

# Time-Dependent Effects of Exposure to Physical and Sexual Violence on Psychopathology Symptoms in Late Childhood: In Search of Sensitive Periods in Development

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**Objective:** Exposure to interpersonal violence is a known risk factor for psychopathology. However, it is unclear whether there are sensitive periods when exposure is most deleterious. We aimed to determine whether there were time periods when physical or sexual violence exposure was associated with greater child psychopathology.

**Method:** This study (N = 4,580) was embedded in Generation R, a population-based prospective birth cohort. Timing of violence exposure, reported through maternal reports (child age, 10 years) was categorized by age at first exposure, defined as: very early (0–3 years), early (4–5 years), middle (6–7 years), and late (8+ years) childhood. Using Poisson regression, we assessed the association between timing of first exposure and levels of internalizing and externalizing symptoms, using the Child Behavior Checklist at age 10 years.

**Results:** Violence exposure at any age was associated with higher internalizing (physical violence: risk ratio [RR] = 1.46,  $p < 0.0001$ ; sexual violence: RR = 1.30,  $p < .0001$ ) and externalizing symptoms (physical violence: RR = 1.52,  $p < 0.0001$ ; sexual violence: RR = 1.31,  $p = 0.0005$ ). However, the effects of violence were time dependent: compared to children exposed at older ages, children first exposed during very early childhood had greater externalizing symptoms. Sensitivity analyses suggested that these time-based differences emerged slowly across ages 1.5, 3, 6, and 10 years, showing a latency between onset of violence exposure and emergence of symptoms, and were unlikely to be explained by co-occurring adversities.

**Conclusion:** Interpersonal violence is harmful to childhood mental health regardless of when it occurs. However, very early childhood may be a particularly sensitive period when exposure results in worse psychopathology outcomes. Results should be replicated in fully prospective designs.

**Key words:** interpersonal violence, sensitive periods, psychopathology, latency

J Am Acad Child Adolesc Psychiatry 2020;59(2):283–295. 

**A**cross multiple disciplines, there is a long-standing belief that there are windows of time when experiences can have lasting effects on behavior, health, and risk for disease.<sup>1,2</sup> During these “sensitive periods,” specific exposure events that coincide with peak periods of brain development<sup>1,3</sup> are posited to shape brain structure and function more than the same exposure occurring earlier or later in the lifecourse.<sup>4</sup> These sensitive periods can therefore be conceptualized both as “high-risk” periods when adverse experiences, including exposure to stress or other types of adversity, are most potent in conferring risk to disease—but also “high-reward” periods when enriching experiences, including interventions, could be even more beneficial in promoting long-term positive health outcomes.

Despite widespread belief in the existence of sensitive periods regulating the etiology and course of mental health problems, there are not yet clearly identified sensitive periods linking experiences after birth to risk for psychopathology. To date, the most thorough work to identify postnatal sensitive periods in humans comes from observational studies that have examined the time-dependent effect of different forms of child exposure to interpersonal violence, as interpersonal violence exposure is known to substantially increase risk for later internalizing<sup>5-8</sup> and externalizing<sup>7,9,10</sup> problems. However, these prior observational studies on the time-dependent effects of interpersonal violence have generally yielded mixed results within both population-based and high-risk samples. Some studies comparing the effect of age at first exposure to violence have

found that maltreatment early in childhood, defined previously as before age 5 or age 12 years, is associated with greater risk for psychopathology<sup>11-15</sup> compared to exposure at later stages. For example, a prospective study of 578 children by Keiley *et al.* of maternal-reported maltreatment found that children maltreated between ages 0 and 5 had significantly higher teacher-reported internalizing and externalizing symptoms by early adolescence compared to unexposed children and children exposed between ages 6 and 9.<sup>14</sup> However, other studies have found that a first experience of maltreatment later in childhood, meaning after age 10 or during adolescence, was associated with more substantially increased psychopathology risk.<sup>16-18</sup> For instance, a prospective study by Thornberry *et al.* compared the effect of maltreatment across childhood on behavioral problems in 738 individuals in late adolescence; maltreatment in adolescence led to a 13% increased odds of internalizing problems and 35% increased odds of externalizing problems, whereas maltreatment during early or late childhood conferred no increased behavioral risk.<sup>18</sup> Furthermore, other studies have found no differential effects on psychopathology symptoms based on the developmental timing of exposure.<sup>19-24</sup> For example, among 4,361 youth followed across childhood, the timing of exposure to cumulative adversity in 4 developmental periods did not differentially affect internalizing or externalizing symptoms.<sup>23</sup>

These mixed findings contrast to those obtained from a seminal experimental study, which followed very young Romanian orphan children who were randomized to high-quality foster care or continued institutionalized care; this study has demonstrated the wide-ranging negative effects of institutionalized care in the first years of life on multiple outcomes, including less secure attachment, lower cognitive performance, and higher rates of psychiatric disorders.<sup>25</sup> Although it is difficult to directly compare a randomized control trial and a specific form of early deprivation to any observational study, results from the Bucharest Early Intervention Project underscore the salience of very early childhood adversity on a host of later outcomes in childhood and beyond. This collective set of mixed observations from human studies on the importance of the developmental timing of violence, deprivation, or other types of interpersonal adversity conflict with numerous animal studies, which have generally also found more consistent time-dependent effects of different forms of social adversity on a range of outcomes, including not only anxious and depressive symptoms<sup>26</sup> but also social, emotional, and behavioral processes (eg, fear conditioning, stress reactivity, aggressive behavior)<sup>27-29</sup> and brain structure and function.<sup>30,31</sup>

The current study aimed to increase knowledge on sensitive periods shaping risk for psychopathology by

exploring the relationship between the developmental timing of exposure to physical and sexual violence on child internalizing and externalizing symptoms measured at age 10 years using data from a unique population-based sample of children. We focused on physical and sexual violence because these two types of exposures are most consistently linked to subsequent mental health and psychosocial functioning, potentially due to their interpersonal nature and serving as a possible indicator of a violent family environment.<sup>32-34</sup> Identification of sensitive periods when these two common forms of violence increase susceptibility to psychopathology symptoms could provide important new clues into when and through what pathways psychopathology emerges and could ultimately help determine when to optimally time interventions so as to reduce the consequences of exposure to adversity.

## METHOD

### Sample and Procedures

Data came from Generation R, a population-based prospective study of children followed from fetal life onward in Rotterdam, the Netherlands. The goal of Generation R was to examine the social, biological, and environmental factors shaping child growth, health, and development. Details about the cohort have been described elsewhere.<sup>35-38</sup> In brief, 9,778 mothers living in Rotterdam at the time of their estimated delivery date (between April 2002 and January 2006) were enrolled during their first prenatal visit, at the birth visit, or in the first few months post-childbirth. Following the prenatal visit, mothers and their offspring were eligible to participate in two additional data collection periods completed via in-person structured interviews at the Generation R study center at child age 10. Ethical approval of the study was obtained by the Medical Ethical Committee of the Erasmus Medical Center, Rotterdam, and the study was conducted in accordance with the World Medical Association Declaration of Helsinki guidelines.

The current study is based on an analytic subsample of 4,580 children whose caregivers (95.7% of whom were mothers) completed the age 10 assessment and had complete exposure and outcome data ( $n = 7,393$  caregivers completed the age 10 assessment, representing 86.5% of the 8,548 caregivers contacted). Children were excluded from the subsample due to incomplete exposure data (24.6%;  $n = 1,822$ ), incomplete outcome data (12.9%;  $n = 953$ ), or unreliable answers due to language barriers (0.51%;  $n = 38$ ). Although the reasons for data missingness were not recorded, data were missing because the child either did not present for the interview or the day-long data collection session ran late (and thus the self-reported sections of the interview from which these data came were skipped).

Children included in our analytic sample ( $N = 4,580$ ) did not differ from those who were excluded ( $n = 2,813$ ) with respect to age, race/ethnicity, sex, and poverty level. However, the excluded sample comprised more children from families living in rural areas (23.1% versus 14.8%;  $p = .05$ ) and mothers with less than a high school education (26.6% versus 15.4%;  $p < .01$ ).

