

PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Child Abuse and Neglect and Cognitive Function at 14 Years of Age: Findings From a Birth Cohort

Ryan Mills, Rosa Alati, Michael O'Callaghan, Jake M. Najman, Gail M. Williams, William Bor and Lane Strathearn

Pediatrics 2011;127;4; originally published online December 6, 2010;

DOI: 10.1542/peds.2009-3479

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/127/1/4.full.html>

PEDIATRICS is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. PEDIATRICS is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2011 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0031-4005. Online ISSN: 1098-4275.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



Child Abuse and Neglect and Cognitive Function at 14 Years of Age: Findings From a Birth Cohort



WHAT'S KNOWN ON THIS SUBJECT: Child abuse and neglect are associated with a range of adverse outcomes including reduced academic performance.



WHAT THIS STUDY ADDS: Both abuse and neglect are independently associated with reduced cognitive performance at 14 years of age. We used prospective follow-up of a birth cohort, independent recording of child-maltreatment reports and substantiation, and adjustment for multiple potential confounders.

abstract

OBJECTIVE: To examine the association between child maltreatment (abuse and neglect) and long-term cognitive outcomes within a prospective birth cohort.

METHODS: A birth cohort of 7223 children was recruited. Independent reports of suspected child maltreatment were confidentially linked to the longitudinal study database. The principal predictor variable was notification to the state child-protection authority for suspected maltreatment (abuse, neglect, or both). The outcome variables were scores on the Wide Range Achievement Test (WRAT) reading test and Raven's Standard Progressive Matrices (RSPM), completed at 14 years of age. Multivariate regression analysis was used to adjust for potential confounders.

RESULTS: A total of 3796 subjects completed either the WRAT or RSPM. There was a higher loss to follow-up among children who had been reported to the state as suspected victims of maltreatment. After controlling for a range of possible confounders and modifiers, notification to the state for child maltreatment (abuse, neglect, or both) was associated with a lower score on both the WRAT (mean difference: -4.4 when the SD is 15 [95% confidence interval: -6.3 to -2.5]) and RSPM (mean difference: -4.8 when the SD is 15 [95% confidence interval: -6.7 to -2.9]). Both reported abuse and neglect were independently associated with lower reading ability and perceptual reasoning.

CONCLUSIONS: Both child abuse and child neglect are independently associated with impaired cognition and academic functioning in adolescence. These findings suggest that both abuse and neglect have independent and important adverse effects on a child's cognitive development. *Pediatrics* 2011;127:4–10

AUTHORS: Ryan Mills, FRACP, MPH,^{a,b} Rosa Alati, PhD,^{a,c} Michael O'Callaghan, FRACP, MD,^{a,d} Jake M. Najman, PhD,^{c,e} Gail M. Williams, PhD,^c William Bor, FRANZP,^{a,f} and Lane Strathearn, FRACP, PhD^g

^aSchools of Medicine, ^cPopulation Health, and ^eSocial Science, University of Queensland, Queensland, Australia; ^bDepartment of Paediatrics, Logan Hospital, Queensland, Australia; ^dDepartment of Developmental Paediatrics, and ^fChild and Youth Mental Health, Mater Children's Hospital, South Brisbane, Queensland, Australia; and ^gMeyer Center for Developmental Pediatrics, Baylor College of Medicine, Texas Children's Hospital, Houston, Texas

KEY WORDS

neglect, abuse, developmental outcomes, cognitive function, longitudinal study

ABBREVIATIONS

WRAT—Wide Range Achievement Test

RSPM—Raven's Standard Progressive Matrices

www.pediatrics.org/cgi/doi/10.1542/peds.2009-3479

doi:10.1542/peds.2009-3479

Accepted for publication Sep 14, 2010

Address correspondence to Ryan Mills, FRACP, MPH, Department of Paediatrics, Logan Hospital, PO Box 4096, Loganholme DC 4129, Australia. E-mail: ryan_mills@health.qld.gov.au

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2011 by the American Academy of Pediatrics

FINANCIAL DISCLOSURE: *The authors have indicated they have no financial relationships relevant to this article to disclose.*

Research evidence spanning several decades has shown that adverse experiences early in life may have a significant effect on subsequent brain growth and development.¹ Child abuse and neglect have long been considered to have a profound influence on the development of a child.^{2,3}

