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Cumulative Risk and Child Development

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Childhood multiple risk factor exposure exceeds the adverse developmental impacts of singular exposures. Multiple risk factor exposure may also explain why sociodemographic variables (e.g., poverty) can have adverse consequences. Most research on multiple risk factor exposure has relied upon cumulative risk (CR) as the measure of multiple risk. CR is constructed by dichotomizing each risk factor exposure (0 = no risk; 1 = risk) and then summing the dichotomous scores. Despite its widespread use in developmental psychology and elsewhere, CR has several shortcomings: Risk is designated arbitrarily; data on risk intensity are lost; and the index is additive, precluding the possibility of statistical interactions between risk factors. On the other hand, theoretically more compelling multiple risk metrics prove untenable because of low statistical power, extreme higher order interaction terms, low robustness, and collinearity among risk factors. CR multiple risk metrics are parsimonious, are statistically sensitive even with small samples, and make no assumptions about the relative strengths of multiple risk factors or their collinearity. CR also fits well with underlying theoretical models (e.g., Bronfenbrenner's, 1979, bioecological model; McEwen's, 1998, allostasis model of chronic stress; and Ellis, Figueredo, Brumbach, & Schlomer's, 2009, developmental evolutionary theory) concerning why multiple risk factor exposure is more harmful than singular risk exposure. We review the child CR literature, comparing CR to alternative multiple risk measurement models. We also discuss strengths and weaknesses of developmental CR research, offering analytic and theoretical suggestions to strengthen this growing area of scholarship. Finally, we highlight intervention and policy implications of CR and child development research and theory.

Keywords: cumulative risk, children, stress, social inequalities

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A risk factor refers to any individual or environmental factor associated with the increased likelihood of developing negative or undesirable outcomes (Kraemer, Lowe, & Kupfer, 2005). Michael Rutter, a child psychiatrist, observed that most children experiencing a single physical or psychosocial risk factor suffered little if any enduring harm. However, he and other clinicians routinely observed that the subset of children experiencing multiple risk factors were much more likely to experience psychological disorder (Rutter, 1979, 1981). This led Rutter and other developmentalists (Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987) to propose the study of multiple risk factor exposures in children given that the analysis of singular risk factor exposure might underestimate the capability of risk factors to interfere with healthy child development. Multiple risk factor exposures can overlap (e.g., harsh and unresponsive parenting) or be independent (e.g., housing quality and temperament), but in each case prediction is enhanced by combining multiple risks in the model (Kraemer et al., 2005).

In the case of overlapping risk factors, the usual approach is to form a composite index by combining the different risk factors into one summary score. Often this is done by standardizing each risk factor because the original units of measurement usually differ for each factor. The standardized scores are then added together. This only makes sense, however, if the multiple risk factors are intercorrelated.

When risk factors are independent or have minimum overlap, combining these various factors into a summary score is not a good idea because having one risk factor does not influence having a second one. The most common approach to creating an aggregate

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metric of risk factor exposures that do not necessarily overlap is to create a composite metric wherein a set of dichotomous risk factor exposures (exposure = 1; no exposure = 0) are summed together.

There are several advantages of formulating indices of multiple risk factor exposure into a composite score. Measurement error is reduced (Ghiselli, Campbell, & Zedeck, 1981; Nunnally, 1978). Validity is also enhanced because no one singular measure adequately captures the full meaning of the construct of interest (Brinberg & Kidder, 1982; Ghiselli et al., 1981). Additionally instead of having multiple, collinear predictors in the model as one might have in an OLS regression model, the researcher can use just one independent predictor. This is beneficial because multiple, correlated predictors in the same general linear model lead to unstable estimates and diminish statistical power (J. Cohen, Cohen, West, & Aiken, 2003; Myers & Wells, 2003). The insights of Rutter, Kraemer, and Sameroff have led to a proliferation of studies of multiple risk factor exposure in children using composite indices.

Rationale for Multiple Risk Factor Assessment

Developmental risk research initially focused on singular risk factors known or suspected to increase the probability of adverse child outcomes. Among the most intensively studied singular risk factors in the child development literature are insecure attachment, divorce, institutionalization, war, racial prejudice, and parental psychopathology. The purpose of early research on exposure to childhood risk factors was to understand how singular risk factors affected development. A nascent approach to multiple risk exposure assessment emerged from this early work wherein investigators examined repeated exposures to the same risk. As an illustration, Douglas (1975) found that the number of times a child was separated from her parents due to hospitalization prior to 5 years of age predicted a variety of adolescent outcomes—troubled behavior, reading deficits, delinquency, and (further on in life) frequent job changes. Interestingly, one hospital admission did not increase the odds of developing subsequent problem behaviors. Parallel data were found by Ackerman, Brown, D'Eramo, and Izard (2002) examining 1- to 9-year-olds' responses to changes in romantic partners of the child's mother.

Probably the most important reason for the widespread use of multiple risk factor metrics in developmental psychology today is the robust finding that multiple relative to single risk exposures have worse developmental consequences (Rutter, 1979, 1981; Sameroff, 2006; Sameroff, Seifer, & McDonough, 2004). As an illustration of both the power of multiple risk factor exposure effects as well as how robust these effects are, consider the following brief snapshot of some representative cumulative risk factor studies: Four-year-old children exposed to five or more risk factors have nearly a threefold elevation in psychological distress relative to their peers exposed to zero or one risk factor (Sameroff, Seifer, Zax, & Barocas, 1987); 9- and 10-year-olds facing six or more risk factors persist 50% less time on a behavioral index of learned helplessness relative to those with zero or one risk (G. W. Evans, 2003); 4% of American high school students with no risk factor exposure smoke daily, 7% of those exposed to one risk factor smoke daily, and 34% of high schools students who are exposed to seven or more risks smoke daily (Newcomb, Maddahian, & Bentler, 1986); finally, 7% of 6- to 9-year-olds with zero risk factors scored in the bottom quartile on standardized reading tests compared to 59% with five or more risk factors (Luster & McAdoo, 1994). As we show in this article, there are many studies with findings like these. Multiple risk factor exposure is detrimental to children, and the more risk factors they are exposed to, the worse the outcome.

Another reason to study multiple risk factor exposure is because children often contend with constellations of risk rather than isolated instances of adverse circumstances. For example, many low-income, inner city children reside in substandard housing located in high crime neighborhoods with low social capital; they attend schools with inadequate facilities staffed by less experienced teachers; and many live in single parent households (G. W. Evans, 2004; McLoyd, 1998). Given the relative strength of multi- versus singular risk factor impacts, studies of singular risk effects likely bias estimates of developmental impacts. The impact of a singular risk factor may be overestimated if it is correlated with one or more other risk factors (overlapping risk factors; Kraemer et al., 2005). For example, attending an elementary school located near an airport is associated with deficits in reading (G. W. Evans, 2006). However, these same schools often have larger class sizes, less experienced teachers, greater student and staff turnover, and are more likely populated by students from low-income households (G. W. Evans, 2004, 2006). Singling out the effects of school noise exposure on reading quality without taking into account these overlapping risk factors for reading deficits could overestimate the harmful impacts of noise on reading deficits. On the other hand, noise by itself may have negligible impact on reading deficits except when accompanied by household disadvantage or only if the exposure happens within the context of a school with inadequate facilities and staff. In the latter case, by isolating the singular impact of noise exposure as a risk factor for reading deficits, we might erroneously conclude that noise does not matter. It may in fact be a contributing risk factor for reading deficits but only when considered within the natural ecological context wherein high noise schools typically operate. Another way to think about this is that perhaps there is no main effect of noise on reading deficits but an interaction or moderator effect. Noise matters but only in the presence of certain other variables. As we explain below however, the use of an interactive, nonadditive model of multiple risk exposure is often not possible when a large number of risk factors are under consideration. Use of additive models of multiple risk factors is a common approach for dealing with this dilemma.

Investigation of multiple risk factor exposure is also valuable because some of the developmental correlates of major sociodemographic factors such as race, social class, and culture are explained, in part, by multiple risk factor exposure. For example, Felner et al. (1995) noted that the positive association between socioeconomic status (SES) and adolescent adjustment was mediated by a composite index of family climate, parent–child relationships, school climate, social support and exposure to stressful life events and daily hassles. G. W. Evans and English (2002) demonstrated that 34% of rural, White 8- to 10-year-olds living at or below the poverty line were exposed to four or more household physical (e.g., substandard housing) and psychosocial (e.g., family turmoil) risk factors, whereas 9% of children 2–4 times the poverty line were exposed to four or more cumulative risks. The obverse was true as well. Sixty-five percent of middle-income rural children were exposed to zero or one risk factor; for poor children, the comparable rate was 21%. In turn, these multiple risk exposures mediated some of the effects of poverty on children's chronic physiological stress, self-regulatory behavior, and psychological distress. In two different British birth cohorts, Schoon et al. (2002) found that the positive association between social class at birth and occupational attainment in middle age was largely mediated by multiple risk factor exposure during childhood. Risks included measures of material conditions (e.g., housing tenure, overcrowding, shared bathroom with other households). Bronfenbrenner (1979) referred to the examination of developmentally salient processes underlying macro societal variables like race, class, and culture, as unpacking social address. His belief in the importance of unpacking social address comes from a central tenet of the bioecological model of human development. According to Bronfenbrenner, the engines of human development are the exchanges of energy between the developing organism and the persons and objects immediately surrounding the child. In order for human development to be successful, these proximal processes must be reciprocal, continuous, and become increasingly complex as the child matures. Proximal processes are the key to understanding how both personal and environmental factors influence child development over time. Thus the study of multiple risk factor exposure among children can be seen as one approach to understanding what lies beneath powerful but distal macrosetting factors such as race, class, and culture. It is one approach to unpacking social address.

Another valuable reason to study multiple risk factor exposure among children is to help target interventions. Because multiple risk factor exposures nearly always have greater impact on children than singular risk factor exposures, identification of children confronted by multiple risk factors is likely to reveal vulnerable individuals who are priority candidates for interventions. Moreover, interventions or policies that target only a singular risk factor are less likely to be effective than those that address the full range of multiple risk factors with which children must contend. We say more about intervention and policy implications of multiple risk factor exposure at the conclusion of this article.

Finally, research and theory about multiple risk exposure is important because the number of children both in America and around the world confronting multiple risk factors is large and expanding. Figure 1, which is from a recent report of the National Center for Children in Poverty, reveals that in 2010, 20% of American children under 6 years of age were exposed to three or more multiple risk factors.

The most common form of developmental multiple risk models, cumulative risk (CR), examines the number of risks experienced rather than the intensity or pattern of risk exposures. CR models of multiple risk exposure define risk factors dichotomously (e.g., one biological parent in the home equals risk; two biological parents equals no risk). CR is then operationalized by summing across different multiple, dichotomous risk factors. Thus, a child with a single parent, living below the poverty line, and with difficult temperament would be assigned a CR value of 3. A child having only two of these risk factors would be assigned a score of 2. Note that the particular pattern or combination of risk factors is ignored—just the amount of risk factor exposure is reflected in the CR index.

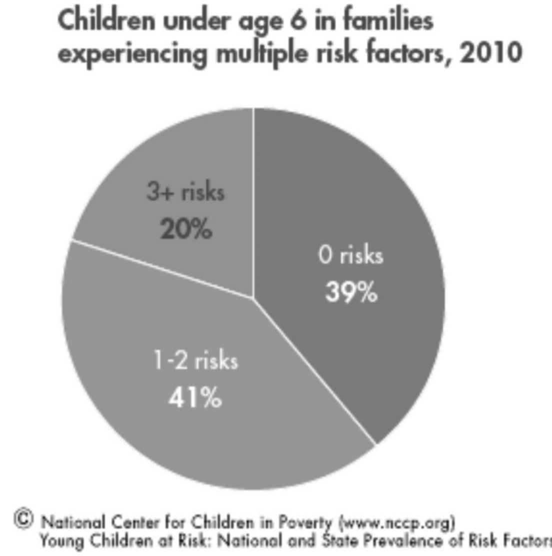

Figure 1. Prevalence of multiple risk factor exposure in American children under 6 years of age. The eight risk factors considered were households without an adult English speaker, family size ≥ 4 children, both parents lack high school degree, ≥1 residential changes in past year, single parent household, mother was teenager at child's birth, parents unemployed for past year, household less than 200% of Federal poverty level. Reprinted with permission from the National Center for Children in Poverty, Mailman School of Public Health, Columbia University.

As an additive model, the CR technique is a straightforward, easily interpretable means for identifying children at increased odds for developing a range of maladaptive outcomes, including cognitive deficits, behavioral adjustment problems, and poor physical health. Despite the utility and burgeoning popularity of CR methodology in human development research, there is no synthesis of the child CR literature, nor is there any in depth analysis of the strengths and weaknesses of CR compared to alternative ways of operationalizing multiple risk factor exposure. The purpose of this article is to fill in these gaps.

In the next section of this article, we explain our methods of review, followed by a summary of the childhood CR literature. We then compare CR to other approaches to multiple risk factor assessment and then conclude the article with a discussion of problems and prospects for the study of CR and child development.

Methods of Review

Although CR is used in a variety of fields, this review is restricted to cognitive, social, and emotional outcomes among children. Children were defined as persons below 19 years of age. In a few cases wherein only adults were included in the sample, we report subsets of outcome data available prior to the child's 19th birthday. Two common examples are dropping out of high school and teenage pregnancy. Research on CR in biological and medical domains among children is not included due to the enormity of this literature. We do not include literature where the CR was made up exclusively of stressful life events because many life events are not risks (e.g., marriage) and most reports of children's life event exposure are obtained via parental report and thus likely reflect some combination of parents' own stress experiences, psychological state, and personality. Additionally, many life events are not independent of the child's own behavior (e.g., juvenile justice offenses). Particularly relevant herein, life event studies rarely report data on specific events and outcomes, instead describing the relation between a total life events score and child outcomes. We did include, however, CR indices when one of the variables constituting CR was total stressful life events.

Using combinations of key words "cumulative risk," "multiple risk," "adversity," and "number of risk factors," we searched electronic databases (PsycINFO, EBSCO, Science Direct, Wiley Interscience, SpringerLink, JSTOR, and WOS) beginning in 1970 and followed up through citations found in articles, chapters, and books. Only published materials in English are included (i.e., conference papers and student theses are not included). Finally, we only included CR articles that defined cumulative risk by dichotomizing singular risk factors and then aggregating them, typically by a simple summation method. From an initial set of 433 articles and book chapters, the 196 papers cited herein were chosen according to the criteria listed above. When the authors did not independently agree on whether an article should be included (<5%), we decided on the basis of discussion among us.

Given that only published studies are included in the present review, potential publication bias may limit the generalizability of our conclusions. Studies with null findings are less likely to be published than those with statistically significant results. However, the threat of publication bias may not be high in the present case because, as we demonstrate herein, CR is a powerful predictor of child development outcomes with numerous findings that have been replicated.

