Adverse Childhood Experiences and School Readiness Among Preschool-Aged Children

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Objective To examine the association between preschool-aged children's exposure to adverse childhood experiences (ACEs) and multiple, intersecting domains of school readiness using a nationally representative sample.

Study design A sample of 15 402 preschool-aged children (3-5 years) in the US from the 3 most recent cohorts (2016-2018) of the National Survey of Children's Health were employed. Primary caregivers were asked survey questions about the adversities experienced by focal children. Four distinct domains of school readiness among the children were also derived from the survey: early learning skills, self-regulation, social-emotional development, and physical health and motor development.

Results Although nearly one-half of children who had not been exposed to ACEs were on-track across all domains, only 1 in 5 children exposed to 3 or more ACEs were on-track across all domains. Follow-up analyses identified parenting stress and reduced positive parenting practices as significant mediators of this association. Multivariate results also indicated that, regardless of the school readiness domain examined, an accumulation of ACEs increased the rate of items on which a child needs support or is at-risk.

Conclusions An accumulation of ACEs among preschool-aged children elevates risk within and across school readiness domains. These findings highlight the urgent need to identify best practices to reduce ACE exposure, as well as improve school readiness during early childhood. *(J Pediatr 2021;230:191-7)*.

Adverse childhood experiences (ACEs) have been linked to a host of deleterious outcomes in children, including poorer mental health, chronic health conditions, and inhibited social development,[1] as well as increased internalizing[2] and externalizing behaviors.[2-4] ACEs can also present challenges to school-related outcomes,[5-8] and can catalyze major school disruptions such as suspension and expulsion.[8] School readiness, defined as preschool-aged children entering school ready to learn,[9,10] is associated with better academic achievement during later stages of development,[11] which in turn can contribute to improved economic and health outcomes over the life-course.[12,13] The American Academy of Pediatrics (AAP) developed a School Readiness Framework for the purpose of improving children's ability to enter school primed to learn, as well as identifying those at greatest risk of not being ready to start school.[10] Although the connection between children's exposure to ACEs and a variety of adverse developmental outcomes is well-documented, scholars have yet to simultaneously examine the impact of preschool-aged children's exposure to ACEs on multiple domains of school readiness. This oversight is surprising, given the clear pattern in prior literature suggesting that exposure to ACEs among very young children can result in disruption of development.[14] Furthermore, research by Jimenez et al connecting ACEs to academic and literacy skills in kindergarten among an urban, at-risk sample, points to the possibility that ACEs may also interfere with intersecting domains of school readiness among preschool-aged children.[6] The lack of attention to comprehensive, multifaceted measures of school readiness in this body of literature overlooks the potential for risk factors across diverse domains of school readiness to operate synergistically in a manner that heightens vulnerability among preschool-aged children. The present study aims to provide new information about the broader constellation of school readiness deficits among the population of preschool-aged children in the US and the role that children's own exposure to ACEs may play in these deficits. We draw upon theories of human development (eg, Bronfenbrenner and Morris' Bioecological model) that not only examine children in context, but also account for proximal processes that regularly occur in the lives of young children, including parent-child interactions directed at learning new skills.[15,16]

We draw from a nationally representative sample with well-characterized measurement of school readiness and posit the following questions:

Is accumulating ACE exposure associated with school readiness among preschool-aged children within and across the following domains: early learning

AAP	American Academy of Pediatrics
ACE	Adverse childhood experience
NSCH	National Survey of Children's Health

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skills, self-regulation, social-emotional development, and physical health and motor development?

To what extent is the association explained by parenting stress and/or reductions in positive parenting practices?

Methods

In the present study, data from the 3 most recent available cohorts (2016-2018) of the National Survey of Children's Health (NSCH) were analyzed. More details on the NSCH and the current sample are available in the **Appendix** (available at www.jpeds.com).

School Readiness Measures

Ghandour et al noted that, prior to the 2016 cohort of the NSCH, "no single US data source support[ed] a multidimensional, population-based assessment of young children's readiness to start school."[9] Following this declaration, they laid out a comprehensive measurement strategy supported by the NSCH from 2016 onward as a means of assessing school readiness among 3- to 5-year-old children. The authors followed numerous steps in developing their pilot measure of school readiness, including item-level analysis and confirmatory factor analysis. Ultimately, they identified 4 distinct domains of school readiness within the NSCH: early learning skills, self-regulation, social-emotional development, and physical health and motor development. The complete coding scheme was adapted from the work of Ghandour et al and is further outlined in **Tables I** and **II** (available at www.jpeds.com).[9]

As indicated in **Tables I** and **II**, children were categorized as at-risk, needs support, or on-track on the basis of primary caregiver responses to individual items within each of the 4 domains. Following this process, 2 domain-specific composite measures were constructed for each domain: a needs support/at-risk index and an at-risk index. The needs support/at-risk index is the sum of the number of items in a given domain on which the child was categorized as needs support or at-risk. The at-risk index is the sum of the number of items in a given domain on which the child was categorized as at-risk.

