, Rome) during the pandemic, indicated that mothers who delivered between early 2020 and 2022 showed significantly higher scores on the Edinburgh Postnatal Depression Scale (EPDS) compared to those who delivered afterward, consistent with international findings [9–11]. Maternal mood deflections have been a central point of our study, not only for its prevalence correlation with pandemic, but also for its strong correlation with alteration of behavioral development in children. In fact, post-partum mood deflections lead to reduction of maternal sensitivity, responsiveness, and affective synchrony, terribly limiting the child's opportunities to develop strong attachment bond and self-regulatory skills [12].

Built on these premises, this study aimed to understand how children's socioemotional and development responded to the exposure of two major risk factors for behavioral alteration in offsprings, which in our sample occurred simultaneously: mothers' post-partum mood deflection and COVID-19 pandemic. The study was conceived as a continuation of the previous Gemelli project, which focused on maternal mood variations during the pandemic. Here, we extended the investigation to the children of those same mothers, using the Child Behavior Checklist (CBCL 1½–5) to assess socioemotional development. Preliminary results did not reveal a direct statistical correlation between maternal EPDS scores and children's CBCL T-scores; however, the data suggested a trend toward higher internalizing and total problems among children evaluated during the pandemic. Several limitations could have influenced these findings: the relatively young mean age of the sample, difficulties in detecting behavioral alterations in preschoolers, and a high rate of attrition likely related to the complex nature of the CBCL1½–5 questionnaire. Nonetheless, our results underscore the importance of continued follow-up for children born during the pandemic. Further longitudinal evaluation - particularly in school-age phases - may help clarify the long-term

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developmental impact of early exposure to maternal distress within an unprecedented global stress context.

2. Materials and Methods

2.1. Study Design

This observational, single-center study was conducted at the Unit of General Pediatrics of *Fondazione Policlinico Universitario A. Gemelli IRCCS* (Rome, Italy), and it represents the second phase of a longitudinal research project started three years ago. This present phase aimed to evaluate the behavioral development of children born to mothers included in the sample of the first this project who delivered during the pandemic (January-April 2022) and post pandemic (October-November 2023).

2.2. Participants

The sample consisted of two cohorts of mothers: the ones who delivered between January 2022 and April 2022 and the ones who delivered between October 2023 and November 2023. They were evaluated, in the first project, using the EPDS with the aim of intercepting post-partum depression in mothers with or without Sars-COV2 infection. In this first project no correlation emerged between post-partum depression and the infection itself but rather with the pandemic period. That's why in our study we decided to recontact the same participants as the first project, to determine whether the pandemic—identified as a stressor increasing postpartum depression prevalence—also affected children's development. Thus, the mothers were administered the CBCL 1½–5 and completed the questionnaire

2.3. Measures and Instruments

2.3.1. Child Behavior Checklist 1½–5 (CBCL)

The CBCL 1½–5 is a standardized questionnaire of ASEBA system (Achenbach System of Empirically Based Assessment) administrated to mothers with the aim of evaluating their child's behavioral and psychological profile, whose age is between 18 months and 5 years. The questionnaire is composed of 99 items each of which is rated by parents on a 3-point Likert scale (0= not true, 1= somewhat or sometimes true, 2= very true or often true). When parents' answers were sent back to the researcher, all the items together have then been analyzed using a digital scoring system established by Achenbach Manual that converted the answers in T-scores which have then been grouped in three broadband scales and one residual scale: 'Internalizing Problems', 'Externalizing Problems', 'Total of the Problems'. and 'Other Problems'.

- Internalizing scale measures behaviors like social withdrawal, anxiety and depressive symptoms, which tend to be internalized and less visible.
- Externalizing scale measures problems such as disobedience, impulsiveness and hyperactivity which tend to manifest more openly in the social context.
- Total problem scale represents a global index of emotional and behavioral problems.
- Other Problems scale captures additional behavioral issues not included in the main scales.