Cumulative Risk

Although some researchers use the terms "multiple risk" and "cumulative risk" interchangeably, others use different models of multiple risk factor exposure, categorizing CR as a specific measurement technique. Multiple risk is as an overarching term that encompasses any model with more than one risk factor as a variable. More specifically, CR models operationalize multiple risk factor exposure in an additive manner, that is, no statistical interactions are examined. The CR model of multiple risk defines exposure to each singular risk categorically (0 = no risk; 1 = risk). Risk assignment is accomplished by a statistical criterion (e.g., upper quartile of risk exposure = 1; all others = 0) or based on a priori theory (e.g., dual caregivers in the home = 0; single parent = 1; above the poverty line = 0; ≤ poverty line = 1). The summation of these dichotomous risk values becomes the CR metric. Conceptually the CR metric puts a premium on high levels of risk factor exposure rather than calculating a risk score that combines variable levels of risk across different risk factors. Whereas in other multiple risk models modest degrees of risk factor exposure contribute to the total multiple risk index, in CR only high levels of risk factor exposure matter. As we discuss below, recent developments in neurobiology and stress align well with the CR model's emphasis on high levels of risk factor exposure.

Developmental Sequelae of CR: Main Effects

Table 1 provides a summary of the number of CR studies with significant main effects among children (age ≤ 18 years). The number of risk factors in these CR main effects studies range from two to 43 with the median number of risk factors being seven. The most common risk factors consist of sociodemographic variables such as gender, income, parental education, single parent household, teenage parenthood, and non-White ethnicity. In most CR studies, sociodemographic factors are assessed at the household level, but recently there has been a surge of interest in neighborhood risk factors as well, most typically low SES. Common psychosocial risk factors incorporated in CR studies include: total life events, violence, family conflict, child separation from family, harsh and/or unresponsive parenting, and parental psychological distress. A third group of risk factors in CR studies includes physical factors such as substandard housing, residential crowding, and noise. For more details on CR main effects studies, see Table A in the online supplemental materials.

Table 1
Number of Studies With Significant Cumulative Risk Main Effects

Outcome measure	Cross-sectional	Longitudinal
Academic achievement, Language	10	12
Attachment	2	
Behavioral conduct problems, Externalizing symptoms	20	16
Cognitive development	1	10
Internalizing symptoms, Suicide	12	10
Learned helplessness, Hopelessness	2	2
Motoric development	1	
Overall psychological well-being, Psychiatric distress	10	6
Parenting, Parent–child interaction		1
Physiological stress	5	
Self-regulatory behavior, Coping	2	4
Social competency, Peer relationships, Antisocial	6	7
School engagement	1	

Note. When multiple measures of the same dependent variable were included in the same study, the outcome was only counted once. When different dependent variables were included in the same study, each one was counted as an outcome.

In the aggregate these studies evidence that CR is associated with children's mental health as typically assessed by parental or self-report. Fewer studies reveal evidence of negative effects on physiological stress and cognitive performance/achievement, although the magnitude of impacts is similar across outcomes. One glaring omission in most CR studies (94%) is evidence that the effects of CR are not due to one particular risk factor incorporated into the CR index. This is important because a primary rationale for CR is that CR outperforms singular risk factor exposure in predicting developmental outcomes. CR could masquerade as a proxy risk factor metric for only one or a subset of the singular risk factors constituting the multiple risk metric. On the other hand, the few studies examining the CR effect when controlling for each one of its singular components indicate a significant residual CR effect (see Table A in the online supplemental materials).

The additive assumption underlying the CR metric implies a linear relation between the number of risk factors encountered and the outcome. An equal proportion of CR studies found linear as opposed to nonlinear functions plotting outcomes against CR. Thirty-two percent of studies with a common CR index but multiple dependent variables found evidence of both linear and nonlinear effects (see Table A in the online supplemental materials). Some caution is necessary in our accounting of the extent of linearity in CR:outcome plots because in most cases no formal tests of linearity were included. We relied upon judgments of the similarity of interval changes in data tables or graphs. When two of us independently came to different conclusions about perceived linearity of the function ($<10\%$), we determined linearity based upon discussion. To reiterate, linear plots for CR suggest that the additivity assumption of the model is tenable. Each of the risk factors appears to operate independently of the other risks as it influences the outcomes. Curvilinear functions of outcomes plotted against CR levels suggest nonadditive relationships. Clearly, the evidence for the additivity assumption in CR research is mixed.

Developmental Sequelae of CR: Moderator Effects

A smaller number of CR studies have examined the question of whether some important variable, most typically an individual characteristic such as gender, alters the nature of the relations between CR and various child outcomes. Some of these studies have conducted a formal interaction analysis, whereas others report effects (e.g., R^2) separately for different levels of some categorical variable (e.g., males vs. females, White vs. non-White). Although much less common than data on the main effects of CR on child development, these CR moderator studies are valuable because they show that CR effects are not necessarily uniform for all children. The patterns of interactions findings for cross sectional and longitudinal studies are summarized in Table 2.

It is important to recognize that many investigators may have examined moderator variables, found no significant interactions, and did not present those results in their papers. Thus, Table 2 probably overestimates the prevalence of moderator effects of CR on children's development. Nonetheless, at a minimum the findings in Table 2 indicate the value of considering moderator variables in CR assessments, particularly gender. Another prime candidate for a moderator construct in CR work is age. There are few truly developmental studies of CR examining either sensitive periods of CR exposure or the consequences of duration of CR exposure. Both of these issues are at the heart of a developmental perspective on risk factor assessment. We discuss the need for more developmental analysis in CR research in the Conceptual and Analytic Issues section below. For more details on CR moderator studies, see Table B in the online supplemental materials.

Developmental Sequelae of CR: Cross-Domain Effects

In addition to examining CR on the basis of exposure to the sum of individual risk factors, a small number of investigators have been interested in the question of what happens when children are exposed to risk factors across different domains of risk. For example, one could estimate CR for the domains of family and neighborhood separately and then look at developmental outcomes for children with risk in no single domain, risk in one domain, or risk in both domains (i.e., family, neighborhood), yielding a cumulative domain risk score in this example from 0 to 2. We summarize multiple domain CR study results in Table 3. As suggested by comparing multiple domains of risk factor exposure in Table 3 to the more traditional CR indices as shown in Table A in the online supplemental materials, there appears to be merit in considering the possibly greater adaptive demands posed by risks occurring in multiple domains rather than counting the total number of risk exposures. Studies that examined the number of different domains of cumulative risk that a child is exposed to (see Table 3) find larger effects ($M = 22.7\%$ increment in adversity per risk factor exposure) than those found when examining an overall CR index as shown in Tables A and B in the online supplemental materials ($M = 5.7\%$ increment in adversity per risk factor exposure). As we discuss further in the last section of this article, it is also possible to use the domain CR approach but also test statistical interactions between different CR domains.

It would also be possible to use the cross risk domain model in conjunction with potential moderator variables. For example, Gerard and Buehler (2004b) found evidence (see Table 3) of a cross risk domain effect on measures of internalizing and externalizing behavior among adolescents. Both outcomes were buffered by high self-esteem. Similarly, Furstenberg, Cook, Eccles, Elder, and Sameroff (1999) found evidence that multiple protective factors in the domains of family processes (e.g., positive family climate) and external resources (e.g., institutional connections) buffered the adverse impacts of cross-domain impacts of low caregiver resources, demographic risks, and neighborhood risks on academic performance, activity involvement, mental health, and behavioral problems.

Comparing CR to Alternative Multiple Risk Modeling Techniques

When evaluating CR as an index of multiple risk exposure, an important issue is how well does CR represent multiple risk exposure in comparison to alternative multiple risk metrics? Although the vast majority of studies listed in Tables 1, 2, A, and B have not done so, there are a few instances of comparative multiple risk assessments. These are summarized in Table 4. The most common comparative investigation has contrasted CR metrics with OLS multiple regression models, utilizing total R^2 as the index of multiple risk exposure effect.

Table 2
Number of Studies With Significant Cumulative Risk Interaction Effects

Outcome measure	Moderators	Cross-sectional	Longitudinal
Academic achievement, Language	Gender	3	2
	Ethnicity		1
	Parenting	4	
	Social/psychological competence	2	2
	Cognitive competence, IQ	2	3
	Biological risk	2	1
	Age		1
	Intervention	1	3
	Attachment		1
	Poverty		3
Behavioral conduct problems, Externalizing symptoms	Gender	8	4
	Ethnicity	8	2
	Parenting	5	
	Social/psychological competence	3	
	Cognitive competence, IQ	1	1
	Biological risk	1	2
	Age	2	1
	Intervention	1	1
	Attachment		3
	Multiple protective factors	1	3
	Urbanism	1	
Cognitive development	Gender		1
	Parenting		1
	Social/psychological competence		1
	Cognitive competence, IQ		1
	Attachment		1
	Multiple protective factors		1
Internalizing symptoms, Suicide	Gender	4	2
	Ethnicity	3	2
	Parenting	2	1
	Social/psychological competence	2	1
	Cognitive competence, IQ	1	1
	Biological risk		1
	Age	1	1
Overall psychological well-being	Gender	4	1
	Social/psychological competence	1	1
	Biological risk	1	1
	Age	1	
Physiological stress	Parenting		1
	Social/psychological competence	1	1
	Poverty	1	
Self-regulatory behavior	Gender		1
	Ethnicity	1	
Social competency, Peer relationships, Antisocial	Gender		1
	Parenting	1	
	Social/psychological competence	1	1
	Attachment		1

Note. When multiple measures of the same dependent variable were included within the same study, the outcome was only counted once. When different dependent variables were included in the same study, each one was counted as an outcome. If more than one moderator was significant within the same study, each significant outcome was counted.

OLS and CR

Inspection of Table 4 indicates that the additive, OLS model approach does a slightly better job of predicting outcome variables compared to CR. In 58 out of 95 comparisons, CR fared more poorly than the additive, nonaggregated metric, whereas in seven of the comparisons, CR was superior. The two different metrics were comparable 30 times. However it is important to recognize that many studies do not provide comparable statistical information for the CR and the OLS regression results. In a comparative study of different multiple risk measurement models, Burchinal, Roberts, Hooper, and Zeisel (2000) found that the CR index did not predict concurrent outcomes as well as the OLS additive model, but it was superior in prospective prediction. Flouri and Kallis (2007) showed that the Bayesian information criterion was lower for a CR model, indicative of better fit, in comparison to one incorporating each singular risk factor exposure in a general linear model.

Use of a nonaggregated OLS technique creates challenging analytical and interpretation problems. The overall model may be significant but individual variable coefficients can be low or nonsignificant (J. Cohen et al., 2003; Myers & Wells, 2003). Their weightings are less stable than unitary assignment (as used in CR

Table 3
Alternative Cumulative Risk Formulations

Author(s)	Age	No. of risks	Outcome measure(s)	CR factors	Domain definition	Functional form	CR effect sizes
Belsky (1996)	126 first-born sons 13 months	3	Father attachment	Continuous Parenting Agreeableness Neuroticism Extraversion Infant Positive temperament Negative temperament Social-context Marital quality Social support Work–family relations Upper quartile = 1 except for fighting (>1) or weapon use, crime victim (any = 1) [done separately by gender]	Domain risk = below median	Linear (descriptive)	% Securely attached[a] 0.75 1.67 2.59 3.55
W. P. Evans et al. (2010)	1,619 8th and 10th graders	5	Sense of coherence (understanding of how world works)	Individual Fighting Threatened or attacked Used weapon Problem behavior Suicide attempt Crime victim Beer use Marijuana use Anger expression Home Single parent Family conflict Peer Peer influence Gang member Friends/family in gang Peer attitudes re: drugs School Times skipped school	Domain risk = ≥1 risk in domain	Linear (statistical)	Male $0 \rightarrow 3.30$ $1 \rightarrow 3.23$ $2 \rightarrow 3.08$ $3 \rightarrow 2.97$ $4 \rightarrow 2.81$ $5 \rightarrow 2.64$ Female $0 \rightarrow 3.29$ $1 \rightarrow 3.16$ $2 \rightarrow 3.02$ $3 \rightarrow 2.89$ $4 \rightarrow 2.75$ $5 \rightarrow 2.71$

Table 3 (*continued*)

Author(s)	Age	No. of risks	Outcome measure(s)	CR factors	Domain definition	Functional form	CR effect sizes
				Community Values re: school dropout Values re: gang membership Values re: violence			
Furstenberg et al. (1999)	482 10–14 years	3	Academic competence, activity involvement, mental health problems, behavioral problems	Within domain score sum of 0/1 for each variable	Domain risk = 1 if >2 risks for demographic and 1 if >1 risk for neighborhood, caregiver	Nonlinear (descriptive)	
				Demographic (parental education, single parent, family income, welfare, number of children)			Academic 0 → .20 1 → .02 2 → −.35 3 → −.42
				Neighborhood (% poverty, institutional resources, climate [∼social capital])			Activity involvement 0 → .13 1 → −.02 2 → −.15 3 → −.52
				Caregiver resources (resourcefulness, self-efficacy, mental health)			Mental health problems 0 → −.21 1 → .00 2 → .29 3 → .80
							Behavioral problems 0 → −.13 1 → .03 2 → .13 3 → .31
Gerard & Buehler (2004b)	5,070 11–18 years	4	Conduct problems, depressed mood	Within domain score sum of 0/1 for each variable	Domain risk = ≥1 risk in domain	Linear (descriptive)	
				Familial Poverty High school dropout Single parent Crowding Low marital quality			Externalizing 0 → 3.35 1 → 3.33 2 → 3.54 3 → 4.78 4 → 5.88

(table continues)

Table 3 (*continued*)

Author(s)	Age	No. of risks	Outcome measure(s)	CR factors	Domain definition	Functional form	CR effect sizes
				Low parental warmth Low parental involvement Peer Low social support Peer rejection School Low connectedness Neighborhood Low quality High problems Low satisfaction Low safety			Internalizing 0 → 9.18 1 → 9.95 2 → 10.10 3 → 11.59 4 → 14.05
Marsh et al. (2009)	1,619 8th and 10th graders	5	Crime victimization	Upper quartile = 1 except for fighting (>1) or weapon use (any = 1) [done separately by gender] Individual Fighting Used weapon Problem behavior Suicide attempt Beer use Marijuana use Anger expression Home Single parent Family conflict Peer Peer influence Gang member Friends/family in gang Peer attitudes re: drugs School Times skipped school Community Values re: school dropout Values re: violence	Domain risk = ≥1 risk in domain	Linear (statistical)	Male 0 → 0.93 1 → 1.16 2 → 1.64 3 → 2.29 4 → 3.31 5 → 4.93 Female 0 → 0.16 1 → 0.55 2 → 1.13 3 → 1.48 4 → 2.14 5 → 2.74

Table 3 (*continued*)

