Maternal depression and child development: Evidence from São Paulo’s Western Region Cohort Study

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SUMMARY

Introduction: While a growing body of evidence has investigated the relationship between maternal mental health and child development, evidence on children’s early life outcomes remains mixed. We analyze the empirical relationship between maternal depression and children’s development at age one using data from the São Paulo Western Region Cohort project.

Method: Seven hundred and ninety-eight (798) mother-child dyads living in the Butantã-Jaguaré region of São Paulo were assessed through a home visit between January and March 2015. Maternal mental health was assessed using the Edinburgh Postnatal Depression Scale (EPDS). Mothers were classified as “possibly depressed” if their EPDS score was between 10 and 13 and as “likely depressed” if their EPDS score was > 13. The child outcomes analyzed were height, weight, and overall development as assessed by the Ages and Stages Questionnaire (ASQ). Height and weight were age-normalized using WHO growth standards. Stunting was defined as height-for-age z-score (HAZ) < -2. Obesity was defined as body mass index z-score (BMIZ) > 2. Adjusted and unadjusted linear regression models were used to assess the associations between Edinburgh scores and child outcomes.

Results: No association was found between maternal depression variables and children’s height, weight, stunting, and obesity. Positive associations were found between possible depression and ASQ (delta = 0.33; 95CI 0.11-0.54; p-value<0.01); no associations were found between likely depression and any of the outcomes analyzed.

Conclusion: The results from this study suggest that symptoms of maternal depression are not associated with delays in child development in the study setting analyzed. Further research will be needed to understand this lack of association: while it is possible that caregivers’ mental health did not affect caregiving behavior, it is possible that the effect of maternal depression can vary according to timing, persistence, and intensity. It is also possible that the EPDS instrument may fail to identify mothers with clinical depression, or that children with depressed mothers get increased support from other family members or public early childhood focused programs.

Keywords: maternal depression, linear growth, child development, child obesity.
Many studies, on the other hand, had found no evidence of associations between maternal depression and child development adverse outcomes, such as Santos et al., Black et al., Ertel et al., and Surkan et al. Grote et al. concluded that maternal postnatal depression may not carry risk at least not in European population.

The controversial findings presented can be a result of diversity in terms of samples, methods and measures. However, due to the large proportion of depression rates among the population, and its possible consequences to child development, such theme demands further exploration.

The present study aims to understand the associations between maternal depression and child development among a low-resource urban population in Brazil.

**Method**

**Study setting**

The study was conducted in the Butantã-Jaguaraé (BJ) region, which is located in the Western Region of São Paulo. The BJ region has an estimated population of 380,000. Infant mortality rates in the region vary between 4.4 deaths per 1,000 live births in Morumbi District and 10.3 deaths per 1,000 live births in Vila Sônia District.

**Study population**

The study population comprised 798 mother-child dyads from the BJ region, assessed as part of the baseline survey conducted for an ongoing intervention trial (ClinicalTrials.gov NCT02704000). All children in the study were born at the University Hospital (HU-USP), the main public general hospital of the region. The hospital covers the large majority of all women enrolled in public national health system (SUS), and about 40% of all births in the region. Nine hundred children born between September 2013 and March 2014 were randomly selected for the intervention trial among all hospital births by mothers living in the BJ region.

**Data**

Data was collected through home visits by trained interviewers between January and March 2015. A total of 900 interviews were conducted. A hundred of them were excluded from this study because the primary caregiver of the child assessed was the child’s grandmother; two records were excluded because the Edinburgh Scale was not administered, leaving a final sample of 798 observations.

**Exposure variables**

The main exposure variable of interest was maternal depression. Mother’s mental health status was assessed us-

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**Exposure variables**

The main exposure variable of interest was maternal depression. Mother’s mental health status was assessed us-
ing the 10-item Edinburgh Postnatal Depression Scale (EPDS). The scale ranges between 0 and 30; following standard scoring guidelines, we classified mothers as “possibly depressed” if their score was between 10 and 13, and as “likely depressed” if their score was greater than 13.

