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Physical Aggression During Early Childhood: Trajectories and Predictors

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ABSTRACT. *Objectives.* Physical aggression in children is a major public health problem. Not only is childhood physical aggression a precursor of the physical and mental health problems that will be visited on victims, but also aggressive children themselves are at higher risk of alcohol and drug abuse, accidents, violent crimes, depression, suicide attempts, spouse abuse, and neglectful and abusive parenting. Furthermore, violence commonly results in serious injuries to the perpetrators themselves. Although it is unusual for young children to harm seriously the targets of their physical aggression, studies of physical aggression during infancy indicate that by 17 months of age, the large majority of children are physically aggressive toward siblings, peers, and adults. This study aimed, first, to identify the trajectories of physical aggression during early childhood and, second, to identify antecedents of high levels of physical aggression early in life. Such antecedents could help to understand better the developmental origins of violence later in life and to identify targets for preventive interventions.

Methods. A random population sample of 572 families with a 5-month-old newborn was recruited. Assessments of physical aggression frequency were obtained from mothers at 17, 30, and 42 months after birth. Using a semiparametric, mixture model, distinct clusters of physical aggression trajectories were identified. Multivariate logit regression analysis was then used to identify which family and child characteristics, before 5 months of age, predict individuals on a high-level physical aggression trajectory from 17 to 42 months after birth.

Results. Three trajectories of physical aggression were identified. The first was composed of children who displayed little or no physical aggression. These individuals were estimated to account for ~28% of the sample. The largest group, estimated at ~58% of the sample, followed a rising trajectory of modest aggression. Finally, a group, estimated to comprise ~14% of the sample, followed a rising trajectory of high physical aggression. Best predictors before or at birth of the high physical aggression trajectory group, controlling for the levels of the other risk factors, were having young siblings (odds ratio [OR]: 4.00; confidence interval [CI]: 2.2–7.4), mothers with high levels of antisocial behavior before the end of high school (OR: 3.1; CI: 1.1–8.6), mothers

who started having children early (OR: 3.1; CI: 1.4–6.8), families with low income (OR: 2.6; CI: 1.3–5.2), and mothers who smoked during pregnancy (OR: 2.2; CI: 1.1–4.1). Best predictors at 5 months of age were mothers' coercive parenting behavior (OR: 2.3; CI: 1.1–4.7) and family dysfunction (OR: 2.2; CI: 1.2–4.1). The OR for a high-aggression trajectory was 10.9 for children whose mother reported both high levels of antisocial behavior and early childbearing.

Conclusions. Most children have initiated the use of physical aggression during infancy, and most will learn to use alternatives in the following years before they enter primary school. Humans seem to learn to regulate the use of physical aggression during the preschool years. Those who do not, seem to be at highest risk of serious violent behavior during adolescence and adulthood. Results from the present study indicate that children who are at highest risk of not learning to regulate physical aggression in early childhood have mothers with a history of antisocial behavior during their school years, mothers who start childbearing early and who smoke during pregnancy, and parents who have low income and have serious problems living together. All of these variables are relatively easy to measure during pregnancy. Preventive interventions should target families with high-risk profiles on these variables. Experiments with such programs have shown long-term impacts on child abuse and child antisocial behavior. However, these impacts were not observed in families with physical violence. The problem may be that the prevention programs that were provided did not specifically target the parents' control over their physical aggression and their skills in teaching their infant not to be physically aggressive. Most intervention programs to prevent youth physical aggression have targeted school-age children. If children normally learn not to be physically aggressive during the preschool years, then one would expect that interventions that target infants who are at high risk of chronic physical aggression would have more of an impact than interventions 5 to 10 years later, when physical aggression has become a way of life. *Pediatrics* 2004;114:e43–e50. URL: <http://www.pediatrics.org/cgi/content/full/114/1/e43>; *physical aggression, early childhood, trajectories, predictors.*

ABBREVIATION. OR, odds ratio.

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Physical aggression in children is a major public health problem. Longitudinal studies show that aggressive school children are at very high risk of being violent in adolescence and beyond.^{1–3} Not only is childhood physical aggression a precursor of the physical and mental health problems that will be visited on victims, but also aggressive children themselves are at higher risk of alcohol and

drug abuse, accidents, violent crimes, depression, suicide attempts, spouse abuse, and neglectful and abusive parenting.⁴⁻⁹ Furthermore, violence commonly results in serious injuries to the perpetrators themselves.^{10,11}

Although media attention is focused on instances of extreme violence during adolescence and beyond, longitudinal studies show that violence later in life is rarely an isolated event in the perpetrator's life. Children who show high levels of physical aggression during the elementary school years are at greatest risk of physical violence during adolescence and adulthood.¹ Much research has been done on risk factors for high levels of aggression in school-aged children and in adolescents. Psychological characteristics include low IQ, impulsivity, hyperactivity, lack of empathy, and fearlessness.^{12,13} Parental risks include low levels of education, antisocial behavior, poor parenting skills, maternal early onset of child-bearing, and family discord.¹⁴⁻²⁰ There is evidence of an intergenerational transmission of these problems through both genetic and environmental channels.^{18,19,21-24} Developmental research also shows that the spontaneous onset of physical aggression in school-aged children is highly unusual.^{1,7,25} Instead, the developmental precursors of chronic physical aggression are present before school entry. Although it is unusual for young children to harm seriously the targets of their physical aggression, studies of physical aggression during infancy indicate that by 17 months of age, the large majority of children are physically aggressive toward siblings, peers, and adults.²⁶⁻³⁰

Because most children seem to learn to inhibit physical aggression during the preschool years, this period of life may be the most appropriate for preventive interventions. Olds et al³¹ showed that nurse home visitation during pregnancy and infancy can prevent child abuse and neglect, as well as juvenile delinquency. However, this study also showed that the program did not have an impact on families with high levels of domestic violence.³² These results suggest that we need better knowledge of the early development of physical aggression to guide preventive interventions with families at high risk of physical violence, yet, although much work has been done on developmental precursors of physical aggression in school-aged children, comparable evidence on the developmental course of physical aggression in preschool-aged children is extremely limited.

