Timing and Chronicity of Maternal Depression Symptoms and Children's Verbal Abilities

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Objective To test the associations between the timing and chronicity of maternal depression symptoms (MDS) and children's long-term verbal abilities.

Study design Participants were 1073 mother-child pairs from a population-based birth cohort in Canada. MDS were assessed at ages 5 months, 1.5, 3.5, and 5 years using the Center for Epidemiologic Studies Depression Scale. Verbal abilities were measured at 5, 6, and 10 years using the Peabody Picture Vocabulary Test-Revised (PPVT-R). Multiple linear regression models were used to estimate the association between timing (early: 5 months and/or 1.5 years vs late 3.5 and/or 5 years) and chronicity (5 months, 1.5, 3.5, and 5 years) of exposure to elevated MDS and children's mean PPVT-R scores.

Results Children exposed to chronic MDS had lower PPVT-R scores than children never exposed (mean difference = 9.04 [95% CI = 2.28-15.80]), exposed early (10.08 [3.33-16.86]) and exposed late (8.69 [1.85-15.53]). There were no significant differences between scores of children in the early compared with the late exposure group. We adjusted for mother-child interactions, family functioning, socioeconomic status, PPVT-R administration language, child's birth order, and maternal IQ, psychopathology, education, native language, age at birth of child, and parenting practices. Maternal IQ, ($\eta^2 = 0.028$), native language ($\eta^2 = 0.009$), and MDS ($\eta^2 = 0.007$) were the main predictors of children's verbal abilities.

Conclusions Exposure to chronic MDS in early childhood is associated with lower levels of verbal abilities in middle childhood. Further research is needed in larger community samples to test the association between MDS and children's long-term language skills. (J Pediatr 2017;■■:■■-■■).

Approximately 9% of women will meet diagnostic criteria for major depression during pregnancy or in the early years of parenthood,[1] so that a large number of young children are exposed. Both clinical and subclinical levels of maternal depression symptoms (MDS) carry risk for the offspring.[2] Several studies have found lower levels of cognitive functioning, including verbal abilities, in children of depressed mothers.[3-7] However, little is known about whether timing and/or chronicity of MDS during early childhood, which is a time at which the child is highly dependent on the mother, is associated with children's long-term verbal abilities.

Because infants are largely dependent on maternal care and stimulation, early exposure (eg, birth-2 years) to MDS may have a larger impact on a child's cognitive development than an exposure later in childhood (eg, 3-5 years).[8] However, the chronicity of MDS, that is, the persistence of symptoms over time, has often been associated with negative behavior and smaller achievement gains in primary school.[9,10] Overall, children exposed to chronic MDS may have a greater risk of accumulating disadvantage over time and are, therefore, more likely to experience lasting negative effects.[11] Notably, few studies have aimed at distinguishing the impact of early versus late vs chronic exposure to MDS on longer term outcomes.

We modeled the association between timing and chronicity of MDS exposure and children's verbal abilities using a population-based cohort study. We hypothesized that (1) children exposed to early MDS would have lower scores on a test of verbal abilities compared with children exposed later during early childhood and that, (2) children exposed to elevated MDS over a longer period of time

CES-D	Center for Epidemiologic Studies Depression Scale
MDS	Maternal depression symptoms
PPVT-R	Peabody Picture Vocabulary Test-Revised
SES	Socioeconomic status

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would have lower scores on this measure than children exposed for shorter periods.

Methods

Data were drawn from the Quebec Longitudinal Study of Child Development, whose protocol was approved by the Quebec Institute of Statistics and the Sainte-Justine Hospital Research Centre ethics committees. Participants were recruited via the Quebec Birth Registry using a stratified procedure based on living area and birth rate. The initial sample included n = 2120 infants born in Quebec in 1997-1998. Our analysis sample included n = 1073 mother-child pairs for whom data was available for MDS at 2 or more time points from 5 months to 5 years, verbal abilities for at least 1 time point from 5 to 10 years, and all covariates. At each data collection, informed written consent was obtained from all participants.

