Poverty and behavior problems during early childhood: The mediating role of maternal depression symptoms and parenting

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Abstract
Poverty is a well-established risk factor for behavior problems, yet our understanding of putative family mediators during early childhood (i.e., before age 5 years) is limited. The present study investigated whether the association between poverty and behavior problems during early childhood is mediated simultaneously by perceived parenting, family dysfunction and/or maternal depression symptoms. Outcomes measures were high trajectories of physical aggression and hyperactivity between 1.5 and 5 years. Poverty was defined as living 2–4 years below the low-income thresholds defined by Statistics Canada. Using data from the first five rounds of the Quebec Longitudinal Study of Child Development, logistic regressions models showed that poverty was associated with a higher likelihood of being assigned to the high trajectory of physical aggression and hyperactivity. Overprotection and maternal depression symptoms mediated observed associations. Interventions targeting maternal depression, parenting, and poverty should help reducing children's risk for early behavior problems.

Poverty is a well-established risk factor for behavior problems across development (Amone-P'Olak et al., 2009; Dearing, McCartney, & Taylor, 2006). This association is robust across high-income countries with different health care and social policy contexts (Kiernan & Mensah, 2009; Spencer, 2003). One of the leading mechanistic hypotheses about how poverty shapes children's behavioral development is through its impact on parental psychological well-being. Previous studies have primarily focused on the family stress model (Conger & Donnellan, 2007), which posits that economic hardship increases parental distress indirectly affecting children's adjustment through parental mental health and the quality of parenting. The family stress model remains understudied with regard to poverty and child development during early childhood (i.e., first 5 years of life), a period characterized by children's high levels of dependence on caregivers and vulnerability to adverse and stressful environmental conditions.

Why should poverty be associated with behavior problems? The family stress model

The family stress model posits that economic hardship is related to higher levels of family stress (Conger & Donnellan, 2007). In this model, higher levels of family stress are reflected in reduced nurturing and involved parenting as well as increased family and marital conflicts, parental emotional distress (e.g. depression, anxiety, anger, and alienation) and behavior problems (e.g. substance use and antisocial behavior). In turn, family stress is proposed to be related to higher levels of behavior problems in the offspring. Hyperactivity and physical aggression are two subtypes of behavior problems which are prevalent during early childhood, a time period

in which children learn to inhibit or control such behaviors within a supportive family environment (Côté, Vaillancourt, LeBlanc, Nagin, & Tremblay, 2006; Tremblay, 2010). In the present study, we test the hypothesis that family stress interferes with children's learning to control behavior problems such as hyperactivity and physical aggression.

Empirical evidence on the direct or indirect associations between poverty and behavior problems

Evidence on the association between poverty and behavior problems from quasi-experimental research (e.g. testing the impact of supplemental income) suggest that poverty is related to children's behavior problems across childhood (Akee, Copeland, Keeler, Angold, & Costello, 2010; D'Onofrio et al., 2009). Most of quasi-experimental studies focus on children aged 4–12 years; the exception being a Swedish study supporting an association between low family income and Attention Deficit/Hyperactivity Disorder

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during children's first 5 years of life (Larsson, Sariaslan, Lång-ström, D'Onofrio, & Lichtenstein, 2014).

With such associations established through both longitudinal and experimental studies, researchers have focused on mechanisms by which poverty is linked to behavior problems. Studies provide three lines of evidence for three types of family mediators that have a either direct or indirect effect on children's behavior problems. First, poverty was shown to be associated with children's behavior problems (2–6 years of age) primarily through less-supportive parenting and family conflict (Rafferty & Griffin, 2010). In particular, parental supervision was found to be an important mediator of the link between poverty and clinical diagnoses of conduct and opposition-defiant disorders at ages 9–13 years (Costello, Compton, Keeler, & Angold, 2003). Further, maternal warmth and parental monitoring were found to mediate the association between neighborhood affluence and antisocial behavior from 5 to 12 years of age (including physical aggression) (Odgers et al., 2012). Second, economic deprivation was shown to be associated with behavior problems indirectly through maternal depression among children aged 2–4 years (Wadsworth et al., 2013). Similar findings were obtained in mediation analyses revealing indirect effects of low-income on behavior problems (7–8 years of age) operating through maternal depression and parenting hassles (Shelleby et al., 2014). The same pattern was found among young children (0-3 years) in which maternal depression, along with disrupted parenting were found to be mediators of the association between economic disadvantage and behavior problems (Rijlaarsdam et al., 2013). In addition, experimental research suggests that changes in maternal depression mediated the association between poverty and behavior problems among children aged 2–3 years (Shaw, Connell, Dishion, Wilson, & Gardner, 2009). Third, research has suggested that poverty was related to higher levels of conduct problems (8–10 years) through increases in family conflicts (Evans & English, 2002). For instance, the association between poverty and behavior problems (age 17 years) was found to be mediated by family conflicts in the home environment including violence and family turmoil (Evans & Cassells, 2014). Together these findings indicate that the stress accompanying poverty may lead to harsher and less responsive parenting, conflicted family interactions as well as feelings of hopelessness due to lack of choices in life and, consequently, depressive symptoms. These factors, in turn, may be harmful to children's behavioral development.

Limitations of past studies

Some limitations in the literature regarding the family stress model and the poverty–behavior problem link should be considered. First, very few studies have tested the mediating role of family processes in the association between poverty in the first year of life and behavior problems in early childhood. Second, there is compelling evidence on the importance of distinguishing subtypes of behavior problems because they have different developmental trajectories and require specific corrective interventions (Tremblay, 2010), but few studies have made distinctions between behavioral subtypes. Indeed, it is possible that different mediators may be more or less pertinent to different subtypes of behavior problems. For instance, the socialization of physically aggressive behavior during early childhood may be more associated with poverty through parenting than other subtype of behavior problems such as hyperactivity, which may be more genetically related (Faraone, Doyle, Mick, &

Biederman, 2014). Third, few studies have distinguished the potential mediating role of different types of parenting constructs simultaneously. One challenge here concerns levels of description and specificity of parenting constructs. Finally, little is known about chronic or long-term poverty and behavior problems during early childhood. Studies have shown that poverty is most strongly associated with child outcomes when it is chronic (Nikiéma, Gauvin, Zunzunegui, & Séguin, 2012; Roy & Raver, 2014), but the association between chronic poverty and behavior problems before age 5 years has not been examined.