There has been considerable interest in investigating adverse outcomes associated with child abuse, particularly physical and sexual abuse.^{4–7} In comparison, child neglect has suffered from a relative paucity of research and community interest.⁸ Child neglect accounts for more than half of the substantiated cases of maltreatment in the United States; the lifetime prevalence is ~6%.^{9,10} The consequences of child neglect, as with child maltreatment in general, are considered to be wide ranging and include social, behavioral, academic, medical, and cognitive outcomes.^{11,12}

A number of studies have revealed lower educational attainment or performance on standardized tests by abused or neglected children when compared with nonmaltreated peers.² Often, the apparent associations between abuse or neglect and educational failure seem to be explained by social, familial, and personal confounders.^{13–15} However, many studies have shown a persistent association between abuse or neglect and adverse educational or cognitive outcome after adjustment for potential confounders (eg, see refs¹⁶ and ^{17–20}).

Of the authors cited above, only Eckenrode et al¹⁹ attempted to identify a specific association between child neglect and cognitive or academic outcome. The remainder either combined abused and neglected children into a single group^{15–18,20} or studied only physical¹⁴ or physical and sexual¹³ abuse.

A study by Strathearn et al²¹ was unique in that they used a combination

of prospective longitudinal follow-up data from birth, third-party (government agency) substantiation of child neglect, and standardized assessment of cognitive outcome. The authors found that after adjustment for perinatal and parental risk factors, child neglect was significantly associated with poorer cognitive outcomes (according to Peabody test scores at 5 years of age) in extremely low birth weight infants (<1000 g). Given that this was a smaller cohort with specific medical problems (extremely low birth weight), the purpose of our study was to apply a similar strong methodology to assess the cognitive and academic outcomes of abused and neglected young people in a large population-based birth cohort in Brisbane, Australia.

As identified previously,^{13,22} the ideal method for assessing the outcomes of child maltreatment involves a population-based longitudinal sample with prospective assessment of child maltreatment and adjustment for relevant social and familial factors. The methodology of our study and its precursor²¹ was aimed at fulfilling these goals.

We hypothesized that children who were reported as suspected cases of maltreatment (any maltreatment and abuse or neglect independently) to the state child-protection authorities would have lower scores on standardized tests of cognitive and academic function at the age of 14 years compared with those who had not been maltreated. The basis for testing the associations for abuse and neglect separately, and together, was that neglect has received relatively less attention in the literature to date, and the need for research examining the types of maltreatment has been well recognized.^{8,22} In addition, results of studies of anatomic brain development in both human and animal subjects who were deprived of sensory stimulation in

early life suggest the biological plausibility of a causative association between child neglect and adverse cognitive outcome.²³

METHODS

Subjects

The Mater University Study of Pregnancy is a longitudinal birth-cohort study comprising 7223 mothers who had enrolled in the study at their first antenatal visit (mean: 18 weeks' gestation) between January 1981 and December 1983. All mothers in the cohort delivered live, singleton infants at the Mater Misericordiae Mothers' Hospital. At the first antenatal visit, detailed data were collected about the mother's sociodemographic, medical, and psychological characteristics.

Additional maternal questionnaires were completed 3 to 5 days after delivery and when the children were aged 6 months, 5 years, and 14 years. The young people themselves (~70% of cohort) completed the Achenbach Youth Self-report at 14 years of age. The young people were also administered the Wide Range Achievement Test (WRAT) reading test and Raven's Standard Progressive Matrices (RSPM) at 14 years of age. A smaller proportion (52%) of the total cohort completed these tests, because this part of the study required attendance in person to the testing site (Fig 1).

Maltreatment Data Collection

Reports of suspected child maltreatment between 1981 and September 2000 were collected from the Department of Families, Youth, and Community Care, Queensland. These data included the date of notification, the types of harm reported or substantiated on formal investigation, and the relationship of the perpetrator(s) to the child.

Maltreatment report data were confidentially linked to the Mater University

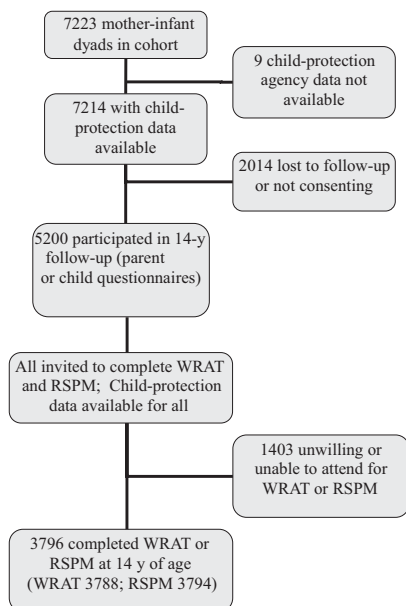


FIGURE 1
Flow of patients through the Mater University Study of Pregnancy.