Author(s)	Age	No. of risks	Outcome measure(s)	CR factors	Domain definition	Functional form	CR effect sizes
Morales & Guerra (2006)	2,754 6–11 years Longitudinal	3	Reading, math, depression, aggression	>1 *SD* above *M* = 1, except for free lunch where 1 = eligible for both years School Peer rejection Peer victimization School problems Family Free lunch eligibility Family transitions Neighborhood Violence	Domain risk 0 if no risk in any domain 1 = one domain 2 = ≥2 domains	N/A	Domain risk *ns* after controlling for cumulative risk (0–6) of six risk factors. No test of domain risk on its own
Shaw et al. (1998)	300 males 6–42 months Longitudinal	4 domains at 18 and 24 months	Int. and ext. at 24 and 42 months, both continuous and clinical cutoffs	Variable for different risks Maternal adjustment Maternal depression (clinical threshold) Maternal social support (>1 *SD*) General life satisfaction (>1 *SD*) Family environment Marital adjustment (>1 *SD*) Child-rearing disagreements (>1 *SD*) Parenting daily hassles (>1 *SD*) Criminal/aggressive behavior Maternal aggression (>1 *SD*) Family criminality (any report) Neighborhood danger (>1 *SD*) Sociodemographic Low family income (<$6,000) Crowding (>4 children or <1 person/room)	Domain risk = ≥1 risk in domain int.	Linear for 18-month-olds except 24-month int.; linear for 24-month- olds except for 24-month ext. (descriptive)	18-month-olds 24-month ext. 0 → 11.6% 1 → 18.2% 2 → 20.3% 3 → 32.1% 4 → 27.3% 24-month int. 0 → 5.8% 1 → 9.6% 2 → 19.1% 3 → 9.7% 4 → 9.1% 42-month ext. 0 → 8.9% 1 → 13.5% 2 → 18.2%

(table continues)

Table 3 (*continued*)

Author(s)	Age	No. of risks	Outcome measure(s)	CR factors	Domain definition	Functional form	CR effect sizes
							3 → 28.6% 4 → 54.5% 42-month int. 0 → 11.9% 1 → 10.8% 2 → 13.6% 3 → 14.8% 4 → 36.4% 24-month-olds 24-month ext. 0 → 13.4% 1 → 15.7% 2 → 22.2% 3 → 47.6% 4 → 11.1% 24-month int. 0 → 1.9% 1 → 10.7% 2 → 12.5% 3 → 23.8% 4 → 22.2% 42-month ext. 0 → 4.2% 1 → 12.7% 2 → 15.9% 3 → 43.5% 4 → 62.6% 42-month int. 0 → 4.2% 1 → 12.7% 2 → 13.0% 3 → 30.0% 4 → 25.0%
Stouthamer-Loeber et al. (2002)	454 1st graders 417 7th graders	6	Persistent, serious juvenile delinquency over 6-year follow-up	Within domain score sum of 0/1 for each variable with 1 = upper quartile. Child behavior domain (substance abuse, cruelty, accountability, trustworthy, manipulative, ADHD, oppositional defiant, internalization) Child attitude domain (delinquency, antisocial behavior, school, scholastic motivation, religiosity)	Domain risk = 1 upper quartile within	Linear (descriptive)	 1st graders 0 CR 2% 5 CR 71% OR = 1.88 CI [1.61, 2.36] 7th graders 0 CR 10% 6 CR 100% OR = 1.37 CI [1.14, 1.65]

Table 3 (*continued*)

Author(s)	Age	No. of risks	Outcome measure(s)	CR factors	Domain definition	Functional form	CR effect sizes
				School and leisure domain (academic achievement, standard test scores, extracurricular, job and chores performance) Family domain (parental monitoring, parent–child joint activities, parental discipline and child counter moves, physical punishment, parental consistency and agreement on discipline, parent–child communication, parent social support, maternal partner relationship quality, maternal satisfaction with partner) Sociodemographic domain (maternal age at child birth, maternal education, number of children, SES, housing quality, neighborhood SES, neighborhood crime)			
Thornberry et al. (1997)	615 13- to 21-year-old males Longitudinal	10	21-year-old fatherhood	> Median or categorical Race Black Hispanic Area characteristics % poverty, % female-headed, arrest rate, neighborhood disorganization Parental stress Life events, family social support, parental depression, violence, friend social support Parent–child relations Lives with both parents, attachment to parent, parental supervision, parental involvement, child abuse report	> Median risk factors within domain = 1	Linear (descriptive)	Cumulative risk 0–1 → 0% 2 → 2% 3 → 5% 4 → 17% 5 → 22% 6 → 40% 7–10 → 44%

(table continues)

Table 3 (*continued*)

Author(s)	Age	No. of risks	Outcome measure(s)	CR factors	Domain definition	Functional form	CR effect sizes
				School Commitment to school, attachment to teacher, college aspirations, parent's college expectation for youth, math score, reading score Early sexual activity Early girlfriend Early sexual intercourse Peers Delinquent peers, gang membership Individual characteristics Religious participation, depression, externalizing, internalizing, delinquent beliefs, self-esteem Deviant behaviors Drug user status, general offender status, violent offender status Family structural position Parental education, welfare, poverty, parental age at 1st birth			
Thornberry et al. (2003)	1,000 13- to 15-year-olds Longitudinal	7	Joining gang ages 16–22 years	> Median or categorical Area characteristics % Black, % poverty, community arrest rate, neighborhood disorganization, neighborhood violence, neighborhood drug use, neighborhood integration Family sociodemographic Black, Hispanic, parent education, family disadvantage, poverty, live with both biological parents, family transitions	> Median risk factors with domain = 1	Linear (descriptive)	Males 0 → 0.0% 1 → 0.9% 2 → 11.0% 3 → 16.7% 4 → 31.6% 5 → 36.5% 6 → 28.8% 7 → 60.6% Females 0 → 0.0% 1 → 0.0% 2 → 11.9% 3 → 3.3% 4 → 26.0% 5 → 16.9%

Table 3 (*continued*)

Author(s)	Age	No. of risks	Outcome measure(s)	CR factors	Domain definition	Functional form	CR effect sizes
				Parent–child relations Attachment to parent, attachment to child, parent involvement, parent supervision, positive parenting, child maltreatment, family hostility School factors Commitment to school, attachment to teacher, college aspirations, college expectations, parental college expectations for youth, math score Peer relationships Delinquent peers, early dating, early sexual activity, unsupervised time with friends Individual characteristics Negative life events, depression, self-esteem, externalizing, delinquent beliefs Early delinquency General delinquency, violent delinquency, drug use, onset age of general delinquency			$6 \rightarrow 22.7\%$ $7 \rightarrow 40.2\%$

Note. CR = cumulative risk; OR = odds ratio; CI = confidence interval; ADHD = attention-deficit/hyperactivity disorder; SES = socioeconomic status; int. = internalizing; ext. = externalizing.
[a]Approximate based on figure.

Table 4
Cumulative Risk and Other Multiple Risk Approaches

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
Adelmann, 2005	5	Negative behaviors (delinquent behavior, sedentary recreation, empty calorie consumption, suicidal behavior, tobacco use, alcohol use, other drug use); positive behaviors (prosocial recreation, productive behavior, exercise behavior, nutrition behavior, seatbelt use, academic achievement)	CR, ANA	$\beta = .33$, $p < .001$ (delinquent behavior); $\beta = .12$, $p < .001$ (sedentary recreation); $\beta = .14$, $p < .001$ (empty calories consumption); $\beta = .29$, $p < .001$ (suicidal behavior); $\beta = .86$, $p < .001$ (tobacco use); $\beta = .63$, $p < .001$ (alcohol use); $\beta = .81$, $p < .001$ (other drug use); $\beta = .05$, $p < .001$ (prosocial recreation); $\beta = .13$, $p < .001$ (productive behavior); $\beta = .09$, $p < .001$ (exercise behavior); $\beta = .08$, $p < .001$ (nutrition behavior); $\beta = -.12$, $p < .001$ (seatbelt use); $\beta = -.14$, $p < .001$ (academic achievement)	ANA: $R^2 = .27$, $p < .001$ (delinquent behavior); $R^2 = .04$, $p < .001$ (sedentary recreation); $R^2 = .05$, $p < .001$ (empty calories consumption); $R^2 = .19$, $p < .001$ (suicidal behavior); $R^2 = .20$, $p < .001$ (tobacco use); $R^2 = .14$, $p < .001$ (alcohol use); $R^2 = .19$, $p < .001$ (other drug use); $R^2 = .02$, $p < .001$ (prosocial recreation); $R^2 = .02$, $p < .001$ (productive behavior); $R^2 = .02$, $p < .001$ (exercise behavior); $R^2 = .02$, $p < .001$ (nutrition behavior); $R^2 = .10$, $p < .001$ (seatbelt use); $R^2 = .07$, $p < .001$ (academic achievement)
Aro et al., 2009	12	IQ, reading fluency, social adaptive behavior	CR, ANA	$\eta^2 = .166$, $p \leq .001$ (IQ); $\eta^2 = .092$, $p \leq .05$ (reading fluency); $\eta^2 = .099$, $p \leq .05$ (social adaptive behavior)	ANA: $\Delta R^2 = .345$, $p < .001$ (IQ); $\Delta R^2 = .224$, $p < .001$ (reading fluency); $\Delta R^2 = .181$, $p < .001$ (social adaptive behavior)
Brooks-Gunn et al., 1995	11	IQ, behavior problems	CR, ANA	The mean IQ difference between the lowest- and highest-risk groups was 12 IQ points in the poor children, and 29 IQ points in the not poor children	ANA: IQ: $R^2 = .06$ (poor), $R^2 = .16$ (not poor). Behavioral problems: $R^2 = .18$ (poor), $R^2 = .25$ (not poor)
Deković, 1999	6	Internalizing, externalizing	CR, ANA	$\Delta R^2 = .24$, $p < .001$ (internalizing); $\Delta R^2 = .22$, $p < .001$ (externalizing)	ANA: $\Delta R^2 = .45$, $p < .001$ (internalizing); $\Delta R^2 = .55$, $p < .001$ (externalizing)
Dubow & Luster, 1990	7	Behavior problems total, behavior problems antisocial, math, reading recognition, reading comprehension	CR, ANA	$r = .14$, $p < .01$ (behavior problems total); $r = .25$, $p < .01$ (behavior problems antisocial); $r = -.25$, $p < .01$ (math); $r = -.27$, $p < .01$ (reading recognition); $r = -.30$, $p < .01$ (reading comprehension)	ANA: $R^2 = .06$, $p < .01$ (behavior problems total); $R^2 = .09$, $p < .01$ (behavior problems antisocial); $R^2 = .10$, $p < .01$ (math); $R^2 = .11$, $p < .01$ (reading recognition); $R^2 = .13$, $p < .01$ (reading comprehension)
Farrell et al., 1992	11	Drug use	CR, ANA	Linear trend: $R^2 = .20$, $p < .001$ (cigarettes); $R^2 = .26$, $p < .001$ (beer); $R^2 = .23$, $p < .001$ (wine); $R^2 = .14$, $p < .001$ (hard liquor); $R^2 = .18$, $p < .001$ (marijuana); $R^2 = .29$, $p < .001$ (gateway drugs); $R^2 = .08$, $p < .001$ (other drugs)	ANA: $R^2 = .25$, $p < .0001$ (cigarettes); $R^2 = .32$, $p < .0001$ (beer/wine); $R^2 = .17$, $p < .0001$ (hard liquor); $R^2 = .28$, $p < .0001$ (marijuana); $R^2 = .32$, $p < .0001$ (gateway drugs); $R^2 = .12$, $p < .0001$ (other drugs)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
Flouri & Kallis, 2007	25	Psychological well-being	CR, ANA	BIC = 125.579	BIC = 211.056
Gassman-Pines & Yoshikawa, 2006	9	School achievement, externalizing, internalizing	CR, ANA	New Hope sample: β =−.17, $p < .01$ (parent-reported school achievement); β = .22, $p < .001$ (parent-reported externalizing); β = .25, $p < .001$ (parent-reported internalizing); β = −.05, $p > .05$ (teacher-reported school achievement); β = −.02, $p > .05$ (teacher-reported externalizing); β = −.03, $p > .05$ (teacher-reported internalizing). Minnesota Family Investment Program sample: β =−.10, $p < .01$ (parent-reported school achievement); β = .24, $p < .001$ (parent-reported externalizing); β = .23, $p < .001$ (parent-reported internalizing)	ANA: For both the New Hope and Minnesota Family Investment Program samples, including each individual risk factor in regressions predicting child outcomes accounted for more variance in the child outcomes than the cumulative risk index. The differences were small in size (about 3% more variance in the New Hope sample; between 3% and 9% more variance in the Minnesota Family Investment Program sample).
Gerard & Buehler, 2004b	14	Externalizing, internalizing	CR, ANA	R^2 = .08, $p < .001$ (Time 1 externalizing); R^2 = .16, $p < .001$ (Time 1 internalizing); R^2 = .001, $p > .05$ (Time 2 externalizing); R^2 = .03, $p < .001$ (Time 2 internalizing)	ANA: R^2 = .17, $p < .001$ (Time 1 externalizing); R^2 = .26, $p < .001$ (Time 1 internalizing); R^2 = .02, $p < .001$ (Time 2 externalizing); R^2 = .03, $p < .01$ (Time 2 internalizing)
Goebert et al., 2004	4	Grades, absences, suspensions, conduct infractions	CR, ANA	χ^2 = 3.20, $p > .05$ (grades); χ^2 = 14.81, $p < .0001$ (absences); χ^2 = 17.17, $p < .0001$ (suspensions); χ^2 = 28.50, $p < .0001$ (conduct infractions)	ANA: Individual risk factors of CR were not strong predictors of the four outcomes. Criminality provided the greatest significant impact, increasing the odds of suspensions (OR = 2.03), conduct infraction (OR = 1.47), and, to a lesser degree, absences (OR = 1.37) when examining Hawaiians and non-Hawaiians combined. However, criminality explained less than 2% of the variance.
D. Hart et al., 2003	4	Change of personality type: Transition from resilient to undercontrolled, transition from undercontrolled to resilient. Change in risk and change in type.	CR, ANA	b = 1.07, SE = .42, $p < .05$	ANA: *ns*
Hooper et al., 1998	10	Cognitive development, expressive communication, receptive communication, at 12 months	CR, ANA	R^2 = .01, $p > .05$ (cognitive development); R^2 = .12, $p < .001$ (expressive communication); R^2 = .17, $p < .001$ (receptive communication)	ANA: R^2 = .14, $p < .03$ (cognitive development); R^2 = .07, $p > .05$ (expressive communication); R^2 = .28, $p < .001$ (receptive communication)
Hubbs-Tait et al., 2002	4	Receptive vocabulary, following instructions	CR, ANA	β = −.23, $p \leq .05$ (receptive vocabulary); β = −.30, $p < .01$ (following instructions)	ANA: ΔR^2 = .09, $p < .05$ (receptive vocabulary); ΔR^2 = .10, $p < .05$ (following instructions)
Jessor et al., 1995	6	Multiple problem behavior index (drinking, drugs delinquency, sexual intercourse)	CR, ANA	ΔR^2 = .132, $p < .001$	ANA: ΔR^2 = .328, $p < .001$