This article reports results from a longitudinal study of children's physical aggression development from 17 to 42 months after birth. Our aims were 1) to identify the trajectories of physical aggression during early childhood and 2) to identify antecedents of high levels of physical aggression early in life. Such antecedents could help us to understand better the developmental origins of violence later in life and to identify targets for preventive interventions. Antecedents selected as putative predictors were shown in other studies to predict antisocial behavior in school-aged children, adolescents, and adults: family income,^{33,34} mother's level of education,^{14,16} mother's

age at birth of the child,^{16,18,20,35} mother's smoking and use of alcohol and drugs,³⁶⁻⁴⁰ family dysfunction,^{14,15,41,42} child temperament,^{43,44} and mother's parenting practices.^{14,15,37,45}

METHODS

Subjects

A total of 504 children were followed from 5 to 42 months of age to assess the developmental course of physical aggression. Mothers were interviewed at home 4 times, when their child was 5, 17, 30, and 42 months of age. Subjects were selected using the Québec Ministry of Health and Social Services registry of new births. A random sample of single births was selected with a stratified procedure on the basis of the mother's area of residence and gender of the child. Area of residence was limited to a 1-hour drive by car from the 2 main urban centers in the province of Québec; also, families were excluded when parents did not understand French or English. Demographic characteristics of the 572 families, first assessed in 1996 when the target child was 5 months of age, differed slightly from a population sample ($N = 2223$) representing 5-month-olds in the province of Québec in the fall of 1997 and the spring of 1998. Compared with the latter, mothers and fathers of the 1996 sample had higher educational attainment (10.3% vs 16.0% did not finish high school; 57.1% vs 50.4% had a postsecondary education), and mothers were slightly older (29.9 vs 28.8 years). The samples did not differ on variables such as the father's age (32.3 vs 31.8 years), family income <\$30 000 (Canadian; 25.5% vs 29.3%), and the number of children in the family (42.0% with 1, 37.8% with 2, 20.3% with 3 or more, in the present sample). A signed informed consent was obtained from mothers when they were visited at home by the interviewer. Ethical approval for the study was obtained from the ethic board of Santé Québec, the governmental agency responsible for data collection.

Measures

Physical Aggression at 17, 30, and 42 Months After Birth

To assess physical aggression, we selected items from rating scales that were used in longitudinal studies with older children.¹ A number of these longitudinal studies have shown that 3 items were sufficient to assess reliably physical aggression in children.^{1,46} Mothers were asked to indicate whether the child never (0), sometimes (1), or often (2) hits, bites, kicks; fights; and bullies others (scores on this 3-item scale may range from 0 to 6). The internal consistency value (α) was .55, .61, and .76 at 17, 30, and 42 months, respectively. Using father ratings at 42 months, the intraclass correlation among mothers and fathers was .61 ($N = 355$).

Child Temperament at 5 Months After Birth

The interview with the mother at 5 months included 7 items from the difficult temperament scale of the Infants Characteristics Questionnaire⁴⁷: 1, easy to calm or soothe; 2, how often fussy per day; 3, how much does he cry or fuss in general; 4, easily upset; 5, general mood; 6, stability of mood; and 7, overall degree of difficulty. Mothers were asked to respond on a scale from 1 (easy temperament) to 7 (difficult temperament). The internal consistency α was .84. Intraclass correlation between mother and father ratings of temperament at 5 months was .60 ($N = 452$).

Mothers' Quality of Parenting at 5 Months After Birth

After the 5-month interview, mothers were asked to complete a questionnaire on parenting behaviors. Mothers answered using a scale from 0 (not at all what I did or think) to 10 (exactly what I did or think). The questionnaire was developed for the present study.⁴⁸ The coercive parenting and self-efficacy scales had internal reliabilities (α) above the .70 level. The coercive parenting scale measures the tendency to respond in a negative and restrictive manner to the child with a 7-item scale: 1, I have been angry with my infant when he was particularly fussy; 2, I have raised my voice or shouted at my infant when he was particularly fussy; 3, When my infant cries, he gets on my nerves; 4, I have spanked my infant when he was particularly fussy; 5, I have lost my temper when my infant was particularly fussy; 6, I have left my infant alone in his bedroom when he was particularly fussy; and 7, I have

shaken my infant when he was particularly fussy. The parent self-efficacy scale has 5 items that measure the mother's perception of her ability to fulfill her role as a parent: 1, I am very good at keeping my infant amused; 2, I am very good at calming my infant when he is upset, fussy, or crying; 3, I am very good at keeping my infant busy while I am doing housework; 4, I am very good at attracting the attention of my infant; and 5, I am very good at feeding my infant, changing his diapers, and giving his bath.