Objectives of the present study

The present study sought to extend our understanding of family mediators through which poverty shapes behavior problems by addressing two objectives: (1) to estimate the associations between chronic poverty from 5 months to 3.5 years of age and high levels of physical aggression and hyperactivity from 1.5 to 5 years of age, and (2) to examine whether the association between poverty and behavior problems is mediated simultaneously by perceived parenting (self-efficacy, parental impact, coercion, and overprotection), family dysfunction and maternal depression symptoms. Previous research has shown that these parenting constructs are linked to behavior problems (Côté, Boivin, et al., 2007; Galéra et al., 2011). Thus, perceived parenting, family dysfunction and maternal depression may be important independent pathways of the poverty-behavior problems link during early childhood. Three main hypotheses were generated from previous research: 1) poverty would be associated with all behavior problems; 2) perceived parenting, family dysfunction and maternal depression symptoms would be associated with all behavior problems; and 3) the association between poverty and behavior problems would be mediated by perceived parenting, family dysfunction, and/or maternal depression symptoms. The additional value of this study resides in informing the time and targets for interventions to limit the detrimental impact of poverty on behavior problems, and providing policy recommendations to further reduce poverty in families with young children.

Methods

Data

Data were obtained from the Quebec Longitudinal Study of Childhood Development. The protocol was approved by the Quebec Institute of Statistics and the Sainte-Justine Hospital Research Center (Montreal) ethics committees. The sample was born during the years 1997 to 1998 and was drawn from the Quebec Birth Registry using a stratified procedure based on living area and birth rate. Families were included if the pregnancy lasted 24 to 42 weeks and the mother could speak French and/or English. Data were collected yearly through home interviews conducted with the person most knowledgeable about the child (mothers in 98% of cases). Written informed consent was obtained from all participating families. Assessments were conducted at: 5 months, 1.5, 2.5, 3.5, 4.5, and 5 years. The initial sample comprised of 2,120 children aged 3–8 months (mean age 5 months). When children were 5 years of age, 1,759 participants from the initial sample remained in the study (i.e., 83% retention rate). All analyses were weighted to correct for non-participation and non-response over time. Each participant was given a weight that was inversely proportional to the probability of being drawn from the initial target population (i.e., at 5 months).

Table 1. Mean levels of physical aggression and hyperactivity by age from 1.5 to 5 years of age

Age	Hyperactivity Mean [95%CI]	Physical aggression Mean [95%CI]
1.5 years	4.00 [3.88; 4.12]	1.35 [1.28; 1.42]
2.5 years	3.98 [3.87; 4.09]	1.94 [1.86; 2.02]
3.5 years	4.25 [4.15; 4.35]	1.40 [1.33; 1.47]
4.5 years	3.93 [3.83; 4.03]	1.12 [1.06; 1.18]
5 years	3.98 [3.88; 4.08]	1.09 [1.03; 1.15]

Note. Behavior problems coded so that higher scores indicated higher levels of behavior problems (range 0–10 for hyperactivity and range 0–6 for physical aggression). Analyses were conducted on our study sample ($n = 1,759$).

The purpose of using weights was to infer the results to the entire target population by taking into account certain demographics characteristics of non-respondents and non-participants such as low-income households, mothers who spoke languages other than French or English at home, one-parent families, mothers who had less than a high school diploma, and mothers younger than 25 years of age (Jetté & Des Groseilliers, 2000). The weight variable was provided by the Quebec Institute of Statistics when children were 5 years of age.

Of the 2,120 participants in the initial sample, we selected for the present study only those with 4 or more time points that included behavior problems and poverty data as well as those with weight variable ($N = 1,759$). From those, 63 were excluded due to non-response on at least one of variables used in analyses. Missing values ranged between 0.6& and 5.2%. No significant difference was noted between the two samples.

Measures

Outcome variables

High trajectories of physical aggression and hyperactivity. Mothers rated their child's behavior five times between 1.5 and 5 years of age using the early childhood behavior scale from the Canadian National Longitudinal Study of Children and Youth (Statistics Canada, 1996). This tool incorporates items from the Child Behavior Checklist (Achenbach & Edelbrock, 1991), the Ontario Child Health Study Scales (Byles, Byrne, Boyle, & Offord, 1988), a modified version of the Children's Behaviour Questionnaire (Behar, 1977); and the Preschool Behaviour Questionnaire (Tremblay, Vitaro, Gagnon, Piché, & Royer, 1992). Mothers rated the frequency scale of their child's behavior problems, namely whether the child never (0), sometimes (1), or often (2) exhibited physical aggression and hyperactivity. Items used were: a) hits, bites, kicks; b) fights; and c) bullies others for physical aggression (range 0–6); and a) can't sit still, is restless, is hyperactive; b) fidgets; c) is impulsive; d) has difficulty waiting turn; and e) cannot settle for hyperactivity (range 0–10). Cronbach's alphas ranged between 0.72 and 0.75 across assessments for physical aggression ratings and between 0.74 and 0.75 for hyperactivity ratings. Mean levels of behavior problems by age are presented in Table 1.