Finally, we categorized children as at-risk, need support, or on-track on a given domain (**Table III** [available at www.jpeds.com] provides more details on the coding scheme).[9] After placing children in these categories for each domain, a count measure of the number of on-track domains was created by summing up the number of domains on which a child was categorized as on-track (0-4). In line with prior research, children who were on-track in none of the domains or only 1 domain were collapsed into a single group, given the small proportion of the sample who were on track in zero domains (~2%).[9]

ACEs

We employed the following 9 lifetime reports of ACEs: (1) Extreme economic hardship, (2) Parent or guardian divorced or separated, (3) Parent or guardian died, (4) Parent or guardian served time in jail, (5) Saw or heard parents or adults slap, hit, kick, or punch one another in the home, (6) Was a victim of violence, or witnessed violence, in the neighborhood, (7) Lived with anyone who was mentally ill, suicidal, or severely depressed, (8) Lived with anyone who had a problem with alcohol or drugs, and (9) Treated or judged unfairly because of his or her race or ethnic group.[5,17] Although the NSCH includes data pertaining to a variety of ACEs, some of the included ACEs (parent death, discrimination) were not included in the original 10 categories described by Felitti et al.[18] We constructed a cumulative, composite measure of ACEs in a similar fashion to prior NSCH research.[19] The cumulative ACE measure was truncated at 3 in light of the young age of respondents in this age-restricted, nationally representative sample (ie, less life lived to experience a given ACE) and the relative infrequency of children experiencing 4 or more ACEs at such a young age (~2%).

Mediators

To measure parenting stress, we followed the lead of Uddin et al and employed an index comprised of 3 items in which parents/caregivers reported how often during the past month they felt the child is much harder to care for than most children, the child does things that bother them, and angry at the child.[20] Response options included never (=0), rarely (=1), sometimes (=2), and usually/always (=3). Items were summed to create an index ranging from 0 to 9 (alpha = 0.76). To measure positive parenting practices, we employed an index comprised of 3 items in which parents/caregivers report how many days per week they engage in reading to focal children, storytelling or singing to focal children, and eating meals together as a family.[21] Response options included never (=0), 1-3 days (=1), 4-6 days (=2), and all 7 days (=3). Items were summed to create an index ranging from 0 to 9 (alpha = 0.60).

Covariates

The following covariates were included in multivariate models to minimize the likelihood of spurious results: child age, child sex, child race (black, Hispanic, other, with white as reference category), child firstborn (including only children), child schooling status (child currently enrolled in school), household poverty ratio (Federal Poverty Level 100%-199%, 200%-399%, 400+%, with below the poverty line as the reference category), English as primary household language, maternal age at birth, parent education, parent marital status, parent immigrant status, and parent primary caregiver status.

Plan of Analyses

We calculated the descriptive statistics for all study variables, stratified by level of ACE exposure. We employed negative binomial regression to examine the association between the extent of ACE exposure, the needs support/at-risk index, and the at-risk index for each of the 4 school readiness dimensions (given count outcomes that were

negatively skewed, zero-inflated, and over-dispersed). Multinomial logistic regression was employed to examine the role of ACE exposure in the relative risk of being on-track across dimensions. A figure was constructed to plot the predicted probabilities of being "on-track" across school readiness domains by level of ACE exposure. Predicted probabilities were calculated using the marginal standardization technique, which is a regression-based form of the common technique of standardization and is designed to proportionally adjust the estimate of interest according to a weight pertaining to each level of the confounding factors.[22] This approach allows predicted probabilities to be employed to make inferences about the whole sample. Finally, follow-up mediation analyses of the role of parenting stress and positive parenting practices in the association between ACEs and school readiness was conducted using the Karlson-Holm-Breen method.[23] All analyses were conducted in STATA v 15.1(StataCorp, College Station, Texas) using multiply imputed data (chained equations, 20 imputations). All multivariate models adjust for cohort-specific fixed effects and employ sample weights that adjust for nonresponse, probability of selection, and the demographic distribution of the target population.

Results

The descriptive results, displayed in **Table IV**, are stratified by level of ACE exposure. The average number of needs support and at-risk items on a given domain increase as ACEs increase (**Table V** [available at www.jpeds.com] provides more details on specific items). Children exposed to 3 or more ACEs are more than 4 times as likely to be on-track on only 1 or none of the school readiness domains compared with children exposed to no ACEs. Conversely, although nearly one-half of children who have not been exposed to ACEs are on-track across all domains, only 1 in 5 children exposed to 3 or more ACEs are on-track across all domains. In addition, the findings indicate that older, non-white children tend to be exposed to a greater number of ACEs, as do children residing in

Table IV. Descriptive statistics, stratified by ACE exposure (N = 15 402)