### Measures

**Exposure: Childhood Adversity.** Children's exposure to physical and sexual violence was determined using a major life events inventory, which asked mothers to indicate whether the child had experienced specific life events at child age 10. The interview in Generation R was based on questionnaires previously used in the TRAILS study and on items in the Life Event and Difficulty Schedule (LEDS).<sup>39,40</sup> The TRAILS self-report questionnaires were changed to an interview format with a caregiver to allow the opportunity for discussion between participant and interviewer. Exposure to physical violence was defined based on two items: "someone threatened violence to the child" or "someone was violent to the child". Exposure to sexual violence was also defined based on two items, translated as follows: "someone made sexual comments or gestures to the child" or "the child was subject to inappropriate sexual misconduct." Children were coded as exposed to physical violence if either or both items were endorsed. Similarly, children were coded as exposed to sexual violence if either or both items were endorsed.

Among children exposed to either type of violence, mother's reported the age (in years) of the child when the event happened. For events occurring multiple times, the interviewer recorded the age at the worst or most negative occurrence. The decision to collect the date information in this format was based on a small pilot study suggesting that mothers could not reliably report the exact time of the first occurrence of a series of multiple events but could reliably remember severe events. If all instances of exposure to violence were of equal severity, the interviewer recorded the age at first occurrence. Using these data, we categorized children as exposed to violence in one of the following developmental time periods; our age groupings were defined to balance sample size across age groups, as well as maintain general consistency with prior studies,<sup>4,13,23</sup> and accepted definitions of developmental stages. These developmental stages were thus defined here as: very early childhood (age 0–3), early childhood (age 4–5), middle childhood (age 6–7), and late childhood (ages 8+). When both items corresponding to a specific violence type were endorsed, age at event occurrence was defined based on the earlier of the two ages reported. Although a limitation of this approach is

that we are unable to consistently classify age of exposure with respect to its severity, it does enable us to include all children in the analysis who have been exposed to both violence events. Importantly, among children exposed to both forms of violence within a given type, reported age at exposure for each form were comparable, suggesting that the classification by developmental stage is unlikely to be inconsistent with respect to severity of exposure (see Measures in Table S1, available online). Prior studies have also shown that caregiver retrospective reporting of their young child's adversity exposure is generally accurate,<sup>41</sup> and use of developmental periods, rather than specific ages, reduces potential recall bias compared to exposures focused on single ages.

**Outcomes: Child Psychopathology Symptoms.** Mothers completed the Child Behavior Checklist (CBCL/6-18)<sup>42</sup> at the child age 10 assessment.<sup>43</sup> Using a 3-point scale (0 = not true; 1 = sometimes true; 2 = very true or often true), mothers rated their child's behavior on 51 items comprising both internalizing and externalizing behavior. We analyzed raw total scores from the Internalizing (Cronbach's  $\alpha = 0.88$ ) and Externalizing (Cronbach's  $\alpha = 0.91$ ) subscales, the 2 main classification schemes for child psychopathology symptoms.<sup>44</sup> Subscales included in these broadband scales are summarized in the supplemental materials (Measures in Supplement 1, available online).

**Covariates.** All models controlled for the following covariates, measured closest to the time of the child's birth: child sex, child race/ethnicity, gestational birth status, household income, highest level of maternal education, maternal marital status, and maternal psychopathology symptoms (see Measures in Supplement 1, available online). The covariates were included because they were found in our study to be potential confounders or are routinely included in birth cohort studies of child health outcomes.<sup>45,46</sup> For example, maternal psychopathology symptoms measured at the time of the child's birth using the Global Severity Index derived from the Brief Symptom Inventory<sup>47</sup> were included to reduce potential impacts of both confounding and common rater bias,<sup>48</sup> as mothers reported about their child's emotional and behavioral problems, mothers were the primary reporters of their child's exposure to adversity, and maternal mood or other factors may influence reports of adversity exposure<sup>49</sup> and psychopathology.<sup>50,51</sup> Of note, we did not adjust for co-occurring violence exposure (meaning adjustment for sexual violence when examining the role of physical violence and vice versa), because of their lack of strong overlap (Measures in Supplement 1, available online).

In our analytic sample of 4,580 children, missingness for each covariate ranged from 1.0% ( $n = 47$ ) for race/

ethnicity, to 5.7% ( $n = 263$ ) for maternal education, 6.2% ( $n = 284$ ) for marital status, 19.4% ( $n = 889$ ) for income, and 23.0% ( $n = 1,054$ ) for maternal psychopathology; there were no missing data for child sex and gestational birth age. Before analysis, we imputed missing covariate data using the MI procedure in SAS, creating 25 imputed datasets to reduce bias associated with missing data.<sup>52</sup> The reported regression results were obtained by pooling estimates from the 25 multiply imputed datasets with the MIANALYZE procedure (further details on Missingness and Multiple Imputation in Supplement 2, available online).

### Data Analysis

We performed univariate analyses to determine the prevalence of exposure to each type of violence and the distribution of violence exposure by covariates. We then estimated two pairs of Poisson multiple regression models with robust standard errors, corresponding to each type of exposure and outcome. We modeled these associations with a Poisson variable, because of the large number of children with no symptoms, which was coded as an outcome value of 0 (internalizing symptoms,  $n = 682$ , 14.9%; externalizing symptoms,  $n = 1,202$ , 26.2%). We also modeled these associations using robust standard errors, given the overdispersion in raw symptom scores (internalizing symptoms, mean = 4.73, SD = 4.9; externalizing symptoms, mean = 3.85, SD = 4.8).

In model 1, we estimated the effect of exposure to each type of violence (versus unexposed) on internalizing and externalizing symptoms, after adjusting for covariates. In model 2, we estimated the effect of the developmental timing of exposure to violence (versus unexposed) on each CBCL score, adjusting for covariates. For model 2, we used omnibus tests of homogeneity to evaluate whether the  $\beta$  coefficients (indicating the effect of age at exposure compared to unexposed) for the developmental time periods (very early childhood, early childhood, middle childhood, and late childhood) were significantly different from each other. For these tests, the null hypothesis is that the covariate-only model is preferred to the developmental timing model, and the alternative hypothesis is that the developmental timing variable significantly improves the model fit. When the omnibus test for homogeneity was rejected (the null hypothesis was that the  $\beta$  coefficients corresponding to each age at exposure were equal; 2-sided  $p$  value < .05), we conducted post hoc Tukey tests to determine whether there were pairwise differences between the developmental time period effects, adjusting for multiple testing. All data analyses were conducted using SAS Version 9.4 (SAS Institute, Inc, Cary, NC).

## RESULTS

The mean age of the analytic sample was 9.7 years (SD = 0.3). As shown in Table 1, the analytic sample was approximately half girls (50.7%), and mostly Dutch (65.5%). The sample varied with respect to maternal education (52.0% had mothers with middle-high to high education) and household income level (53.5% had high income), with the majority of mothers reporting either being married (46.8%) or living with a partner (37.9%). Most children (93.3%) were born full term. Maternal psychopathology symptoms varied (mean Global Severity Index = 0.24, SD = 0.31), with 8.3% of mothers reporting severe psychological distress.

Physical violence exposure was reported in 16.0% of the cohort, and sexual violence was reported in 4.6%. Physical and sexual violence exposure were weakly correlated with one another (tetrachoric correlation = 0.27;  $p < .001$ ).

As shown in Table 1, physical violence was more commonly reported for boys, with 21.3% of boys experiencing physical violence compared to 10.8% of girls. In contrast, sexual violence was more commonly reported for girls, with 5.9% of girls experiencing sexual violence compared to 3.3% of boys. The prevalence of exposure to physical violence was higher among children from minority racial or ethnic groups, and children who had lower socioeconomic status, mothers with no partner, and mothers with a history of psychopathology. The prevalence of exposure to sexual violence also differed by household income level, maternal marital status, and maternal psychopathology (all  $p < .05$ ), but not by race/ethnicity, maternal education, or gestational age (all  $p > .05$ ).

Both internalizing and externalizing symptoms were higher among children who were non-Dutch, non-European, whose mothers had less education, less household income, lived in a household with no partner present, and had a history of maternal psychopathology (all  $p < .05$ ) (Table 1). Boys had higher externalizing symptoms compared to girls ( $p < .0001$ ), whereas internalizing symptoms did not significantly differ between boys and girls ( $p = .80$ ).