(*table continues*)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
Jones et al., 2002	4	Externalizing, internalizing	CR, ANA	R^2 = .01, $p > .05$ (externalizing); R^2 = .03, $p < .01$ (internalizing)	ANA: R^2 = .06, $p < .01$ (externalizing); R^2 = .12, $p < .01$ (internalizing)
Klebanov & Brooks-Gunn, 2006	9	IQ	CR, ANA	*F*s > 3.38, *p*s < .02 (IQ scores at 3, 5, and 8 years of age)	ANA: Few individual risk factors were significantly associated with children's IQ scores. Welfare receipt was associated with about a third of a standard deviation decrease in IQ scores at 5 years of age (4.8 points, $\beta = -.16$, $p < .05$). Less than a high school education was associated with close to a half standard deviation decrease in IQ scores at 8 years of age (7.4 points, $\beta = -.26$, $p < .001$)
Larson et al., 2008	8	Socioemotional health	CR, ANA	For 1, 2, 3, 4, 5, 6+ risk factors, OR = 1.42 (95% CI [1.27, 1.59]), 2.24 (95% CI [1.99, 2.52]), 2.63 (95% CI [2.32, 2.98]), 3.35 (95% CI [2.92, 3.84]), 3.46 (95% CI [2.95, 4.05]), 4.29 (95% CI [3.61, 5.08])	ANA: No summary statistical information for the total equation (e.g., R^2) is available. No education more than high school: OR = 0.99 (95% CI [0.91, 1.08]); family poverty: OR = 1.37 (95% CI [1.25, 1.49]); not 2-parent household: OR = 1.53 (95% CI [1.41, 1.67]); Black/Hispanic: OR = 0.76 (95% CI [0.69, 0.83]); uninsured: OR = 0.74 (95% CI [0.64, 0.86]); family conflict: OR = 1.47 (95% CI [1.37, 1.58]); low maternal mental health: OR = 2.07 (95% CI [1.91, 2.24]); unsafe neighborhood: OR = 1.40 (95% CI [1.26, 1.56]).
Laucht et al., 1997	11	Motor skills, cognitive development, socio-emotional skills	CR, ANA	R^2 = .049 (motor skills); R^2 = .080 (cognitive development); R^2 = .049 (socio-emotional skills)	ANA: R^2 = .056 (motor skills); R^2 = .138 (cognitive development); R^2 = .101 (socio-emotional skills)
Liaw & Brooks-Gunn, 1994	13	IQ, severe behavior problems (externalizing, internalizing) at 36 months	CR, ANA	$t = -5.88$, $p < .001$ (IQ); $t = 3.19$, $p < .001$ (severe behavior problems)	ANA: R^2 = .13, $p < .05$ (IQ); R^2 = .12, $p < .05$ (severe behavior problems)
Lichter et al., 2002	5	Volunteer activity	CR, ANA	OR = 0.88, $p = .11$ (males); OR = 0.82, $p < .05$ (females)	ANA: Males: No summary statistical information available for the total equation (e.g., R^2) is available. Females: No summary statistical information available for the total equation (e.g., R^2) is available.
Luster & McAdoo, 1994	9	Vocabulary, math, reading recognition, reading comprehension, antisocial behavior, total behavioral problem	CR, ANA	For 0, 1–2, 3–4, 5 or more risk factors: 7%, 13%, 29%, 46% (vocabulary); 0%, 25%, 26%, 39% (math); 7%, 18%, 22%, 47% (reading recognition); 9%, 17%, 30%, 59% (reading comprehension); 15%, 16%, 27%, 45% (antisocial behavior). For 0, 1–2 risk factors: 16%, 32% (total behavioral problems)	ANA: R^2 = .22, $p < .05$ (vocabulary); R^2 = .13, $p < .05$ (math); R^2 = .16, $p < .05$ (reading recognition); R^2 = .11, $p < .05$ (reading comprehension); R^2 = .11, $p < .05$ (antisocial behavior); R^2 = .06, $p < .05$ (total behavioral problems)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
Margolin et al., 2010	3	Somatic complaints, depression, anxiety, over-arousal, aggression, delinquency, academic failure, comorbidity of symptoms	CR, ANA	Adjusted RR = 1.12, $p < .05$ (somatic complaints); 1.77, $p < .001$ (depression); 1.58, $p < .001$ (anxiety); 1.17, $p > .05$ (over-arousal); 1.14, $p > .05$ (aggression); 1.25, $p < .01$ (delinquency); 1.20, $p < .01$ (academic failure). Adjusted OR = 1.32, $p < .001$ (comorbidity of symptoms).	ANA: Somatic complaints: adjusted RR = 1.03, $p < .05$ (parent-to-youth aggression); 1.01, $p > .05$ (physical marital aggression); 1.03, $p > .05$ (community violence). Depression: adjusted RR = 1.02, $p > .05$ (parent-to-youth aggression); 1.001, $p > .05$ (physical marital aggression); 1.04, $p > .05$ (community violence). Anxiety: adjusted RR = 1.003, $p > .05$ (parent-to-youth aggression); 1.06, $p < .001$ (physical marital aggression); 1.05, $p > .05$ (community violence). Over-arousal: adjusted RR = 1.01, $p > .05$ (parent-to-youth aggression); 1.03, $p > .05$ (physical marital aggression); 1.12, $p < .001$ (community violence). Aggression: adjusted RR = 1.03, $p < .01$ (parent-to-youth aggression); 0.93, $p > .05$ (physical marital aggression); 1.04, $p > .05$ (community violence). Delinquency: adjusted RR = 1.03, $p < .05$ (parent-to-youth aggression); 1.04, $p < .001$ (physical marital aggression); 1.03, $p > .05$ (community violence). Academic failure: adjusted RR = 1.03, $p < .001$ (parent-to-youth aggression); 1.03, $p < .001$ (physical marital aggression); 1.10, $p < .001$ (community violence).
McGauhey et al., 1991	6	School loss days, school failure, low school-ranking, behavior problems	CR, ANA	School-loss days: OR = 1.5, $p < .05$ (normal birth weight); OR = 2.7, $p < .05$ (low birth weight). School failure: OR = 2.1, $p < .05$ (normal birth weight); OR = 4.4, $p < .05$ (low birth weight). Low school-ranking: OR = 1.7, $p < .05$ (normal birth weight); *ns* (low birth weight). Behavior problems: OR = 1.7, $p < .05$ (normal birth weight); OR = 4.2, $p < .05$ (low birth weight).	ANA: No summary statistical information for the total equation (e.g., R^2) is available.

(*table continues*)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
					School-loss days: (1) normal birth weight: *ns* (mother/alone family); *ns* (mother/other family); *ns* (family income); *ns* (low maternal education); *ns* (mother high school graduate); OR = 0.7, $p < .05$ (3–4 children); *ns* (≥5 children); *ns* (extent of crowding); OR = 1.8, $p < .05$ (maternal self-perception of health status as fair/poor); *ns* (maternal self-perception of health status as good). (2) Low birth weight: *ns* (mother/alone family); *ns* (mother/other family); *ns* (family income); *ns* (low maternal education); *ns* (mother high school graduate); *ns* (3–4 children); *ns* (≥5 children); *ns* (extent of crowding); OR = 5.7, $p < .05$ (maternal self-perception of health status as fair/poor); OR = 2.3, $p < .05$ (maternal self-perception of health status as good).
					School failure: (1) normal birth weight: *ns* (mother/alone family); *ns* (mother/other family); OR = 2.0, $p < .05$ (family income); OR = 1.7, $p < .05$ (low maternal education); *ns* (mother high school graduate); OR = 1.5, $p < .05$ (3–4 children); OR = 1.8, $p < .05$ (≥5 children); *ns* (extent of crowding); *ns* (maternal self-perception of health status as fair/poor); OR = 1.5, $p < .05$ (maternal self-perception of health status as good). (2) Low birth weight: *ns* (mother/alone family); *ns* (mother/other family); OR = 3.1, $p < .05$ (family income); *ns* (low maternal education); *ns* (mother high school graduate); *ns* (3–4 children); *ns* (≥5 children); *ns* (extent of crowding); OR = 3.3, $p < .05$ (maternal self-perception of health status as fair/poor); OR = 2.3, $p < .05$ (maternal self-perception of health status as good).

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
					Low school-ranking: (1) normal birth weight: *ns* (mother/alone family); OR = 1.7, $p < .05$ (mother/other family); *ns* (family income); OR = 1.5, $p < .05$ (low maternal education); *ns* (mother high school graduate); *ns* (3–4 children); OR = 2.9, $p < .05$ (≥5 children); *ns* (extent of crowding); OR = 1.9, $p < .05$ (maternal self-perception of health status as fair/poor); *ns* (maternal self-perception of health status as good). (2) Low birth weight: *ns* (mother/alone family); *ns* (mother/other family); *ns* (family income); *ns* (low maternal education); *ns* (mother high school graduate); *ns* (3–4 children); *ns* (≥5 children); *ns* (extent of crowding); *ns* (maternal self-perception of health status as fair/poor); *ns* (maternal self-perception of health status as good).
					Behavior problems: (1) normal birth weight: *ns* (mother/alone family); *ns* (mother/other family); OR = 1.3, $p < .05$ (family income); OR = 2.0, $p < .05$ (low maternal education); OR = 1.4, $p < .05$ (mother high school graduate); *ns* (3–4 children); *ns* (≥5 children); *ns* (extent of crowding); OR = 1.9, $p < .05$ (maternal self-perception of health status as fair/poor); OR = 1.2, $p < .05$ (maternal self-perception of health status as good). (2) Low birth weight: *ns* (mother/alone family); *ns* (mother/other family); OR = 2.9, $p < .05$ (family income); *ns* (low maternal education); *ns* (mother high school graduate); *ns* (3–4 children); *ns* (≥5 children); *ns* (extent of crowding); OR = 2.3, $p < .05$ (maternal self-perception of health status as fair/poor); OR = 2.4, $p < .05$ (maternal self-perception of health status as good).

(*table continues*)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
Newcomb et al., 1987	12	Substance use	CR, ANA	r = .51 (cigarettes); r = .56 (alcohol); r = .57 (cannabis); r = .43 (cocaine); r = .44 (hard drug); r = .64 (composite substance use score)	ANA: multiple R = .54 (cigarettes); multiple R = .62 (alcohol); multiple R = .65 (cannabis); multiple R = .46 (cocaine); multiple R = .51 (hard drug); multiple R = .71 (composite substance use score)
Perkins et al., 1998	10	Early sexual activity (before 17 years of age)	CR, ANA	No main effect reported	ANA: No summary statistical information for the total equation (e.g., R^2) is available.
Phillips et al., 2005	13	Depression, anxiety	CR, ANA	OR = 0.85, $p > .05$ (depression); OR = 1.50, $p < .01$ (anxiety)	ANA: No summary statistical information for the total equation (e.g., R^2) is available. Depression: OR = 0.94, $p > .05$ (partner separation); OR = 0.42, $p > .05$ (change partner); OR = 1.00, $p > .05$ (marital quality, prenatal); OR = 1.01, $p > .05$ (marital quality, birth); OR = 0.97, $p > .05$ (marital quality, 6 months); OR = 1.01, $p > .05$ (marital quality, 5 years); OR = 2.43, $p > .05$ (maternal deviance); OR = 0.75, $p > .05$ (partner deviance); OR = 0.98, $p > .05$ (poverty); OR = 0.48, $p > .05$ (child hospitalizations); OR = 0.94, $p > .05$ (chronic child illness); OR = 1.08, $p > .05$ (maternal stress—prenatal); OR = 1.21, $p < .05$ (maternal stress—postnatal). Anxiety: OR = 1.87, $p < .05$ (partner separation); OR = 3.67, $p < .01$ (change partner); OR = 0.94, $p < .01$ (marital quality, prenatal); OR = 0.96, $p < .10$ (marital quality, birth); OR = 0.94, $p < .01$ (marital quality, 6 months); OR = 0.99, $p > .05$ (marital quality, 5 years); OR = 1.00, $p > .05$ (maternal deviance); OR = 1.81, $p < .05$ (partner deviance); OR = 2.18, $p < .05$ (poverty); OR = 1.26, $p > .05$ (child hospitalizations); OR = 0.49, $p > .05$ (chronic child illness); OR = 1.22, $p < .05$ (maternal stress—prenatal); OR = 1.23, $p < .05$ (maternal stress—postnatal).
Price & Hyde, 2009	12	Early sexual activity (before 15 years of age)	CR, ANA	R^2 = .19, $p < .001$ (girls); R^2 = .32, $p < .001$ (boys)	ANA: R^2 = .34, $p < .01$ (girls); R^2 = .36, $p < .001$ (boys)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
Roberts et al., 2009	10	Anxiety, mood, ADHD, disruptive behavior, substance use, one or more diagnoses, two or more diagnoses	CR, ANA	For 0, 1, 2, 3, 4, 5, 6, 7, 8 risk factors: OR = 1.00, 1.00, 3.07, 16.37, 13.26, 24.42, 25.62, 51.23, 47.04 (anxiety); for 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 risk factors, OR = 1.00, 1.00, 1.00, 3.52, 5.50, 4.38, 5.10, 18.64, 23.99, 34.35, 52.95 (mood); for 0, 1, 2, 3, 4, 5 risk factors, OR = 1.00, 0.96, 3.50, 5.32, 10.14, 7.77 (ADHD); for 0, 1, 2, 3, 4, 5, 6, 7 risk factors, OR = 1.00, 0.64, 2.84, 2.32, 5.47, 4.02, 8.73, 8.24 (disruptive behavior); for 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 risk factors, OR = 1.00, 1.00, 1.00, 1.77, 3.83, 4.48, 7.16, 11.98, 15.25, 28.84, 39.28 (substance use)	ANA: No summary statistical information for the total equation (e.g., R^2) is available. Anxiety: *ns* (gender F:M); *ns* (age M:L); *ns* (age H:L); OR = 0.54, $p < .05$ (income H:L); OR = 0.50, $p < .05$ (social support H:L); *ns* (family satisfaction M:L); OR = 0.36, $p < .05$ (family satisfaction H:L); *ns* (self-esteem M:L); OR = 0.46, $p < .05$ (self-esteem H:L); *ns* (mastery M:L); OR = 0.32, $p < .05$ (mastery H:L); *ns* (coping style H:L); *ns* (school stress M:L); OR = 2.00, $p < .05$ (school stress H:L); OR = 2.41, $p < .05$ (neighborhood stress H:L); *ns* (economic stress M:L); OR = 2.90, $p < .05$ (economic stress H:L); OR = 1.84, $p < .05$ (mother stress H:L); *ns* (father stress H:L). Mood: OR = 3.02, $p < .05$ (gender F:M); OR = 3.28, $p < .05$ (age M:L); OR = 3.90, $p < .05$ (age H:L); *ns* (income H:L); *ns* (social support H:L); *ns* (family satisfaction M:L); OR = 0.44, $p < .05$ (family satisfaction H:L); *ns* (self-esteem M:L); OR = 0.34, $p < .05$ (self-esteem H:L); OR = 0.46, $p < .05$ (mastery M:L); OR = 0.47, $p < .05$ (mastery H:L); *ns* (coping style H:L); OR = 3.09, $p < .05$ (school stress M:L); OR = 3.19, $p < .05$ (school stress H:L); OR = 2.36, $p < .05$ (neighborhood stress H:L); OR = 2.27, $p < .05$ (economic stress M:L); *ns* (economic stress H:L); OR = 2.67, $p < .05$ (mother stress H:L); OR = 2.34, $p < .05$ (father stress H:L).