Parent Background and Family Characteristics

Fathers and mothers were asked to complete a questionnaire during the 5-month interview. The questionnaire included items on antisocial behavior exhibited before they had left high school.⁴⁹ Fathers were asked whether before the end of high school they had often been in fights that they had started, stolen more than once, been involved with youth protection or the police because of their misbehavior, or been expelled or suspended from school. Mothers were asked whether before the end of high school they had been in >1 fight that they had started, stolen more than once, been involved with youth protection or the police because of their misbehavior, skipped school more than twice in 1 year, or ran away from home overnight. Responses were transformed into dummy variables that distinguished mothers and fathers who acknowledged engaging in 2 or more of these behaviors. Mother's age at birth of first child, level of education, cigarette and alcohol consumption during pregnancy, and postpartum depression were obtained during the interview when the child was 5 months of age. For each pregnancy trimester, mothers were asked how many cigarettes they smoked daily and how much alcohol they drank daily. Mothers were also asked whether they experienced postpartum depression and for how long in days, weeks, and months. Family composition, household income, and family functioning were also assessed during the interview. Household income was measured as an ordinal variable that takes integer values between 1 (<\$10 000 CAN) and 8 (>\$80 000 CAN). Level of education was transformed into a dummy variable indicating whether the mother had (= 0) or not (= 1) a high school diploma. Family composition at birth was also treated as a dummy variable when both parents were living with the child (= 0) or not (= 1). Family functioning was assessed with an 8-item scale ($\alpha = .83$, $N = 546$) measuring the functionality of the family (eg, there are lots of bad feelings in our family; in times of crises, we can turn to each other for support; we don't get along well together).⁵⁰ Mothers answered on a scale from 1 (strongly agree) to 4 (strongly disagree). Higher values indicate less functional households. A dummy variable indicated whether the mother reported smoking (= 1) or not (= 0) during pregnancy; a dummy variable also indicated whether the mother reported having >5 drinks on 1 occurrence during pregnancy (= 1) or not (= 0).

Data Analysis

A developmental trajectory describes the course of a behavior across ages. The objectives of the data analysis were 2-fold: 1) to identify distinctive groups of developmental trajectories of physical aggression over the ages of 17, 30, and 42 months and 2) to determine risks factors that predict a child's membership in the high-aggression trajectory group. The analysis proceeded in 2 stages. First, the distinctive clusters of developmental trajectories were identified using a semiparametric, mixture model described in Nagin⁵¹ and Roeder et al.⁵² For each such trajectory group, the model defined the shape of the trajectory (rising, falling, stable, or hump-shaped) and the estimated proportion of the population belonging to the trajectory group. A key step in model estimation was selection of the number of trajectory groups that best fit the data. Model selection was based on the Bayesian Information Criterion. Specifically, models with 2 to 5 groups were estimated. The model with the maximum Bayesian Information Criterion was selected as the optimal model.

In the second stage of the analysis, an examination of the predictors of trajectory group membership was conducted. The "posterior probabilities of group membership" were central to this aspect of the analysis. For each individual in the sample, the posterior probabilities estimate the probability of the child's belonging to each trajectory group. For example, consider a child whose mother persistently rated him as highly physically aggressive. For this individual, the posterior probability estimate of the child's belonging to a low trajectory group would be near 0,

whereas the probability estimate of the child's belonging to a high-aggression group would be high. Each child was assigned to the group for which he or she had the largest posterior probability estimate. This is the group that best conforms to the child's observed behavior.

Two types of analyses were conducted to identify parent and child characteristics that distinguished trajectory group membership. χ^2 tests of joint significance ($\alpha = .05$) were used to identify parent and child characteristics, measured at birth and at 5 months of age, that differed significantly across the 3 trajectory groups identified in the first stage of the analysis. Also, t tests were conducted to examine whether prevalence levels were significantly higher for the high-aggression group compared with the low and medium groups combined. Multivariate logit regression was then used to examine the capacity of the risk factors to distinguish membership in the high physical aggression trajectory group as opposed to the other 2 trajectory groups, controlling for the levels of the other risk factors. Two models were estimated, one including only the at-birth risk factors and another including both the at-birth and the at-5-months variables. For the logit-based analyses and the t tests of differences in means, 1-tailed tests of significance were conducted ($\alpha = .05$) because we had an a priori prediction about the direction of the effect for each predictor variable. All risk factors were measured as binary variables. The results of the analysis were substantively identical when risk factors based on nonbinary scales were entered in their nonbinary form.

RESULTS

Three trajectories of physical aggression were identified (Fig 1; plot of means and standard errors by trajectories). The first was composed of children who displayed little or no physical aggression. These individuals were estimated to account for ~28% of the sample. The largest group, estimated at ~58% of the sample, followed a rising trajectory of modest aggression. Finally, a group, estimated to comprise ~14% of the sample, followed a rising trajectory of high physical aggression.

Table 1 reports the prevalence of each risk factor by trajectory group. Most were statistically significant predictors of trajectory group membership. Also, prevalence levels of significant predictors generally increased from the low- to the medium- to the high-aggression trajectory groups. For all significant predictors, the high group had the highest prevalence level. Of the 16 predictors, only 6 were nonsignificant: young mother now, mother has no high school diploma, mother depressed, mother drank during pregnancy, mother feels ineffective, and father antisocial before end of high school. However, half of these were close to significance and in the predicted direction. Furthermore, the t tests contrasting the high group versus the low and medium groups combined showed that these 3 predictors (young mother now, mother depression, mother has no high school diploma) significantly distinguished the groupings.