The distribution of age at first or worst exposure to violence is displayed in Table 2. As shown, both physical and sexual violence exposure was most commonly reported as having occurred recently, during late childhood (8+ years old), with 60.0% and 46.0% of exposure occurring in this age group, respectively.

### Exposure to Violence and Child Psychopathology Symptoms

Children exposed to either type of violence had significantly higher internalizing and externalizing symptoms relative to their peers who were never exposed (Table 3). Specifically,

**TABLE 1** Distribution of Baseline Covariates in the Total Analytic Sample and by Exposure to Violence and Child Psychopathology Scores in the Generation R Analytic Sample (N = 4,580)

Covariates	Total Sample		Exposed to Physical Violence			Exposed to Sexual Violence			Internalizing CBCL			Externalizing CBCL		
	N	%	n	%	p	n	%	p	Mean	SD	p	Mean	SD	p
Sex					.001			<.001			.799			<.0001
Male	2,259	49.32	482	21.34		75	3.32		4.71	5.05		4.42	5.27	
Female	2,321	50.68	250	10.77		136	5.86		4.74	4.78		3.31	4.21	
Race/Ethnicity					.009			.158			.001			.054
Dutch	3,000	65.50	453	15.10		128	4.27		4.62	4.87		3.75	4.62	
Non-Dutch European	355	7.75	52	14.65		23	6.48		4.22	4.51		3.73	5.00	
Non-Dutch Non-European	1,178	25.72	222	18.85		56	4.75		5.13	5.11		4.14	5.11	
Maternal Education					<.001			.097			<.0001			.0001
High	1,316	28.73	152	11.55		45	3.42		4.20	4.39		3.42	4.38	
Mid-High	1,064	23.23	167	15.70		44	4.14		4.68	4.68		3.81	4.64	
Mid-Low	1,290	28.17	244	18.91		66	5.12		4.83	5.09		3.97	4.82	
Low	647	14.13	133	20.56		35	5.41		5.50	5.49		4.43	5.42	
Household Income Level					<.001			.009			<.0001			<.0001
High	2,448	53.45	334	13.64		90	3.68		4.27	4.39		3.45	4.25	
Middle	697	15.22	138	19.80		41	5.88		4.96	5.17		4.15	5.35	
Low	545	11.90	107	19.63		32	5.87		5.83	5.86		4.66	5.60	
Maternal Marital Status					<.001			<.001			<.0001			<.0001
Married	2,145	46.83	300	13.99		87	4.06		4.51	4.69		3.43	4.35	
Living Together	1,734	37.86	294	16.96		63	3.63		4.67	4.70		3.93	4.70	
No Partner	416	9.08	102	24.52		38	9.13		6.15	6.37		5.49	6.36	
Gestational Birth Status					.080			.525			.610			.635
Full Term	4,271	93.25	694	16.25		194	4.54		4.72	4.89		3.84	4.79	
Preterm	309	6.75	38	12.30		17	5.50		4.86	5.26		3.98	4.86	
Maternal Psychopathology					<.001			<.001			<.0001			<.0001
Absent	4,201	91.72	624	14.85		180	4.28		4.51	4.69		3.69	4.60	
Present	379	8.28	108	28.50		31	8.18		7.10	6.47		5.68	6.29	

**Note:** Descriptive statistics are presented for the analytic sample without imputation. Simple linear regressions were performed for each covariate by each exposure and outcome with p values reported. Maternal education: High (University), Mid-high (Some higher education), Mid-low (Secondary), Low (Primary/some secondary). Household income level: High (>2,200 Euros/mo), Middle (1,400–2,200 Euros/mo), Low (<1,400 Euros/mo). Maternal psychopathology was assessed using a global severity score of psychological distress reported at the time of the child's birth; presence was defined as the top 90th percentile, whereas absence was defined as anything lower. In our analysis, we controlled for continuous symptoms to allow for greater variation. CBCL = Child Behavior Checklist.



**TABLE 2** Age at Exposure to Violence (N = 4,580)

	n	%
<b>Physical Violence</b>		
Ever Exposed	732	15.98
Age, y, at First or Worst Exposure		
Very Early Childhood (0–3)	31	4.23
Early Childhood (4–5)	66	9.02
Middle Childhood (6–7)	196	26.78
Late Childhood (8+)	439	59.97
<b>Sexual Violence</b>		
Ever Exposed	211	4.61
Age at First or Worst Exposure		
Very Early Childhood (0–3)	13	6.16
Early Childhood (4–5)	43	20.38
Middle Childhood (6–7)	58	27.49
Late Childhood (8+)	97	45.97

*Note:* The first row, labeled ever exposed, indicates the lifetime prevalence of exposure to violence. The remaining rows indicate the age (in years) at first or worse exposure.

exposure to physical violence was associated with 1.46 times higher risk of internalizing symptoms (risk ratio [RR] = 1.46, 95% CI = 1.36, 1.57) and 1.52 times higher risk of externalizing symptoms (RR = 1.52, 95% CI = 1.39, 1.67), after adjusting for covariates. In addition, exposure to sexual violence was associated with 1.30 times higher risk of internalizing symptoms (RR = 1.30, 95% CI = 1.15, 1.45) and 1.31 times higher risk of externalizing symptoms (RR = 1.31, 95% CI = 1.13, 1.52), after adjusting for covariates.

#### Developmental Timing of Exposure to Violence and Child Psychopathology Symptoms

As indicated by the significant tests of homogeneity (all  $p < .05$ ), the effects of violence exposure on child psychopathology symptoms differed based on the age at first or worst exposure, especially for externalizing symptoms (Table 3).

Specifically, children exposed to physical violence in very early childhood had 2.39 times higher risk of externalizing symptoms (RR = 2.39, 95% CI = 1.84, 3.13), relative to unexposed children. Based on the Tukey two-way comparison, this effect of exposure during very early childhood (RR = 2.39) was significantly larger than the effects of exposure during middle (RR = 1.40) and late childhood (RR = 1.49) (see Table S2, available online, for all Tukey comparisons).

Similarly, children exposed to sexual violence in very early childhood also had significantly higher externalizing symptoms (RR = 2.72, 95% CI = 1.77, 4.18). This effect during very early childhood (RR = 2.72) was also

significantly larger than the effects of exposure at all later time periods (compared to early (RR = 1.23), middle (RR = 1.20), and late (RR = 1.23) childhood); Tukey two-way comparison  $p < .05$ ).

No significant Tukey 2-way comparisons were found for the effect of timing of physical or sexual violence on internalizing symptoms, despite the significant tests of homogeneity ( $p < .05$ ), which evaluates global differences across means of all groups rather than specific 2-way comparisons. Tukey test  $p$  values also adjust for multiple comparisons, and thus this is a more conservative test.

#### Sensitivity Analysis

Although these results are suggestive of a very early childhood sensitive period when violence exposure may be most harmful, they may also reflect the effects of adversity accumulation, as children exposed to violence during very early childhood could have been exposed for a longer period of time, and a greater duration of exposure could have contributed to higher psychopathology symptoms. To explore this possibility, we conducted a sensitivity analysis to examine the impact of very early childhood exposure to violence on the development of psychopathology symptoms across early and middle childhood. Specifically, we compared the effect of violence exposure in very early childhood, relative to those never exposed at all time periods, on internalizing and externalizing symptoms assessed when the child was 1.5, 3, and 6 years of age (CBCL/1.5–5<sup>53</sup> and CBCL/6–18<sup>42</sup>). These repeated psychopathology symptom assessments across development allowed us to determine patterns in symptoms across childhood following exposure to violence in very early childhood, and thus to evaluate whether psychopathology symptoms emerged early in development. Of note, although the instruments vary in the specific items used to assess psychopathology,<sup>42</sup> such differences reflect developmental competencies, making comparisons of elevated symptoms across time comparable.

Children exposed to violence during very early childhood generally did not have greater psychopathology symptoms at either 1.5 or 3 years of age as compared to children who were unexposed to violence (Figure 1). However, at age 6 years, differences in psychopathology symptoms began to emerge. Internalizing symptoms were significantly higher at age 6 among children with very early childhood exposure to physical violence (RR = 1.52, 95% CI = 1.14, 2.03) or sexual violence (RR = 1.45, 95% CI = 1.11, 1.88). Similarly, externalizing symptoms were significantly higher among children with very early childhood exposure to physical violence (RR = 1.50, 95% CI = 1.03, 2.19) or sexual violence (RR = 1.75, 95% CI = 1.34, 2.29).