Study of Pregnancy survey database, as previously described.²⁴ The study was given ethical approval from the Mater Children’s Hospital and Mater Mothers’ Hospital ethical review committees and the University of Queensland Behavioral and Social Sciences’ ethical review committee.

Child-Maltreatment Predictor Variables

The predictor variable of interest in this study was the occurrence of at least 1 episode of notification to the state child-protection authority, with or without a substantiated outcome, of child abuse or neglect. No exclusions were made from analysis on the basis of the age of the child at the time of first notification to the state because of what was considered to be a high probability that children whose cases were reported to the state at a relatively late age (eg, 15 or 16 years) were likely to have experienced unreported abuse or neglect at younger ages. The analysis also was performed by using substantiated outcome of abuse or neglect as the predictor variable.

Other Predictor Variables

On the basis of the literature and the availability of data, 18 variables from the Mater University Study of Pregnancy were selected for analysis in this study as possible confounders or mediators of any observed association between child abuse or neglect and cognitive outcome. These variables are listed in Table 1.

In relation to maternal smoking during pregnancy, the category “heavy smoker” corresponded to smoking more than 20 cigarettes per day, on average, as assessed at the first antenatal visit. Binge-drinking was defined as having 5 or more glasses of alcohol in 1 episode; subjects were categorized as never binge-drinking, occasionally binge-drinking, or binge-drinking on more than half of drinking occasions.

The mother’s attitude to the pregnancy was assessed at baseline. The variable used in this study was a composite scale derived from 4 questions asked of the mother about whether she had planned to become pregnant or avoid pregnancy, whether she had wanted to get pregnant at that time, and whether there had been a failure of contraception. The responses were categorized into 1 of 3 groups: planned/wanted; unsure; and unplanned/unwanted. Maternal anxiety and depression were assessed by using maternal responses to the short form of the Delusions-Symptoms-States Inventory.²⁵

Infant-related variables included gender, birth weight z score, prematurity (ie, <37 weeks’ completed gestation at birth), and the occurrence of neonatal complications as measured by admission to the NICU. Birth weight z score, based on SD and adjusted for age and gender, was calculated with relation to 1990 Child Growth Foundation (United Kingdom) data. The corresponding birth weight for male subjects of 40 weeks’ gestation with a z

score nearest to 0 was 3550 g, and for female subjects it was 3410 g.

At 6 months of age, the duration of breastfeeding was recorded. A variable based on the number of infant medical symptoms, as reported by the mother at 6 months, also was included in the analysis. The list included symptoms, such as colic, sleeplessness, vomiting, and feeding problems, that were considered from the researchers’ clinical experience to be relevant to the relative ease or difficulty of caring for the infant.

Outcome Variables

The 14-year outcomes were based on 2 tests. The WRAT is a measure of reading, spelling, and arithmetic computation. For this study, only the reading component (from the third edition) was administered.²⁶ The RSPM is a set of 60 multiple-choice exercises that tested abstract reasoning. We used the timed version of the test, with the 1986 Australian norms.²⁷ The scores of both tests were standardized to a mean of 100 and an SD of 15.

Statistics

The 18 potential confounding or mediating variables were evaluated for the presence of an association with reported child abuse or neglect. Separately, an association was sought with each measure of performance (WRAT and RSPM) on standardized testing at the age of 14. Separate multivariate models were constructed for the WRAT and RSPM, including the type of maltreatment (any maltreatment, abuse, or neglect), gender, and each variable that was significantly ($P < .05$) associated with both maltreatment status and the WRAT or RSPM. The models for the WRAT and RSPM were not necessarily the same, depending on which of the 18 variables were associated with each. In addition, in the models for abuse and neglect, each was corrected

for the presence of the other (abuse or neglect) to ascertain the relative importance of each as an independent predictor of the outcomes. A test for interaction between abuse and neglect, with adjustment for confounders and modifiers, also was performed.