We used a semi-parametric mixture model approach (using software package Statistical Analysis System Trajectory Procedure; SAS Proc Traj) to examine behavioral profiles of physical aggression and hyperactivity, represented by different combinations of the trajectories (Jones & Nagin, 2007). The modeled trajectories allow (1) identifying groups of children with distinct levels of a given behavior over time, (2) estimating the proportion of children in each of the identified trajectory groups, and (3) estimating the patterns of stability and variations in trajectories. This procedure assigns individuals to categories on the basis of a posterior probability rule. Resulting groups are approximations of probabilities used to classify the participant in the trajectory group he or she most likely belongs to (Nagin, 2005). Specifically, each participant is assigned to the trajectory group for which he or she had the largest probability estimate. For instance, a participant with high physical aggression scores throughout early childhood will have a high probability of being classified in the high physical aggression trajectory. At least 4 data points were available to estimate behavioral trajectories for 94.8% of the study sample. Models with 2 to 4 trajectories groups were estimated. The selection of the final model was based on: A) Two statistical indexes: the model that maximized the Bayesian Information Criterion (BIC, i.e., closer to 0) and maximized entropy (i.e., the extent to which groups are well separated) (Schwarz, 1978), and B) the size of the trajectory groups. That is, the selected model had a sufficient proportion of children in the different groups to be usable in prediction analyses. In addition, the high trajectory group included a sufficiently small number of children to reflect an atypically elevated developmental pattern. There are no set cut-off criteria for deciding whether the size of the trajectory groups is reasonably sufficient. However, using simulations, Nylund, Asparouhov, and Muthén (2007) reported that modeling trajectories where there was a very small group (i.e., 5%) might lead to convergence problems and misspecified models. To avoid this, we specified a cut-off criterion of 10% of the sample for determining the size of the trajectory groups.

Table 2 shows BIC statistics and the percentages of participants for models with 2 to 4 trajectories groups. For both subtypes of behavior problems, 2-trajectory group models had the highest BIC but the proportion of children in each group was nearly the same, indicating that groups were not substantially different in the identified trajectories. For 4-trajectory group models, BIC values were smaller than other models with a low proportion of children in one of the trajectory groups. When considering the criterion of the sufficient proportion of children in different trajectory groups, the best model comprised 3-trajectory groups for both physical aggression and hyperactivity. For the 3-trajectory group model, the average probability for group membership ranged between 0.83 and 0.88 for physical aggression, and 0.88 and 0.90 for hyperactivity, thereby indicating a good fit of the model (i.e., higher than .80) (Nagin, 2005). Further, intercept estimates for models with varying number of trajectory groups are presented in the Supplementary material (Table S1).

The three physical aggression trajectories were as follows: high (17.54%), moderate (50.63%), and low (31.84%). The three hyperactivity trajectories were as follows: high (14.15%), moderate (53.99%), and low (31.86%). Figure 1 shows the 3-trajectory groups models. High trajectory groups of physical aggression and hyperactivity were treated as a dichotomous variable (1 = yes; 0 = no, i.e., when children followed a low/moderate groups). The rational for comparing children belonging to the high trajectory group to all other groups was to identify children with atypically high levels of behavior problems.

Independent variable

Poverty. We used a measure of relative poverty. Mothers reported the total annual household income before taxes in the past 12 months. Poverty was established as a function of living in a

Table 2. BIC statistics and the percentage of participants for models with 2, 3, and 4 trajectory groups

	Physical Aggression				
	BIC	Low (%)	Moderate (%)	High (%)	High-rising (%)
Model					
2-trajectory	−13,419.05	45.28	54.72	–	–
3-trajectory	−13,257.30	31.84	50.63	17.54	–
4-trajectory	−13,245.14	8.81	30.22	44.82	16.14

	Hyperactivity				
	BIC	Low (%)	Moderate (%)	High (%)	High-rising (%)
Model					
2-trajectory	−20,537.29	55.22	44.78	–	–
3-trajectory	−20,216.69	31.86	53.99	14.15	–
4-trajectory	−20,133.29	14.34	43.45	34.21	8.0

Note. The table presents a comparison between models with 2, 3, and 4 trajectory groups based on the 2,045 participants with data available for behavior problems from 1.5 to 5 years of age.
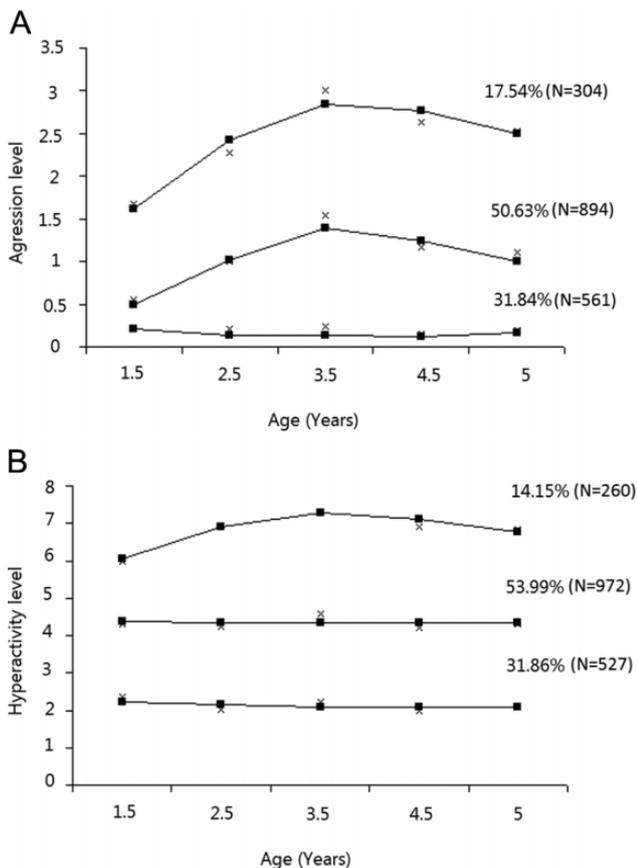
Figure 1. Developmental trajectories of physical aggression (A) and hyperactivity (B) from 1.5 to 5 years of age.
Note. "■" is to the estimated value and "x" is the average value based on the observations. The figure presents behavior problems trajectories based on analyses conducted on our study sample ($n = 1,759$).