**TABLE 3** Association Between Violence Exposure and Timing of Exposure to Violence on Child Psychopathology Scores at Age 10 Years

	Internalizing Symptoms			Externalizing Symptoms		
	RR	95% CI	Homogeneity p	RR	95% CI	Homogeneity p
<b>Physical Violence</b>						
Ever exposed	1.46*	(1.36, 1.57)		1.52*	(1.39, 1.67)	
Timing of Physical Violence			<.0001			<.0001
Very Early Childhood	1.70*	(1.38, 2.12)		2.39*	(1.84, 3.13)	
Early Childhood	1.73*	(1.38, 2.18)		1.63*	(1.27, 2.12)	
Middle Childhood	1.45*	(1.28, 1.65)		1.40 <sup>a</sup>	(1.21, 1.63)	
Late Childhood	1.40*	(1.28, 1.54)		1.49 <sup>a</sup>	(1.34, 1.67)	
<b>Sexual Violence</b>						
Ever Exposed	1.30*	(1.15, 1.45)		1.31*	(1.13, 1.52)	
Timing of Sexual Abuse			.004			.028
Very Early Childhood	1.49	(0.99, 2.25)		2.72*	(1.77, 4.18)	
Early Childhood	1.35*	(1.04, 1.75)		1.23 <sup>a</sup>	(0.83, 1.82)	
Middle Childhood	1.28*	(1.05, 1.57)		1.20 <sup>a</sup>	(0.90, 1.58)	
Late Childhood	1.25*	(1.06, 1.45)		1.23 <sup>a</sup>	(1.02, 1.49)	

**Note:** Risk ratios and 95% CIs are shown. Poisson regression models with robust standard errors are adjusted for household income, maternal education, race/ethnicity, sex, maternal marital status, gestational birth status, and maternal psychopathology. The reference group for all models is unexposed, making each effect estimate an indicator of the effect of being exposed (at any time period or at a certain time period) relative to being never exposed. After tests of homogeneity, for which p values are shown, post hoc Tukey pairwise comparisons were estimated. Significant differences are shown using superscript letters as detailed below. Tukey pairwise comparisons may be nonsignificant even in cases of significant tests of homogeneity, as tests of homogeneity assess global differences across groups rather than two-way comparisons, and Tukey p values are adjusted for multiple comparisons. RR = risk ratio.

<sup>a</sup>Significantly different from very early childhood based on post hoc Tukey test.

\*p < .05.

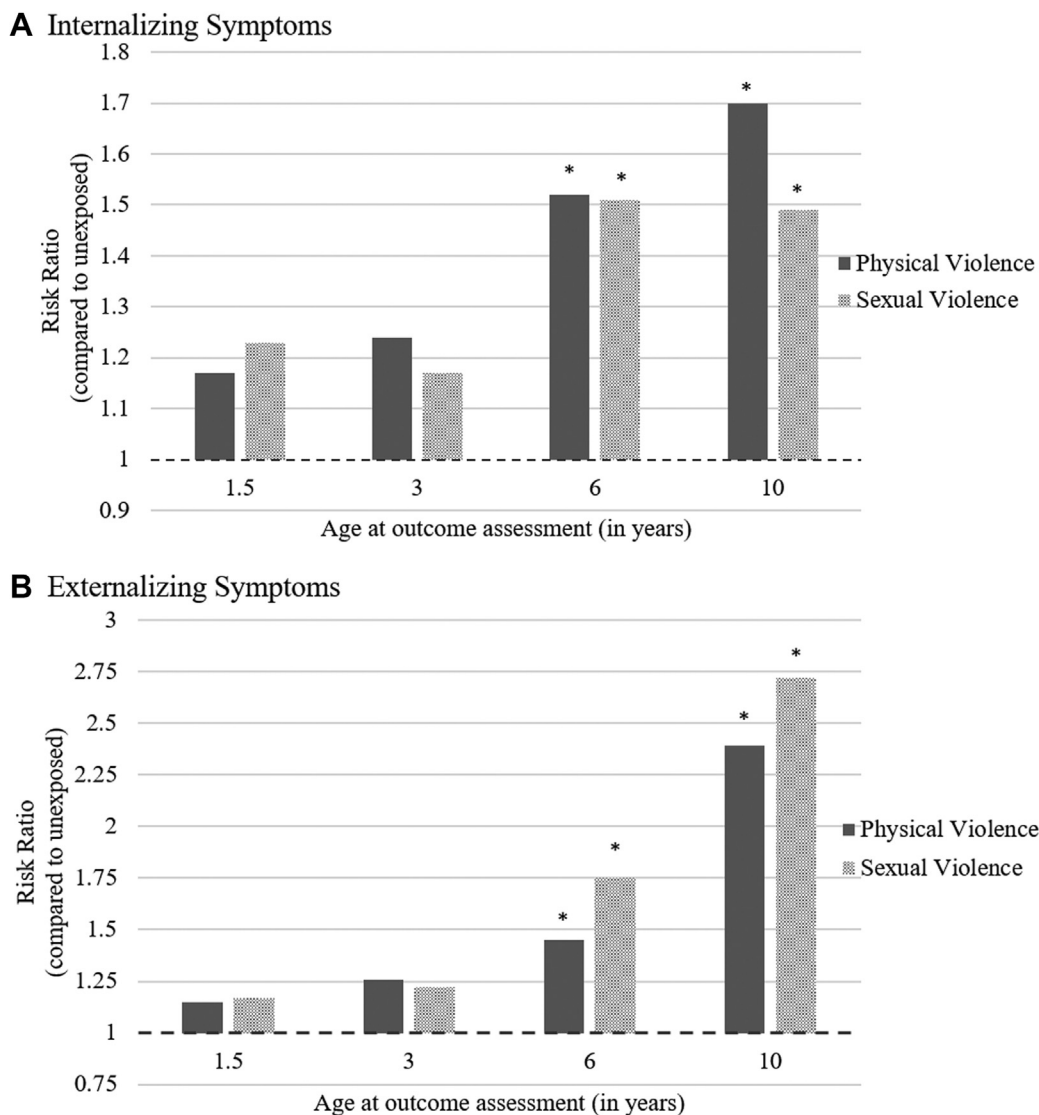
Recognizing that childhood adversities often co-occur, we also conducted additional analyses to determine whether the impact of physical and sexual violence in very early childhood may be due to the occurrence of other forms of adversity occurring during the same time period. For these analyses, we re-ran the primary analytic models to determine the impact of physical and sexual violence on psychopathology symptoms at age 10 years, after further adjustment for experiences of other very early childhood adversity exposures. The measure of other adversity exposure was derived as a count variable (ranging from 0 to 11) that captured the total number of other adversities reported during age 0 to 3 based on a list of 11 events that could have occurred at these ages (Measures in Supplement 1, available online).

Most of the sample (n = 2,394, 52.3%) were unexposed to other adversities in the very early childhood period, meaning during the first 3 years of their life, with 1,422 (31.0%) exposed to one event, 362 (7.9%) to 2 events, and 95 (2.1%) to 3 or more events. Children exposed to any physical violence reported a greater number of other adversities in very early childhood compared to those with no physical violence exposure (mean = 0.76; SD = 0.9 versus mean = 0.54; SD = 0.7, respectively,  $p < .0001$ ).

However, the number of reported other adversities did not differ between children exposed or unexposed to sexual violence (mean = 0.64; SD = 0.8 versus mean = 0.57; SD = 0.8, respectively,  $p = .21$ ).

As shown in Table 4, the general pattern of findings mirrored the main findings, with very early childhood exposure to physical and sexual violence associating with higher externalizing symptoms, although, as expected, most effect estimates were attenuated slightly after adjusting for other very early adversities. For example, the magnitude effect of very early childhood physical violence on externalizing symptoms decreased from a risk ratio of 2.39 (95% CI = 1.84, 3.13) to a risk ratio of 2.18 (95% CI = 1.68, 2.93), adjusting for other very early adversities. However, despite such adjustments, exposure to both physical and sexual violence in very early childhood still conferred the greatest risk for externalizing symptoms when compared to children who were unexposed, as well as compared to those exposed at most later time periods.

In addition, effects from the primary models did not substantially change when excluding children whose mothers had severe psychological distress (Table S3, available online).