2.3.2. Supplementary Questionnaire

An ad hoc Google Form questionnaire was created with the aim of understanding children's growth environment and of intercepting family situations that could have influenced children's development beyond the primary risk factors investigated. This tool included questions related to:

- Traumatic or stressful events occurred in the previous 12 months
- Changes in household composition or in the place of residence
- Other eventual subjective factors considered relevant by mothers for their child's wellbeing

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2.4. Procedure and Data Collection

Data entry was then performed, after collecting the consensus, in an anonymized format and automatically stored in the study's encrypted institutional database. Data integrity was ensured through built-in validation rules and double verification of entries. Children's CBCL results were matched to corresponding maternal EPDS data using anonymized unique identifiers generated during the first phase.

2.5. Statistical Analysis

Statistical analyses were performed using the software R-studio (RS) open source.

Continuous variables were tested for normality using the Shapiro–Wilk test. Depending on data distribution, group comparisons were conducted with parametric (*t*-test) or non-parametric (*Mann–Whitney U*) tests for continuous variables, and χ^2 or Fisher's exact tests for categorical variables.

Correlation analyses were used to explore associations between maternal EPDS scores and children's CBCL T-scores. Sensitivity analyses were conducted to assess the robustness of results, with statistical significance set at $p < 0.05$.

2.6. Ethical Consideration

The study was conducted in accordance with the ethical standards of the *Declaration of Helsinki* and approved by the *Ethics Committee of Fondazione Policlinico Universitario A. Gemelli IRCCS* (approval code 0031589/22, date 06/10/2022).

Written informed consent was obtained digitally from all participants before inclusion in the study. Data was anonymized prior to analysis, and no identifying information was collected or stored.

2.7. Data Availability Statement

The dataset generated and analyzed during the current study is stored in a secure institutional repository at Fondazione Policlinico Universitario A. Gemelli IRCCS. Data will be made available from the corresponding author upon reasonable request.

2.8. AI and Writing Disclosure

Generative artificial intelligence (GenAI) tools were not used in the study design, data collection, statistical analysis, or interpretation of results. Language and style editing were performed manually by the authors, with minor grammar refinements assisted by standard proofreading tools in compliance with MDPI policy.

1. Results

3.1. Sample

Fifty-two mother-child dyads were assessed (loss-rate from the original mothers cohort ≈ 63.9%). Children belonged to two birth cohorts: during-pandemic (Jan-Apr 2022. N=30) and post-pandemic (Oct-Nov 2023, n=22). Mean child age at assessment was 3 years in the during pandemic cohort and 18 months in the post-pandemic one. Data collection for the CBCL took place between March and May 2025. Statistical analyses were conducted using RStudio (open source).

3.2. Maternal Mood (EPDS)

The sample of mothers we analyzed were previously (in 2024) screened for postpartum depression with EPDS for another project. Between mothers who took part in this study, mean maternal EPDS was 8.9 in during pandemic cohort and 6.8 in the post-pandemic one. The proportion with EPDS>9 was 36.7% (11/30) vs 27.3% (6/22) respectively.

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3.3. Child Socioemotional Outcomes (CBCL 1½–5)

Across the whole children sample, there was a clear difference in child results between the two cohorts:

-During Pandemic (3 years, n=30)

- Internalizing: 21 normal (70.0%), 6 borderline (20.0%), 3 clinical (10.0%)
- Externalizing: 23 normal (76.7%), 7 borderline (23.3%), 0 clinical
- Total problems: 25 normal (83.3%), 5 borderline (16.7%), 0 clinical
- Other problems (raw): mean = 7.50

-Post-pandemic (18 months, n=22)

- Internalizing: **21 normal (95.5%), 1 borderline (4.5%), 0 clinical**
- Externalizing: **21 normal (95.5%), 1 borderline (4.5%), 0 clinical**
- Total problems: 19 normal (86.4%), 3 borderline (13.6%), 0 clinical
- Other problems (raw): mean = 5.19

Between cohort comparisons (primary contrast)

-Internalizing (non-normal vs normal): 9/30 vs 1/22 → Fisher's exact p=0.032, OR=9.00 (non-normal more likely during-pandemic).