household with annual income below the Canadian low income cut-offs. Low income cut-offs were calculated by Statistics Canada and available yearly in the sample, with the exception of the 4.5 years of age assessment. The calculation is based on family income, the number of people in the household, and the level of urbanization of the place of residence in the past 12 months (Giles, 2004). A family at or below the low income cut-offs attributes 20% or more of their household income than the average Canadian family to food, shelter, and clothing. For example, in 2008, low income cut-offs were CA\$22,724, CA\$26,007, CA\$29,378, CA\$29,013; and CA\$34,738 for a family of four living in rural areas, towns (< 30,000 inhabitants), towns between 30,000 and 99,999 inhabitants, cities between 100,000 and 499,999 inhabitants or large cities (> 500,000 inhabitants), respectively (Statistics Canada, 2012). In the present study, poverty was defined as chronic poverty, where families lived at or below low income cut-offs on two to four occasions when children were aged 5 months to 3.5 years (26.8% of the sample). Poverty was treated as a dichotomous variable (1 = chronic; 0 = otherwise).

Potential mediators

Family dysfunction, perceived parenting, and maternal depression symptoms. Maternal ratings of family dysfunction (when the child was 1.5 years of age) assessed family conflict based on communication, problem resolution, control of disruptive behavior, and showing and receiving affection (Byles et al., 1988) (e.g. "there are lots of bad feelings in our family"). Higher values indicated greater family dysfunction (range 0–10 and $\alpha = 0.83$). Maternal depression symptoms (when the child was 1.5 years of age) were assessed through an 8-item abridged version of the Diagnostic Interview Schedule (Robins, Cottler, Bucholz, & Compton, 1995; Roy et al., 2005). An interviewer asked mothers questions regarding depression symptoms and entered responses into a computer. Higher scores indicate greater levels of depressive symptoms (range –10 and $\alpha = 0.81$). When the child was 1.5 and 2.5 years of age, mothers completed a parenting questionnaire using the Parental Cognitions and Conduct toward the Infant Scale (PACOTIS) (Boivin et al., 2005). Parenting constructs reflecting the mother's perceptions towards their infant were: (1) Self-efficacy: the perceived ability to carry out tasks associated with the role of a parent (e.g. "I feel that I am very good at keeping my baby amused"; $\alpha = 0.62$ at 1.5 years of age and 0.95 at 2.5 years of age). (2) Parental impact: mother's evaluation of the effect of his/her behavior on the child (e.g. "My behavior has little effect on the personal development of

my child"; $\alpha = 0.58$ at 1.5 years of age and 0.78 at 2.5 years of age). (3) Coercion: mother's hostile and restrictive responses to children's difficult behaviors (e.g. "I have been angry with my baby when he or she was particularly fussy"; $\alpha = 0.69$ at 1.5 years of age and 0.85 at 2.5 years of age). (4) Overprotection: an excessive concern for the safety and protection of the child (e.g. "I insist upon keeping my baby close to me at all times, within my eyesight and in the same room as I am"; $\alpha = 0.70$ at 1.5 years of age and 0.68 at 2.5 years of age). Mean scores for parenting constructs measured at 1.5 and 2.5 years of age were computed. For all parenting constructs, higher scores indicated higher levels of perceived parenting (range 0–10). All items used to measure self-efficacy, parental impact, coercion, overprotection, family functioning, and depression symptoms are available in the Supplementary material (Table S2).

Control variables

We selected confounders on the basis of their putative association with low family income and behavior problems in previous studies (Burt, Barnes, McGue, & Iacono, 2008; Côté et al., 2006; Côté Vaillancourt, et al., 2007; Essex et al., 2006; Tremblay et al., 2004). Models adjusted for the child's sex, low maternal education, and family structure. Low maternal education referred to mothers who did not complete high-school when the child was 5 years of age (coded as 1 = yes; 0 = no). Family structure referred to children whose parents were single or separated at least twice from 5 months to 5 years of age (coded as 1 = yes; 0 = no). The sex of the child was treated as a dummy variable (1 = boys; 0 = girls).

Analytic design

The analyses were conducted in three steps: (1) testing the association between poverty and children's high trajectories of physical aggression and hyperactivity; (2) selecting potential mediators; (3) testing potential mediators. We used z-standardized ratings for all potential mediators. We imputed values for our study sample ($N = 1,759$) allowing for the inclusion of 63 individuals with missing data in the analyses. A total of 5 imputed datasets were produced. Then, estimates from imputed datasets were combined producing a single estimate and standard errors for subsequent analyses. Results addressing the modeling of the association between poverty and behavior problems were reported using imputed data. P values were based on two-tailed tests. Analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 21 software. Threshold for statistical significance was set at $p < .05$.

Multiple logistic regression models were used to examine whether poverty was associated with a child's membership in the high trajectory groups versus other groups. The two outcomes were: (1) belonging to a high physical aggression trajectory; and (2) belonging to a high hyperactivity trajectory. Models were adjusted for confounders including child's sex, low maternal education, and family structure.

To select potential mediators, we used (1) linear regression models to test whether poverty was associated with potential mediators (i.e., self-efficacy, parental impact, coercion, overprotection, maternal depression symptoms, and family dysfunction), and (2) logistic regression models to test whether potential mediators were associated with a child's membership in the high-trajectory groups of physical aggression and hyperactivity using backward selection method. Mediators were retained for multiple mediation models if

meeting the requirements of mediation analyses (i.e., being associated with poverty and with behavior problems).