The χ^2 test was used to assess the statistical significance of differences in categorical variables, and the *t* test was used for continuous outcome variables. The effect of potential confounding variables was assessed by using multiple linear regression. A 2-tailed *P* value of $<.05$ was considered statistically significant. Statistical analyses were performed by using Stata 10 (Stata Corp, College Station, TX).

RESULTS

Of 7223 mother-and-child dyads in the original cohort, the statutory agency child-protection history was able to be ascertained for 7214 subjects. For 8 pairs, there was insufficient demographic data to positively identify the child-protection record. One additional subject was inadvertently omitted from the child-protection search. Eight hundred thirty-three participants, or 11.5% of the cohort, had been the subject of a report of suspected child maltreatment to the Department of Families, Youth, and Community Care; of these reports, 44 were only in the form of telephone intake and did not meet the threshold for investigation, which left 789 participants (10.9%) who were formally reported to the state as suspected cases of maltreatment, and the investigation was initiated. The total proportion of the cohort who experienced at least 1 substantiated notification for maltreatment was 7.0% (506 subjects).

Figure 1 illustrates the flow of subjects through the study. Of 7223 subjects in the cohort, 3796 (53%) completed either the WRAT or RSPM at the age of 14, of whom 3784 (52%) completed both.

TABLE 1 Characteristics of the Cohort, According to Completion of Either the WRAT or RSPM at the 14-Year Follow-up

Characteristic	<i>n</i> (<i>N</i> = 7214)	Not Completed, %		Agency Notified, %	
		χ^2 , <i>P</i>	χ^2 , <i>P</i>		
Maltreatment notification					
No notifications	6425	45.6	—	0	—
Any notification	789	62.2	78.4, $<.001$	100.0	NS
Abuse notification	663	61.1	—	100.0	—
Neglect notification	500	69.6	—	100.0	—
Maternal age in pregnancy					
13–19 y	1178	57.6	—	20.0	—
20–34 y	5718	45.6	61.1, $<.001$	9.4	123.8, $<.001$
≥ 35 y	318	41.8	—	5.7	—
Marital status during pregnancy					
Married	5380	43.2	—	8.0	—
Single	735	56.5	155.0, $<.001$	21.1	201.9, $<.001$
Living together	843	62.2	—	18.0	—
Separated, divorced, widowed	193	63.2	—	23.8	—
Race					
White	6250	46.1	—	10.7	—
Asian	307	52.1	42.2, $<.001$	7.8	24.1, $<.001$
Aboriginal/TSI/Pacific	444	61.5	—	17.6	—
Other/NS	213	47.9	—	9.4	—
Unemployment in pregnancy					
Not unemployed	5803	44.2	115.1, $<.001$	8.6	153.2, $<.001$
Unemployed	1291	60.7	—	20.5	—
Family income (annual) before birth					
\$10 399 or less	2304	54.6	89.7, $<.001$	16.1	106.8, $<.001$
More than \$10 400	4436	42.5	—	7.9	—
Maternal education status in pregnancy					
Incomplete high school	1304	52.9	—	19.1	—
Completed high school	4601	47.2	30.5, $<.001$	10.0	132.8, $<.001$
Post-high school	1256	42.0	—	5.4	—
Maternal smoking in pregnancy					
Nonsmoker	4411	43.9	—	8.07	—
Smoker	2112	51.4	62.8, $<.001$	14.3	114.7, $<.001$
Heavy smoker	617	58.0	—	20.1	—
Maternal alcohol in pregnancy					
Abstainer	3596	49.4	—	12.3	—
Light	3449	44.9	20.3, $<.001$	9.1	47.4, $<.001$
≥ 1 per d	107	58.9	—	27.1	—
Maternal binge-drinking in pregnancy					
Never	5614	46.4	—	10.2	—
Occasional	1284	48.8	16.2, $<.001$	11.6	38.5, $<.001$
More than half	229	59.4	—	23.1	—
Attitude to pregnancy at first clinic visit					
Unplanned/unwanted	1369	46.3	—	10.1	—
Unsure	1844	53.0	31.7, $<.001$	15.1	45.4, $<.001$
Planned/wanted	3826	45.1	—	9.3	—
Maternal anxiety in pregnancy					
Not anxious	6097	46.1	32.8, $<.001$	9.8	63.0, $<.001$
Anxious	922	56.2	—	18.6	—
Maternal depression in pregnancy					
Not depressed	6621	46.7	23.7, $<.001$	10.3	50.2, $<.001$
Depressed	408	59.1	—	21.6	—
Infant gender					
Male	3755	47.4	0.00, .96	10.1	5.4, .02
Female	3459	47.4	—	11.8	—
Birth weight z score					
<10 th centile	723	52.3	7.7, .005	15.1	14.1, $<.001$
≥ 10 th centile	6490	46.8	—	10.5	—
Prematurity					
Term	6919	47.4	0.07, .79	10.8	1.6, .20
Preterm	295	48.1	—	13.2	—