**FIGURE 1** Effect of Violence Exposure in Very Early Childhood on Child Psychopathology Scores at Ages 1.5, 3, 6, and 10 Years Compared to Never Exposed

**Note:** The figure displays the estimated risk ratios in behavioral symptoms at age 1.5, 3, 6, and 10 years for exposure to violence in very early childhood (age 0–3 years) relative to children who were never exposed to violence. Results were derived from a set of Poisson regression models with robust standard errors, adjusting for covariates. Panel A presents the results for internalizing symptoms, and panel B presents the results for externalizing symptoms. Exposures are physical violence and sexual violence (as indicated by the key). The effect estimates shown here for age 10 years were previously reported in Table 3.

\* $p < .05$ .

## DISCUSSION

The main finding from this study is that very early childhood, here defined as the time period from birth to the third birthday, may be a sensitive period when exposure to interpersonal violence is associated with the greatest risk for psychopathology symptoms in later childhood. These results did not appear to be explained by a greater number of exposures to multiple types of adversity. That is, even after

controlling for the effects of exposure to other co-occurring early life adversities, we continued to see a heightened risk for psychopathology symptoms at age 10 among children exposed to physical and sexual violence during very early childhood compared to children who were never exposed to these types of violence.

These results are consistent with findings from a randomized controlled trial on the effects of institutional care



**TABLE 4** Association Between Violence Exposure and the Timing of Exposure to Violence on Child Psychopathology Scores at Age 10 Years, Adjusting for Burden of Other Adversity Exposure in Very Early Childhood

	Internalizing Symptoms			Externalizing Symptoms		
	RR	95% CI	Homogeneity p	RR	95% CI	Homogeneity p
<b>Physical Violence</b>						
Ever Exposed	1.43*	(1.34, 1.55)		1.49*	(1.36, 1.63)	
Timing of Physical Violence			<.0001			<.0001
Very Early Childhood	1.55*	(1.25, 1.92)		2.18*	(1.68, 2.93)	
Early Childhood	1.65*	(1.31, 2.08)		1.57*	(1.22, 2.01)	
Middle Childhood	1.43*	(1.27, 1.63)		1.39 <sup>a</sup>	(1.20, 1.62)	
Late Childhood	1.39*	(1.28, 1.52)		1.48 <sup>a</sup>	(1.31, 1.65)	
<b>Sexual Violence</b>						
Ever Exposed	1.27*	(1.14, 1.43)		1.31*	(1.13, 1.52)	
Timing of Sexual Abuse			.007			.034
Very Early Childhood	1.40	(0.91, 2.16)		2.59*	(1.68, 3.94)	
Early Childhood	1.36*	(1.04, 1.79)		1.26 <sup>a</sup>	(0.85, 3.94)	
Middle Childhood	1.31*	(1.08, 1.58)		1.23 <sup>a</sup>	(0.94, 1.62)	
Late Childhood	1.20*	(1.02, 1.40)		1.20 <sup>a</sup>	(0.99, 1.45)	

**Note:** Risk ratios and 95% CIs are shown. Poisson regression models with robust standard errors are adjusted for household income, maternal education, race/ethnicity, sex, maternal marital status, gestational birth status, maternal psychopathology, and a count of other adversity exposure in very early childhood. A count of other adversity exposure in very early childhood was determined by counting the number of types of other events to which the child was exposed during the same time period: child illness, household member illness, someone else close to the child experienced an illness, parent/caregiver death, death of someone else who was close to the child, unsafe neighborhood, financial problems, household experienced enduring conflict, divorce, parent job loss, and moved homes. The reference group for all models is unexposed, making each effect estimate an indicator of the effect of being exposed (at any time period or at a certain time period) relative to being never exposed. After tests of homogeneity, for which p values are shown, post hoc Tukey pairwise comparisons were estimated. Significant differences are shown using superscript letters as detailed below. Tukey pairwise comparisons may be nonsignificant even in cases of significant tests of homogeneity, as tests of homogeneity assess global differences across groups rather than two-way comparisons, and Tukey p values are adjusted for multiple comparisons. RR = risk ratio.

<sup>a</sup>Significantly different from very early childhood based on post hoc Tukey test.

\*p < .05.

in young children,<sup>25,54</sup> and both prospective<sup>12,14</sup> and retrospective<sup>55</sup> epidemiological studies showing that adversity exposure before age 5 years is most associated with risk for child psychopathology symptoms. Our findings are also consistent with studies of rodents and primates in showing the existence of sensitive periods, particularly shortly after birth, when parental care disruptions and other environmental inputs produce worse outcomes across social, emotional, behavioral, and biological processes domains.<sup>28,31,56</sup>

There are a number of reasons why exposure to interpersonal violence in the first 3 years of life could be more harmful than later violence exposure. From the perspective of developmental psychopathology theories,<sup>57</sup> early violence exposure likely compromises a child's ability to successfully master early stage-salient developmental tasks, such as self-regulation or the development of secure attachments, which in turn hinders the ability to master subsequent developmental tasks. Moreover, according to the developmental neuroscience literature, early life adversities may be more deleterious because they occur when the foundation of

brain architecture and neurobiological systems involved in regulating arousal, emotion, stress responses, and reward processing are being wired.<sup>58,59</sup> Exposure to violence early in life can therefore disrupt the development of neural circuits that interfere with typical patterns of brain development, heightening vulnerability to a variety of mental health problems.<sup>60-63</sup> Thus, "early life" adversity likely predicts a cascade of many negative consequences.

Although the general pattern of findings did not differ between physical and sexual violence, there may be different risk factors associated with each form of violence and thus more long-term consequences associated with each type of violence.<sup>64</sup> For example, low maternal involvement and perinatal problems are found to increase risk for physical abuse, whereas being female and living with a stepfather increases risk for sexual abuse.<sup>64</sup> Therefore, physical and sexual violence in very early childhood may be associated with different patterns of risk factors and differentially comorbid with other adversities.

We also found evidence suggesting that the behavioral effects of these sensitive periods may not emerge

immediately. Specifically, early psychopathology symptoms scores, measured at age 1.5 and 3 years, were generally indistinguishable across children with (versus without) exposure to interpersonal violence during very early childhood. However, at age 6, significant differences in psychopathology symptoms began to emerge between the very early childhood exposed and never exposed groups; these differences then persisted to age 10.

There are a number of possible explanations for such findings. First, the lack of observable differences between exposed and unexposed groups in psychopathology symptoms at ages 1.5 and 3 could reflect challenges inherent to measuring psychopathology symptoms in very young children. The limited ability of young children to articulate their emotional states requires the use of assessments largely based on observation.<sup>65</sup> Age-related variation in the manifestation of symptoms across development have also been noted.<sup>44</sup>

Second, the lack of early differences across exposure groups could also suggest that the consequences of adversity during a sensitive period may not be immediately detectable but, rather, that there may be a lag in time or latency period from the occurrence of exposure to presentation of behavioral symptoms. Curiously, there is little evidence from either empirical research or theoretical work to pinpoint exactly when symptoms would be expected to emerge following stress exposure. For example, studies on the effects of interpersonal stress, including child physical or sexual abuse, on risk for depression have shown that the time from onset of stress to the occurrence of depression could vary from a period of several months<sup>66-68</sup> to a few years,<sup>69</sup> and even up to a decade.<sup>8,70</sup>

The strongest evidence available addressing this question comes from studies of posttraumatic stress disorder (PTSD), which distinguish between immediate (eg, within days to 3 months following trauma exposure) and delayed-onset (eg, 6 months or more following trauma) symptom onset following trauma exposure.<sup>71,72</sup> Epidemiological studies suggest that the majority of young people exposed to trauma who develop PTSD will manifest symptoms within 6 months.<sup>73,74</sup> In children and adolescents, the timing and presentation of PTSD symptoms following acute trauma depends in part on level of developmental maturation of brain structures, functional physiological correlates, and cognitive and emotional regulation.<sup>71</sup>

However, the notion of a delayed “time to impact” associated with exposure to adversity during sensitive periods is consistent with work from animal studies on the neural underpinnings of critical periods, which have found that the effects on behavior of early postnatal experience do not occur immediately but, rather, gradually over time.<sup>75</sup>