Outcome variables

The primary outcome of interest was children’s development at 1 year of age. For physical development, age- and gender-normalized height-for-age (HAZ), weight-for-age (WAZ) and body mass index (BMIZ) z-scores were computed using the WHO’s anthro software. Stunting was defined as HAZ < -2; child obesity was defined as BMIZ > 2. Children’s age was adjusted for prematurity. Gestational-length adjusted age was computed as the number of months between the time of the assessment and the child’s due date. Children’s overall development was assessed using the Brazilian version of the Ages and Stages Questionnaire (BR-ASQ).

Statistical analysis and empirical strategy

To assess the associations between maternal depression and child development we estimate multivariate linear regression models. The basic model estimated can be described as follows:

$$ y_i = \alpha + \beta_{\text{possibleD}} i + \delta_{\text{likelyD}} i + X_i \gamma + \epsilon_i \quad (1) $$

where $y_i$ is the child outcome of interest, possible $D$ is an indicator for possible depression (EPDS score 10-13) and likely $D$ is an indicator for likely depression (EPDS score > 13). $X$ is a vector of maternal and child characteristics. As a first step, we estimate unadjusted as well as adjusted models in the pooled sample; we then estimate these models separately for male and female children, and show non-parametric estimates of the relationship between EPDS scores and child outcomes.

All statistical analysis was performed using the Stata 14 statistical software package. Ethical clearance for the intervention study was obtained from the University of São Paulo’s Institutional Review Board.

RESULTS

Figure 1 shows the empirical distribution of Edinburgh Postnatal Depression Scale (EPDS) scores. A total of 100 mothers (12.5%) were categorized as possibly depressed (EPDS score 10-13), and 70 mothers (8.8%) were classified as likely depressed (EPDS score > 13).

Table 1 summarized sample characteristics by EPDS category. Average height-for-age z-score was -0.12, with 7.3% stunted. Average weight-for-age z-score was 0.44, with 18.0% of children falling in the obese category (BMI z-score > 2). Average age of children was 12.5 months at the time of the interview; 55% of children were female, and 1.3% referred to multiple births. Eight percent (8.3%) of children were born prematurely and 13% had teenage mothers. Most caregivers had secondary education; 16% had higher education; only 48.6% of caregivers were married at the time of the interview.

Table 2 shows the results of the multivariable regression analysis. No associations were found between the two depression variables and physical growth variables, including stunting and obesity. For child development (Ages and Stages z-scores), slightly higher scores were found for mothers with possible (but not likely) depression. On average, children of mothers in this group scored 0.33 standard deviations higher than children of mothers with EPDS scores < 10 (delta = 0.33, 95CI 0.11-0.54; p-value<0.01). No associations were found between likely depression and developmental outcomes.

Figure 2 shows polynomial smoothed relationships between our main outcome variables and EPDS scores separately for male and female children. Virtually all trend lines are nearly perfectly flat up to a score of about 15. Among mothers with an EPDS score of > 15, negative trends were observed for all outcomes (including ASQ) for females; for males, trends seem opposite, with improvements in ASQ, but also improvements in the prevalence of under- and over nutrition. Due to the small sample size in this bracket – only 44 women (5.5%) have a score > 15 – none of the observed subgroup differences were statistically significant.
### TABLE 1 Sample characteristics by EPDS category.