Pathways from poverty to children's high trajectories of behavior problems were estimated in a single-step multiple mediation model using PROCESS (Hayes, 2013). In this model (Preacher & Hayes, 2008), X is hypothesized to have indirect effects on Y simultaneously through $M_1, M_2, \ldots M_j$ where Y is the outcome, X is the independent variable, and $M_1, M_2, \ldots M_j$ are mediators. To test for simultaneous multiple indirect effects, we used the product-of-coefficients method based on the standard error of the product of paths a and path b (ab) (Preacher & Hayes, 2008). As an example, in a model with two mediators, this method involves estimating equations $[M_1 = d_1 + a_1X]$ and $[M_2 = d_2 + a_2X]$ for both mediators (M_1 and M_2) and equation $[Y = e + c'X + b_1M_1 + b_2M_2]$ for the outcome (Y), and computing the product of coefficients a and b to obtain indirect effects a_1b_1 and a_2b_2. Path a represents the regression coefficient for X in a model predicting M from X. Paths b_1, b_2 and c' are regression coefficients in a model predicting Y from M_1, M_2 and X, respectively. Path c' quantifies the direct effect of X on Y adjusting for M_1 and M_2. The total effect of X on Y is the regression coefficient c in a simple model predicting Y from X $[Y = f + cX]$. First, we used linear regression models because the mediators M_1 and M_2 were continuous. Then, we used logistic regressions models because our outcomes Y were dichotomous while including all selected mediators to estimate multiple mediation effects. The procedure was repeated for each outcome adjusting for child's sex, low maternal education, and family structure. Due to skewed distributions for indirect effects a_1b_1 and a_2b_2 bootstrap procedures (here, 5,000 bootstrap resamples) were used to obtain 95% confidence intervals (CIs) for direct, indirect, and total effects (Imai, Keele, & Tingley, 2010).

Results

Table 3 describes the demographic characteristics of our study sample. Further changes in the sample composition from 5 months to 5 years are available in the Supplementary material (Table S3).

The association between poverty and behavior problems

Table 4 presents the results of unadjusted and adjusted logistic regressions of poverty predicting a child's membership in the high-trajectory groups of physical aggression or hyperactivity. After adjusting for confounders (i.e., child's sex, low maternal education, and family structure), we found a 43% increased odds of being assigned to the high physical aggression trajectory (Odds Ratio; OR = 1.43 [CI 1.26; 1.62]) following exposure to poverty and a 76% increased odds of being assigned in high hyperactivity trajectory (OR = 1.76 [CI 1.55; 2.00]).

Selecting potential mediators

Table 5 provides the results of selected potential mediators of the link between poverty and children's high trajectories of physical aggression and hyperactivity. Using multiple linear regression models, poverty was associated with greater levels of maternal depression symptoms, family dysfunction, overprotection, self-efficacy, and lower levels of parental impact. Coercion was not associated with poverty; hence this variable was excluded in

Table 3. Characteristics summarizing 1,759 participants present in the QLSCD at 5 years of age by exposure to chronic poverty.

Variables	Full sample	Poverty		Sig.[†]
		Not chronic	Chronic	
n (%)				
		1,286 (73.0)	473 (27.0)	<.001
Male sex	881 (50.1)	629 (71.4)	252 (28.6)	.046
Separated or single parents	312 (17.7)	113 (36.2)	199 (63.8)	<.001
No high school diploma	317 (18.0)	137 (43.2)	180 (56.8)	<.001
Mean [95%CI]			Cohen's *d*	
Maternal depression symptoms	1.43 [1.37; 1.50]	1.27 [1.20; 1.34]	1.88 [1.73; 2.01]	.043	<.001
Self-efficacy	8.29 [8.23; 8.34]	8.27 [8.21; 8.33]	8.33 [8.21; 8.45]	.005	.384
Parental impact	8.25 [8.17; 8.33]	8.49 [8.41; 8.57]	7.58 [7.39; 7.76]	.051	<.001
Coercive parenting	3.82 [3.72; 3.92]	3.82 [3.70; 3.94]	3.82 [3.62; 4.02]	.001	.827
Overprotection	4.40 [4.29; 4.50]	4.04 [3.93; 4.15]	5.37 [5.12; 5.61]	.059	<.001
Family dysfunction	1.34 [1.28; 1.41]	1.24 [1.17; 1.31]	1.63 [1.48; 1.78]	.029	<.001

Note. Poverty coded so 1 = chronic and 0 = otherwise. Maternal depression symptoms coded so that higher scores indicated at risk of depression or in need of treatment (range 0–10). Parenting constructs coded so that higher scores indicated higher levels of perceived parenting (range 0–10). Family dysfunction coded so that higher scores indicated higher levels of family conflict (range 0–10).
[†]*p* value determined using X^2 test (categorical variables) or analysis of variance *F* test (continuous variables).

Table 4. Logistic regression models of poverty predicting a child's membership in the high trajectory groups of physical aggression and hyperactivity.

Poverty	Physical aggression				Hyperactivity			
	OR	*p* value	95%CI	Log-likelihood	OR	*p* value	95%CI	Log-likelihood
Unadjusted model	1.56	<.001	1.40; 1.74	9,626.2	2.25	<.001	2.02; 2.52	8,617.6
Adjusted model	1.43	<.001	1.26; 1.62	9,332.1	1.76	<.001	1.55; 2.00	8,406.8

Note. Poverty coded so 1 = chronic and 0 = otherwise. Trajectories of behavior problems coded so 1 = high group and 0 = low/moderate groups. Adjusted models controlled for child's sex, low maternal education, and family structure. Analyses were conducted on our study sample (*n* = 1,759).

Table 5. Multiple logistic and linear regressions models for selecting potential mediators.