	Number of ACEs			
	None (69.39%) n = 10 688	One (19.09%) n = 2940	Two (6.18%) n = 952	Three or more (5.34%) n = 822
Variables	Mean (SD) or % (n)	Mean (SD) or % (n)	Mean (SD) or % (n)	Mean (SD) or % (n)
School readiness variables				
Early learning skills				
Needs support/at-risk index	1.49 (1.35)	1.64 (1.37)	1.82 (1.44)	1.87 (1.40)
At-risk index	0.50 (1.07)	0.81 (1.42)	0.93 (1.54)	1.33 (1.79)
Self-regulation				
Needs support/at-risk index	0.69 (0.94)	0.89 (1.04)	1.09 (1.14)	1.31 (1.21)
At-risk index	0.04 (0.23)	0.10 (0.41)	0.16 (0.52)	0.25 (0.63)
Social-emotional development				
Needs support/at-risk index	0.64 (0.83)	0.77 (0.91)	0.79 (0.94)	1.01 (1.02)
At-risk index	0.04 (0.23)	0.08 (0.33)	0.11 (0.37)	0.14 (0.49)
Physical health and motor development				
Needs support/at-risk index	0.29 (0.53)	0.39 (0.61)	0.46 (0.65)	0.53 (0.70)
At-risk index	0.06 (0.25)	0.12 (0.37)	0.14 (0.40)	0.19 (0.48)
Number of on-track domains				
One or none	5.82% (622)	12.11% (356)	15.97% (152)	24.09% (198)
Two	12.31% (1316)	17.21% (506)	21.11% (202)	22.63% (186)
Three	34.18% (3653)	33.74% (992)	31.51% (300)	32.48% (267)
Four	47.69% (5097)	36.94% (1086)	31.30% (298)	20.80% (171)
Covariates				
Child age	3.97 (0.82)	4.01 (0.82)	4.03 (0.81)	4.14 (0.80)
Child male	51.84% (5541)	52.42% (1541)	53.99% (514)	50.00% (411)
Child white	71.18% (7608)	64.32% (1891)	60.19% (573)	60.95% (501)
Child black	4.30% (460)	9.08% (267)	9.77% (93)	9.98% (82)
Child Hispanic	9.67% (1034)	13.91% (409)	17.44% (166)	14.72% (121)
Child other race/ethnicity	14.84% (1586)	12.69% (373)	12.61% (120)	14.36% (118)
Child firstborn	53.30% (5697)	55.99% (1646)	61.13% (582)	56.45% (464)
Child schooling status	67.91% (7258)	63.37% (1863)	64.29% (612)	63.99% (526)
FPL <100%	6.59% (704)	17.86% (525)	25.84% (246)	30.54% (251)
FPL 100%-199%	11.71% (1252)	26.29% (773)	27.94% (266)	28.10% (231)
FPL 200%-399%	32.27% (3449)	33.67% (990)	31.30% (298)	27.37% (225)
FPL 400% +	49.43% (5283)	22.18% (652)	14.92% (142)	13.99% (115)
English as primary household Language	91.82% (9814)	91.67% (2695)	94.64% (901)	95.74% (787)
Maternal age at birth	30.80 (5.20)	28.86 (5.83)	27.77 (6.13)	26.19 (5.79)
Parent education	3.63 (0.68)	3.28 (0.84)	3.07 (0.85)	2.98 (0.86)
Parent marital status	90.04% (9623)	57.04% (1677)	30.67% (292)	16.18% (133)
Parent immigrant status	13.82% (1477)	11.33% (333)	7.35% (70)	3.89% (32)
Parent primary caregiver status	96.62% (10 327)	86.80% (2552)	80.67% (768)	63.14% (519)

FPL, Federal Poverty Level.

low-income households. Children with less educated parents, unmarried parents, and a non-parent caregiver are more likely to be exposed to a greater number of ACEs, whereas children of immigrant parents are less likely to be exposed to a greater number of ACEs.

The needs supports/at-risk index for each school readiness domain was then regressed on the cumulative ACEs measure. ACE exposure increases the rate of needs support/at-risk items within all 4 domains (ie, early learning skills, self-regulation, social-emotional development, and physical health and motor development) (**Table VI**). Even so, the increased rate of need support/at-risk items is significantly heightened as ACEs accumulate. For instance, increases in the rate of needs support/at-risk items associated with exposure to a single ACE range from 16% to 33%, contingent on the domain being examined. Comparatively, increases in the rate of needs support/at-risk items associated with exposure to 3+ ACEs range from 76% to 136%, contingent on the domain being examined. For children reporting 3+ ACEs, for instance, the rate of at-risk items is especially high in the case of self-regulation (incidence rate ratio 5.49; CI 3.34-9.02) and social-emotional development (incidence rate ratio 3.97; CI 2.43-6.49).

Finally, multinomial logistic regression was employed to examine the role of ACE exposure in the relative risk of being on-track on 1 or none of the 4 school readiness domains, 2 of the school readiness domains, and 3 of the school readiness domains (relative to all 4; **Table VII**). Children who are exposed to ACEs are at significantly greater risk of failing to attain on-track status across domains. These findings become much more pronounced as ACEs accumulate. Children exposed to a single ACE incur only a 1.55-fold increase in the risk of being on-track on 1 or none of the domains (relative to all 4), whereas children exposed to 3+ ACEs incur a 9.15-fold increase in the risk of being on-track on 1 or none of the domains (relative to all 4). Effects are somewhat attenuated as the number of on-track domains increase (relative to all 4). For children experiencing only 1 ACE, these effects attenuate to non-significance. However, for children experiencing 3+ ACEs, they are also significantly more likely to experience being on-track on only 2 (relative risk ratio = 3.60; CI = 2.23-5.77) or 3 (relative risk ratio = 2.69; CI = 1.73-4.16) domains relative to all 4. Ancillary analyses also revealed that this pattern of findings holds regardless of children's disability status.