-Externalizing (non-normal vs normal): 7/30 vs 1/22 → p=0.118, OR=6.39 (ns).

-Total Problems (non-normal vs normal): 5/30 vs 3/22 → p=1.000, OR=1.27 (ns).

Overall, Internalizing and Total Problems tended to be lower post-pandemic; Externalizing distributions were similar between cohorts.

Table 1. Sample characteristics and CBCL outcomes by cohort.

Characteristic	During-pandemic cohort (Jan–Apr 2022) n=30	Post-pandemic cohort (Oct–Nov 2023) n=22
Child age at assessment	3 years	18 months
Maternal EPDS, mean	8.9	6.8
EPDS > 9, n (%)	36.7%	27.3%
CBCL Internalizing, (%) – Normal	70.0%	95.5%
CBCL Internalizing, (%) – Borderline	20.0%	4.5%
CBCL Internalizing, (%) – Clinical	10.0%	0%
CBCL Externalizing, n (%) – Normal	76.7%	95.5%
CBCL Externalizing, n (%) – Borderline	23.3%	4.5%
CBCL Externalizing, n (%) – Clinical	0%	0%
CBCL Total Problems, n (%) – Normal	83.3%	86.4%
CBCL Total Problems, n (%) – Borderline	16.7%	13.6%
CBCL Total Problems, n (%) – Clinical	0%	0%
Other Problems (raw), mean	7.50	5.19

Notes: CBCL 1½–5 T-scores were converted to normative categories (0 = normal, 1 = borderline, 2 = clinical) using age/sex-specific norms. "Other Problems" is reported as raw mean because scored continuously in the dataset.

As shown in Figure 1, the prevalence of Internalizing problems was significantly higher in children assessed during the pandemic; while Externalizing and Total Problems did not differ between cohorts.

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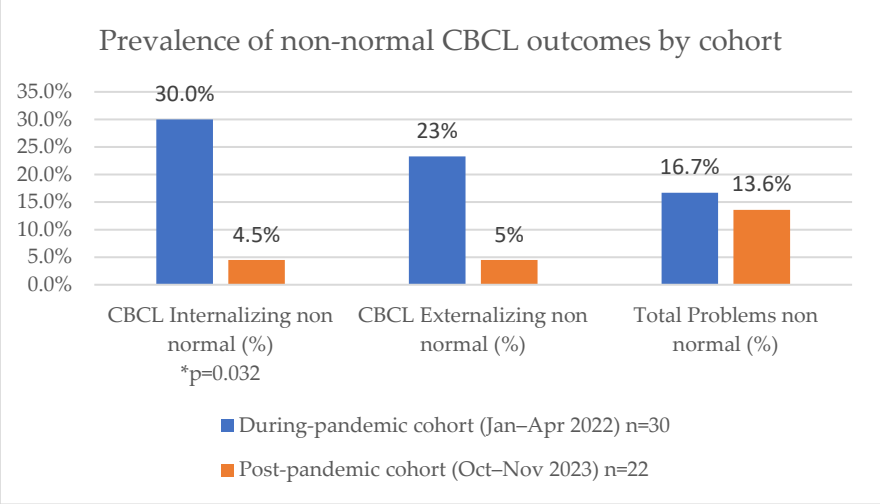

Figure 1. Prevalence of non-normal CBCL outcomes by cohort: Proportion of children showing borderline or clinical CBCL scores in Internalizing, Externalizing, and Total Problems scales during and after the COVID-19 pandemic. Significant between-group difference was observed only for Internalizing ($p = 0.032$, Fisher's exact test).