Andersen and Teicher<sup>76</sup> have also specifically posited that the expression of symptoms resulting from exposure to adversity during earlier-life sensitive periods may only manifest later in life, such as during adolescence, when specific maturational events occur that trigger the presentation of symptoms among vulnerable individuals. Their hypothesis is consistent with the notion of a “latent vulnerability” wherein exposure to maltreatment is thought to cause alterations across neurobiological systems that are at first adaptive but that later prove harmful in navigating subsequent experiences outside of the maltreatment environment.<sup>77</sup>

A third possibility for the lack of observable differences in psychopathology symptoms at ages 1.5 and 3 years could be based on how violence and other co-occurring adversities accumulate across time. Accumulation of risk models propose that every additional year of exposure (or greater levels of exposure to multiple adversities across time) increase risk for poor health in a dose–response manner.<sup>78,79</sup> Although there were no measures available in this dataset that would allow us to determine whether children were exposed to violence repeatedly, it is possible that children experiencing violence early had more chronic exposure to violence and other adversities. Indeed, violence exposure is often correlated with other environmental risk factors, suggesting that very early violence exposure may be indicative of a dysfunctional home environment. Descriptive analyses somewhat hinted at this possibility (see Table S1, available online, for distribution of covariates by age at exposure to violence). Thus, as children age, the effects of violence could accumulate, increasing risk for psychopathology symptoms in an additive fashion.

This study had several strengths. Data came from a large population-based sample of youth, enabling us to obtain more generalizable results as compared to clinical or community-based samples. Although interpersonal violence was retrospectively assessed via maternal reports at child age 10 years, we were able to leverage the longitudinal nature of this large birth cohort to investigate the development of psychopathology symptoms across early to late childhood, as internalizing and externalizing symptoms were measured repeatedly during the study (at child age 1.5, 3, 6, and 10 years).

However, there are several limitations. First, exposure to violence was assessed retrospectively at age 10 years via maternal self-report. Although prospective reports may be more reliable and valid than retrospective reports, especially in recording information about the age at exposure, both retrospective and prospective study designs are vulnerable to underreporting with parental self-reporters, who may be reluctant to disclose such personal matters, especially if they are implicated in their occurrence.<sup>41</sup> Yet, even if such

reporting biases were present, prior work has shown that retrospective and prospective measures produce similar estimates of association with mental disorders,<sup>80</sup> suggesting that adversity exposure is detected as harmful regardless of ascertainment strategy. Exposure measures were also derived from only four items, which could affect the precision of these estimates. However, the prevalence estimates of exposure to physical (16%) and sexual violence (5%) derived here were comparable to estimates obtained from nationally representative epidemiological samples of youth across the globe.<sup>81,82</sup> Potentially key features of adversity were also not measured in Generation R, including the severity, chronicity, or duration of violence and the relationship of the child to the perpetrator of violence. Other forms of interpersonal violence, such as neglect or emotional abuse, were also unmeasured. There was also a small number of children exposed to sexual violence in very early childhood ( $n = 13$ ), suggesting that these findings should be interpreted with caution. Furthermore, despite the rich cohort data, there may be additional unmeasured factors, such as relationships with siblings, parental divorce, presence of a non-biological parent caregiver, or other indicators of cumulative environmental risk that could confound the relationship between violence exposure and behavioral symptoms. Of note, however, we did not find a strong relationship between maternal reports of her own exposure to violence and her reporting of children's violence exposure (correlations ranged from 0.04 to 0.14), suggesting that these findings were not explained by maternal problems. Finally, there was also attrition over time, which we attempted to address using multiple imputation.

In summary, results from this study suggest that even though exposure to violence is harmful across childhood, it may be particularly damaging when it occurs before age 3 years. These insights could be used to guide the tailoring of screening efforts to improve detection of experiences of adversity among all children, but especially among the youngest children, who may be the most vulnerable. They may also be used to help guide policy decisions and the

allocation of limited resources toward children most in need.

Accepted May 3, 2019.

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Research reported in this publication was supported by the National Institute of Mental Health of the National Institutes of Health under award no. K01MH102403 (Dunn) and 1R01MH113930 (Dunn). A. Neumann and H. Tiemeier are supported by a grant of the Dutch Ministry of Education, Culture, and Science and the Netherlands Organization for Scientific Research (NWO grant no. 024.001.003, Consortium on Individual Development). The work of H. Tiemeier is further supported by the Gravitation program of the Dutch Ministry of Education, Culture, and Science and the Netherlands Organization for Scientific Research (NWO grant no. 024.001.003) and NWO-VICI grant (NWO-ZonMW: 016.VICI.170.200). C. Cecil has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement no. 707404.

The Generation R Study is conducted by the Erasmus Medical Center in close collaboration with the Erasmus University Rotterdam, Faculty of Social Sciences, the Municipal Health Service Rotterdam area, and the Stichting Trombosedienst and Artsenlaboratorium Rijnmond (STAR), Rotterdam. The Generation R Study is made possible by financial support from Erasmus Medical Center, Rotterdam, and the Netherlands Organization for Health Research and Development (ZonMw). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Garrett Fitzmaurice, ScD, of Harvard University T.H. Chan School of Public Health, served as the statistical expert for this research.

The authors gratefully acknowledge the contribution of general practitioners, hospitals, midwives, and pharmacies in Rotterdam.

Disclosure: Drs. Dunn, Cecil, Susser, Tiemeier, Ms. Nishimi, Mr. Neumann, and Ms. Renaud have reported no biomedical financial interests or potential conflicts of interest.

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0890-8567/\$36.00/©2019 American Academy of Child and Adolescent Psychiatry

<https://doi.org/10.1016/j.jaac.2019.02.022>

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## SUPPLEMENT 1

### Method

**Measures: Child Psychopathology Symptoms.** For the primary analyses, we used mother reports of child behavior on the Child Behavior Checklist for ages 6 to 18 (CBCL/6-18).<sup>1</sup> For the sensitivity analyses, we used mother reports of child behavior for the ages 1.5 to 5 measure (CBCL/1.5-5).<sup>2</sup> On both standardized CBCL measures, internalizing and externalizing weighted subscales were calculated based on CBCL syndrome scales. Although the subscales are generally consistent across the two CBCL scales, the syndrome scales differ slightly across age, consistent with developmental competencies. Specifically, for the CBCL/6-18, the internalizing subscale consists of the following subscales: anxious/depressed, withdrawn/depressed, and somatic complaints; and the externalizing subscale includes: attention problems, rule-breaking behavior, and aggressive behavior. For the CBCL/1.5-5, the internalizing subscale includes: emotionally reactive, anxious/depressed, somatic complaints, and withdrawn; and the externalizing subscale includes: attention problems and aggressive behavior.

**Covariates.** A detailed description of our definition of covariates is as follows. Sex was coded as boy or girl. Race/ethnicity included the following three categories: Dutch, Non-Dutch European, and Non-Dutch Non-European, including people of the following racial or ethnic groups: Indonesian, Cape Verdean, Moroccan, Dutch Antilles, Surinamese, Turkish, African, American (western), American (nonwestern), Asia (western), Asia (nonwestern), and Oceania. Gestational age was coded as: preterm (<37 weeks) or full-term (≥37 weeks). Income was coded into three categories: Low (<1,400 Euros/mo), Middle (1400–2200 Euros/mo), and High (>2200 Euros/mo). Maternal education was coded into four groups: Low (less than secondary education), Mid-Low (secondary education), Mid-High (some higher education/vocational training), and High (university/college degree or higher). Maternal marital status was coded into three groups: Married, Living Together, and No Partner (living together indicates that the child had two parents in their household but that they were not married).

Maternal psychopathology was measured at the time of the child's birth using the Brief Symptom Inventory (BSI),<sup>3</sup> a 53-item self-report questionnaire that asked mothers the extent to which they experienced a range of psychopathology symptoms over the previous week. Participants rated the frequency of these symptoms on a scale from 0 ("Not at all") to 4 ("Continually"). The BSI consists of nine subscales: Somatization, Obsessive-Compulsive, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobia, Paranoia, and Psychoticism. For the present study, we used the Global Severity Index (GSI), a mean of all subscales, as a global

measure of maternal psychopathology symptoms. This measure of general psychopathology has a reported internal consistency reliability of 0.95<sup>3</sup> and is included in all analytic models as a continuous variable to allow for greater variation. For descriptive purposes in Table 1, the GSI total score was dichotomized at the 90th percentile to indicate presence versus absence of elevated psychological symptoms.