Table VI. ACEs and school readiness: analysis of the healthy and ready-to-learn domains

Number of ACEs	Adjusted IRR (CI)	
	Needs support/at-risk index	At-risk index
	Early learning skills	
One	1.22* (1.10-1.35)	1.47* (1.22-1.78)
Two	1.47* (1.29-1.67)	1.76* (1.53-2.01)
Three or more	1.71* (1.39-2.10)	2.37* (1.86-3.02)
	Self-regulation	
One	1.28* (1.13-1.45)	1.08* (1.41-3.05)
Two	1.70* (1.43-2.03)	2.36* (2.00-2.79)
Three or more	3.32* (1.90-5.80)	5.49* (3.34-9.02)
	Social-emotional development	
One	1.16† (1.03-1.30)	1.40* (1.16-1.69)
Two	1.46† (1.01-2.11)	2.20* (1.42-3.43)
Three or more	1.99* (1.60-2.46)	3.97* (2.43-6.49)
	Physical health and motor development	
One	1.33* (1.14-1.56)	1.76* (1.39-2.23)
Two	1.42† (1.04-1.94)	2.37* (1.58-3.57)
Three or more	1.98* (1.56-2.50)	2.19* (1.33-3.61)

IRR, incidence rate ratio.
In adjusted models, covariates are suppressed to conserve space. Covariates include child age, child sex, child race, child firstborn, child schooling status, household poverty ratio, English as primary household language, maternal age at birth, parent education, parent marital status, parent immigrant status, and parent primary caregiver status. Estimates are weighted to represent the US population of 3- to 5-year-old children and models are adjusted for survey year to account for year-specific fixed effects.
Reference category is on-track.
*$P < .01$;
†$P < .05$.

The pattern of findings linking ACE exposure to on-track status across domains is illustrated in the **Figure**, which plots the predicted probability of each school readiness category by degree of ACE exposure, adjusting for covariates using the marginal standardization method.[18] Overall, ACE exposure significantly alters the predicted probability of being on-track across all 4 school readiness domains, with a predicted probability of approximately 0.42 for children exposed to no ACEs, 0.36 for children exposed to 1 ACE, 0.24 for children exposed to 2 ACEs, and only 0.16 for children exposed to 3+ ACEs. The predicted probability of being on-track on none or only 1 of the domains also varies substantially by ACE exposure, with heavily exposed children being most likely to belong to this group. As was the case when examining the predicted probability of being on-track across all domains, a dose-response effect of ACEs emerged, except in the opposite direction (ie, additional ACEs incrementally increased the probability of being on-track on none or only 1 of the domains).

Follow-up Karlson-Holm-Breen analyses, (**Table VIII**; available at www.jpeds.com), revealed that both parenting stress and positive parenting experiences emerged as significant mediators of the association between accumulating ACEs and school readiness. When examining the association between 3+ ACEs and being on track on one or none of the domains, parenting stress explained 26.57% of the association ($z = 6.62$; $P < .01$), whereas positive parenting practices explained only 4.46% of the association ($z = 2.73$; $P < .01$). Ultimately, across levels of ACE exposure, parenting stress and positive parenting experiences collectively explained anywhere from ~ 27% to 61% of the association between ACE exposure and school readiness among preschool-aged children.

Discussion

Research has illustrated the potential for the accumulation of childhood adversities to engender toxic stress,[24] which can be defined as "the extreme, frequent, or extended activation of the stress response, without the buffering presence of a supportive adult."[25] The AAP has also acknowledged the

Table VII. ACEs and school readiness across healthy and ready-to-learn domains

School readiness		On-track			
Number of domains		Four	Three	Two	One or None
One ACE	Adjusted RRR (CI)	Ref	1.09 (0.84-1.43)	1.38* (0.97-1.98)	1.55* (0.99-2.42)
Two ACEs	Adjusted RRR (CI)	Ref	1.59† (1.10-2.30)	2.57‡ (1.62-4.06)	4.42‡ (2.81-6.94)
Three or more ACEs	Adjusted RRR (CI)	Ref	2.69‡ (1.73-4.16)	3.60‡ (2.23-5.77)	9.15‡ (5.44-15.42)

RRR, relative risk ratio.
In adjusted models, covariates are suppressed to conserve space. Covariates include child age, child sex, child race, child firstborn, child schooling status, household poverty ratio, English as primary household language, maternal age at birth, parent education, parent marital status, parent immigrant status, and parent primary caregiver status. All models are weighted to represent the US population of 3- to 5-year-old children and adjust for survey year to account for year-specific fixed effects.
*$P < .10$.
†$P < .05$.
‡$P < .01$.

negative, cascading consequences of this form of stress for various facets of child development,[24,26] including brain development.[26] Given the role of toxic stress in disrupting brain circuitry,[24,26] it is perhaps not surprising that ACEs have been linked to adverse scholastic outcomes.[5-8] The present study builds upon this literature. First, prior research assessing the educational outcomes associated with ACE exposure has relied largely on school-aged children.[5-7] However, the current study investigates the link between ACEs and school readiness among preschool-aged children. We provide initial evidence that early life exposure to ACEs can set the stage for disadvantageous educational trajectories by hindering the ability of children to start school "healthy and ready to learn."[9] Research on ACEs has also revealed downstream impacts on conduct problems,[27-29] which may be exacerbated to the extent that adverse educational outcomes (eg, school failure, dropout) and school disengagement result from children being unprepared upon entering school.[9,11,30] Prior work has focused on the influence of ACEs for various metrics of school performance, such as language and math skills,[6] student absenteeism,[5] repeating a grade,[5,7] and child's homework completion.[7] The current