<table>
<thead>
<tr>
<th></th>
<th>No depression (EPDS &lt; 10)</th>
<th>Possible depression (EPDS 10-13)</th>
<th>Likely depression (EPDS &gt; 13)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>N</td>
<td>SD</td>
</tr>
<tr>
<td>Height-for-age z-score</td>
<td>-0.17</td>
<td>1.36</td>
<td></td>
</tr>
<tr>
<td>Child is stunted</td>
<td>0.08</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Weight-for-age z-score</td>
<td>0.44</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>Child is obese</td>
<td>0.19</td>
<td>106</td>
<td></td>
</tr>
<tr>
<td>Ages and Stages z-score</td>
<td>-0.05</td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td>Child age in months</td>
<td>12.45</td>
<td>1.87</td>
<td></td>
</tr>
<tr>
<td>Child is female</td>
<td>0.53</td>
<td>336</td>
<td></td>
</tr>
<tr>
<td>Child is a twin</td>
<td>0.01</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Child was born small for gestational age</td>
<td>0.08</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Child was born prematurely</td>
<td>0.08</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Mother age &lt; 20</td>
<td>0.13</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>Mother age 20-34</td>
<td>0.75</td>
<td>471</td>
<td></td>
</tr>
<tr>
<td>Mother age 35+</td>
<td>0.13</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Mother is primary caregiver</td>
<td>0.83</td>
<td>523</td>
<td></td>
</tr>
<tr>
<td>Caregiver primary education</td>
<td>0.29</td>
<td>182</td>
<td></td>
</tr>
<tr>
<td>Caregiver secondary education</td>
<td>0.45</td>
<td>282</td>
<td></td>
</tr>
<tr>
<td>Caregiver higher education</td>
<td>0.17</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>Caregiver married</td>
<td>0.50</td>
<td>318</td>
<td></td>
</tr>
<tr>
<td>Asset quintile 1</td>
<td>0.18</td>
<td>114</td>
<td></td>
</tr>
<tr>
<td>Asset quintile 2</td>
<td>0.27</td>
<td>167</td>
<td></td>
</tr>
<tr>
<td>Asset quintile 3</td>
<td>0.14</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>Asset quintile 4</td>
<td>0.20</td>
<td>125</td>
<td></td>
</tr>
<tr>
<td>Asset quintile 5</td>
<td>0.22</td>
<td>136</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 2 Adjusted and unadjusted associations between depression scores and child developmental outcomes.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Height-for-age z-score</th>
<th>Child is stunted</th>
<th>Weight-for-age z-score</th>
<th>Child is obese</th>
<th>Ages and Stages z-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unadjusted associations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possible depression</td>
<td>0.266</td>
<td>-0.028</td>
<td>-0.002</td>
<td>-0.019</td>
<td>0.309***</td>
</tr>
<tr>
<td>(0.163)</td>
<td>(0.022)</td>
<td>(0.176)</td>
<td>(0.044)</td>
<td>(0.110)</td>
<td></td>
</tr>
<tr>
<td>Likely depression</td>
<td>0.191</td>
<td>0.020</td>
<td>0.083</td>
<td>0.011</td>
<td>0.086</td>
</tr>
<tr>
<td>(0.176)</td>
<td>(0.036)</td>
<td>(0.144)</td>
<td>(0.052)</td>
<td>(0.128)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>795</td>
<td>795</td>
<td>707</td>
<td>703</td>
<td>602</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.007</td>
<td>0.007</td>
<td>0.000</td>
<td>0.002</td>
<td>0.011</td>
</tr>
<tr>
<td>Adjusted associations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possible depression</td>
<td>0.251</td>
<td>-0.031</td>
<td>-0.080</td>
<td>-0.035</td>
<td>0.329***</td>
</tr>
<tr>
<td>(0.166)</td>
<td>(0.023)</td>
<td>(0.177)</td>
<td>(0.046)</td>
<td>(0.109)</td>
<td></td>
</tr>
<tr>
<td>Likely depression</td>
<td>0.212</td>
<td>0.017</td>
<td>0.098</td>
<td>0.012</td>
<td>0.142</td>
</tr>
<tr>
<td>(0.166)</td>
<td>(0.034)</td>
<td>(0.143)</td>
<td>(0.053)</td>
<td>(0.128)</td>
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<td>707</td>
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<td>602</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.070</td>
<td>0.065</td>
<td>0.065</td>
<td>0.027</td>
<td>0.098</td>
</tr>
</tbody>
</table>