TABLE 1 Continued

Characteristic	n (N = 7214)	Not Completed, %		Agency Notified, %	
		χ^2	P	χ^2	P
NICU admission					
No NICU	6696	47.3	0.08, .78	10.6	10.1, .002
NICU	515	48.0	—	15.2	—
Breastfeeding					
Not at all	1437	51.6	—	14.6	—
<4 mo	2598	47.2	70.4, <.001	11.7	87.5, <.001
≥ 4 mo	2624	38.8	—	6.0	—
Infant medical symptoms					
0–3 symptoms	5683	44.7	—	9.6	—
4 symptoms	501	45.3	0.42, .81	13.8	11.2, .004
≥5 symptoms	450	46.2	—	12.2	—

TSI indicates Torres Strait Islander; NS, not stated.

Table 1 compares the characteristics of those in the cohort who completed 1 or both of these tests with those who completed neither. It can be seen in Table 1 that the loss to follow-up of children who had been reported to the state as suspected cases of abuse or neglect was disproportionately high. This association was evident for almost all of the markers of socioeconomic disadvantage tested. Table 1 also lists the characteristics of the subjects in relation to notification for suspected maltreatment; every predictor variable except prematurity was associated with agency notification.

In the cohort of children who completed the WRAT or RSPM (n = 3796), the number of subjects with a history

of agency notification for abuse or neglect was 298 (7.9%). Two hundred fifty-eight (6.8%) subjects' cases were reported for suspected abuse (physical, emotional, or sexual), and 152 (4.0%) were reported for suspected neglect. Of these subjects, 113 (3.0% of remaining cohort) were reported because of both abuse and neglect. Most (157 [53%]) of the children's cases had been reported to the state (and investigation initiated) on only 1 occasion. The maximum number of child-protection notifications was 17. Eighty-nine (30%) participants' cases were reported to the state for the first time before 5 years of age, and a total of 244 (82%) had been reported to the state by the time of the 14-year follow-up.

The identity of the alleged perpetrator(s) was available for the substantiated cases only (186 of 298 reported subjects [62%]): the mother alone was listed for 50 (27%); the father alone was listed for 37 (20%); both parents were listed for 19 (10%); the mother's partner/stepfather alone was listed for 12 (6%); and combinations of parents, stepparents, and others were listed for the remainder of the subjects.

Univariate analyses were performed to assess associations between the 18 maternal and infant factors and the WRAT and RSPM (data not shown). The potential confounders and modifiers that were associated with these outcomes, and therefore used in the final models, are listed in Table 2.

Table 2 lists the unadjusted and adjusted associations between both notification and substantiation for any maltreatment, abuse and neglect independently, and WRAT and RSPM scores at the age of 14 years. When compared with the nonmaltreated peers, both the WRAT and RSPM scores were significantly lower for the children who had been reported to the state because of any maltreatment and because of both abuse and neglect independently.

TABLE 2 Differences in Outcome for the WRAT and RSPM at 14 Years of Age, According to Child-Protection Notification and Substantiation of Outcome