Variable	Poverty			Hyperactivity			Physical aggression		
	B	*p* value	95%CI	OR	*p* value	95%CI	OR	*p* value	95%CI
1. Family dysfunction	0.39	<.001	0.33; 0.44	1.01	.592	0.97; 1.06	1.01	.652	0.97; 1.05
2. Self-efficacy	0.06	.020	0.01; 0.11	0.81	<.001	0.77; 0.85	0.88	<.001	0.84; 0.92
3. Parental impact	−0.91	<.001	−0.98; −0.84	0.98	.280	0.95; 1.02	0.94	<.001	0.91; 0.97
4. Coercive parenting	−0.01	.784	−0.10; 0.08	1.22	<.001	1.18; 1.25	1.16	<.001	1.13; 1.19
5. Overprotection	1.32	<.001	1.23; 1.41	1.17	<.001	1.14; 1.20	0.91	<.001	0.89; 0.94
6. Maternal depression symptoms	0.60	<.001	0.54; 0.66	1.10	<.001	1.05; 1.14	1.17	<.001	1.13; 1.22

Note. Poverty coded so 1 = chronic and 0 = otherwise. Trajectories of behavior problems coded so 1 = high group and 0 = low/moderate groups. Maternal depression symptoms coded so that higher scores indicated at risk of depression or in need of treatment (range 0–10). Parenting constructs coded so that higher scores indicated higher levels of perceived parenting (range 0–10). Family dysfunction coded so that higher scores indicated higher levels of family conflict (range 0–10). Analyses were conducted on our study sample (*n* = 1,759).

subsequent multiple mediation models. Next, variables were entered all at once into multiple logistic regressions predicting both outcomes. Family dysfunction and parental impact were found to be unrelated to both outcomes; hence, these variables were also excluded in subsequent multiple mediation models. Because maternal depression symptoms, self-efficacy and overprotection were related to both outcomes ($p < .05$), they were retained in multiple mediation models. Both models were significant (Wald χ^2 = 422.34, $p < .001$ for children's high physical aggression trajectory; Wald χ^2 = 528.65, $p < .001$ for children's high hyperactivity trajectory). See the Supplementary material (Table S4 and Table S5) for bivariate analyses between poverty, behavior problems, and potential mediators.
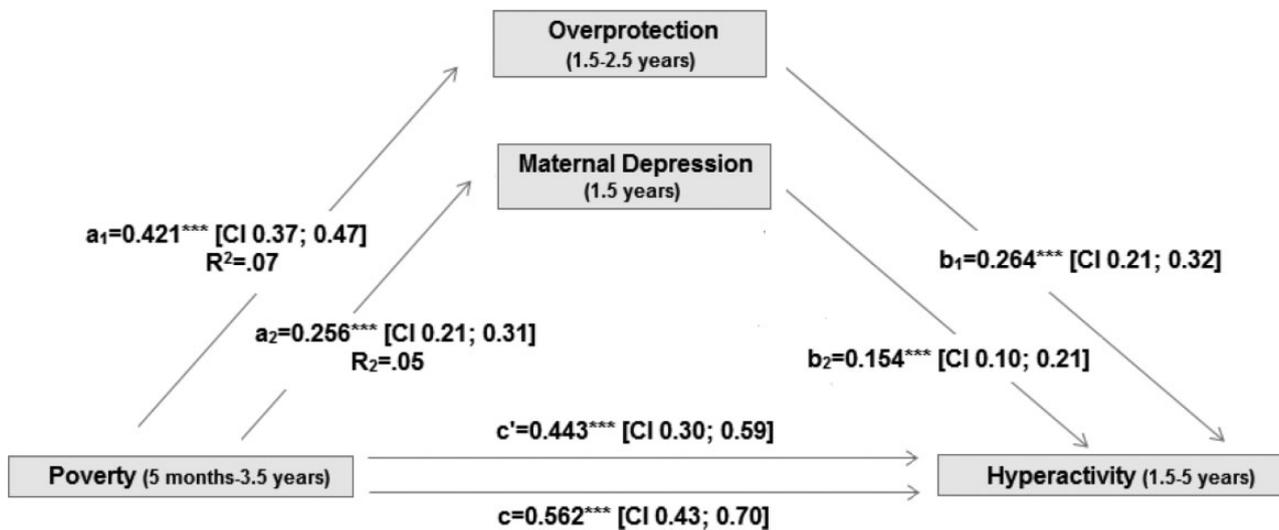
Testing potential mediators

High physical aggression trajectory. Overprotection and maternal depression symptoms mediated the association between poverty and children's high physical aggression trajectory. Self-efficacy did not emerge as a significant mediator (−0.007 [CI −0.02; 0.01]). Poverty was associated with children's high physical aggression trajectory (i.e., path *c*; $p < .001$ [CI 0.23; 0.49]). Using the product-of-coefficients strategy (Preacher & Hayes, 2008), we found the specific indirect effects from poverty to children's high physical aggression trajectory to be mediated by overprotection (−0.088 [CI −0.12; −0.06]) and by maternal depression (0.059 [CI 0.04; 0.08]). Specifically, overprotection reduced the likelihood
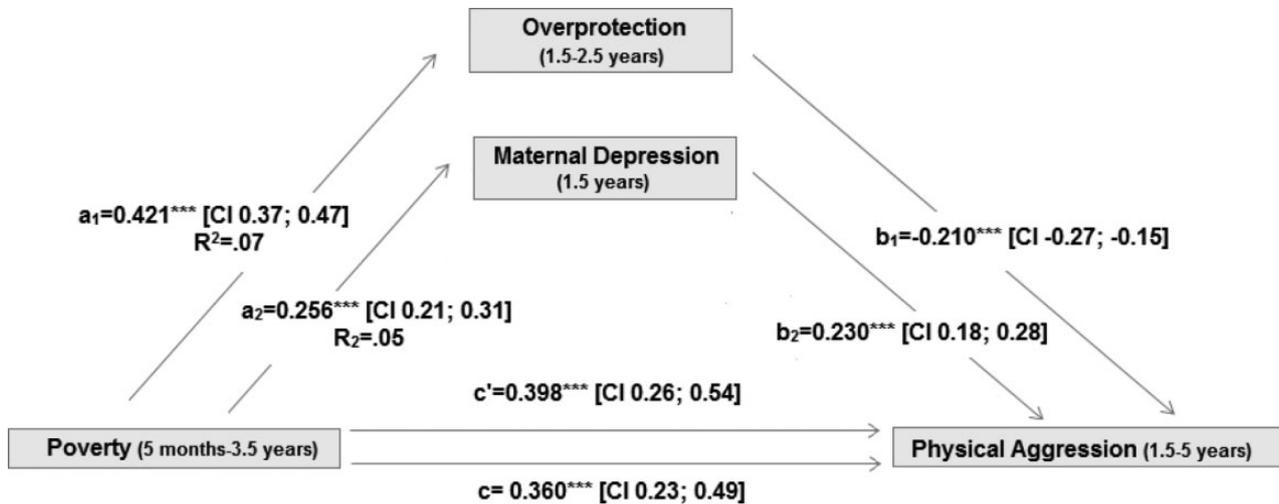
Figure 2. Overprotection and maternal depression symptoms as mediators of the association between poverty and children's high physical aggression trajectory.
Note. Path c = Total effect of poverty on physical aggression (Log-likelihood = 9,005.5). Path c' = Direct effect of poverty on physical aggression adjusting for overprotection and maternal depression symptoms (Log-likelihood = 8,789.1). All models were adjusted for child's sex, low maternal education, and family structure. Analyses were conducted on our study sample (n = 1,759). *p < .05; **p < .01; ***p < .001.