(*table continues*)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
					ADHD: OR = 0.36, $p < .05$ (gender F:M); OR = 0.43, $p < .05$ (age M:L); *ns* (age H:L); *ns* (income H:L); *ns* (social support H:L); *ns* (family satisfaction M:L); OR = 0.22, $p < .05$ (family satisfaction H:L); OR = 0.23, $p < .05$ (mastery M:L); OR = 0.30, $p < .05$ (mastery H:L); *ns* (coping style M:L); *ns* (coping style H:L); OR = 3.05, $p < .05$ (neighborhood stress H:L); *ns* (school stress M:L); *ns* (school stress H:L); *ns* (economic stress H:L); *ns* (mother stress H:L); *ns* (father stress H:L).
					Disruptive behavior: *ns* (gender F:M); *ns* (age M:L); *ns* (age H:L); *ns* (income H:L); *ns* (social support H:L); *ns* (family satisfaction M:L); OR = 0.35, $p < .05$ (family satisfaction H:L); *ns* (mastery M:L); OR = 0.49, $p < .05$ (mastery H:L); *ns* (coping style M:L); OR = 0.49, $p < .05$ (coping style H:L); *ns* (neighborhood stress H:L); *ns* (school stress M:L); OR = 2.08, $p < .05$ (school stress H:L); OR = 2.73, $p < .05$ (economic stress H:L); OR = 2.47, $p < .05$ (mother stress H:L); OR = 3.16, $p < .05$ (father stress H:L).
					Substance use: OR = 0.35, $p < .05$ (gender F:M); OR = 7.04, $p < .05$ (age M:L); OR = 14.84, $p < .05$ (age H:L); OR = 0.25, $p < .05$ (family satisfaction H:L); OR = 0.58, $p < .05$ (self-esteem H:L); OR = 0.54, $p < .05$ (coping style M;L); OR = 0.33, $p < .05$ (coping style H:L); *ns* (mastery H:L); OR = 2.18, $p < .05$ (school stress M:L); OR = 2.97, $p < .05$ (school stress H:L); *ns* (economic stress M:L); *ns* (economic stress H:L); OR = 1.85, $p < .05$ (mother stress M:L); OR = 2.52, $p < .05$ (mother stress H:L); OR = 2.09, $p < .05$ (father stress M:L); OR = 4.73, $p < .05$ (father stress H:L).

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
Roberts et al., 2010	9	Suicide attempts	CR, ANA	The odds for 2 factors were 9.0 (95% CI [2.6, 30.7]), for 3 factors 14.2 (95% CI [3.9, 51.8]), and for 4 factors 21.7 (95% CI [4.7, 98.9])	ANA: OR = 4.72, $p < .05$ (school stress); OR = 2.85, $p < .05$ (depression); OR = 4.81, $p < .05$ (marijuana use); OR = 5.34, $p < .05$ (disorders); OR = 4.23, $p < .05$ (impairment); OR = 4.81, $p < .05$ (caregivers suicide attempt—lifetime); OR = 4.04, $p < .05$ (bio-parents lifetime)
Saner & Ellickson, 1996	18	Violence	CR, ANA	Demographic risk factors: Only 6% of those respondents with no demographic risk factors had been involved in any serious violence. By contrast, almost one in two (46%) of those with five demographic or background risk factors had engaged in at least one form of serious predatory behavior in the past year. Behavioral risk factors: Among youths who reported none of these behaviors, three out of four (74.6%) had not been violent at all in the past year, and only one in 25 (4.1%) had engaged in any serious violence. By contrast, 89% of the respondents with six behavioral risk factors had been involved in some type of violent activity, and three out of four had committed at least one act of predatory violence. Similarly, adolescents exhibiting six behavioral risk factors were 5–10 times as likely to have engaged in persistent hitting as those with either none or only one risk factor.	ANA: No summary statistical information for the total equation (e.g., R^2) is available. Any violence: (1) demographic risk factors: OR = 2.3, $p < .05$ (male); *ns* (disrupted family); *ns* (low income); *ns* (low SES); *ns* (high mobility). (2) Behavioral risk factors: OR = 2.7, $p < .05$ (nonviolent felony); OR = 2.4, $p < .05$ (nonviolent minor delinquency); OR = 2.4, $p < .05$ (drug selling); OR = 1.3, $p < .05$ (problem drug use); OR = 1.2, $p < .05$ (early drug use); *ns* (full time work). (3) Environmental risk factors: *ns* (high perceived friends' drug use); OR = 1.2, $p < .05$ (high perceived parental drug use); OR = 1.3, $p < .05$ (low academic orientation); OR = 0.8, $p < .05$ (low religiosity); OR = 1.6, $p < .05$ (low perceived parental support); OR = 0.8, $p < .05$ (low perceived peer support).

(*table continues*)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
				Environmental risk factors: Youths with five environmental risk factors were twice as likely to have engaged in any violence as those with no risk factors, about four times as likely to have been seriously violent, or to have been a persistent hitter.	Persistent hitting: (1) demographic risk factors: OR = 1.6, $p < .05$ (male); *ns* (disrupted family); *ns* (low income); *ns* (low SES); *ns* (high mobility). (2) Behavioral risk factors: OR = 1.9, $p < .05$ (nonviolent felony); OR = 2.3, $p < .05$ (nonviolent minor delinquency); OR = 2.2, $p < .05$ (drug selling); *ns* (problem drug use); OR = 1.1, $p < .05$ (early drug use); OR = 1.3, $p < .05$ (full time work). (3) Environmental risk factors: *ns* (high perceived friends' drug use); OR = 1.3, $p < .05$ (high perceived parental drug use); OR = 1.3, $p < .05$ (low academic orientation); *ns* (low religiosity); OR = 1.6, $p < .05$ (low perceived parental support); *ns* (low perceived peer support). Environmental risk factors: (1) demographic risk factors: OR = 3.5, $p < .05$ (male); *ns* (disrupted family); *ns* (low income); *ns* (low SES); *ns* (high mobility). (2) Behavioral risk factors: OR = 2.6, $p < .05$ (nonviolent felony); OR = 3.6, $p < .05$ (nonviolent minor delinquency); OR = 2.1, $p < .05$ (drug selling); OR = 1.6, $p < .05$ (problem drug use); OR = 1.1, $p < .05$ (early drug use); *ns* (full time work). (3) Environmental risk factors: *ns* (high perceived friends' drug use); OR = 1.3, $p < .05$ (high perceived parental drug use); OR = 1.6, $p < .05$ (low academic orientation); *ns* (low religiosity); OR = 1.4, $p < .05$ (low perceived parental support); *ns* (low perceived peer support).
Shaw et al., 1994	7	Externalizing, internalizing at 36 months	CR, ANA	For age 1 CR: $r = .27$, $p < .01$ (externalizing); $r = .42$, $p < .001$ (internalizing). For age 2 CR: $r = .25$, $p < .05$ (externalizing); $r = .32$, $p < .01$ (internalizing).	ANA: No effect size measures that can be used for comparison were reported.

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
Shaw & Emery, 1988	4	Internalizing, externalizing, perceived social competence, IQ	CR, ANA	$F(2, 99) = 11.79$, $p < .001$ (internalizing); $F(2, 99) = 3.47$, $p < .05$ (externalizing); $F(2, 97) = 4.33$, $p < .05$ (perceived social competence); $F(2, 90) = 1.41$, *ns* (IQ)	ANA: $R^2 = .34$, $p < .001$ (internalizing); $R^2 = .28$, $p < .001$ (externalizing); $R^2 = .16$, $p < .05$ (perceived social competence); $R^2 = .17$, $p < .05$ (IQ)
Small & Luster, 1994	14	Early sexual activity (before 18 years of age)	CR, ANA	For males with 0, 1, 2, 3, 4, 5 risk factors: 15%, 39%, 55%, 76%, 88%, 93%; for females with 0, 1, 2, 3, 4, 5, 6, 7, 8+ risk factors: 1%, 8%, 22%, 42%, 50%, 53%, 54%, 63%, 80%	ANA: For males, the individual risk factors explained 32% of the variance. For females, the individual risk factors explained 38% of the variance.
Vega et al., 1993	10	Alcohol use	CR, ANA	No main effect reported	ANA: $\chi^2 = 614.2$, users correctly classified: 42.9%
Wilson et al., 2009	17	Internalizing, inhibitory control problems, problem behavior intensity	CR, ANA	No main effect reported	ANA: No effect size measures that can be used for comparison were reported.
Yumoto et al., 2008	8	IQ, externalizing, internalizing, delinquency, aggression	CR, ANA	IQ: $r = -.19$, $p < .01$ (nonexposed); $r = -.15$, $p < .05$ (exposed).	ANA: IQ: $r = -.42$, $p < .01$ (nonexposed); $r = -.35$, $p < .05$ (exposed).
				Externalizing: $r = .06$, $p > .10$ (nonexposed); $r = .06$, $p > .10$ (exposed).	Externalizing: $r = .36$, $p < .01$ (nonexposed); $r = .25$, $p < .05$ (exposed).
				Delinquency: $r = .12$, $p > .10$ (nonexposed); $r = .20$, $p < .01$ (exposed).	Delinquency: $r = .39$, $p < .01$ (nonexposed); $r = .36$, $p < .01$ (exposed).
				Aggression: $r = .04$, $p > .05$ (nonexposed); $r = .03$, $p > .10$ (exposed).	Aggression: $r = .34$, $p < .01$ (nonexposed); $r = .24$, $p < .05$ (exposed).
				Internalizing: $r = -.02$, *ns* (nonexposed); $r = .20$, $p < .01$ (exposed).	Internalizing: *ns* (nonexposed); *ns* (exposed).
Deater-Deckard et al., 1998	20	Teacher report of externalizing, mother report of externalizing, peer report of aggression	CR, ANA, CA	Teacher report of externalizing: $\Delta R^2 = .01$, $p < .01$ (child); $\Delta R^2 = .02$, $p < .001$ (sociocultural); $\Delta R^2 = .01$, $p < .01$ (parenting/caregiving); $\Delta R^2 = .03$, $p < .001$ (peer); $\Delta R^2 = .10$, $p < .001$ (total).	ANA: Teacher report of externalizing: $\Delta R^2 = .04$, $p < .001$ (child); $\Delta R^2 = .04$, $p < .05$ (sociocultural); $\Delta R^2 = .02$, $p > .05$ (parenting/caregiving); $\Delta R^2 = .13$, $p < .001$ (peer); $R^2 = .36$, $p < .001$ (total).
				Mother report of externalizing: $\Delta R^2 = .07$, $p < .001$ (child); $\Delta R^2 = .01$, $p < .01$ (sociocultural); $\Delta R^2 = .04$, $p < .001$ (parenting/caregiving); $\Delta R^2 = .01$, $p < .01$ (peer); $\Delta R^2 = .16$, $p < .001$ (total).	Mother report of externalizing: $\Delta R^2 = .07$, $p < .001$ (child); $\Delta R^2 = .03$, $p < .10$ (sociocultural); $\Delta R^2 = .06$, $p < .001$ (parenting/caregiving); $\Delta R^2 = .05$, $p < .001$ (peer); $R^2 = .37$, $p < .001$ (total).
				Peer report of aggression: $\Delta R^2 = .006$, $p < .10$ (child); $\Delta R^2 = .01$, $p < .01$ (sociocultural); *ns* (parenting/caregiving); $\Delta R^2 = .02$, $p < .01$ (peer); $\Delta R^2 = .04$, $p < .001$ (total).	Peer report of externalizing: $\Delta R^2 = .19$, $p < .001$ (child); $\Delta R^2 = .01$, $p > .05$ (sociocultural); $\Delta R^2 = .04$, $p < .05$ (parenting/caregiving); $\Delta R^2 = .10$, $p < .001$ (peer); $R^2 = .45$, $p < .001$ (total).
					CA: Teacher report of externalizing: $F(4, 225) = 0.42$, $p > .7$.

(*table continues*)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
					Mother report of externalizing: $F(4, 209) = 0.93$, $p > .4$. Peer report of aggression: $F(4, 205) = 1.55$, $p > .18$.
Furrer & Skinner, 2003	3	Behavioral engagement, emotional engagement	CR, ANA, CA	Teacher report: for 0, 1, 2, 3 risk factors: 0.33, 0.07, −0.02, −0.43 (behavioral engagement); 0.36, 0.06, −0.08, −0.39 (emotional engagement). Child report: for 0, 1, 2, 3 risk factors: 0.71, 0.11, −0.17, −0.76 (behavioral engagement); 0.76, 0.10, −0.25, −0.74 (emotional engagement).	ANA: Teacher report: $R^2 = .09$, $p < .001$ (behavioral engagement); $R^2 = .10$, $p < .001$ (emotional engagement). Child report: $R^2 = .33$, $p < .001$ (behavioral engagement); $R^2 = .39$, $p < .001$ (emotional engagement). CA: No effect size measures that can be used for comparison were reported.
Rathbun et al., 2005	4	Reading, mathematics	CR, ANA, CA	Initial status, reading: $b = -3.19$, $SE = 0.140$, $p < .05$. Initial status, mathematics: $b = -2.67$, $SE = 0.128$, $p < .05$. Growth rate, reading: $b = -0.09$, $SE = 0.006$, $p < .05$.	ANA: No summary statistical information for the total equation (e.g., R^2) is available. Initial status, reading: $b = -1.19$, $SE = 0.527$, $p < .05$ (non-English); $b = -4.72$, $SE = 0.309$, $p < .05$ (mother's education less than high school); $b = -3.75$, $SE = 0.300$, $p < .05$ (poverty); $b = -2.32$, $SE = 0.309$, $p < .05$ (single-parent). Initial status, mathematics: $b = -1.07$, $SE = 0.404$, $p < .05$ (non-English); $b = -4.06$, $SE = 0.295$, $p < .05$ (mother's education less than high school); $b = -2.99$, $SE = 0.263$, $p < .05$ (poverty); $b = -1.85$, $SE = 0.232$, $p < .05$ (single-parent).