MDS were assessed at 5 months, 1.5, 3.5, and 5 years using a short version (5-12 questions) of the Center for Epidemiologic Studies Depression Scale (CES-D).[12] Responses were standardized to a score between 0 and 10. This version of the CES-D is highly correlated with the original.[13] The CES-D does not provide a clinical diagnosis of depression, but instead captures MDS. It is a valid and reliable measure of MDS assessing the occurrence and severity of symptoms during the previous week. Responses ranged between 0 (none) to 3 (all the time): all scores were significantly correlated with each other ($r = 0.36$-0.44; $P < .0001$). A threshold of 2.67 (out of 10) was used to approximate the conventional cut-off (16/60) for elevated MDS from the original CES-D.[12,14,15] We created a single variable for MDS with 4 categories of interest including mothers who (1) never met criteria for elevated MDS ("no exposure"; 63.8%, n = 684), (2) met criteria for "early exposure" (at either 5 months and/or 1.5years; 18.1%, n = 194), (3) met criteria for "late exposure" (at either 3.5 and/or 5 years; 16.8%, n = 181), and (4) mothers who met criteria for chronic exposure (at 5 months, 1.5, 3.5, and 5 years; 1.3%, n = 14).

Verbal abilities were assessed at ages 5, 6, and 10 years using the Peabody Picture Vocabulary Test-Revised (PPVT-R)[16]; the child was presented with pictures and had to identify the picture that matched the word read out by the interviewer. Test scores were age-corrected and used in linear regression models. Preliminary analyses showed that the pattern of associations between the exposure and outcome was largely similar across ages. Longitudinal research shows that development of verbal abilities in young children remains relatively stable over time.[17,18] PPVT-R scores at ages 5, 6, and 10 years were strongly correlated with each other ($r = 0.54$-0.64; $P < .0001$); therefore, outcomes between 5 and 10 years were combined into a single mean score (n = 480 had a PPVT-R score at all 3 ages, n = 380 had at least 2 and n = 213 had at least 1 score). Tests were administered in either French[19] or English; therefore, we adjusted for the language of test administration in analyses. To facilitate interpretation, our global verbal abilities score was converted to a standardized score (mean = 100, SD = 15).

Maternal education, verbal IQ, maternal language spoken at home (dichotomized as English and/or French and/or another language or neither French nor English), age at birth of target child (dichotomized as ≤21 years or <21 years),[20] and birth order of target child were assessed at baseline and considered as potential controls.[21,22] To isolate the role of MDS in children's verbal abilities, we adjusted for 2 main types of maternal psychopathology symptoms that may co-occur with MDS. General, trait-like maternal anxiety was assessed when the target child was 4.5 years using validated items inspired by *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition* criteria.[23] Antisocial behavior in adolescence was assessed by asking mothers whether they had exhibited 5 different conduct problems.[24] The scale ranged from 0 to 5. Mother-child interactions at baseline were assessed by an observer using the Home Observation Measurement of the Environment.[25] Maternal parenting practices and family functioning at baseline were self-reported using the Parental Cognitions and Conduct toward the Infant Scale[26] and the family dysfunction scale,[27] respectively. Socioeconomic status (SES) of the family at baseline was derived from 5 variables including maternal education (years of schooling), spouse's education and occupational status, maternal occupational status, and household income. The final SES composite was standardized for all families. Further information on the questionnaires and methods of data collection can be found online at http://www.jesuisjeserai.stat.gouv.qc.ca.

Statistical Analyses

Data analyses included 3 steps. First, we selected control variables on the basis of previous literature indicating an association between a given variable and/or MDS and children's verbal abilities, and epidemiologic guidelines for modeling longitudinal data, whereby potential confounders are selected at baseline and not at subsequent time points[28,29] and, bivariate association at $P < .05$ between a control variable and either MDS or verbal abilities. Next, linear regression models were used to examine the association between the timing and chronicity of MDS and children's verbal abilities. Finally, to adjust for attrition, we identified variables which differed significantly between the initial and analysis samples and created inverse probability weights based on these variables.

In post hoc regression analyses, we tested the association between the number of times a mother had elevated MDS and children's verbal abilities using the same covariates. We created a categorical variable with 5 categories of mothers who (1) never had elevated MDS (63.8%, n = 684), (2) had elevated MDS once (21.4%, n = 230), (3) twice (9.2%, n = 99), (4) 3 times (4.3%, n = 46), and (5) 4 times (1.3%, n = 14). All statistical analyses were conducted in SAS v 9.4 (SAS Institute, Cary, North Carolina).

Results

Our analysis sample (n = 1073) significantly differed from our initial cohort sample (n = 2120). Mothers included in our analysis sample were less likely to have male children (50% in analysis sample vs 57% in initial sample, $\chi^2 = 9.31$, $P = .002$), be unemployed (45% vs 55%, $\chi^2 = 22.39$, $P < .0001$), have a high