Notes: All estimates are based on ordinary least squares regression models with robust standard errors in parentheses. Adjusted models control for the full list of covariates shown in Table 1.
The results presented in this paper suggest that symptoms of maternal depression (as measured by the Edinburgh Postnatal Depression Scale) are not associated with child development in the Western Region of São Paulo. While we do not find any associations at all for measures of physical growth and child weight, intermediate EPDS scores actually seem to be positively associated with children’s overall development, while only very high EPDS scores appear to be associated with reductions in early childhood development scores, and only for girls.

The general lack of association between maternal depression scores and developmental outcomes is somewhat surprising; while there are studies with similar findings, the majority of the existing literature discussed in the introduction suggests negative associations between maternal depression and children’s physical as well as overall development. Several factors potentially contribute to the rather weak overall association observed: first, children were on average only 12 months old when assessed, which makes it relatively difficult to assess cognitive and socio-emotional development of children. In terms of physical growth, most children in the area are doing rather well as evidenced by a stunting rate of only 7% – large differences in this domain are thus relatively unlikely to occur. Conceptually, maternal mental health may also become more relevant once children become a little bit older and depend more on child-caregiver interactions for stimulation and early learning, and as demonstrated in other studies, the effects of maternal depression during early life can become evident later in life. Second, and related, access to health services is almost universal in the study area, so that children with early developmental problems are likely to have received external support, reducing the differentials between depressed and non-depressed mothers. Last, it is also possible that the relative short EPDS scale is not sensitive enough to clearly distinguish between clinically depressed and healthy mothers; the resulting measurement error will mechanically bias all of our coefficients towards zero. In addition to it, maternal depression was assessed only once, so our analysis cannot distinguish mothers with a persisting depression from the ones with acute episodes, or antenatal depression.

The presented study has several limitations: first, as already mentioned, it relies on the EPDS as primary measure of maternal depression; while the EPDS has been widely used as a screening tool, it is not a direct measure of clinical depression, and thus does not allow us to directly

**FIGURE 2** Non-parametric trend estimates: Edinburgh Postnatal Depression Scale (EPDS) score, Ages and Stages Questionnaire (ASQ), stunting and obesity.
compare healthy to clinically depressed mothers. Second, and along similar lines, the study did not conduct a direct assessment of children’s cognitive and socio-emotional development. While the ASQ tool used has been validated in Brazil, it relies on maternal self-reports, which may be biased differentially across EPDS groupings. The same obviously does not apply to the anthropometric measures which were taken by study staff as part of the interviews. Last, as it is always the case for cross-sectional studies, we cannot rule out confounding bias. While we use a large set of covariates in our adjusted models, it is possible that omitted variables like maternal family background or maternal social networks affect both maternal health and child outcomes. In most cases, we would expect such omitted factors to improve maternal mental health as well as child well-being; if this was the case, the true associations between maternal mental health and child outcomes would be even more positive than the one reported here.

Despite these limitations, the study has several important strengths: it is, to our knowledge, one of the very few studies assessing the relationship between maternal mental health and child development in a representative urban sample; the large amount of data collected as part of the larger study allows us to control for most environmental factors; the large number of child developmental measures collected allows us to conduct a multi-domain assessment rather than just focusing on nutritional or developmental outcomes.

**CONCLUSION**

Maternal depression is highly common among mothers in poor urban settings. According to our estimates, depression seems possible for 12.5% of mothers and likely for 8.8% of mothers. The results of this study suggest that depression symptoms are not generally associated with reductions in child development at age one. Negative associations seem plausible for mothers with higher EPDS scores; our study was not powered to detect such differences. Overall, the effect of maternal depression on child development appears to vary substantially depending on local context, and, as suggested by Claessens et al., the timing, persistence and intensity of depressive symptoms.

**REFERENCES**