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
				Growth rate, mathematics: $b = -0.05$, $SE = 0.005$, $p < .05$.	Growth rate, reading: $b = 0.06$, $SE = 0.018$, $p < .05$ (non-English); $b = -0.17$, $SE = 0.018$, $p < .05$ (mother's education less than high school); $b = -0.14$, $SE = 0.015$, $p < .05$ (poverty); $b = -0.04$, $SE = 0.012$, $p < .05$ (single-parent). Growth rate, mathematics: $b = 0.07$, $SE = 0.015$, $p < .05$ (non-English); $b = -0.12$, $SE = 0.013$, $p < .05$ (mother's education less than high school); $b = -0.09$, $SE = 0.011$, $p < .05$ (poverty); $b = -0.02$, $SE = 0.009$, $p < .05$ (single−parent). CA: No summary statistical information for the total equation (e.g., R^2) is available. Initial status, reading: $b = -5.67$, $SE = 0.518$, $p < .05$ (poverty); $b = -1.82$, $SE = 0.729$, $p < .05$ (non-English); $b = -7.56$, $SE = 0.482$, $p < .05$ (mother's education less than high school); $b = -3.10$, $SE = 0.351$, $p < .05$ (single-parent); $b = -6.78$, $SE = 1.110$, $p < .05$ (poverty and non-English); $b = -8.98$, $SE = 0.605$, $p < .05$ (poverty and mother's education less than high school); $b = -6.42$, $SE = 0.411$, $p < .05$ (poverty and single-parent); $b = -6.63$, $SE = 0.869$, $p < .05$ (non-English and mother's education less than high school); $b = -5.33$, $SE = 2.301$, $p < .05$ (non-English and single-parent); $b = -7.96$, $SE = 0.654$, $p < .05$ (mother's education less than high school and single-parent); $b = -7.75$, $SE = 0.558$, $p < .05$ (three or four risk factors).

(*table continues*)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
					Initial status, mathematics: $b = -4.70$, $SE = 0.510$, $p < .05$ (poverty); $b = -2.40$, $SE = 0.562$, $p < .05$ (non-English); $b = -6.41$, $SE = 0.541$, $p < .05$ (mother's education less than high school); $b = -2.68$, $SE = 0.308$, $p < .05$ (single-parent); $b = -4.76$, $SE = 1.112$, $p < .05$ (poverty and non-English); $b = -7.68$, $SE = 0.685$, $p < .05$ (poverty and mother's education less than high school); $b = -5.17$, $SE = 0.425$, $p < .05$ (poverty and single-parent); $b = -4.77$, $SE = 0.927$, $p < .05$ (non-English and mother's education less than high school); $b = -4.29$, $SE = 1.722$, $p < .05$ (non-English and single-parent); $b = -5.49$, $SE = 0.758$, $p < .05$ (mother's education less than high school and single-parent); $b = -7.08$, $SE = 0.546$, $p < .05$ (three or four risk factors).
					Growth rate, reading: $b = -0.18$, $SE = 0.027$, $p < .05$ (poverty); $b = 0.02$, $SE = 0.021$, $p > .05$ (non-English); $b = -0.21$, $SE = 0.031$, $p < .05$ (mother's education less than high school); $b = -0.06$, $SE = 0.014$, $p < .05$ (single-parent); $b = -0.08$, $SE = 0.054$, $p > .05$ (poverty and non-English); $b = -0.36$, $SE = 0.043$, $p < .05$ (poverty and mother's education less than high school); $b = -0.17$, $SE = 0.020$, $p < .05$ (poverty and single-parent); $b = -0.10$, $SE = 0.041$, $p < .05$ (non-English and mother's education less than high school); $b = -0.07$, $SE = 0.066$, $p > .05$ (non-English and single-parent); $b = -0.20$, $SE = 0.051$, $p < .05$ (mother's education less than high school and single-parent); $b = -0.25$, $SE = 0.026$, $p < .05$ (three or four risk factors).

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
					Growth rate, mathematics: $b = -0.12$, $SE = 0.020$, $p < .05$ (poverty); $b = 0.07$, $SE = 0.022$, $p < .05$ (non-English); $b = -0.18$, $SE = 0.024$, $p < .05$ (mother's education less than high school); $b = -0.03$, $SE = 0.013$, $p < .05$ (single-parent); $b = -0.01$, $SE = 0.044$, $p > .05$ (poverty and non-English); $b = -0.24$, $SE = 0.034$, $p < .05$ (poverty and mother's education less than high school); $b = -0.10$, $SE = 0.020$, $p < .05$ (poverty and single-parent); $b = -0.11$, $SE = 0.036$, $p < .05$ (non-English and mother's education less than high school); $b = -0.03$, $SE = 0.049$, $p > .05$ (non-English and single-parent); $b = -0.13$, $SE = 0.037$, $p < .05$ (mother's education less than high school and single-parent); $b = -0.12$, $SE = 0.025$, $p < .05$ (three or four risk factors).
Sameroff et al., 1993	10	IQ	CR, ANA, CA	$r = -.58$, $p < .01$ (at 4 years); $r = -.61$, $p < .01$ (at 13 years)	ANA: $R^2 = .50$, $p < .01$ (at 4 years); $R^2 = .51$, $p < .01$ (at 13 years). CA: No effect with controls for number of risk factors at either age.
Sameroff, Seifer, Barocas, et al., 1987	10	Verbal IQ at 4 years	CR, ANA, CA	The difference between the lowest and highest groups was about 2 *SD*, that is, about 30 IQ points, $F(1, 187) = 100.24$, $p < .01$	ANA: $R^2 = .16$, $p < .01$. CA: $F(4, 74) = 0.38$, $p = .82$, with the means of verbal IQ ranging from 92.8 to 97.7
Sameroff, Seifer, Zax, et al., 1987	10	Verbal IQ, social-emotional functioning	CR, ANA, CA	Only the multiple risk analyses related to social-emotional functioning are reported here; the results from the analysis of factors contributing to IQ scores were quite similar. The difference in the multiple risk analysis was about 1.33 *SD*, compared with the .05 *SD* differences found in the single risk analyses.	ANA: $R^2 = .45$, $p < .01$ (verbal IQ); $R^2 = .26$, $p < .01$ (social-emotional functioning). CA: Results supported the view that it was not any single risk factors but the total number that reduced the child's social emotional competence.
Gerard & Buehler, 1999	3	Internalizing, externalizing, total problem behaviors	CR, ANA, NANA	Total problem behaviors: $\Delta R^2 = .143$, $p < .001$ (youth report, linear trend); $\Delta R^2 = .030$, $p < .001$ (teacher report, linear trend). Externalizing: $\Delta R^2 = .015$, $p < .001$ (youth report); $\Delta R^2 = .009$, $p < .05$ (teacher report).	ANA: Total problem behaviors: $\Delta R^2 = .241$, $p < .001$ (youth report); $\Delta R^2 = .049$, $p < .001$ (teacher report). Externalizing: $\Delta R^2 = .048$, $p < .001$ (youth report); $\Delta R^2 = .023$, $p < .05$ (teacher report).

(*table continues*)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
				Internalizing: $\Delta R^2 = .009$ $p < .01$ (youth report, linear trend); $\Delta R^2 = .017$, $p < .01$ (teacher report).	Internalizing: $\Delta R^2 = .007$, $p > .05$ (youth report); $\Delta R^2 = .066$, $p < .001$ (teacher report). NANA: No significant interaction between risk factors was found.
Krishnakumar & Black, 2002	6	Internalizing, externalizing, cognitive development	CR, ANA, NANA	$R^2 = .04$, $p < .01$ (externalizing at age 5, linear trend); $R^2 = .004$, $p < .01$ (internalizing at age 5); $R^2 = .07$, $p < .001$ (cognitive development at age 5); $R^2 = .45$, $p < .001$ (externalizing at age 6); $R^2 = .39$, $p < .001$ (internalizing at age 6); $R^2 = .39$, $p < .001$ (cognitive development at age 6)	ANA: $R^2 = .13$, $p < .05$ (externalizing at age 5); $R^2 = .20$, $p < .05$ (internalizing at age 5); $R^2 = .21$, $p < .05$ (cognitive development at age 5); $R^2 = .50$, $p < .05$ (externalizing at age 6); $R^2 = .44$, $p < .05$ (internalizing at age 6); $R^2 = .41$, $p < .05$ (cognitive development at age 6). NANA: Results supported the buffering impact of the quality of the home environment in the association between family economic hardship and externalizing problem behaviors at age 6 and between family economic hardship and cognitive development at age 6. No effect size measures that can be used for comparison were reported.
Rouse & Fantuzzo, 2009	5	Poor reading achievement, poor mathematics achievement, second grade retention, poor classroom learning behavior, poor classroom social skills, high absences, suspension history	CR, ANA, NANA	OR = 1.28, $p < .0001$ (poor reading achievement); OR = 1.21, $p < .0001$ (poor mathematics achievement); OR = 1.32, $p < .0001$ (second grade retention); OR = 1.32, $p < .0001$ (poor learning behavior); OR = 1.27, $p < .0001$ (poor social skills); OR = 1.33, $p < .0001$ (high absences); OR = 1.25, $p < .0001$ (suspension history)	ANA: Poverty OR = 1.37; Birth risk OR = 1.19; Low maternal education OR = 1.47; Maltreatment OR = 1.60; Homeless OR = 1.23 (poor reading achievement). Poverty OR = 1.28; Birth risk OR = 1.18; Low maternal education OR = 1.32; Maltreatment OR = 1.50; Homeless OR = 1.24 (poor math achievement). Poverty OR = 1.62; Birth risk OR = 1.28; Low maternal education OR = 1.47; Maltreatment OR = 1.80; Homeless OR = 1.34 (second grade retention). Poverty OR = 1.50; Birth risk OR = 1.13; Low maternal education OR = 1.36; Maltreatment OR = 1.62; Homeless OR = 1.34 (poor classroom learning behaviors).

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
					Poverty OR = 1.30; Birth risk OR = 1.03; Low maternal education OR = 1.25; Maltreatment OR = 1.62; Homeless OR = 1.50 (poor classroom social skills). Poverty OR = 2.00; Birth risk OR = 1.03; Low maternal education OR = 1.23; Maltreatment OR = 1.47; Homeless OR = 1.54 (high absenteeism). Poverty OR = 1.41; Birth risk OR = 0.96; Low maternal education OR = 1.06; Maltreatment OR = 2.48; Homeless OR = 1.51 (school suspension). NANA: Maltreatment × Homeless OR = 0.73 (poor reading achievement). Maltreatment × Low maternal education OR = 0.61 (school suspension). No other significant interactions between risk factors were found.
Szatmari et al., 1994	14 (psychiatric disorder), 15 (school performance)	Psychiatric disorder, school performance	CR, ANA, NANA	$\chi^2(8) = 134.34$, $p < .0001$ (psychiatric disorder); $\chi^2(8) = 94.43$, $p < .001$ (school performance)	ANA: OR (in combination in order shown) = 128.25, Hosmer–Lemeshow $\chi^2(8) = 5.70$, $p = .68$ (psychiatric disorder); OR (in combination in order shown) = 47.84, Hosmer–Lemeshow $\chi^2(8) = 7.86$, $p = .45$ (school performance). NANA: $\chi^2(8) = 2.79$, $p = .95$ (psychiatric disorders); $\chi^2(8) = 4.00$, $p = .86$ (school performance).
Ackerman, Schoff, et al., 1999	11	Aggression, anxiety/depression	CR, CR (D), ANA	$\Delta R^2 = .16$, $p < .005$ (aggression); $\Delta R^2 = .01$, $p > .05$ (anxiety/depression)	CR (D): $\Delta R^2 = .16$, $p < .01$ (aggression); $\Delta R^2 = .17$, $p < .01$ (anxiety/depression). ANA: $\Delta R^2 = .19$, $p < .01$ (aggression); $\Delta R^2 = .06$, $p > .05$ (anxiety/depression).
W. P. Evans et al., 2010	5 domain-risk factors were constructed based on 19 risk variables	Sense of coherence	CR, CR (D), ANA	Separate analyses were conducted for males and females, but statistical information not available.	CR (D): For males with 0, 1, 2, 3, 4, 5 domains of risk, the means of sense of coherence were 3.30, 3.23, 3.08, 2.97, 2.81, 2.64. For females with 0, 1, 2, 3, 4, 5 domains of risk, the means of sense of coherence were 3.29, 3.16, 3.02, 2.89, 2.75, 2.71. ANA: $R^2 = .434$, $p < .001$ (males); $R^2 = .406$, $p < .001$ (females).

(*table continues*)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
Gerard & Buehler, 2004a	15	Externalizing, internalizing	CR, CR (D), ANA	$\Delta R^2 = .09$, $p \leq .001$ (Time 1 externalizing); $\Delta R^2 = .17$, $p \leq .001$ (Time 1 internalizing)	CR (D): No effect size measures that can be used for comparison were reported. ANA: $R^2 = .19$, $p \leq .001$ (Time 1 externalizing); $R^2 = .32$, $p \leq .001$ (Time 1 internalizing).
Thornberry et al., 1997	9 in variable-based model; 38 in domain-based model	Teenage parenthood	CR, CR (D), ANA	For 0–1, 2, 3, 4, 5, 6, 7–10 risk factors: 0%, 2%, 5%, 17%, 22%, 40%, 44%	CR (D): Young men who experienced more than average risk in only a few of these 10 domains are unlikely to become teen fathers. For example, only 5% of those experiencing risk in three domains are teen fathers. After that point, the chance of teen fatherhood increases exponentially—to 17% of those experiencing risk in four domains and leveling out at over 40% of the young men who experience risk in six or more domains. ANA: Log likelihood = 406.63, $\chi^2 = 121.39$, $p < .01$.
Ackerman, Izard, et al., 1999	11	Problem behavior	CR, ANA, FS	$\Delta R^2 = .07$, $p < .01$	ANA: $\Delta R^2 = .13$, $p < .01$. FS: $R^2 = .18$, $p < .001$.
Burchinal et al., 2000	9	Cognitive development, expressive language development, receptive language development	CR, ANA, FS	Cognitive development: $R^2 = .03$, $p > .05$ (12 months); $R^2 = .04$, $p > .05$ (24 months); $R^2 = .10$, $p < .01$ (36 months); $R^2 = .13$, $p < .001$ (48 months). Expressive language: $R^2 = .00$, $p > .05$ (12 months); $R^2 = .00$, $p > .05$ (24 months); $R^2 = .05$, $p > .05$ (36 months). Receptive language: $R^2 = .17$, $p < .001$ (12 months); $R^2 = .05$, $p < .05$ (24 months); $R^2 = .05$, $p > .05$ (36 months).	ANA: cognitive development: $R^2 = .26$, $p < .05$ (12 months); $R^2 = .23$, $p < .05$ (24 months); $R^2 = .20$, $p < .05$ (36 months); $R^2 = .35$, $p < .01$ (48 months). Expressive language development: $R^2 = .08$, $p > .05$ (12 months); $R^2 = .22$, $p < .05$ (24 months); $R^2 = .33$, $p < .001$ (36 months). Receptive language development: $R^2 = .28$, $p < .01$ (12 months); $R^2 = .34$, $p < .01$ (24 months); $R^2 = .26$, $p < .01$ (36 months). FS: cognitive development: $R^2 = .11$, $p < .05$ (12 months); $R^2 = .13$, $p < .01$ (24 months); $R^2 = .16$, $p < .01$ (36 months); $R^2 = .26$, $p < .001$ (48 months). Expressive language development: $R^2 = .01$, $p > .05$ (12 months); $R^2 = .06$, $p > .05$ (24 months); $R^2 = .19$, $p < .001$ (36 months).