Table 2 reports the results of the analysis aimed at identifying risk factors that distinguish the relatively small group of children (13.9%) in the high-aggression trajectory group from the other 2 groups in the context of a multivariate model. The largest risk was for the presence of other young siblings in the household. Having another sibling as a target for physical aggression increased the odds of membership in the high-aggression group by more than a factor of 4. Several mother characteristics were also associated

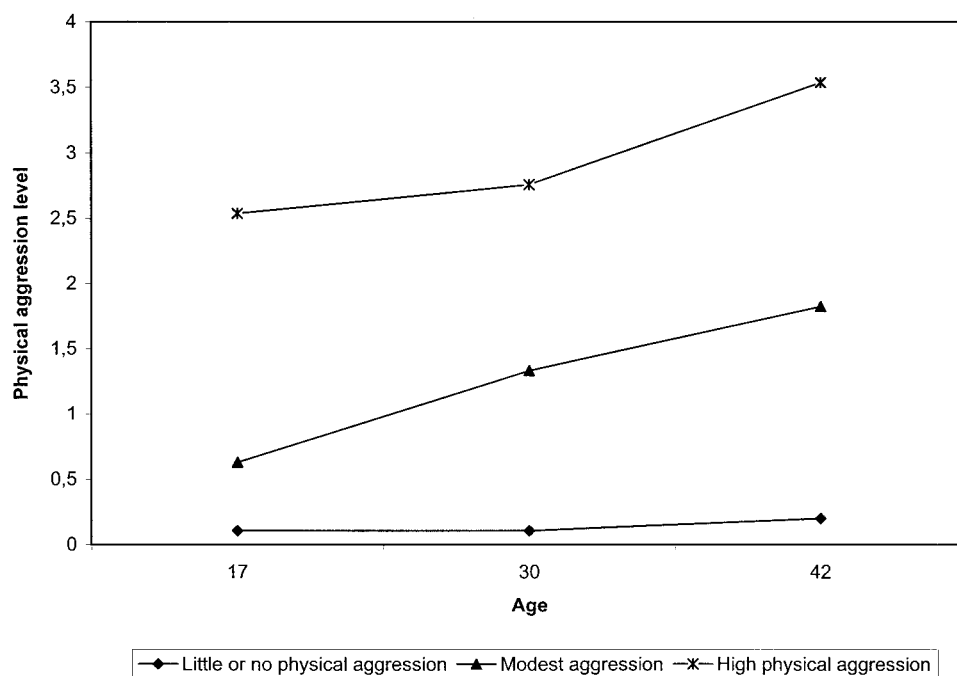


Fig 1. Trajectories of physical aggression from 17 to 42 months of age.

TABLE 1. Parental and Child Characteristics by Trajectory Group

Variable	Trajectory Group			P Value on χ^2 Joint Test of Significance ($df = 2$)	P Value on <i>t</i> Tests of High vs Low and Medium ($df = 1$)
	Low	Medium	High		
N	140	294	70	N/A	N/A
At birth, %					
Male	38.6	50.3	58.6	.012	.032
Young siblings	16.4	40.8	57.1	<.001	<.001
Low income	20.5	20.2	43.9	<.001	<.001
Parents separated	3.7	3.2	11.8	.025	<.001
Early motherhood	22.8	22.2	42.4	.004	<.001
Young mother now	26.2	20.0	31.3	.094	.048
Mother no high school diploma	5.3	9.7	15.4	.071	.036
Mother antisocial (before end of high school)	.1	4.9	14.0	.016	.003
Mother smoked (during pregnancy)	20.1	22.1	38.2	.014	.003
Mother drank alcohol (during pregnancy)	3.0	5.0	4.4	.93	.479
Maternal postpartum depression	17.9	16.6	29.4	.067	.008
Father antisocial (before end of high school)	13.6	11.2	12.9	.768	.418
At 5 mo of age, %					
High family dysfunction	32.8	29.2	53.8	.001	<.001
Mother coercive parenting	8.1	12.1	31.3	.001	<.001
Mother feels ineffective	18.3	17.5	20.9	.814	.271
Difficult temperament	25.4	21.2	40.0	.010	.003

with large and significant increases in the risk for high aggression. Early motherhood was associated with a 3-fold increase in the odds ratio (OR) of high-aggression group membership. The counterpart increase in the OR for mother antisocial behavior before end of high school was even larger, 3.6. Combined, these 2 predictors increased the OR of high aggression by a factor of 10.9. Other significant risk factors were mother smoking during pregnancy, postpartum maternal depression, and low income. Each of these risks factors increased the OR of high aggression by at least a factor of 2.

The addition of the risks present at 5 months of age to the previous step had little impact on the antecedent risk factors described above. With the exception

of maternal postpartum depression, which falls just below significance, all variables that were significant remain significant and all those that were nonsignificant remain nonsignificant. The high family dysfunction and coercive parenting risks at 5 months of age each were significant, with both increasing the OR of membership in the high-aggression group by approximately a factor of 2. Neither maternal feeling of ineffectiveness nor the child's having a difficult temperament at 5 months of age was a significant predictor. However, because the difficult temperament risk factor is a significant predictor without controls for the at-birth risk factors, it seems that some combination of these risks accounts for its discriminating power.