3.4. Exploratory Models and Sensitivity Analyses

Ordinal logistic models (Internalizing 0/1/2) and binary logistic models (Externalizing 0/1; Total Problems 0/1) were estimated:

-Internalizing: EPDS (raw) was not associated ($\beta = -0.032$; $p = 0.635$). Adding traumatic events left results unchanged. Child age showed a near-significant effect ($\beta = 1.417$; $p = 0.053$), indicating higher odds of internalizing difficulties at 3 years vs 18 months. SARS-CoV-2 around delivery showed no association ($\beta = 0.53$; $p = 0.451$). Other Problems (raw) had a positive, borderline association ($\beta = 0.252$; $p = 0.068$).

-Externalizing: In univariable models no predictors reached significance; in a multivariable model child age moved toward significance ($\beta = 0.921$; $p = 0.134$; OR≈2.51 per additional year), while maternal age and COVID at delivery were null. Other Problems (raw) was significant ($\beta = 0.22$; $p = 0.014$; OR≈1.25 per point).

-Total problems: Other Problems (raw) was significantly associated ($\beta = 0.3253$; $p = 0.004$; OR≈1.38 per point). No other predictors were significant.

These findings were robust to non-parametric checks and alternative coding of covariates.

Table 2. Key regression results (parsimonious models).

Outcome	Predictor(s)	β (SE)*	p-value	Interpretation
Internalizing (ordinal)	EPDS (raw)	-0.032	0.635	ns
	Child age (3 y vs 1.5 y)	1.417	0.053	trend ↑ risk at 3 y
	Other Problems (raw)	0.252	0.068	trend
Externalizing (binary)	Other Problems (raw)	0.220	0.014	OR≈1.25 per point
	Child age (years)	0.921	0.134	trend; OR≈2.51 per year
Total Problems (binary)	Other Problems (raw)	0.3253	0004	OR≈1.38 per point

Notes: β from ordinal (Internalizing) or binary logistic (Externalizing, Total) regressions; OR reported when interpretable from β (Externalizing/Total).

Figure 2 summarizes the logistic models, highlighting a significant positive association between 'Other Problems' scores and both Externalizing and Total Problems outcomes.

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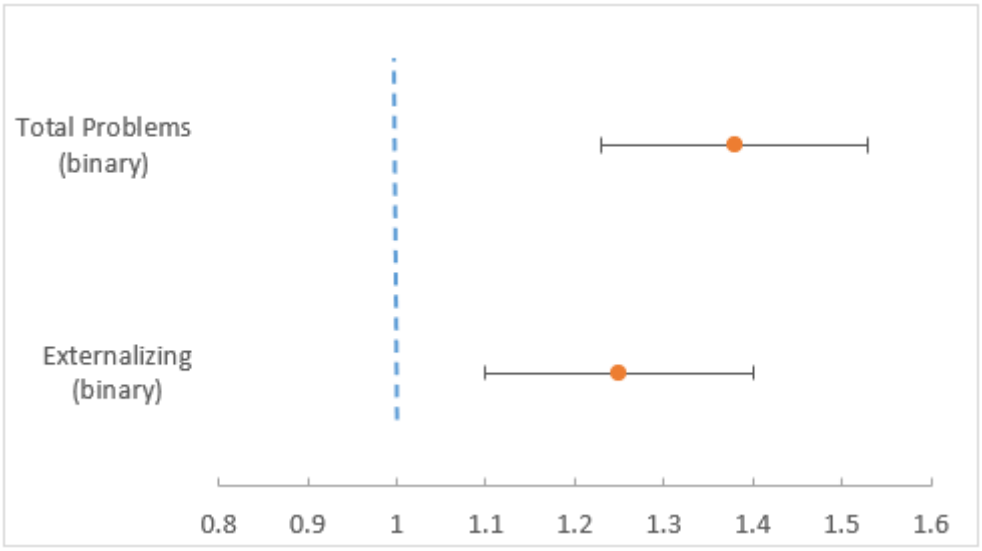

Figure 2. Association between "Other Problems" scores and CBCL outcomes. Forest plot of Odds Ratios (OR) for the association between "Other Problems" raw scores and CBCL outcomes. Each point represents the estimated effect size (β converted to OR) from logistic regression models adjusted for child age. Error bars represent 95% confidence intervals.