	WRAT		RSPM	
	Unadjusted Difference (95% CI) (N = 3787)	Adjusted Difference (95% CI) (N = 3402) ^a	Unadjusted Difference (95% CI) (N = 3793)	Adjusted Difference (95% CI) (N = 3345) ^b
No notification	0.00	0.00	0.00	0.00
Any notification	-6.2 (-7.9 to -4.4)	-4.4 (-6.3 to -2.5)	-6.8 (-8.5 to -5.0)	-4.8 (-6.7 to -2.9)
Neglect ^c	-7.2 (-9.6 to -4.8)	-5.1 (-7.7 to -2.4)	-9.4 (-11.8 to -7.0)	-4.1 (-7.2 to -1.0)
Abuse ^d	-6.3 (-8.2 to -4.4)	-4.3 (-6.3 to -2.3)	-7.2 (-9.1 to -5.3)	-3.4 (-5.8 to -1.0)
No substantiation	0.00	0.00	0.00	0.00
Any substantiation	-7.0 (-9.2 to -4.8)	-5.3 (-7.6 to -2.9)	-7.0 (-9.2 to -4.8)	-4.3 (-6.6 to -2.0)
Neglect ^c	-9.2 (-12.7 to -5.8)	-4.4 (-8.5 to -0.4)	-11.5 (-14.9 to -8.1)	-5.7 (-9.7 to -1.7)
Abuse ^d	-7.2 (-9.5 to -4.8)	-4.3 (-7.0 to -1.5)	-7.4 (-9.7 to -5.1)	-3.1 (-5.8 to -0.4)

One SD of both WRAT and RSPM is 15. CI indicates confidence interval.

^a Variables in the adjusted model for WRAT were maternal age, marital status, maternal education level, race, family income, infant gender, birth weight z score, alcohol use, NICU admission, breastfeeding, and infant medical symptoms (not unemployment, smoking, binge-drinking, anxiety, depression, attitude to pregnancy, or prematurity).

^b Variables in the adjusted model for RSPM were maternal age, marital status, maternal education level, race, unemployment, family income, infant gender, birth weight z score, smoking, alcohol use, binge-drinking, maternal depression, NICU admission, and breastfeeding (not anxiety, attitude to pregnancy, infant medical symptoms, or prematurity).

^c Adjusted model also included abuse.

^d Adjusted model also included neglect.

For example, notification of any child maltreatment (abuse, neglect, or both) was associated with a significantly lower score on both reading ability (WRAT) (mean difference: -4.4 when the SD is 15 [95% confidence interval: -6.3 to -2.5]) and perceptual reasoning (RSPM) (mean difference: -4.8 when the SD is 15 [95% confidence interval: -6.7 to -2.9]) tests. As seen in Table 2, the results were similar when the analysis was conducted by using only substantiated abuse or neglect as the predictor. The magnitude of association was similar between the abuse and neglect groups, which were not mutually exclusive but in each analysis were adjusted for the presence of the other maltreatment type. To identify any interaction between abuse and neglect, an additional analysis was conducted by using an interaction variable. For both outcomes (WRAT and RSPM) and for both notification and substantiation, the interaction variable was not statistically significant.

DISCUSSION

Using data from a large, population-based birth cohort study, we found that on measures of literacy (WRAT reading score) and abstract reasoning (RSPM), the sample of young people who had experienced notification to the state or substantiation of child maltreatment had scores of approximately one-third of an SD lower than those who had not been maltreated, after adjustment for a range of potentially confounding or modifying variables. The effects of abuse and neglect were found to be independent and quantitatively similar; children who experienced both abuse and neglect were doubly affected.

There are a number of important strengths of this study. It was based on a large, population-based longitudinal study and included independent and prospective documentation of sus-

pected (reported) and substantiated child abuse and neglect. Comprehensive data were available to adjust for potential confounders and modifiers. Furthermore, objective, standardized assessment tools were used to measure cognitive outcomes.

The ability to distinguish between the effects of different types of child maltreatment has been hindered by the fact that studies have repeatedly demonstrated that at least half of maltreated children experience more than 1 type of abuse or neglect.^{28,29} Our sample was no different; 74% of the children reported to the state as suspected cases of neglect also had been reported as suspected victims of abuse. Recent studies^{28,30} have tried to find a balance between identifying patterns of maltreatment while acknowledging the large concurrence of types of abuse and neglect.

Our method involved grouping the abuse cases (physical, emotional, and sexual abuse) together and assessing both abuse and neglect (reported or substantiated) as independent nonexclusive predictor variables. The results support the notion that child neglect has developmental effects that are independently at least as deleterious as abuse, which has important implications for the allocation of resources into additional research into, and prevention of, child neglect.

In this cohort, the subjects who were lost to follow-up were consistently of more adverse socioeconomic background than those who were tested at the age of 14 and at the same time were more likely to have been reported as cases of abuse or neglect. Therefore, the possibility of attrition bias exists. However, any effect of attrition on our outcomes would be more likely to decrease the strength of the apparent association between maltreatment and cognitive outcome. Therefore, there is good reason to be-

lieve that, if anything, our results underestimate the association between child maltreatment and adverse cognitive outcome.