Figure 3. Overprotection and maternal depression symptoms as mediators of the association between poverty and children's high hyperactivity trajectory.
Note. Path c = Total effect of poverty on hyperactivity (Log-likelihood = 8,077.5). Path c' = Direct effect of poverty on hyperactivity adjusting for overprotection and maternal depression symptoms (Log-likelihood = 7,826.2). All models were adjusted for child's sex, low maternal education, and family structure. Analyses were conducted on our study sample (n = 1759). *p < .05; **p < .01; ***p < .001.

of membership in the high physical aggression trajectory, whereas maternal depression increased the likelihood of membership in the high physical aggression trajectory. After adding mediators, the direct effect of poverty on children's high physical aggression trajectory remained significant and was even strengthened (i.e., path c'; p < .001 [CI 0.26; 0.54]). Figure 2 illustrates total, direct, and indirect effects from poverty to children's high physical aggression trajectory through mediators.

High hyperactivity trajectory. Overprotection (0.111 [CI 0.08; 0.14]) and maternal depression symptoms (0.039 [CI 0.03; 0.06]) mediated the association between poverty and children's

high hyperactivity trajectory. Self-efficacy was not a significant mediator (−0.011 [CI −0.03; 0.17]). Poverty was associated with the children's high hyperactivity trajectory (i.e., path c; p < .001 [CI 0.43; 0.70]). Poverty was associated with higher levels of overprotection and maternal depression symptoms, which in turn increased the likelihood of membership in the high hyperactivity trajectory group. After including mediators in the model, the direct effect of poverty on children's high hyperactivity trajectory remained significant (i.e., path c'; p < .001 [CI 0.30; 0.59]). Figure 3 illustrates total, direct, and indirect effects from poverty to children's high hyperactivity trajectory through mediators.

Complementary analyses

The following analyses aimed to examine the association between duration of poverty (i.e., never poor, transiently poor, and chronically poor) and high trajectories of behavior problems. Logistic regression models adjusted for confounders including child's sex, low maternal education, and family structure. We used dummy coding to refer to transient and chronic poverty based on the number of episodes of household income below low income cut-offs for each participant and used "never poor" as the reference category. Models showed that children living in transient poverty were more likely to belong to the high physical aggression trajectory (OR = 1.54 [CI 1.31; 1.82]) than children who were never poor. However, they were not more likely to belong to the high hyperactivity trajectory (OR = 1.03 [CI 0.85; 1.25]). With chronic poverty, children were more likely to belong to the high physical aggression trajectory (OR = 1.74 [CI 1.52; 1.99]) and to the high hyperactivity trajectory (OR = 1.77 [CI 1.54; 2.04]) than children who were never poor. Associations remained significant when accounting for transient poverty. Please see the Supplementary material, Table S6.

Further, we tested for mediation models using poverty at 5 months of age as a predictor of behavior problems from 3.5 to 5 years of age through selected mediators at 1.5 and 2.5 years of age, to account for the lack of temporally ordered data in mediation models using chronic poverty. Mean levels of behavior problems were computed from 3.5 to 5 years of age and used as the outcome variable. Pathways from poverty at 5 months to children's behavior problems at 3.5 to 5 years of age were estimated in a single-step multiple mediation model using PROCESS (Hayes, 2013). Specifically, results showed that poverty at 5 months was associated with physical aggression from 3.5 to 5 years of age (i.e., path *c*; *p* < .001[CI 0.09; 0.20]), and both maternal depression symptoms and overprotection mediated this association. The specific indirect effects from poverty at 5 months to physical aggression through overprotection was −0.046 (CI −0.06; −0.04), and through maternal depression symptoms was 0.034 (CI 0.03; 0.04). For the hyperactivity outcome from 3.5 to 5 years of age, poverty at 5 months was directly associated with the children's hyperactivity (i.e., path *c*; *p* < .001[CI 0.16; 0.34]), and both maternal depression symptoms and overprotection were significant mediators. The specific indirect effects from poverty at 5 months to hyperactivity from 3.5 to 5 years of age through overprotection was 0.039 (CI 0.02; 0.06) and through maternal depression symptoms was 0.034 (CI 0.03; 0.04). For physical aggression and hyperactivity from 3.5 to 5 years of age, patterns of associations were similar to previous mediation models in that we found that chronic poverty from 5 months to 3.5 years was associated with children's high-behavior problems trajectories from 1.5 to 5 years of age through maternal depression symptoms and overprotection. See the Supplementary material, Figure S1 and Figure S2 for regression estimates of total, direct, and indirect effects from poverty at 5 months of age to children's mean levels of behavior problems from 3.5 to 5 years of age through mediators at 1.5 and 2.5 years of age.