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
					Receptive language development: $R^2 = .18$, $p < .001$ (12 months); $R^2 = .13$, $p < .01$ (24 months); $R^2 = .22$, $p < .001$ (36 months).
Barocas et al., 1985	6	Intellectual functioning, social functioning	CR, NANA	$F(1, 179) = 16.34$, $p < .01$, $W^2 = .048$ (intellectual functioning); $F(1, 196) = 14.69$, $p < .01$, $W^2 = .056$ (social functioning)	NANA: No effect size measures that can be used for comparison were reported.
Pungello et al., 1996	3	Reading achievement, Math achievement	CR, NANA	Math achievement intercepts: $\beta = 69.65$, $SE = 1.2$ (CR = 0); $\beta = 57.17$, $SE = 1.3$ (CR = 1); $\beta = 45.57$, $SE = 1.3$ (CR = 2); $\beta = 35.63$, $SE = 1.9$ (CR = 3).	NANA: Ethnicity × Low Income → Math Achievement Intercepts: $F(1, 3381) = 7.91$, $p < .01$.
				Math achievement slopes: $\beta = 2.12$, $SE = 0.55$ (CR = 0); $\beta = 0.25$, $SE = 0.57$ (CR = 1); $\beta = -0.69$, $SE = 0.58$ (CR = 2); $\beta = -2.74$, $SE = 0.81$ (CR = 3).	No other significant interactions.
				Reading achievement intercepts: $\beta = 67.48$, $SE = 1.2$ (CR = 0); $\beta = 54.83$, $SE = 1.2$ (CR = 1); $\beta = 38.48$, $SE = 1.3$ (CR = 2); $\beta = 33.25$, $SE = 1.9$ (CR = 3).	
				Reading achievement slopes: *ns*.	
Copeland et al., 2009	17	Disruptive and emotional disorders	CR, CA	Adding the cumulative risk variable to the dummy variables representing the six risk configurations significantly improved model fit for both disruptive and emotional disorders ($\Delta -2$ log likelihoods = 22.3 and 15.1, $df = 1$, $p < .001$; ΔAIC = 21.0 and 13.2). Results for the specific emotional and disruptive disorders were similar.	CA: Specific configurations of risk factors (low risk, interparental problems, single/poor/crime, uneducated/poor, step-parent/crime, poor relations) distinguished youths in terms of their risk for having psychiatric outcomes.
Lanza et al., 2010	13	Externalizing, school failure, academic achievement	CR, CA	OR = 1.3, $p < .0001$ (parent-reported externalizing); OR = 1.3, $p < .0001$ (teacher-reported externalizing); OR = 1.3, $p < .0001$ (school failure); OR = 1.4, $p < .0001$ (academic achievement)	CA: Parent-reported externalizing: (1) urban African American: reference group (two-parent low risk); OR = 0.1 (single parent/history of problems); OR = 4.8 (multilevel risk one parent); OR = 3.0 (multilevel risk two parents). (2) Urban White: reference group (two-parent low risk); OR = 1.4 (single parent/history of problems); OR = 0.2 (multilevel risk one parent); OR = 2.9 (multilevel risk two parents). (3) Rural White: reference group (two-parent low risk); OR = 0.3 (single parent/history of problems); OR > 100 (multilevel risk one parent); OR = 6.2 (multilevel risk two parents).

(*table continues*)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
					Teacher-reported externalizing: (1) Urban African American: reference group (two-parent low risk); OR = 2.1 (single parent/history of problems); OR = 6.3 (multilevel risk one parent); OR = 2.8 (multilevel risk two parents). (2) Urban White: reference group (two-parent low risk); OR = 1.6 (single parent/history of problems); OR = 76.2 (multilevel risk one parent); OR = 2.7 (multilevel risk two parents). (3) Rural White: reference group (two-parent low risk); OR = 0.2 (single parent/history of problems); OR > 100 (multilevel risk one parent); OR = 6.7 (multilevel risk two parents).
					Failing grades: (1) Urban African American: reference group (two-parent low risk); OR = 3.6 (single parent/history of problems); OR = 8.5 (multilevel risk one parent); OR = 5.9 (multilevel risk two parents). (2) Urban White: reference group (two-parent low risk); OR = 1.8 (single parent/history of problems); OR = 2.5 (multilevel risk one parent); OR = 2.5 (multilevel risk two parents). (3) Rural White: reference group (two-parent low risk); OR = 2.3 (single parent/history of problems); OR = 0.1 (multilevel risk one parent); OR = 5.0 (multilevel risk two parents).

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
					Low academic achievement: (1) Urban African American: reference group (two-parent low risk); OR = 44.7 (single parent/history of problems); OR > 100 (multilevel risk one parent); OR > 100 (multilevel risk two parents). (2) Urban White: reference group (two-parent low risk); OR = 0.4 (single parent/history of problems); OR = 3.3 (multilevel risk one parent); OR = 2.3 (multilevel risk two parents). (3) Rural White: reference group (two-parent low risk); OR = 0.9 (single parent/history of problems); OR > 100 (multilevel risk one parent); OR = 10.3 (multilevel risk two parents).
Burchinal et al., 2008	7	Cognitive development	CR, SS	$r = -.14$, $p < .001$	SS: $r = -.22$, $p < .001$
Biederman et al., 1995	6	ADHD	CR, FS	$\chi^2(4) = 70.9$, $p < .0001$. OR = 7.4, 9.5, 34.6, 41.7 for 1, 2, 3, 4 risk factors.	FS: $\chi^2(1) = 14.6$, $p = .0001$ (Factor 1: maternal psychopathology, paternal criminality, and SES), and $\chi^2(1) = 18.0$, $p = .0001$ (Factor 2: family size and family conflict)
Hall et al., 2010	11	Cognitive development	CR, LV	$R^2 = .21$, $p < .001$ (36 months); $R^2 = .55$, $p < .001$ (58 months)	LV: Latent composite from dichotomous risks: $R^2 = .26$, $p < .001$ (36 months); $R^2 = .57$, $p < .001$ (58 months). Latent composite from ordinal and dichotomous risks: $R^2 = .32$, $p < .001$ (36 months); $R^2 = .57$, $p < .001$ (58 months).
Morales & Guerra, 2006	6	School achievement (math and reading), depression, aggression	CR, CR (D), LV	Math achievement: For 0, 1, 2, 3, 4, 5, and 6 risk factors, the *M* (*SD*) were 56.1 (28.9), 48.3 (28.6), 42.0 (28.2), 36.6 (26.8), 39.3 (29.6), 37.1 (30.2), and 49.5 (68.6), respectively, $F(6, 1292) = 2.76$, $p < .01$.	CR (D): The hypothesis that multiple context stress would predict variance beyond cumulative stress alone was not supported. In each model, the CR (D) was not found to be significant, although there were several marginal findings.

(*table continues*)

Table 4 (*continued*)

Author(s)	No. of risks	Outcome measure(s)	Risk measurement technique	Effect sizes of CR	Effect sizes of alternative approaches
				Reading achievement: For 0, 1, 2, 3, 4, 5, and 6 risk factors, the *M* (*SD*) were 49.8 (27.2), 43.0 (27.5), 40.0 (27.4), 36.9 (26.0), 42.4 (27.8), 35.4 (29.7), and 51.0 (67.9), respectively, $F(6, 1299) = 1.78$, $p < .10$. Depression: For 0, 1, 2, 3, 4, 5, and 6 risk factors, the *M* (*SD*) were 0.36 (1.0), 0.54 (1.3), 0.71 (1.5), 1.1 (1.9), 1.3 (2.2), 0.44 (1.1), and 0.0 (0.0), respectively, $F(6, 1363) = 4.74$, $p < .001$. Aggression: For 0, 1, 2, 3, 4, 5, and 6 risk factors, the *M* (*SD*) were 0.95 (0.88), 1.2 (0.9), 1.6 (1.0), 1.9 (1.1), 2.0 (1.1), 2.3 (1.0), and 2.4 (0.8), respectively, $F(6, 1579) = 4.18$, $p < .001$.	LV: $R^2 = .10$ (school achievement, T1), $R^2 = .40$ (school achievement, T2); $R^2 = .09$ (depression, T1), $R^2 = .07$ (depression, T2); $R^2 = .58$ (aggression, T1), $R^2 = .52$ (aggression, T2).
Mrug et al., 2008	18	Anxiety, depression, aggressive fantasies, delinquency, overt aggression	CR, CR (D), NANA	$\beta = .34$, $p < .001$ (anxiety); $\beta = .39$, $p < .001$ (depression); $\beta = .31$, $p < .001$ (aggressive fantasies); $\beta = .13$, $p < .01$ (delinquency); $\beta = .12$, $p < .05$ (overt aggression)	CR (D): *ns*. NANA: $\Delta R^2 = .09$, $p < .001$ (anxiety); $\Delta R^2 = .10$, $p < .001$ (depression); $\Delta R^2 = .01$, $p < .01$ (delinquency). No significant interactions between risk factors were found for aggressive fantasies and overt aggression.
Greenberg et al., 2001	4	Clinical referral versus non-referral for behavioral problems	CR (D), ANA, CA	CR (D): 0 Risks, OR = 0.05; 1 Risk, OR = 0.20; 2 Risks, OR = 0.61; 3 Risks, OR = 5.0; 4 Risks, OR = 34.0	ANA: Child risk, $\lambda = .41$; Parenting risk, $\lambda = .58$; Attachment risk, $\lambda = .35$; Family risk, $\lambda = .21$. CA: CPAF, OR = 34.3; CPA, OR = 4.2; CPF, OR = 8.3; CAF, OR = 1.4; PAF, OR = 7.6. No single or double risk clusters had significant ORs.

Note. CR = cumulative risk; ANA = additive, non-aggregated; RR = relative ratio; BIC = Bayesian information criterion; OR = odds ratio; CI = confidence interval; ADHD = attention-deficit/hyperactivity disorder; F:M = female:male; M:L = medium:low; H:L = high:low; SES = socioeconomic status; CA = cluster analysis; NANA = non-additive, non-aggregated; CR (D) = cumulative risk (domain-based model); FS = factor score; AIC = Akaike information criterion; SS = summary score; LV = latent variable; T1 = Time 1; T2 = Time 2; CPAF = child characteristics, parenting practices, attachment, family ecology; CPA = child characteristics, parenting practices, attachment; CPF = child characteristics, parenting practices, family ecology; CAF = child characteristics, attachment, family ecology; PAF = parenting practices, attachment, family ecology.

0|1; J. Cohen et al., 2003; Farrington & Loeber, 2000; Flouri, 2008; Wainer, 1976), although see DeCoster, Iselin, and Gallucci (2009) for an alternative view. Weighted regression terms are also quite sensitive to multicollinearity (J. Cohen et al., 2003; Myers & Wells, 2003). The OLS model provides better fit when a small number of variables are related to the outcome; however, the CR index is a better predictor when multiple, correlated predictors are related to the outcome of interest (Hooper, Burchinal, Roberts, Zeisel, & Neebe, 1998). OLS also requires a larger sample size given that each predictor takes up a degree of freedom. The use of a larger number of predictors in the OLS multiple risk index vis a vis the CR index also contributes to the instability of weights given fewer cases per predictor (Babyak, 2004). The CR model also has the advantage of parsimony over OLS models of multiple risk factor exposure because the CR metric in one value reflects the number of risk factor exposures rather than relying on continuous values of multiple, singular predictors.

Summary Score and CR

Another multiple risk metric is calculation of a summary score. The summary score technique for multiple risk measurement works by standardizing all predictor variables and combining the standardized values into one composite measure of risk, treating each predictor as an unweighted contributor to the total level of multiple risk exposure. Felner et al. (1995) were interested in whether expected SES effects on adolescent behavioral adjustment and school achievement could be explained by proximal environmental conditions. They developed an index of proximal environmental conditions by standardizing variables and then forming a composite of family social climate, parental acceptance and rejection of the youth, school social climate, social support from family and friends, and exposure to negative stressful life events and daily hassles. This summary index of multiple risk factors mediated the association between SES and behavioral adjustment but not school achievement. Ackerman, Kogos, Youngstrom, Schoff, and Izard (1999) formed a summary score of multiple indicators of chronically chaotic and unpredictable risk among preschool children. Their index of instability included residential mobility, number of romantic partners of the child's mother, number of families with whom the child had lived, serious childhood illnesses, and recent negative life events. Instability predicted both concurrent and subsequent psychological distress as rated by caregivers and teachers. In another program of research, investigators assessed chaotic living conditions among households using a summary index that tapped exposure to multiple dimensions of household disorder including noise, crowding, irregular family routines, and lack of structure in daily life (G. W. Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005). Chaos was related in a prospective, longitudinal design to multimethodological indices of behavioral adjustment in children. Chaos also appeared to mediate links between childhood poverty and these multiple indices of psychological distress.

Similar to CR, the summary score approach has the advantage of being applicable to small sample sizes because only one variable is used as a predictor. It also retains information on intensity of risk factor exposure for each variable. One major downside of the approach is sample specificity. If one sample were made up of high risk children, those on the lower end of high risk would receive a low z score for that variable, whereas in a sample of low risk children the same z score value would likely reflect a very different level of absolute risk. The meaning of the z score is tied to the mean and the variability of scores within the sample. If the mean or variance differs markedly across samples, then the meaning of "risk" becomes variable. The CR model's dichotomous designation of risk factors using the upper tail of the distribution of risk factors does not eliminate the problem of invariance of risk designation across samples but will provide more robust criteria for risk designation because extreme score values are used rather than the risk criterion value being continuous and dependent upon the mean and variance of the distribution. Note also that the summary score approach only makes sense when the individual risk variables are highly intercorrelated (i.e., Cronbach alpha should exceed .60; Ghiselli et al., 1981; Nunnally, 1978). This means that variables that confer risk but are uncorrelated with other risk factors will be left out of the metric. Furthermore, because this is an aggregated approach, interactions between risk factors are precluded and the relative salience of particular risk factors is not taken into account.

Finally, there are two potentially important conceptual limitations to the summary score approach. One, unlike a CR index, the overall impact of risk is calculated across the total spectrum of risk exposure. In the summary score approach, very high exposure for one risk factor and low risk exposure in three other factors could yield the same summary risk index as moderate risk exposure across all four risk factors. As indicated above, CR metrics typically count high levels of risk exposure exclusively. The number of risk exposures exceeding high thresholds determines the CR exposure score, whereas all degrees of risk exposure determine a summary score. A second conceptual drawback of the summary score metric is its insensitivity to the potential importance of multiple risk exposures across different life domains. There is reason to believe that risk exposures across multiple domains present more challenging adaptive demands on children than intense but concentrated intradomain risk exposure (compare Tables A and B in the online supplemental materials). As indicated in Table 4, one study found that the summary score had a greater relation to cognitive development than the CR metric.