Our results further inform the debate about whether child maltreatment cases in research can be sufficiently defined by government agency notification, without the need for full investigation and substantiation. Our data permitted the opportunity to conduct the entire analysis with both reported (ie, substantiated or unsubstantiated) and substantiated abuse and neglect. There were no significant differences in the outcomes when notification was used compared with the results when substantiation was used. In light of the study by Hussey et al³¹, the results of which indicated a lack of difference in outcome between children subject to unsubstantiated reports when compared with those whose cases were substantiated, our results lend additional support to the use of notification alone as a marker for exposure to maltreatment.

This study has provided additional strong evidence of the important developmental implications of child maltreatment. We found a significant cognitive disadvantage among children whose cases were reported or substantiated for abuse and neglect, which is likely to have consequences for a wide range of developmental outcomes as the young person enters adulthood. We also confirmed that the adverse cognitive outcome for maltreated children is similar with both abuse and neglect. Although continuing research will refine our knowledge of the consequences of child maltreatment, including neglect, the other great challenge is to identify interventions that can be shown to be effective in preventing child abuse and neglect and, thus, interrupt this trajectory of disadvantage.

CONCLUSIONS

There is a growing body of research that emphasizes the importance of child neglect in young people's long-term outcome, emotionally, cognitively, and aca-