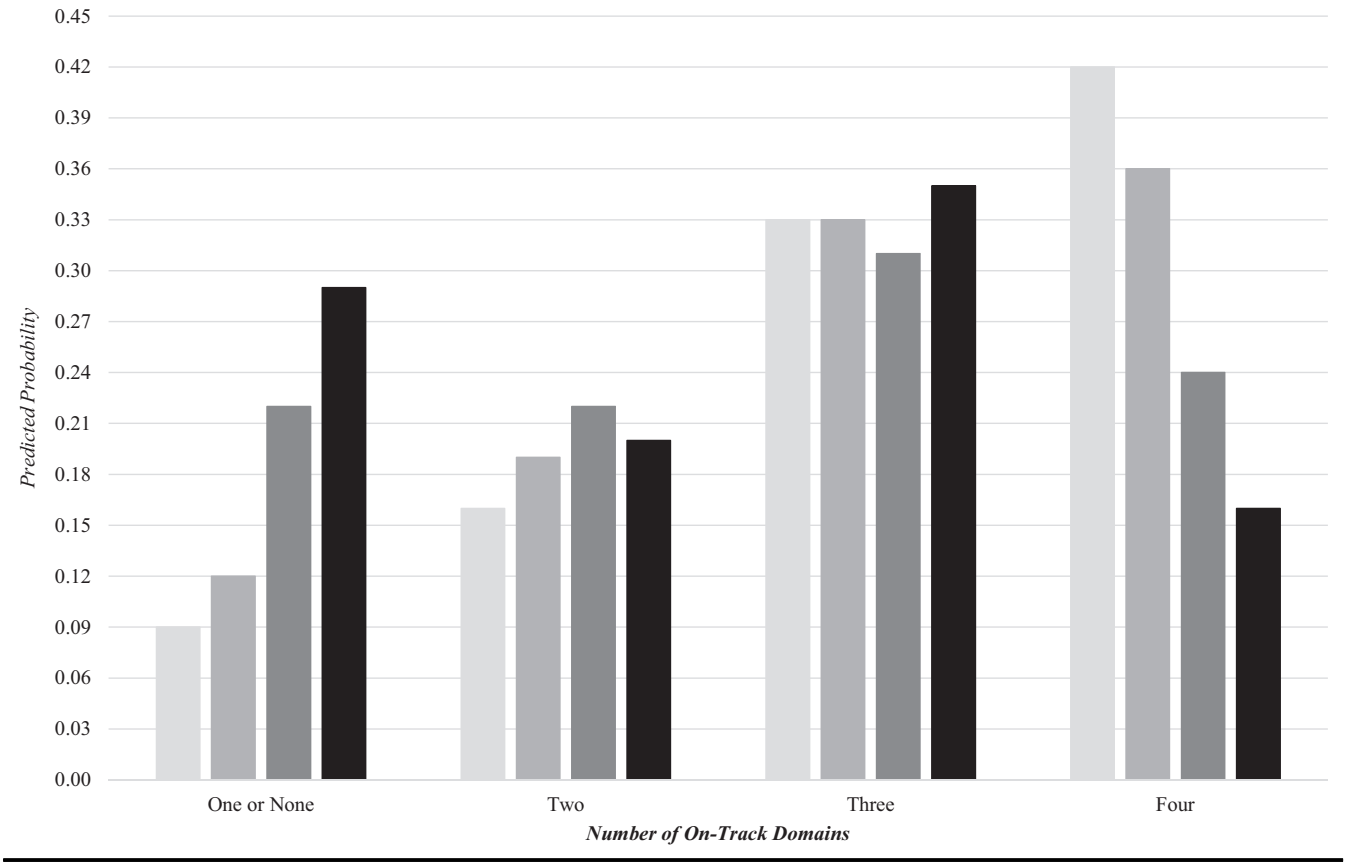

Figure. The predicted probability of being on-track across school readiness domains by degree of ACE exposure. Predicted probabilities were calculated using the marginal standardization technique.

study, however, focuses on a multifaceted measure of school readiness, which is comprised of 4 key domains established by the National Educational Goals Panel.[9,31] The study findings reveal a robust link between exposure to accumulating childhood adversities and all 4 domains of school readiness among a nationally representative sample of preschool-aged children in the US. Notably, the AAP has warned of the potential for ACEs to undermine school readiness because of the negative repercussions of ACEs for cognitive development and mental health.[32-34] The present results reinforce the AAP recommendation for pediatricians to "lend their voices as advocates" in their efforts to both mitigate childhood adversities and promote school readiness.[35]

The AAP statement on school readiness explicitly states that "an individual child's school readiness is determined in large measure by the environment in which he or she lives and grows" and that to enter school ready to learn, "children need protection from injury, abuse, and neglect as well as from exposure to violence and discrimination."[10] Our findings point to the need for pediatricians to screen for ACEs to address inadequacies in school readiness that may emanate—at least in part—from a toxic home environment. Routine pediatric visits can serve as a window to screen for and provide information regarding injury prevention and community resources for families to promote child wellness and early learning. In cases where children display behavioral concerns, pediatricians may consider referring families to appropriate, evidence-based behavioral health resources.[10]