TABLE 2. Predictors of High Aggression Trajectory: Multivariate Logit Model

Variable	At-Birth Variables Only		At-Birth and 5 Months Old Variable	
	OR	90% CI	OR	90% CI
At birth, %				
Male	1.6	(0.9–2.8)	1.4	(0.8–2.6)
Young siblings	4.1*	(2.3–7.5)	4.0*	(2.2–7.4)
Low income	2.7*	(1.4–5.4)	2.6*	(1.3–5.2)
Parents separated	3.5	(0.9–14.3)	3.1	(0.7–12.9)
Early motherhood	3.0*	(1.4–6.6)	3.1*	(1.4–6.8)
Young mother now	0.8	(0.3–1.8)	0.7	(0.3–1.8)
Mother no high school diploma	0.7	(0.3–1.8)	1.0	(0.4–2.5)
Mother antisocial (before end of high school)	3.6*	(1.4–9.5)	3.1*	(1.1–8.6)
Mother smoked (during pregnancy)	2.7*	(1.5–4.9)	2.2*	(1.1–4.1)
Mother drank alcohol (during pregnancy)	1.0	(0.2–5.9)	0.9	(0.1–5.3)
Maternal postpartum depression	2.0*	(1.0–3.7)	1.7	(0.9–3.3)
Father antisocial (before end of high school)	0.8	(0.3–1.8)	0.7	(0.3–1.7)
At 5 mo of age				
High family dysfunction	—	—	2.2*	(1.2–4.1)
Mother coercive parenting	—	—	2.3*	(1.1–4.7)
Mother feels ineffective	—	—	0.6	(0.3–1.4)
Difficult temperament	—	—	1.5	(0.7–3.1)

CI indicates confidence interval.

* significant for $\alpha = .05$ (1-tailed test).

DISCUSSION

Our findings show that the traditional predictors of antisocial behavior during preadolescence, adolescence, and adulthood also predict high levels of physical aggression from 17 to 42 months of age. These results support growing evidence that chronic physical aggression during childhood, which, in some cases, becomes serious violence during adolescence and adulthood, starts with high levels of physical aggression during infancy and toddlerhood.^{27,29,53}

Our analyses attempted to address the issue of intergenerational transmission of antisocial behavior. Results clearly show that girls' high level of antisocial behavior before the end of high school tends to be followed by their children's high levels of physical aggression in early childhood. These results confirm earlier studies that had shown that mothers' criminal history was associated with their children's criminal behavior.^{23,54} However, for the first time, we show that the intergenerational transmission of antisocial behavior probably starts as early as infancy with high levels of physical aggression. The strength of the relationship with fathers' antisocial behavior was weak, but this could be a measurement problem, because we had to rely on mothers' reports when fathers were not living with their children and could not be located or convinced to participate. These fathers may have been among the most antisocial before the end of high school. However, it would not be surprising that mothers' antisocial behavior history plays a more important role than fathers' antecedents in teaching infants to regulate physical aggression.

Age of the mother at the birth of her first child was a better predictor than age of the mother at birth of the child targeted for the study. It remained a significant predictor after having controlled for many concurrent variables that are correlated with young motherhood: antisocial behavior, low education, smoking, drinking, single parent, poverty, and de-

pression. It also remained a significant predictor after having controlled for more proximal variables that are often considered mediators of young parenthood: parenting practices and family dysfunction. These results suggest that women who start to have children at a much earlier age than the majority do not learn to help their child regulate physically aggressive behavior, even if they have children at a later age, and/or, for some yet unknown reason, that it is more difficult to teach most of their children alternatives to physical aggression.

Smoking during pregnancy has been shown to predict antisocial behavior during later childhood and adolescence.^{36–40} Our results show that it predicts high levels of physical aggression in infancy after having controlled for many of the confounding variables that could explain the association, eg, antisocial behavior, low education, postpartum depression, and early parenthood. We clearly need good studies of the physiologic mechanisms during pregnancy that could explain the impact of smoking on infants' problems with behavioral regulation.

Low income and single parenthood are classic predictors of youth antisocial behavior. In some studies, both of these predictors tend not to be significant once other variables have been controlled, eg, parents' education, depression, parenting, family dysfunction.^{14,15,33} Our results show that poverty remains a significant predictor after control of other variables, whereas single parenthood does not. However, these 2 variables are correlated. Poverty and single parenthood, which start at birth, may have a stronger impact on regulation of physical aggression than poverty and separation that occur later in life.^{33,55} We clearly need studies that will identify the mechanisms by which these 2 factors have an impact on the development of physical aggression in early childhood.

Our results show that presence of a sibling had the largest impact on level of physical aggression during

early childhood. This is not surprising because, by definition, to be physically aggressive, one needs to have a target. Few studies have focused on physical aggression among siblings during early childhood. Dunn and Munn²⁶ reported that between ages 14 and 24 months, younger siblings tended to be physically aggressive toward older siblings more often than the reverse. This finding may be explained by the fact that when the younger sibling starts to be physically aggressive, the older sibling has started to learn not to be physically aggressive.⁵³ Also, parents of human children, like parents of nonhuman primates, probably punish more severely older sibling physical aggression because it is more likely to result in injury than the younger sibling aggression.⁵⁶ Although presence of a sibling had the largest OR, it should be remembered that all of the other significant predictors were obtained after having statistically controlled for presence of a sibling.

The bivariate analyses showed that boys were more likely than girls to be in the high physical aggression trajectory. However, this association disappeared once we entered the other independent variables in the regression. Most studies of physical aggression indicate that girls have lower frequencies than boys.^{30,46,57-59} It will be important in future studies to investigate why girls have lower frequencies of physical aggression already in early childhood, although the mechanisms that lead to control over physical aggression seem to be the same for girls and boys.