REFERENCES

1. Committee on Integrating the Sciences of Early Childhood Development. The developing brain. In: Shonkoff JP, Phillips DA, eds. *From Neurons to Neighborhoods: The Science of Early Childhood Development*. Washington, DC: National Academy Press; 2000
2. Tanner JM, Taylor GR. *Growth*. New York, NY: Time Incorporated; 1965:58
3. American Academy of Pediatrics, Stirling J Jr; Committee on Child Abuse and Neglect and Section on Adoption and Foster Care; American Academy of Child and Adolescent Psychiatry, Amaya-Jackson L; National Center for Child Traumatic Stress, Amaya-Jackson L. Understanding the behavioral and emotional consequences of child abuse [published correction appears in *Pediatrics*. 2009;123(1):197]. *Pediatrics*. 2008; 122(3):667–673
4. Bergen HA, Martin G, Richardson AS, Allison S, Roeger L. Sexual abuse and suicidal behaviour: a model constructed from a large community sample of adolescents. *J Am Acad Child Adolesc Psychiatry*. 2003; 42(11):1301–1309
5. Conte JR, Schuerman JR. Factors associated with an increased impact of child sexual abuse. *Child Abuse Negl*. 1987;11(2): 201–211
6. Fergusson DM, Boden JM, Horwood LJ. Exposure to childhood sexual and physical abuse and adjustment in early adulthood. *Child Abuse Negl*. 2008;32(6):607–619
7. Keiley MK, Howe TR, Dodge KA, Bates JE, Pettit GS. The timing of child physical maltreatment: a cross-domain growth analysis of impact on adolescent externalizing and internalizing problems. *Dev Psychopathol*. 2001;13(4):891–912
8. Polonko KA. Exploring assumptions about child neglect in relation to the broader field of child maltreatment. *J Health Hum Serv Adm*. 2006;29(3):260–284
9. Theodore A, Runyan D, Chang JJ. Measuring the risk of physical neglect in a population-based sample. *Child Maltreat*. 2007;12(1):96–105
10. US Department of Health and Human Services. We found that both child abuse and child neglect were independently and strongly associated with lower cognitive functioning in adolescence after adjustment for potential confounders. This finding points to the need to find strategies to improve young people's cognitive outcomes and to diminish long-term consequences of childhood abuse and neglect.
11. Connell-Carrick K, Scannapieco M. Ecological correlates of neglect in infants and toddlers. *J Interpers Violence*. 2006;21(3):299–316
12. Trocme N, MacLauren B, Fallon B1, et al. *Canadian Incidence Study of Reported Child Abuse and Neglect: Final Report*. Ottawa, Ontario, Canada: Minister of Public Works and Government Services Canada; 2001
13. Boden JM, Horwood LJ, Fergusson DM. Exposure to childhood sexual and physical abuse and subsequent educational achievement outcomes. *Child Abuse Negl*. 2007; 31(10):1101–1114
14. Lansford JE, Dodge KA, Pettit GS, Bates JE, Crozier J, Kaplow J. A 12-year prospective study of the long-term effects of early child physical maltreatment on psychological, behavioral, and academic problems in adolescence. *Arch Pediatr Adolesc Med*. 2002; 156(8):824–830
15. Nightingale NN, Walker EF. The impact of social class and parental maltreatment on the cognitive functioning of children. *J Fam Violence*. 1991;6(2):115–130
16. Kerr MA, Black MM, Krishnakumar A. Failure-to-thrive, maltreatment and the behavior and development of 6-year-old children from low-income, urban families: a cumulative risk model. *Child Abuse Negl*. 2000; 24(5):587–598
17. Perez CM, Widom CS. Childhood victimization and long-term intellectual and academic outcomes. *Child Abuse Negl*. 1994; 18(8):617–633
18. Leiter J, Johnsen MC. Child maltreatment and school performance declines: an event-history analysis. *Am Educ Res J*. 1997;34: 563–589
19. Eckenrode J, Laird M, Doris J. School performance and disciplinary problems among abused and neglected children. *Dev Psychol*. 1993;29(1):53–62
20. Leiter J. School performance trajectories after the advent of reported maltreatment. *Child Youth Serv Rev*. 2007;29(3):363–382
21. Strathearn L, Gray P, O'Callaghan M, Wood DO. Childhood neglect and cognitive development in extremely low birth weight infants: a prospective study. *Pediatrics*. 2001;108(1):142–151
22. English DJ, Bangdiwala BM, Runyan D. The dimensions of maltreatment: introduction. *Child Abuse Negl*. 2005;29(5):441–460
23. Perry BD. Childhood experience and the expression of genetic potential: what childhood neglect tells us about nature and nurture. *Brain Mind*. 2002;3(1):79–100
24. Strathearn L, Mamun AA, Najman JM, O'Callaghan MJ. Does breastfeeding protect against substantiated child abuse and neglect? A 15-year cohort study. *Pediatrics*. 2009;123(2):483–493
25. Bedford A, Foulds G. *Delusions-Symptoms-States Inventory: State of Anxiety and Depression*. Berkshire, England: NEFR Publishing; 1978
26. Wilkinson GS. *Wide Range Achievement Test: Administration Manual*. 3rd ed. Wilmington, DE: Jastak; 1993
27. de Lemos MM. *Standard Progressive Matrices, Australian Manual*. Hawthorn, Victoria, Australia: Australian Council for Educational Research; 1989
28. Pears KC, Kim JE, Fisher PA. Psychosocial and cognitive functioning of children with specific profiles of maltreatment. *Child Abuse Negl*. 2008;32(10):958–971
29. Arata CM, Langhinrichsen-Rohling J, Bowers D, O'Brien N. Differential correlates of multi-type maltreatment among urban youth. *Child Abuse Negl*. 2007;31(4): 393–415
30. Lau AS, Leeb RT, English DJ, et al. What's in a name? A comparison of methods for classifying predominant type of maltreatment. *Child Abuse Negl*. 2005;29(5):533–551
31. Hussey JM, Marshall JM, English DJ, et al. Defining maltreatment according to substantiation: distinction without a difference? *Child Abuse Negl*. 2005;29(5): 479–492

Child Abuse and Neglect and Cognitive Function at 14 Years of Age: Findings From a Birth Cohort

Ryan Mills, Rosa Alati, Michael O'Callaghan, Jake M. Najman, Gail M. Williams, William Bor and Lane Strathearn

Pediatrics 2011;127;4; originally published online December 6, 2010;

DOI: 10.1542/peds.2009-3479

Updated Information & Services	including high resolution figures, can be found at: http://pediatrics.aappublications.org/content/127/1/4.full.html
References	This article cites 24 articles, 7 of which can be accessed free at: http://pediatrics.aappublications.org/content/127/1/4.full.html#ref-list-1
Subspecialty Collections	This article, along with others on similar topics, appears in the following collection(s): Office Practice http://pediatrics.aappublications.org/cgi/collection/office_practice
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: http://pediatrics.aappublications.org/site/misc/Permissions.xhtml
Reprints	Information about ordering reprints can be found online: http://pediatrics.aappublications.org/site/misc/reprints.xhtml

PEDIATRICS is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. PEDIATRICS is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2011 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0031-4005. Online ISSN: 1098-4275.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