Routine pediatric wellness visits can also involve broader assessments of interactions between the parent and the child, as well as evaluations of the degree to which steps have been taken to prepare a child for school entry. Pediatricians have a critical and active role to play in counseling families not only on children's physical health, but also in delivering primary prevention services that support parent-child relationships, interactions, and resilience more broadly, including through the promotion of positive parenting practices that foster learning. As noted by O'Connell et al, it is expected that pediatricians "provide extensive anticipatory guidance and problem-based counseling, much of which addresses the behavior of parents."[36] Given our findings pointing to the significant role of parenting stress and parent-child interactions in the connection between ACEs and school readiness, pediatricians' investment in parent wellness and parenting behaviors constitutes a key resource for families and an avenue for the promotion of school readiness among young children, even in the face of adversity.[36,37]

The current study is not without limitations. Because of the cross-sectional design of the NSCH, we cannot infer a causal association between ACEs and school readiness. Notwithstanding the inability to determine causality, the measures of ACEs in the current study are lifetime reports whereas school readiness is current, which suggests an appropriate temporal ordering of the key variables in the study. The measure of ACEs in the current study does not align precisely with the original 10 categories described by Felitti et al.[18] Still, the current items have been used in numerous studies employing NSCH data and capture several ACEs relevant to preschool-aged children.[5,17,19] The present study uses a novel and innovative multidimensional measure of school readiness. However, this remains a pilot measure that has yet to be validated using other data sources. Future research may also consider the association between ACEs and school readiness among subgroups that may be of particular interest (eg, immigrant children). We also did not examine trends over time, as only 3 years of NSCH school readiness data are currently available. Many children who were not exposed to ACEs were not consistently on track across school readiness domains; future research might explore the clinical utility and the potential limitations of ACE screenings future studies should also explore additional factors that might explain why some children are not consistently on-track across school readiness domains even in the absence of ACEs. Finally, the current findings cannot address efficacy of relevant, targeted prevention or intervention programming that may be useful in addressing specific needs at the intersection of ACEs and school readiness (eg, early home visiting, resilience training, preschool education programs for low-income children).[38-40]

Our findings indicate that exposure to an accumulation of ACEs diminishes school readiness across 4 key domains. Thus, public health professionals and pediatricians should focus on the development and implementation of interventions that can reduce the prevalence of ACEs, as doing so may foster school readiness among young children. ■

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Table I. Survey questions/statements pertaining to of each of the individual domain items

Domains	Items	Survey question/statement
Early learning skills	Beginning sounds	How often can this child recognize the beginning sound of a word?
	Letters	How many letters of the alphabet can this child recognize?
	Rhyming	Can this child rhyme words?
	Verbal expression	How often can this child explain things he or she has seen or done so that you get a very good idea of what happened?
	Writing	How often can this child write his or her first name, even if some of the letters aren't quite right or are backwards?
	Counting	How high can this child count?
	Shapes	How often can this child identify basic shapes, such as a triangle, circle, or square?
Self-regulation	Attention	How often is this child easily distracted?
	Sitting still	Compared to other children his or her age, how often is this child able to sit still?
	Task persistence	How often does this child keep working at something until he or she is finished?
	Following instructions	When he or she is paying attention, how often can this child follow instructions to complete a simple task?
Social-emotional development	Peer interactions	How often does this child play well with others?
	Peer relationships	Compared to other children his or her age, how much difficulty does this child have making or keeping friends?
	Emotional resilience	This child bounces back quickly when things do not go his or her way.
	Empathy	How often does this child show concern when others are hurt or unhappy?
Physical health and motor development	General health	In general, how would you describe this child's health?
	Oral health	How would you describe the condition of this child's teeth?
	Fine motor skills	When this child holds a pencil, does he or she use fingers to hold, or does he or she grip it in his or her fist?

Table II. Coding scheme for categorizing children as on-track, needs support, or at-risk on individual domain items, by age