Family dysfunction and coercive parenting were the best "5 months old" predictors of a high physical aggression trajectory measured initially 12 months later. These 2 variables are classic predictors of antisocial behavior in older children and adolescents.^{15,45} It is clear from our results that, if they are causal factors, they are having their impact within the first year after birth. They may have a strong impact because they start early but also because they tend to remain part of the child's environment throughout childhood and adolescence. In the bivariate analyses, difficult temperament measured at 5 months was strongly associated with the high physical aggression trajectory initially measured 1 year later. As expected, difficult temperament and coercive parenting at 5 months of age were associated ($r = .30$). This association probably reflects the day-to-day transactions between mother and child that start in utero and probably have both genetic and environmental inputs. For example, the mother's lifestyle during pregnancy has an impact on the child's developing brain, and the ability of this brain to control the child's behavior will have an impact on the mother's lifestyle.^{60,61} We need to study more closely the mechanism that leads to these associations. The method that we used cannot rule out the reciprocal effect of temperament on mothers' coercive behavior and on later physical aggression.

It is also important to remember that our results are limited by the fact that mothers provided the information on the predictors and the outcome under study. Mothers who are more inclined to notice or report the physical aggressions of their children

may be more inclined to report other problems that they have, such as smoking, family dysfunction, and negative reactions to their child. It is extremely difficult to find other observers of young children's daily aggressions, except for those who go to child care. However, many children do not go to child care, and many of those seem to be among the more aggressive.⁶² The ideal study would include independent observers of children's behavior over long periods of time. Unfortunately, such studies with large epidemiologic samples over many years are difficult to organize and even more difficult to finance. Also note that the internal consistency of the aggression assessments at 17 and 30 months of age was low. The impact of this measurement problem and the other biases that could be related to the use of mother ratings, however, are reduced by the fact that the aggression trajectories are based on 3 different ratings over a 3-year period. The increase in physical aggression that we described corresponds to the increase reported by observational studies on small samples,^{63,64} and the predictors correspond to those observed in studies with older children in which aggression was assessed by other means than mother reports.^{12,16,65}

CONCLUSION

Most children have initiated the use of physical aggression during infancy, and most will learn to use alternatives in the following years before they enter primary school.⁵³ Humans seem to learn to regulate the use of physical aggression during the preschool years. Those who do not learn seem to be at highest risk of serious violent behavior during adolescence and adulthood. Results from the present study indicate that children who are at highest risk of not learning to regulate physical aggression in early childhood have mothers who have a history of antisocial behavior during their school years, who start childbearing early, and who smoke during pregnancy and have parents who have low income and serious problems living together. All of these variables are relatively easy to measure during pregnancy. Preventive interventions should target families with high-risk profiles on these variables.

Experiments with such programs have shown long-term impacts on child abuse and child antisocial behavior.^{31,66} However, these impacts were not observed in families with physical violence.³² The problem may be that the prevention programs that were provided did not specifically target the parents' control over their physical aggression and their skills in teaching their infant not to be physically aggressive. Most intervention programs to prevent youth physical aggression have targeted school-aged children.⁶⁷ If children normally learn not to be physically aggressive during the preschool years, then one would expect that interventions that target infants who are at high risk of chronic physical aggression would have more of an impact than interventions 5 to 10 years later, when physical aggression has become a way of life.