4. Discussion

For the purpose of this study we followed a cohort of children - born to mothers previously screened for post-partum depressive symptoms with EPDS during the particular COVID19 pandemic era – to assess whether socioemotional profiles differed in relation to these two major risk factors. Three main findings emerged. First, internalizing difficulties were more frequent during the pandemic (borderline/clinical) than after it, whereas externalizing and total problems were broadly similar between cohorts. Second, child age showed a consistent trend, with higher odds of internalizing (and a nearly-significant tendency for externalizing) at 3 years compared with 18 months. Third, the "Other Problems" raw score—an index capturing atypical or additional concerns—was positively associated with both externalizing and total problems. By contrast, neither the maternal EPDS score nor maternal SARS-CoV-2 infection around delivery related to children's CBCL outcomes in this sample.

4.1. Interpreting Cohort Differences: Pandemic versus Infection

The higher proportion of internalizing problems observed in children born during the pandemic is coherent with our a priori rationale: the pandemic functioned as a psychosocial stressor that disrupted caregiving routines and social contact in early life, a period of heightened neuroplasticity. Our data therefore aligns more with a period effect (contextual stress) than with a biological infection effect, as maternal COVID-19 status around delivery did not associate with child outcomes. This pattern converges with literature indicating that environmental stressors borne by families—reduced support networks, unpredictability, and altered caregiving—are salient for early socioemotional development, especially under 3 years, rather than the infection itself.

4.2. The Role of Age and Measurement Window

Age effects provide an important lens for interpreting the cohort contrast. Children in the during-pandemic cohort were assessed at approximately 3 years, while the post-pandemic cohort was assessed at approximately 18 months, which is the lower bound for the CBCL 1½–5. Two non-exclusive explanations follow.

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-Developmental visibility: at 3 years, internalizing signs (such as separation anxiety, inhibition and withdrawal) are easier for caregivers to recognize, and this aspect may have contributed to inflate different results in two cohorts.

-Instrument sensitivity: some CBCL items might not be sufficiently sensitive to assess behavior of children who belong to post-pandemic cohort (~18 months).

Together these factors suggest that the difference observed between the during pandemic and post pandemic cohorts might reflect both period-related stress and age-linked detectability. Furthermore, these observations lay the foundation for an important reflection on the importance of a future hypothetical re-assessment of our sample in a scholar age, when internalizing and executive-function–related behaviors stabilize and instruments show better discrimination.

4.3. Maternal Mood and Child Behavior: Level versus Context

Within the maternal cohort included in this study, the presence of post-partum depressive symptoms (tested with EPDS) did not predict internalizing, externalizing nor total CBCL outcomes, either alone or after adding traumatic events as variable. An important consideration may account for this null association: the EPDS snapshot used to define maternal mood disturbance risk may not match the time, the chronicity or the day-to-day interaction processes that most influence children's behavior basis. Thus, '*how long and when'* symptoms occur might be more important than *'how high at one point*' they are. A longitudinal design with repeated EPDS and dyadic measures would test this hypothesis.

4.4. Other Problems Scale as a Cross-Cutting Risk Indicator

Across models, higher "Other Problems" raw scores were associated to greater odds of both externalizing and total CBCL problems (OR ≈ 1.25 and 1.38 per point, respectively), and showed a borderline association with internalizing. Although the 'Other problems' scale is not a syndrome scale, it assesses concerns observed by caregivers (e.g., sleep disruption, regressions, somatic complaints) that often precede or accompany more structured difficulties (which are instead studied by major scales, such as internalizing, externalizing and total problems). Clinically, this underscores the value of listening to non-syndromic concerns in well-child visits: they may flag children who would benefit from brief, supportive interventions (parent guidance on routines, emotion coaching, sleep hygiene) even when syndrome T-scores are not yet elevated.

4.5. Strengths and Limitations

Strengths include: (i) a clinically relevant sampling frame; (ii) standardized outcomes (CBCL 1½–5) with normative categorization; (iii) analyses that separated period effects from infection status, allowing a cleaner interpretation.