		At risk			Needs support			On-track		
Domains	**Items**	**3 y**	**4 y**	**5 y**	**3 y**	**4 y**	**5 y**	**3 y**	**4 y**	**5 y**
Early learning skills	Beginning sounds	None of the time	Some/none of the time	Some/none of the time	Some of the time	Most of the time	Most of the time	Most/all of the time	All of the time	All of the time
	Letters	None of them	Some/none of them	Some/none of them	Some of them	Most of them	Most of them	Most/all of them	All of them	All of them
	Rhyming	-	No	No	No	-	-	Yes	Yes	Yes
	Verbal expression	None of the time	Some/none of the time	Some/none of the time	Some of the time	Most of the time	Most of the time	Most/all of the time	All of the time	All of the time
	Writing	-	None of the time	Some/none of the time	None of the time	Some of the time	Most of the time	Some/most/all of the time	Most/all of the time	All of the time
	Counting	Not at all	Not at all/up to 5	Not at all/up to 5/10	Up to 5	Up to 10	Up to 20	Up to 10/20/50/100 or more	Up to 20/50/100 or more	Up to 50/100 or more
	Shapes	None of the time	Some/none of the time	None/some/Most of the time	Some of the time	Most of the time	-	Most/all of the time	All of the time	All of the time
Self-regulation	Attention	All of the time	All of the time	All of the time	Most of the time	Most of the time	Most of the time	Some/none of the time	Some/none of the time	Some/none of the time
	Sitting still	None of the time	None of the time	None of the time	Some of the time	Some of the time	Some of the time	Most/all of the time	Most/all of the time	Most/all of the time
	Task persistence	None of the time	None of the time	None of the time	Some of the time	Some of the time	Some of the time	Most/all of the time	Most/all of the time	Most/all of the time
	Following instructions	None of the time	None of the time	None of the time	Some of the time	Some of the time	Some of the time	Most/all of the time	Most/all of the time	Most/all of the time
Social-emotional development	Peer interactions	None of the time	None of the time	None of the time	Some of the time	Some of the time	Some of the time	Most/all of the time	Most/all of the time	Most/all of the time
	Peer relationships	A lot of difficulty	A lot of difficulty	A lot of difficulty	A little difficulty	A little difficulty	A little difficulty	No difficulty	No difficulty	No difficulty
	Emotional resilience	Not true	Not true	Not true	Somewhat true	Somewhat true	Somewhat true	Definitely true	Definitely true	Definitely true
	Empathy	None of the time	None of the time	None of the time	Some of the time	Some of the time	Some of the time	Most/All of the time	Most/all of the time	Most/all of the time
Physical health and motor development	General health	Fair/poor	Fair/poor	Fair/poor	Good	Good	Good	Very good/excellent	Very good/excellent	Very good/excellent
	Oral health	Fair/poor	Fair/poor	Fair/poor	Good	Good	Good	Very good/excellent	Very good/excellent	Very good/excellent
	Fine motor skills	Cannot hold pencil	Cannot hold pencil	Cannot hold pencil/grips in fist	Grips in fist	Grips in fist	-	Uses fingers	Uses fingers	Uses fingers

For more details, see.[19] Coding was altered slightly from the above scheme in 2 instances (1) for items with none/some/most/all response options, and (2) the emotional resilience item. In the first instance, an additional option of "about half of them/the time" was available from the 2017 NSCH onward. This item was grouped with the "some of them/the time" options for the purpose of this analysis. In the second instance, the 2018 NSCH item had response options of "always," "usually," "sometimes," and "never." For the purpose of this analysis, "always" corresponded to "definitely true" and "never" corresponded to "not true." Responses of "usually" or "sometimes" corresponded to "somewhat true."

Table III. Coding scheme for categorizing children as on-track, needs support, or at-risk on a given domain

Domains	Coding scheme
Early learning skills	Children were placed into 3 categories based on their scores on a summative index of the 7 early learning skills items, coded as outlined in **Tables I** and **II** (index range: 0-14). Following the lead of Ghandour et al,[9] children scoring between 12 and 14 points were categorized as on-track, children scoring between 7 and 11 points were categorized as needs support, and children scoring below 7 points were categorized as at-risk.
Self-regulation	Children were placed into 3 categories based on their scores on a summative index of the 4 self-regulation items, coded as outlined in **Tables I** and **II** (index range: 0-8). Following the lead of Ghandour et al,[9] children scoring 7 or 8 points were categorized as on-track, children scoring between 4 and 6 points were categorized as needs support, and children scoring below 4 points were categorized as at-risk.
Social-emotional development	Children were placed into 3 categories based on their scores on a summative index of the 4 social-emotional development items, coded as outlined in **Tables I** and **II** (index range: 0-8). Following the lead of Ghandour et al,[9] children scoring 7 or 8 points were categorized as on-track, children scoring between 4 and 6 points were categorized as needs support, and children scoring below 4 points were categorized as at-risk.
Physical health and motor development	Children were placed into 3 categories based on their scores on a summative index of the 3 physical health/motor development items, coded as outlined in **Tables I** and **II** (index range: 0-6). Following the lead of Ghandour et al,[9] children scoring 5 or 6 points were categorized as on-track, children scoring 3 or 4 points were categorized as needs support, and children scoring below 3 points were categorized as at-risk.

For more details, see reference.[19]

Table V. ACEs and school readiness items: percentage of on-track, needs support, and at-risk children by number of ACEs