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REFERENCES

1. Broidy LM, Nagin DS, Tremblay RE, et al. Developmental trajectories of childhood disruptive behaviors and adolescent delinquency: a six-site, cross-national study. *Dev Psychol.* 2003;39:222-245
2. McCord J, Widom CS, Crowell NE. *Juvenile Crime, Juvenile Justice.* Washington, DC: National Academy Press; 2001
3. Reiss AJ, Roth JA, eds. *Understanding and Preventing Violence.* Washington, DC: National Academy Press; 1993
4. Farrington DP. Childhood, adolescent, and adult features of violent males. In: Huesmann LR, ed. *Aggressive Behavior: Current Perspectives.* New York, NY: Plenum Press; 1994:215-240
5. Fergusson DM, Horwood LJ. Early conduct problems and later life opportunities. *J Child Psychol Psychiatry.* 1998;39:1097-1108
6. Kokko K, Pulkkinen L. Aggression in childhood and long-term unemployment in adulthood: a cycle of maladaptation and some protective factors. *Dev Psychol.* 2000;36:463-472
7. Nagin D, Tremblay RE. Trajectories of boys' physical aggression, opposition, and hyperactivity on the path to physically violent and non-violent juvenile delinquency. *Child Dev.* 1999;70:1181-1196
8. Serbin LA, Cooperman JM, Peters PL, Lehoux PM, Stack DM, Schwartzman AE. Intergenerational transfer of psychosocial risk in women with childhood histories of aggression, withdrawal, or aggression and withdrawal. *Dev Psychol.* 1998;34:1246-1262
9. Stattin H, Magnusson D. The role of early aggressive behavior in the frequency, seriousness and types of later crime. *J Consult Clin Psychol.* 1989;57:710-718
10. Rivara FP, Shepherd JP, Farrington DP, Richmond PW. Victim as offender in youth violence. *Ann Emerg Med.* 1995;26:609-614
11. Shepherd JP, Ali MA, Hughes AO, Levers BG. Trends in urban violence: a comparison of accident department and police records. *J R Soc Med.* 1993;86:87-88
12. Lipsey MW, Derzon JH. Predictors of violent or serious delinquency in adolescence and early adulthood: a synthesis of longitudinal research. In: Loeber R, Farrington DP, eds. *Serious and Violent Juvenile Offenders: Risk Factors and Successful Interventions.* Thousand Oaks, CA: Sage Publications; 1998:86-105
13. Tremblay RE, LeMarquand D. Individual risk and protective factors. In: Loeber R, Farrington D, eds. *Child Delinquents: Development, Interventions and Service Needs.* Thousand Oaks, CA: Sage Publications; 2001: 137-164
14. Juby H, Farrington DP. Disentangling the link between disrupted families and delinquency. *Br J Criminol.* 2001;41:22-40
15. McCord J. Family relationships, juvenile delinquency, and adult criminality. *Criminology.* 1991;29:397-417
16. Nagin D, Tremblay RE. Parental and early childhood predictors of persistent physical aggression in boys from kindergarten to high school. *Arch Gen Psychiatry.* 2001;58:389-394
17. Patterson GR, Crosby L, Vuchinich S. Predicting risk for early police arrest. *J Quant Criminol.* 1992;8:335-355
18. Nagin D, Pogarsky G, Farrington DP. Adolescent mothers and the criminal behavior of their children. *Law Soc Rev.* 1997;31:137-162
19. Raine A, Brennan P, Mednick SA. Interaction between birth complications and early maternal rejection in predisposing individuals to adult violence: specificity to serious, early-onset violence. *Am J Psychiatry.* 1997;154:1265-1271
20. Moffitt TE, E-Risk Study Team. Teen-aged mothers in contemporary Britain. *J Child Psychol Psychiatry.* 2002;43:727-742
21. Dionne G, Tremblay RE, Boivin M, Laplante D, Pérusse D. Physical aggression and expressive vocabulary in 19 month-old twins. *Dev Psychol.* 2003;39:261-273
22. Lyons JJ, True WR, Eisen SA, et al. Differential heritability of adult and juvenile antisocial traits. *Arch Gen Psychiatry.* 1995;52:906-915
23. Rowe DC, Farrington DP. The familial transmission of criminal convictions. *Criminology.* 1997;35:177-201
24. Caspi A, McClay J, Moffitt T, et al. Role of genotype in the cycle of violence in maltreated children. *Science.* 2002;297:851-854
25. Brame B, Nagin DS, Tremblay RE. Developmental trajectories of physical aggression from school entry to late adolescence. *J Child Psychol Psychiatry.* 2001;42:503-512
26. Dunn J, Munn P. Becoming a family member: family conflict and the development of social understanding in the second year. *Child Dev.* 1985;56:480-492
27. Hay DF, Castle J, Davies L. Toddlers' use of force against familiar peers: a precursor of serious aggression? *Child Dev.* 2000;71:457-467
28. Keenan K, Shaw DS. The development of aggression in toddlers: a study of low-income families. *J Abnorm Child Psychol.* 1994;22:53-77
29. Keenan K, Wakschlag LS. More than the terrible twos: the nature and severity of behavior problems in clinic-referred preschool children. *J Abnorm Child Psychol.* 2000;28:33-46
30. Tremblay RE, Japel C, Pérusse D, et al. The search for the age of "onset" of physical aggression: Rousseau and Bandura revisited. *Crim Behav Ment Health.* 1999;9:8-23
31. Olds D, Henderson CR, Cole R, et al. Long-term effects of nurse home visitation on children's criminal and antisocial behavior: fifteen-year follow-up of a randomized controlled trial. *JAMA.* 1998;280:1238-1244
32. Eckenrode J, Ganzel B, Henderson CR Jr, et al. Preventing child abuse and neglect with a program of nurse home visitation: the limiting effects of domestic violence. *JAMA.* 2000;284:1385-1391
33. Pagani L, Boulerice B, Vitaro F, Tremblay RE. Effects of poverty on academic failure and delinquency in boys: a change and process model approach. *J Child Psychol Psychiatry.* 1999;40:1209-1219
34. Sampson RJ, Laub JH. Urban poverty and the family context of delinquency: a new look at structure and process in a classic study. *Child Dev.* 1994;65:523-540
35. Jaffee S, Caspi A, Moffitt TE, Belsky J, Silva P. Why are children born to teen mothers at risk for adverse outcomes in young adulthood? Results from a 20-year longitudinal study. *Dev Psychopathol.* 2001;13:377-397
36. Fergusson DM, Woodward LJ, Horwood LJ. Maternal smoking during pregnancy and psychiatric adjustment in late adolescence. *Arch Gen Psychiatry.* 1998;55:721-727
37. Wakschlag LS, Lahey BB, Loeber R, Green SM, Gordon RA, Leventhal BL. Maternal smoking during pregnancy and the risk of conduct disorder in boys. *Arch Gen Psychiatry.* 1997;54:670-676
38. Orlebecke JF, Knol DL, Verhulst FC. Child behavior problems increased by maternal smoking during pregnancy. *Arch Environ Health.* 1999;54: 15-19
39. Brennan PA, Grekin ER, Mednick SA. Maternal smoking and criminal outcomes. *Arch Gen Psychiatry.* 1999;56:215-219
40. Weissman MM, Warner V, Wickramaratne PJ, Kandel DB. Maternal smoking during pregnancy and psychopathology in offspring followed to adulthood. *J Am Acad Child Adolesc Psychiatry.* 1999;38:892-899
41. Pagani L, Boulerice B, Tremblay RE, Vitaro F. Behavioural development in children of divorce and remarriage. *J Child Psychol Psychiatry.* 1997; 38:769-781
42. Wadsworth MEJ. *The Imprint of Time: Childhood, History, and Adult Life.* Oxford, England: Clarendon Press; 1991
43. Raine A, Reynolds C, Venables PH, Mednick SA, Farrington DP. Fearlessness, stimulation-seeking, and large body size at age 3 years as early predispositions to childhood aggression at age 11 years. *Arch Gen Psychiatry.* 1998;55:745-751
44. Tremblay RE, Pihl RO, Vitaro F, Dobkin PL. Predicting early onset of male antisocial behavior from preschool behavior. *Arch Gen Psychiatry.* 1994;51:732-738
45. Patterson GR, Reid JB, Dishion TJ. *Antisocial Boys.* Eugene, OR: Castalia; 1992
46. Cairns RB, Cairns BD, Neckerman HJ, Ferguson LL, Gariépy JL. Growth and aggression: 1. childhood to early adolescence. *Dev Psychol.* 1989;25: 320-330
47. Bates J, Freeland C, Lounsbury ML. Measurement of infant difficulty. *Child Dev.* 1979;50:794-803
48. Boivin M, Pérusse D, Sayset V, Tremblay N, Tremblay RE. Parenting perceptions and behaviors. In: *Longitudinal Study of Child Development in Québec (ÉLDEQ 1998-2002).* Québec, Québec, Canada: Institut de la statistique du Québec; 2000:21-35
49. Zoccolillo M. Parents' health and social adjustment: part II, social adjustment. In: *Longitudinal Study of Child Development in Québec (ÉLDEQ 1998-2002).* Québec, Québec, Canada: Institut de la statistique du Québec; 2000:37-45