Limitations warrant caution.

-Sample size attrition: only 52/144 dyads were reassessed (follow-up ≈ 36%), with non-random loss—responders tended to be older and highly educated. This selection likely increases resilience signals and reduces variance, making it harder to detect associations. Furthermore, these data lead to an important observation concerning the complexity of administering the CBCL questionnaire which could have contributed to reducing the number of participants.

-Age imbalance between cohorts (3years vs. 18 months) and measurement window: as shown before, children aged 18 months – post pandemic – were numerically inferior than 3 years old children – during pandemic cohort. This data affects the issue because it complicates causal attribution to period alone and at the same time it lowers the CBCL questionnaire's sensitivity in recognizing internalizing problems especially in post pandemic cohort.

-Single informant and cross-sectional outcome: only maternal report and a single child time-point were available; teacher/daycare reports and clinical observational measures would improve construct validity.

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-Exposure characterization: EPDS level at one time-point may not index chronicity; timing of symptom peaks relative to child developmental windows was not modeled.

4.6. Clinical Implications

Despite these constraints, two messages are actionable for pediatric care:

1. Context matters: children assessed during the pandemic showed more internalizing difficulties, consistent with the stress-laden caregiving surroundings. Thus, pediatricians should inquire proactively about routines, sleep, separations and emotion regulation in children born or cared during high-stress-periods.
2. Attend to ''small signals'': elevated "Other Problems"—even with otherwise "normal" scales—should prompt anticipatory guidance and early supports (sleep/routine interventions, parent–child play based strategies, brief parenting programs), which are low-risk and potentially protective.

4.7. Future Directions

Three design refinements follow directly from our findings:

1. Longitudinal follow-up through school age, with repeated CBCL and executive-function measures, to determine whether the internalizing difference during the pandemic persists, normalizes, or shifts profile.
2. Richer exposure modeling: repeated EPDS to index timing and chronicity, plus micro-level caregiving indices (sensitivity, responsiveness) to test mediation from maternal mood to child adjustment.
3. Multi-informant, or multi method assessment (mother, teacher/daycare; clinical observational), and digital data capture (online ASEBA scoring) to reduce burden and attrition. Pre-registration and targeted sample-size planning would increase power for small effects.

5. Conclusions

This study provides evidence of an increased rate of socioemotional behavioral difficulties in children born during pandemic compared to those born afterwards. Furthermore, our findings suggest that these problems are not directly linked to SARS-COV2 infection, but rather to the broader pandemic experience itself, considered as stressful environmental event. Beyond its methodological constraints, this observation highlights the importance of continuing a longitudinal follow-up until school age, in order to clarify whether the observed differences are due to age-related bias or represent persistent effects.

From a clinical point of view, these data emphasize the need for pediatricians to pay close attention when visiting children born and cared during pandemic - or more generally during global stressful periods, including possible future pandemics. Even subtle behavioral or emotional signals should be carefully evaluated through a broader developmental and socioemotional assessment. Raising pediatric awareness on these aspects could promote tempestive interventions and ultimately foster healthier developmental outcomes.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of the *Ethics Committee of Fondazione Policlinico Universitario A. Gemelli IRCCS* (approval code 0031589/22, date 06/10/2022).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.".

Data Availability Statement: The datasets generated and analyzed during the current study are stored at *Fondazione Policlinico Universitario A. Gemelli IRCCS*, Rome, Italy, and are available from the corresponding author on reasonable request, in accordance with institutional data protection and ethical guidelines.

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Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results. Abbreviations.

Abbreviations

The following abbreviations are used in this manuscript:

MDPI	Multidisciplinary Digital Publishing Institute
DOAJ	Directory of open access journals
TLA	Three letter acronym
LD	Linear dichroism
CBCL	Child Behavior Checklist
EPDS	Edinburgh Postnatal Depression Scale
IRB	Institutional Review Board
SD	Standard Deviation
OR	Odds Ratio

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