	Number of ACEs			
	None	One	Two	Three or more
Variables	Percentage	Percentage	Percentage	Percentage
Beginning sounds – on-track	62.2%	55.1%	49.5%	44.1%
Beginning sounds – needs support	27.2%	28.6%	32.4%	33.5%
Beginning sounds – at-risk	10.6%	16.3%	18.1%	22.4%
Letters – on-track	62.7%	57.2%	51.0%	43.4%
Letters – needs support	26.8%	26.7%	32.0%	31.7%
Letters – at-risk	10.5%	16.1%	17.0%	24.9%
Rhyming – on-track	75.3%	68.1%	63.6%	65.2%
Rhyming – needs support	15.3%	16.8%	18.8%	15.1%
Rhyming – at-risk	9.4%	15.1%	17.6%	19.7%
Verbal expression – on-track	67.9%	61.4%	57.8%	47.9%
Verbal expression – Needs support	27.7%	30.1%	31.6%	38.9%
Verbal expression – at-risk	4.4%	8.5%	10.6%	13.2%
Writing – on-track	65.1%	58.7%	54.5%	48.8%
Writing – needs support	28.6%	31.3%	32.9%	32.7%
Writing – at-risk	6.3%	10.0%	12.6%	18.5%
Counting – on-track	81.5%	74.7%	72.3%	62.7%
Counting – needs support	15.6%	19.1%	22.0%	24.9%
Counting – at-risk	2.9%	6.2%	5.7%	12.4%
Shapes – on-track	85.5%	79.1%	75.0%	67.8%
Shapes – needs support	8.7%	10.8%	12.6%	13.8%
Shapes – at-risk	5.8%	10.1%	12.4%	18.4%
Attention – on-track	88.4%	82.0%	75.1%	67.7%
Attention – needs support	9.8%	13.7%	17.8%	20.9%
Attention – at-risk	1.8%	4.3%	7.1%	11.4%
Sitting still – on-track	76.0%	66.9%	59.6%	53.3%
Sitting still – needs support	23.1%	30.8%	36.4%	40.7%
Sitting still – at-risk	0.9%	2.3%	4.0%	6.0%
Task persistence – on-track	70.3%	64.7%	57.9%	50.8%
Task persistence – needs support	28.9%	33.0%	38.0%	44.1%
Task persistence – at-risk	0.8%	2.3%	4.1%	5.1%
Following instructions – on-track	92.5%	86.8%	81.5%	75.4%
Following instructions – needs support	7.3%	12.3%	17.4%	23.1%
Following instructions – at-risk	0.2%	0.9%	1.1%	1.5%
Peer interactions – on-track	94.6%	90.7%	87.5%	82.3%
Peer interactions – needs support	5.3%	8.7%	11.9%	16.5%
Peer interactions – at-risk	0.1%	0.6%	0.6%	1.2%
Peer relationships – on-track	86.8%	81.2%	78.9%	73.7%
Peer Relationships – needs support	11.9%	16.3%	17.4%	20.9%
Peer relationships –at-risk	1.3%	2.5%	3.7%	5.4%
Emotional resilience – on-track	64.1%	59.4%	58.3%	49.5%
Emotional resilience –needs support	34.2%	37.8%	37.2%	44.7%
Emotional resilience – at-risk	1.7%	2.8%	4.5%	5.8%
Empathy – on-track	86.6%	84.9%	83.7%	81.1%
Empathy – needs support	12.5%	13.4%	15.0%	16.9%
Empathy – at-risk	0.9%	1.7%	1.3%	2.0%
General health – on-track	96.0%	92.5%	88.2%	83.9%
General health – needs support	3.6%	6.5%	10.0%	13.8%
General health – at-risk	0.4%	1.0%	1.8%	2.3%
General oral health – on-track	90.4%	82.1%	78.1%	71.1%
General oral health – needs support	7.5%	12.8%	15.3%	18.4%
General oral health – at-risk	2.1%	5.1%	6.6%	10.5%
Fine motor skills – on-track	78.8%	75.2%	71.7%	73.8%
Fine motor skills – needs support	18.1%	19.5%	22.5%	18.9%
Fine motor skills – at-risk	3.1%	5.3%	5.8%	7.3%

Table VIII. Karlson-Holm-Breen analysis of mediators of the association between ACEs and school readiness across healthy and ready-to-learn domains

	Number of on-track domains					
	One or none (ref: 4)					
Mediators	**One ACE**		**Two ACEs**		**Three or more ACEs**	
Mediators	% Reduction	z score	% Reduction	z score	% Reduction	z score
Positive Parenting Practices	16.57%	3.11*	5.70%	2.64*	4.46%	2.73*
Parenting Stress	44.96%	3.59*	26.72%	5.25*	26.57%	6.62*
Total	61.53%	-	32.42%	-	31.03%	-
	Two (ref: 4)					
	One ACE		**Two ACEs**		**Three or More ACEs**	
Mediators	% Reduction	z score	% Reduction	z score	% Reduction	z score
Positive Parenting Practices	14.04%	3.15*	6.69%	2.66*	6.03%	2.76*
Parenting Stress	31.00%	3.52*	25.51%	5.05*	29.26%	6.23*
Total	45.04%	-	32.20%	-	35.29%	-
	Three (ref: 4)					
	One ACE		**Two ACEs**		**Three or More ACEs**	
Mediators	% Reduction	z score	% Reduction	z score	% Reduction	z score
Positive Parenting Practices	-	-	11.44%	2.81*	7.42%	2.92*
Parenting Stress	-	-	24.16%	4.59*	19.94%	5.42*
Total	-	-	35.60%	-	27.36%	-

Covariates are included by suppressed to converse space. All estimates are weighted to represent the US population of children ages 3-5 years. Estimates are only obtained in cases where models met the criteria of Baron and Kenny.[41] In 1 case, the independent variable was not significantly predictive of the outcome in any of the models displayed in Table VI. Specifically, 1 ACE (X) was not significantly associated with being on-track on 3 domains relative to all 4 (Y); therefore, no mediation effects were estimated in Table VII for this nonsignificant association.[41]

*$P < .01$.