In the sensitivity analyses, we also adjusted for a count of the number of unique exposures children were exposed to during very early childhood. This count variable was derived by counting the number of types of other events to which the child was exposed during the same early childhood time period: child illness, household member illness, someone else close to the child experienced an illness, parent/caregiver death, death or someone else who was close to the child, unsafe neighborhood, financial problems, household experienced enduring conflict, divorce, parent job loss, and moved homes. This count variable ranged from 0 to 11.

**Composition of Physical and Sexual Violence Age at Exposure Variables.** The physical and sexual violence measures were created based on four individual items, two for physical and two for sexual violence. To be consistent, when both items were endorsed within a single type of violence, the youngest age of reported exposure was used to indicate overall age of exposure to that form of violence. As the severity of the items potentially differs, some of the violence ages may refer to earlier but less severe exposure. For example, among children whose parents reported exposure to only one of the two items included in the physical violence measure, the mean age of exposure to either item was comparable (someone was violent to my child [ $n = 198$ ]: mean age 7.45 [SD = 1.8] versus someone threatened violence to my child [ $n = 431$ ]: mean age 7.59 [SD = 1.6]). For the sexual violence measure, there was a difference in age of exposure between the two items composing the sexual violence measure (someone made sexual comments to my child [ $n = 140$ ]: mean age 7.49 [SD = 1.6] versus child was subject to inappropriate sexual misconduct [ $n = 45$ ]: mean age 5.84 [SD = 1.9]). For individuals with exposure to both items, mean ages at exposure were consistent in both physical violence ( $n = 102$ : someone was violent to my child: mean age 7.07 [SD = 2.1] versus someone threatened violence to my child: mean age 7.28 [SD = 2.1]) and sexual violence [ $n = 26$ ]: someone made sexual comments to my child: mean age 5.52 [SD = 2.8] versus child was subject to inappropriate sexual misconduct: mean age 5.31 [SD = 2.6]). Given the general consistencies in reported exposure age within each type of violence, this classification scheme does not appear to introduce bias to our analyses.

**Co-occurring Physical and Sexual Violence Exposure.** We explored the association between exposure to sexual and

physical violence to evaluate the extent to which these types of stressors co-occurred. We also explored the extent to which there was overlap with respect to the reported age at first or worst exposure to violence.

Overall, we did not see strong evidence for co-occurrence of these types of violence with respect to either their presence (versus absence) or developmental timing of occurrence. Among the 875 children exposed to any violence, only 68 (7.8% of those exposed) experienced both physical and sexual violence. Among children exposed to both types of violence, the average difference (in years of age) between the reported age of physical violence and reported age of sexual violence was 0.29 (SD = 2.99). In other words, physical violence tended to occur after sexual violence, when children were slightly older. There was also wide variability in the year of ages reported, as evident through the large standard deviation. This meant that for some children, the reported experience of one type of violence occurred during two distinct developmental time periods (eg, very early childhood versus early childhood). For these reasons, we decided not to adjust for physical violence when examining the effects of sexual violence and vice versa.

Descriptive statistics reporting the distribution of covariates by mean age at exposure to violence and by developmental timing of violence exposure are presented in Table S1.

## SUPPLEMENT 2

### Missingness

The current analytic sample included participants with complete exposure and outcome data assessed at child age 10 years. Among children with complete exposure and outcome data at age 10, covariate missingness levels were as follows: maternal education = 5.74%; income = 19.43%; race/ethnicity = 1.03%; marital status = 6.22%; and maternal psychopathology = 23.0%. All other covariates were complete in the analytical dataset.

Children included in our analytic sample ( $n = 4,580$ ) differed significantly from those children who were excluded ( $n = 5,321$ ; 53.7% of the original cohort of  $n = 9,901$ ). Specifically, children in the excluded sample were more likely to be male (51.8% versus 49.3%;  $p = .01$ ), slightly older (mean age 10.0 versus 9.8 at age 10 wave;  $p < .0001$ ), of non-Dutch, non-European descent (58.3% versus 33.6%;  $p < .0001$ ), residing in families with low household incomes (39.2% versus 14.8%;  $p < .0001$ ), and with parents who had less than a high school education (37.9% versus 15.0%;  $p < .0001$ ).

We were also able to examine the distribution of exposure to violence among children who were excluded from the analytic sample due to missing outcome information or unreliably reported data, but who had violence exposure information available. We found that children who were excluded from our analysis experienced more physical violence (19.6% versus

16.0%;  $p = .005$ ) compared to the analytic sample ( $N = 4,580$ ). Children who were excluded from our analysis also had slightly higher age of exposure to physical violence compared to the analytic sample (mean age 7.6 versus 7.4;  $p < .0001$ ). There were no differences between the analytic sample and excluded sample with respect to exposure to sexual violence ( $p > .05$ ).

Similarly, we were also able to examine the distribution of psychopathology symptoms among children who were excluded from the analytic sample due to missing exposure or unreliable data but had complete CBCL information at age 10 ( $n = 341$ ). We found that children excluded from the analysis had higher CBCL scores (mean internalizing score 5.40 versus 4.73;  $p < .0001$ ; mean externalizing scores 4.59 versus 3.85;  $p < 0.0001$ ) compared to the analytic sample ( $N = 4,580$ ).

Taken together, these findings suggest that children excluded from the analytic sample tended to have more physical violence exposure and higher internalizing and externalizing scores, suggesting that our results may be underestimating associations.

### Multiple Imputation

To reduce bias and minimize loss of power due to missingness, we imputed missing covariate data prior to analysis using the MI and MIANALYZE procedures in SAS.<sup>4</sup> Only covariates with missingness were imputed (ie, race/ethnicity, maternal education, marital status and income). The following variables were allowed to enter the imputation model: all exposures (ie, exposure to physical violence, exposure to sexual violence, age of exposure to physical violence, age of exposure to sexual violence) and all covariates (ie, race/ethnicity, maternal education, marital status, income, sex, gestational age, and maternal psychopathology symptoms).

For each imputed variable, the predictors included: 1) variables that were correlated with the imputed variable, and 2) variables that were correlated with the probability of observing this imputed variable. The threshold of the absolute Pearson coefficient was set to be 0.05. For the analyses, we performed multiple Poisson regression with robust variance estimates on 25 datasets and calculated the pooled effect estimates (regression coefficients) across the datasets. The CIs and the  $p$  values of the pooled estimates were obtained following Rubin's rules, accounting for the variance within as well as between the imputed datasets.<sup>5</sup>

## RESULTS

Results for all of the two-way comparisons tested using the Tukey post hoc comparison are presented in Table S2.

Primary models excluding the 8.3% ( $n = 297$ ) of children with mothers who had severe psychological distress (analysis performed on  $n = 4,201$  children) are presented in Table S3.

**TABLE S1** Distribution of Baseline Covariates by Age at Exposure to Violence in the Generation R Analytic Sample (N = 4,580)