50. Statistics Canada. *Overview of Survey Instruments for 1994–95 Data Collection, Cycle 1*. Ottawa, Ontario, Canada: Statistics Canada; 1995
51. Nagin D. Analyzing developmental trajectories: a semi-parametric, group-based approach. *Psychol Methods*. 1999;4:139–177
52. Roeder K, Lynch K, Nagin DS. Modeling uncertainty in latent class membership: a case study in criminology. *J Am Stat Assoc*. 1999;94:766–776
53. Tremblay RE. The development of aggressive behaviour during childhood: what have we learned in the past century? *Int J Behav Dev*. 2000;24:129–141
54. Robins LN, West PA, Herjanic BL. Arrest and delinquency in two generations: a study of black urban families and their children. *J Child Psychol Psychiatry*. 1975;16:125–140
55. Pagani L, Boulerice B, Tremblay RE. The influence of poverty upon children's classroom placement and behavior problems during elementary school: a change model approach. In: Duncan G, Brooks-Gunn J, eds. *Consequences of Growing Up Poor*. New York, NY: Sage; 1997:311–339
56. Suomi SJ. Developmental trajectories, early experiences, and community consequences: lessons from studies with rhesus monkeys. In: Keating DP, Hertzman C, eds. *Developmental Health and the Wealth of Nations*. New York, NY: Guilford Press; 1999:185–200
57. Bjorkqvist K, Lagerspetz KM, Kaukiainen A. Do girls manipulate and boys fight? Developmental trends in regard to direct and indirect aggression. *Aggress Behav*. 1992;18:117–127
58. Crick NR, Casas JF, Mosher M. Relational and overt aggression in preschool. *Dev Psychol*. 1997;33:579–588
59. Tremblay RE, Boulerice B, Harden PW, et al. Do children in Canada become more aggressive as they approach adolescence? In: Human Resources Development Canada, Statistics Canada, eds. *Growing up in Canada: National Longitudinal Survey of Children and Youth*. Ottawa, Ontario, Canada: Statistics Canada; 1996:127–137
60. Patterson GR. *A Social Learning Approach to Family Intervention: III. Coercive Family Process*. Eugene, OR: Castalia; 1982
61. Raine A. Annotation: the role of prefrontal deficits, low autonomic arousal, and early health factors in the development of antisocial and aggressive behavior in children. *J Child Psychol Psychiatry*. 2002;43:417–434
62. Borge A, Rutter M, Côté S, Tremblay RE. Early childcare and physical aggression: differentiating social selection and social causation. *J Child Psychol Psychiatry*. 2004;45:367–376
63. Holmberg MC. *The Development of Social Interchange Patterns From 12 to 42 Months: Cross-Sectional and Short-Term Longitudinal Analyses*. PhD Thesis. Chapel Hill, NC: The University of North Carolina at Chapel Hill; 1977 (Microfilms International 78-7137)
64. Restoin A, Montagner H, Rodriguez D, et al. Chronologie des comportements de communication et profils de comportement chez le jeune enfant [Chronology of communication behaviors and behavior patterns in young children]. In: Tremblay RE, Provost MA, Strayer FF, eds. *Ethologie et Développement de l'Enfant*. Paris, France: Editions Stock/Laurence Pernoud; 1985:93–130
65. Wakschlag L, Pickett KE, Cook E, Benowitz NL, Leventhal B. Maternal smoking during pregnancy and severe antisocial behavior in offspring: a review. *Am J Public Health*. 2002;92:966–974
66. Olds DL, Henderson CR, Chamberlin R, Talelbaum R. Preventing child abuse and neglect: a randomized trial of nurse home visitation. *Pediatrics*. 1986;78:65–78
67. Tremblay RE, LeMarquand D, Vitaro F. The prevention of ODD and CD. In: Quay HC, Hogan AE, eds. *Handbook of Disruptive Behavior Disorders*. New York, NY: Kluwer Academic/Plenum Publishers; 1999:525–555

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