Discussion

Grounded on the family stress model, we examined the associations between chronic poverty and children's high trajectories of physical aggression and hyperactivity during early childhood and tested weather family processes such as perceived parenting, family functioning, or maternal depression symptoms mediated these

associations. Our findings indicate that children exposed to chronic poverty are more likely to exhibit high levels of physical aggression and hyperactivity between 1.5 and 5 years than children not exposed, or children exposed to transient poverty. Only overprotection and maternal depression symptoms emerged as significant mediators of the association between poverty and children's high trajectories of behavior problems. Contrary to previous studies among older children, coercion and family dysfunction were not identified as mediators of the poverty–behavior problems link (Evans & Cassells, 2014; Shelleby et al., 2014).

The finding that maternal depression symptoms mediated the association between poverty and behavior problems is consistent with previous research linking parental mental health to children's behavior problems (Kim-Cohen, Moffitt, Taylor, Pawlby, & Caspi, 2005). Also, experimental research suggests that clinical depression as well as less severe depressive symptoms are prevalent and particularly likely to persist beyond the postpartum period into the child's second and third year of life among low-income mothers (Beeber et al., 2013).

Differentiated patterns of mediation were obtained for overprotection. Specifically, while overprotection mediated the association between poverty and both subtypes of behaviors problems, higher levels of overprotection were related to higher hyperactivity scores but unexpectedly also to lower physical aggression scores. Hence, the results suggest that overprotection is a mechanism through which poor families support children's capacity to inhibit physical aggression. However, overprotection is also a mechanism through which poor families may foster hyperactive behavior. The finding for physical aggression is consistent with previous work indicating that parental separation anxiety (more overprotective behavior) is associated with less physical aggression during early childhood (Casas et al., 2006). Yet, this overprotective behavior may lead to poor engagement and distractibility by disrupting the child, rather than facilitating the infant's own self-initiated interest in the environment, and result in more hyperactive behavior (Morrell & Murray, 2003; Sarsour et al., 2011). Further investigation is needed to replicate the opposite indirect effects linking poverty, overprotection, and subtypes of behavior problems.

Overall, our findings are consistent with prior research showing that poverty is associated with children's mental health both directly and indirectly through mediators such as maternal depression symptoms and perceived parenting (Conger, Conger, & Martin, 2010; Shelleby et al., 2014). Although indirect effects from poverty to both subtypes of behavior problems through overprotection and maternal depression symptoms were small, any observed association is potentially important in understanding how sustained deprivation during a sensitive period of life is associated with the early onset of psychopathology. The results of this study also provide additional evidence to the existing literature on the role of chronic poverty in the etiology of behavior problems (Najman et al., 2010).

Strengths and limitations

This study includes several strengths. The first is the study's reliance on a high quality and large longitudinal data base of a representative birth cohort. A second strength relies on the repeated measures, collected at multiple points over the first 5 years of life, of poverty, parenting constructs, and children's behavior problems. Repeated measures were particularly useful for the measurement of

behavior problems for which the distinction between typical and atypical development is important during early childhood. Behavior problems were modeled using a semi-parametric trajectory approach, which allowed to distinguish children on an atypically elevated trajectory and as such, reduced measurement error in the classification of children as highly disruptive. Third, this data base provides the ability to control for several confounders described in the literature and to explore simultaneously several types of parental factors rarely considered in the literature. Finally, the detailed measures of behavior problems allowed the examination of two subtypes of behavior problems separately.

Limitations should be considered regarding our results. First, associations in main mediation models may be bidirectional due to (1) the correlational design of the study, and (2) to the lack of temporally ordered data. Reassuringly, complementary analysis showed that models respecting temporal ordering of variables replicated patterns of associations found in main mediation models. Second, the sole reliance on maternal ratings to assess children's behavior problems, maternal depression, family dysfunction and parenting constructs means that associations between these measures are likely inflated by shared method variance (Affrunti & Woodruff-Borden, 2015). Ideally, children's behavior problems should be assessed by multiple informants (e.g. parents and teachers). However, we focused on maternal ratings, as mothers were systematically identified as the person being most knowledgeable about the child and because mothers could provide information across early childhood, which is not the case for teacher's ratings (available after age 5 years). Furthermore, our sample is a representative population-based cohort. Such samples generally have low base rates of clinically severe mental health problems, especially during early childhood. Also, because our objective was to model normal variations in behavior problems, clinical assessments are not appropriate in this population to study our research questions. Third, despite the fact that we used weighted data to correct for non-participation and non-response, lost to follow-up could underestimate the observed associations if attrition was dependent on both being poor and having high levels of behavior problems. Finally, mothers who did not speak French or English were not included in the study. Therefore, results cannot be inferred to children whose mothers were unable to communicate in either English or French.

Conclusions

Study findings indicate that poverty is a key risk factor for behavior problems and highlight the importance of family-mediating factors. In this article, we identify two potential targets for intervention and prevention efforts at the family level: overprotection and maternal depression. Results add specificity to the family stress model at least through age 5 years. Our findings support antipoverty policies directed at reducing child poverty. Support may be at the family level in the form of service delivery such as child care and parental interventions, or at societal level through public policy for the redistribution of wealth and the reduction of poverty in families with young children. For instance, studies on the same sample have shown that early and regular out of home child care services for mothers with low education (Geoffroy et al., 2010; Laurin et al., 2015) or depressed mothers (Herba et al., 2013) play a protective role in children's social development. These findings, together with experimental research showing a positive impact of financial benefits on children's behavior problems (Duncan, Morris, & Rodrigues, 2011), suggests that relieving economic pressure among families with young children may offer the largest benefit in lowering children's risk for behavior problems.

Supplementary material

The supplementary material is available at http://ijbd.sagepub.com/supplemental.

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