Covariates	Exposed to Physical Violence (n = 732)					p	Exposed to Sexual Violence (n = 211)					p
	Mean Age (SD)	Very Early (age 0–3) n = 31 (4.2%)	Early (age 4–5) n = 66 (9.0%)	Middle (age 6–7) n = 196 (26.8%)	Late (age 8+) n = 439 (60.0%)		Mean Age (SD)	Very Early (age 0–3) n = 13 (6.2%)	Early (age 4–5) n = 43 (20.4%)	Middle (age 6–7) n = 58 (27.5%)	Late (age 8+) n = 97 (46.0%)	
Sex												
Male	7.48 (1.7)	18 (58.1)	45 (68.2)	122 (62.2)	297 (67.7)	<.0001	6.65 (1.8)	3 (23.1)	19 (44.2)	23 (39.7)	30 (30.9)	.0005
Female	7.31 (1.8)	13 (41.9)	21 (31.8)	74 (37.8)	142 (32.4)		6.96 (2.2)	10 (76.9)	24 (55.8)	35 (60.3)	67 (69.1)	
Race/Ethnicity												
Dutch	7.47 (1.8)	16 (51.6)	42 (65.6)	125 (63.8)	270 (61.9)	.113	6.52 (2.4)	5 (41.7)	25 (59.5)	35 (61.4)	63 (65.6)	.353
Non-Dutch European	7.44 (1.7)	4 (12.9)	5 (7.8)	15 (7.7)	28 (7.9)		7.02 (1.9)	1 (8.3)	4 (9.5)	6 (10.5)	12 (12.5)	
Non-Dutch Non-European	7.11 (1.9)	11 (35.5)	17 (26.6)	56 (28.6)	138 (31.7)		7.04 (1.8)	6 (50.0)	13 (31.0)	16 (28.1)	21 (21.9)	
Maternal Education												
High	7.28 (1.8)	9 (31.0)	13 (22.0)	42 (22.5)	88 (20.9)	<.0001	6.98 (1.9)	3 (33.3)	7 (18.0)	13 (25.0)	22 (24.4)	.088
Mid-High	7.71 (1.6)	4 (13.8)	10 (17.0)	40 (21.4)	113 (26.8)		6.98 (1.8)	0 (0)	13 (33.3)	10 (19.2)	21 (23.3)	
Mid-Low	7.37 (1.8)	11 (27.9)	22 (37.3)	70 (37.4)	141 (33.5)		6.89 (2.0)	2 (22.2)	14 (35.9)	22 (42.3)	28 (31.1)	
Low	7.44 (1.7)	5 (17.2)	14 (23.7)	35 (18.7)	79 (14.2)		7.03 (2.4)	4 (44.4)	5 (12.8)	7 (13.5)	19 (21.1)	
Household Income Level												
High	7.55 (1.6)	9 (37.5)	29 (59.2)	87 (56.9)	209 (59.2)	.0001	7.26 (1.6)	2 (50.0)	13 (43.3)	30 (60.0)	45 (57.0)	.137
Middle	7.38 (1.9)	6 (25.0)	13 (26.5)	37 (24.2)	82 (23.2)		7.07 (1.9)	1 (25.0)	9 (30.0)	11 (22.0)	20 (25.3)	
Low	7.21 (1.9)	9 (37.5)	7 (14.3)	29 (19.0)	62 (17.6)		6.78 (1.8)	1 (25.0)	8 (26.7)	9 (18.0)	14 (17.7)	
Maternal Marital Status												
Married	7.55 (1.7)	10 (34.5)	23 (27.7)	82 (44.3)	185 (43.9)	<.0001	7.11 (2.0)	4 (50.0)	15 (40.5)	21 (39.6)	47 (52.2)	.0001
Living Together	7.44 (1.7)	9 (31.0)	28 (45.9)	79 (42.7)	178 (42.3)		6.98 (1.7)	1 (12.5)	14 (37.8)	21 (39.6)	27 (30.0)	
No Partner	7.11 (2.1)	10 (24.5)	10 (16.4)	24 (13.0)	58 (13.8)		6.76 (2.4)	3 (37.5)	8 (21.6)	11 (20.8)	16 (17.8)	
Gestational Birth Status												
Full Term	7.43 (1.8)	30 (96.8)	62 (93.9)	183 (93.4)	419 (95.4)	.337	6.80 (2.0)	11 (84.6)	42 (97.7)	56 (96.6)	85 (87.6)	.067
Pre-Term	7.37 (1.5)	1 (3.2)	4 (6.1)	13 (6.6)	20 (4.6)		7.35 (2.5)	2 (15.4)	1 (2.3)	2 (3.5)	12 (12.4)	
Maternal Psychopathology												
Absent	7.45 (1.7)	25 (80.7)	53 (80.3)	168 (85.7)	378 (86.1)	<.0001	6.81 (2.1)	12 (92.3)	35 (81.4)	53 (91.4)	80 (82.5)	.002
Present	7.25 (1.9)	6 (19.4)	13 (19.7)	28 (14.3)	61 (13.9)		7.06 (2.3)	1 (7.7)	8 (18.6)	5 (8.6)	17 (17.5)	

**Note:** Descriptive statistics are presented for the analytic sample without imputation. Simple linear regressions were performed for each covariate by each age at violence exposure with p values reported. Maternal education: High (University), Mid-high (Some higher education), Mid-low (Secondary), Low (Primary/some secondary). Household income level: High (>2,200 Euros/mo), Middle (1,400–2,200 Euros/mo), Low (<1,400 Euros/mo). Maternal psychopathology was assessed using a global severity score of psychological distress reported at the time of the child's birth; presence was defined as the top 90th percentile, whereas absence was defined as anything lower.

**TABLE S2** Tukey Post Hoc Comparison p Values for Timing of Physical and Sexual Violence Exposure on Internalizing and Externalizing Symptoms

	Internalizing Symptoms			Externalizing Symptoms				
		Early	Middle	Late	Early	Middle	Late	
Physical Violence	Very Early Childhood	0.675	0.574	0.393	Very Early Childhood	0.061	0.003	0.005
	Early Childhood	—	0.295	0.174	Early Childhood	—	0.420	0.652
	Middle Childhood	—	—	0.696	Middle Childhood	—	—	0.532
	Late Childhood	—	—	—	Late Childhood	—	—	—
Sexual Violence	Very Early Childhood	0.908	0.764	0.487	Very Early Childhood	0.014	0.004	0.001
	Early Childhood	—	0.800	0.400	Early Childhood	—	0.930	0.813
	Middle Childhood	—	—	0.477	Middle Childhood	—	—	0.885
	Late Childhood	—	—	—	Late Childhood	—	—	—

**Note:** p values from post hoc Tukey pairwise comparisons from primary analytic models are presented. p values indicate significant differences between the effects of timing of violence exposure on internalizing and externalizing symptoms, all relative to unexposed (eg, effect of physical violence in very early childhood relative to unexposed on externalizing symptoms is significantly different from the effect of physical violence in middle childhood relative to unexposed on externalizing symptoms,  $p = .003$ ). Tukey p values correct for multiple comparisons.

**TABLE S3** Association Between Violence Exposure and the Timing of Exposure to Violence on Child Psychopathology Scores at Age 10 Years, Excluding Mothers With High Psychological Distress ( $n = 4,201$ )

	Internalizing Symptoms			Externalizing Symptoms		
	RR	95% CI	Homogeneity p	RR	95% CI	Homogeneity p
<b>Physical Violence</b>						
Ever exposed	1.44*	(1.33, 1.56)		1.47*	(1.34, 1.62)	
Timing of Physical Violence			<.0001			<.0001
Very Early Childhood	1.88*	(1.58, 2.23)		2.51*	(1.90, 3.32)	
Early Childhood	1.72*	(1.31, 2.25)		1.54* <sup>a</sup>	(1.14, 2.09)	
Middle Childhood	1.44* <sup>a</sup>	(1.25, 1.66)		1.42* <sup>a</sup>	(1.22, 1.66)	
Late Childhood	1.36* <sup>a</sup>	(1.24, 1.51)		1.42* <sup>a</sup>	(1.25, 1.60)	
<b>Sexual Violence</b>						
Ever Exposed	1.25*	(1.10, 1.42)		1.19*	(1.01, 1.40)	
Timing of Sexual Abuse			.048			.237
Very Early Childhood	1.42	(0.89, 2.28)		2.44*	(1.49, 3.98)	
Early Childhood	1.30	(0.96, 1.76)		1.05 <sup>a</sup>	(0.70, 1.57)	
Middle Childhood	1.28*	(1.03, 1.58)		1.10 <sup>a</sup>	(0.81, 1.48)	
Late Childhood	1.18	(0.98, 1.43)		1.13 <sup>a</sup>	(0.91, 1.41)	

**Note:** Risk ratios and 95% CIs are shown. Poisson regression models with robust standard errors are adjusted for household income, maternal education, race/ethnicity, sex, maternal marital status, gestational birth status, and maternal psychopathology. The reference group for all models is unexposed, making each effect estimate an indicator of the effect of being exposed (at any time period or at a certain time period) relative to being never exposed. After tests of homogeneity, for which p values are shown, post hoc Tukey pairwise comparisons were estimated. Significant differences are shown using superscript letters as detailed below. Tukey pairwise comparisons may be nonsignificant even in cases of significant tests of homogeneity, as tests of homogeneity assess global differences across groups rather than two-way comparisons, and Tukey p values are adjusted for multiple comparisons. RR = risk ratio

<sup>a</sup>Significantly different from very early childhood based on post-hoc Tukey test.

\* $p < .05$ .

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