Factor Analysis and CR

Multiple risk factor exposures can also be factor analyzed to create a smaller number of empirically derived, grouped risk factors. The factor score approach retains information on the intensity of individual risk factor exposures, enhances statistical power by reducing the number of variables in the model, and can ensure orthogonality between the risk factors. Any number of relevant factors can be extracted and then entered into a multiple regression equation as predictors. Compared to nonaggregated data, factor scores allow for more easy interpretable regression coefficients given that the predictors are uncorrelated (J. Cohen et al., 2003). One major disadvantage of this approach is its reliance on the data at hand. Because factor scores depend on the distribution of variables in the sample, generalization to other populations can be limited. To put it differently, the stability of factor scores across samples is of concern (Guadagnoli & Velicer, 1988). Factor analysis also demands large samples sizes although principal components analysis can be conducted with smaller samples and is appropriate if the goal is data reduction (Fabrigar, Wegener, MacCaullum, & Strahan, 1999). Although factor scores maintain the continuous range of risk exposures, they remove information on specific risk exposures. Factor analysis, like the summary score approach, will also cast off potentially important risk factors because they are uncorrelated with other risk factors. Because factor analysis allows for the retention of the underlying continuous scores for risk factors while also minimizing the number of predictors, the factor score approach acts as a middle ground between the additive, nonaggregated technique (ordinary least squares [OLS] regression) and CR. A few studies have compared CR and factor analytic metrics to represent multiple risk factor exposures. In nine out of 11 comparisons with cross-sectional data, the factor score techniques explained more variance than CR approaches (see Table 4); however, in prospective analyses, the CR approach was superior.

Structural Equation Modeling and CR

Another multiple risk assessment technique that has been compared directly with CR is latent variable constructs formulated by structural equation modeling. Although less common at this point in time, latent variable models have the benefit of preserving continuous data and tend to be more invariant across samples than cluster or factor scores because of the explicit inclusion of measurement error estimation in the latent index (Kline, 2005). A major downside of the technique is the large sample size required to model multiple indicators. Furthermore, it is more complicated to test interaction effects between variables in latent models.

As an illustration of the latent variable approach to operationalize multiple risk factor exposure, Loukas, Prelow, Suizzo, and Allua (2008) examined the impact of multiple risk exposure among 10- to 14-year-old Latino youths on adjustment 16 months later. The multiple risk latent construct consisted of household financial strain, neighborhood problems, and maternal psychological distress. Independent of prior mental health, this latent multiple risk construct predicted subsequent internalization and externalization symptoms in youths. Belsky, Schlomer, and Ellis (2012) used structural equation modeling to develop and test the role of environmental harshness and unpredictability on premature sexual activity in early adolescence. The latent construct multiple risk index explained the same degree of variance as the CR metric 75% of the time and was superior 25% of the time.

Cluster Analysis and CR

Clearly there are both advantages and disadvantages to each approach for measuring multiple risk factor exposure. One interesting but underutilized solution to the tradeoffs among different multiple risk factor exposure metrics are aggregated, nonadditive models. In this approach the continuous nature of each risk parameter is maintained but instead of calculating all possible statistical interactions, investigators determine whether certain combinations or profiles of risk are common. These clusters or profiles are then used to predict outcomes. For example Sanson, Oberklaid, Pedlow, and Prior (1991) examined different combinations of infancy risk factors and mental health in 4- to 5-year-olds. Two conclusions emerged from their data. One, single risk factors had little or no predictive power, whereas exposure to two and three infancy risk factors led to linear increases in adjustment problems. Two, only certain combinations of multiple risk exposures were salient. In other words, the constellation of risk mattered. In Sanson et al.'s research, difficult temperament in conjunction with prematurity, male gender, or low family SES in infancy mattered most for preschooler's behavioral adjustment. Greenberg, Speltz, DeKlyen, and Jones (2001) examined various combinations of four risk factors that predicted preschool boys' referrals to outpatient psychiatric clinics for problem behaviors. Each risk factor included multiple variables. Risk was defined either by clinical cutoffs or scoring in the upper third of the distribution. Single and double risk clusters had little predictive power, whereas three-factor combinations were predictive of referrals as long as one of the factors was ineffective parenting practices (e.g., harsh or abusive treatment). The other three risk factors included insecure attachment, family risk factors (e.g., conflict, low SES), and atypical child characteristics (e.g., low IQ). Comparisons of cluster indices of multiple risk to CR metrics indicated CR was superior all of the time (see Table 4).

One important drawback to cluster formulation of multiple risk indices is the lack of stability of cluster composition across samples (Dolnicar, 2003; Tuma, Decker, & Scholz, 2011). Moreover, similar to summary score and factor analytic multiple risk metrics, variables not loading on the cluster are typically ignored in subsequent analyses. If that discarded variable turns out to be an important, independent risk factor for child development, its contribution to adverse impacts would be lost. Cluster techniques are also vulnerable to over determination wherein too many predictors given sample sizes are considered in the model (Babyak, 2004; Tuma et al., 2011). Over fitted models inflate estimates of effect size (e.g., R^2) and contribute to cluster instability because parameters are kept that increase explained variance regardless of chance. Note that these risk cluster profile results challenge the additivity assumption of CR models. Both the Sanson and the Greenberg results show that risks may not be interchangeable; it may matter which configuration of multiple risk factors one is exposed to. On the other hand, several investigators have shown that different clusters or combinations of risk factors did not matter, it was the number of risk factors the child was exposed to that was important (Deater-Deckard, Dodge, Bates, & Pettit, 1998; G. W. Evans, 2003; Sameroff, 2006).

Conceptual and Analytic Issues

In this section, we briefly reiterate some of the strengths and weaknesses of the CR approach to multiple risk factor measurement. We then propose some fruitful areas for further development in work on multiple risk factor exposure and child development.

Weaknesses

Atheoretical model. One of the primary limitations of CR is the lack of theoretical explanation for its predictive power. At present, there is no theoretically compelling rationale to account for the superior predictive power of multiple versus singular risk factor exposures on child outcomes. Recent advances in the biology of stress provide a promising perspective for understanding why people are sensitive to high levels of risk factor exposure. Allostatic load has emerged as a model of chronic stress that has aroused considerable interest because of its links to both concurrent and prospective health outcomes, including mortality (McEwen, 1998; McEwen & Gianaros, 2010) as well as a potent explanatory variable for psychological disturbances in emotions and cognition (Ganzel, Morris, & Wethington, 2010; Juster et al., 2011). Allostatic load is an index of cumulative wear and tear on the body caused by repeated mobilizations of multiple physiological systems over time in response to environmental demands. These multiple, bodily response systems are dynamic and interact with one another. Longer, more frequent exposures to environmental demands accelerate wear and tear on the body because a more sustained combination of multiple bodily response systems will be engaged in order to meet the multitude of demands. This not only exhausts singular response system reserves (e.g., hypothalamic pituitary adrenal axis) but also makes it harder for the different systems to work well together (e.g., hypothalamic pituitary adrenal axis and the immune system) in a complementary fashion. More of these interactive bodily response systems will become engaged to meet the combination of demands afforded by multiple risk factor exposure. Moreover if this happens repeatedly, the physiological response systems become recalibrated, altering their sensitivity to external demands. Furthermore, the elasticity of these multiple response systems is compromised because of repeated mobilizations, rendering them less efficient in turning off the response system and returning to a resting state when the demand has ceased. Organism physiological response capacities are depleted more readily by exposure to multiple risk factors than by singular risk factor exposure.

Not surprisingly cumulative risk in childhood predicts allostatic load both concurrently (G. W. Evans, 2003) and prospectively (G. W. Evans, Kim, Ting, Tesher, & Shanis, 2007). CR also mediates the prospective, longitudinal relationship of early childhood poverty to elevated allostatic load in young adulthood (G. W. Evans & Kim, 2012). Therefore, the CR metric is well aligned with emerging models of chronic physiological stress and human well-being. One reason why CR is powerful is because it is more likely than singular risk exposure to elevate allostatic load. High intensity exposure to multiple environmental demands may do one of two things, each of which would elevate allostatic load. Higher CR means that the probability is greater that multiple response systems will be engaged because they must respond to more than one type of demand. Higher CR also means that the body will on average have less down time to restore itself because it must continue to respond to a higher rate of demands placed on it by repeated insults. No single risk factor is as likely to determine adverse developmental outcomes compared to the power of multiple risks because accumulated risk is more likely to overwhelm the adaptive capacities of bodily response systems (G. W. Evans, 2003; Flouri, 2008; Sameroff et al., 2004).

A second way to understand the superior power of CR to predict child outcomes relative to singular risk exposures is to consider underlying mediational mechanisms that can account for the adverse impacts of CR on children. Strong mediation by one process would suggest commonality of underlying operating mechanisms and thus argue in favor of the additivity model inherent in CR metrics. A small set of studies have examined whether characteristics of parenting, the child, or the home environment mediate CR. Maternal responsiveness helps account for some of the adverse impacts of CR on academic achievement (Barocas et al., 1991; Mistry, Benner, Biesanz, Clark, & Howes, 2010) as well as on poor socioemotional outcomes (Candelaria, Teti, & Black, 2011; Dumka, Roosa, & Jackson, 1997; Mistry et al., 2010; Trentacosta et al., 2008). Various parenting beliefs and practices (e.g., discipline, efficacy, knowledge about children) can also mediate the impacts of CR on achievement (Barocas et al., 1991; Kim & Brody, 2005; Kim, Brody, & McBride Murry, 2003) as well as on socioemotional outcomes (Dumka et al., 1997; Huth-Bocks, Levendosky, Bogat, & von Eye, 2004; Kim & Brody, 2005; Kim et al., 2003; Lengua, Honorado, & Bush, 2007). Access to supportive and caring adults accounts for some of the covariance between cumulative risk exposure and middle school engagement (Woolley & Bowen, 2007). More adaptable temperament (Ackerman, Kogos, et al., 1999), greater self-worth (Sandler, 2001), and elevated academic competency/aspirations (Lichter, Shanahan, & Gardner, 2002; Reynolds, 1998; Sandler, 2001) weaken the link between CR and adverse socioemotional outcomes. Children's self-regulatory skills explain part of the association between CR and cognitive outcomes (Barocas et al., 1991; Kim & Brody, 2005; Kim et al., 2003). Finally, levels of cognitive stimulation in the home environment mediate the effects of CR on both cognitive (Klebanov, Brooks-Gunn, McCarton, & McCormick, 1998; Mistry et al., 2010; Poehlmann, 2005) and socioemotional outcomes (Mistry et al., 2010). From early infancy through late adolescence, it is apparent that child characteristics such as self-regulatory skills and academic competency as well as parenting, particularly sensitivity, and cognitive stimulation in the home, can help account for some of the negative outcomes associated with elevated CR.

Bronfenbrenner's bioecological theory of human development (Bronfenbrenner & Evans, 2000; Bronfenbrenner & Morris, 1998) provides another explanation why CR impacts on child development exceed those of singular risk exposures. According to Bronfenbrenner, the engines of human development are the exchanges of energy between the developing organism and the persons, objects, and settings surrounding the child. Multiple risk factor exposures may be more likely to disrupt these proximal processes of development because they interfere with the continuity and the progressively more complex exchanges of energy necessary to support healthy development. The developing organism can more readily handle a singular disruption, even if rather severe (e.g., parental loss), if it has the opportunity to cultivate alternative sources of the interrupted proximal process (e.g., a responsive and involved grandparent or adoptive parent). However, in the circumstance where multiple risk factors are encountered (e.g., parental loss, multiple, temporary foster parents, disinterested or incapable grandparent), then the possibility is much greater that this fundamental exchange of energy between the developing organism and a predictable, attentive, and caring adult caregiver will be disrupted, causing damage to the developing child.

Better articulation of underlying, mediating processes would also move CR research toward stronger inferential grounds given that the majority of CR and child development studies are cross-sectional (see Tables 1, 2, A, and B) and thus subject to alternative explanations for what appear to be CR effects. Although longitudinal studies have replicated the cross-sectional findings, we need more prospective longitudinal studies, interventions that reduce CR exposure, and utilization of behavioral genetics research designs. Since parents and not children choose the environments they inhabit, it could be argued that selection biases are less problematic in the CR studies reviewed herein. However, this argument ignores the potential role of genetic influences on parental choices as well as developmental outcomes. Although we are unaware of any CR behavioral genetics analyses, several investigators have recently examined genetic contributions to robust adverse outcomes of chaos on children's development (G. W. Evans & Wachs, 2010). The overall conclusion of these recent studies is that perceptions of chaos do in fact appear to have a genetic liability but environmental properties account for a larger share of chaos ratings (Hanscombe, Howarth, Davis, Jaffee, & Plomin, 2011). Other twin studies also show that the adverse impacts of chaotic living conditions on children's development are primarily environmentally mediated (S. A. Hart, Petrill, Deater-Deckard, & Thompson, 2007; Jaffee, Hanscombe, Haworth, Davis, & Plomin, 2012; Petrill, Pike, Price, & Plomin, 2004). At the same time, observational studies probably overestimate the developmental impacts of chaos since some of the effects appear to be due to shared genetic influence.

Choosing variables for inclusion in CR. Another theoretical shortcoming of CR is the conceptualization of risk factors for inclusion in the CR metric. For a given developmental outcome(s) of interest, what risk factors should be incorporated into the multiple risk index? One approach is to include singular risk factors that are known or believed to be reasonable candidates as risk factors for the outcome of interest. If one is interested in juvenile delinquency, several factors are already known to be associated with this outcome and could be combined into a CR index (e.g., male gender, familial criminality, low social capital, deviant peer exposure, low parental monitoring).

Another approach to the choice of risk factors for inclusion is to think carefully about salient mediating processes that underlie the target outcome and then to include risk factors known to share some overlap with those mediating processes. More secure attachment is afforded by greater caregiver responsiveness. Less secure attachment is evident in children with a less responsive primary caregiver. Thus, risk factors known or reasonably suspected to disrupt maternal responsiveness could be used to generate a candidate list of risk factors for insecure attachment (e.g., maternal stress, maternal depression, low maternal social support, high family turmoil/conflict). Consideration of salient proximal processes for a given developmental outcome can also shed light on what risk factors in combination are likely to elevate adversity. As an illustration, multiple indicators of human capital early in life ought to be especially important for cognitive development and school achievement, whereas risk factors encompassing maternal mental health would seem more salient for children's socioemotional development. In a recent multiple risk study using national data from low birth weight babies, human capital consisted of maternal employment and welfare status and maternal mental health included life events, social support, and depression (Pressman, Klebanov, & Brooks-Gunn, 2012). These investigators found support for both predictions. A combined multiple risk metric encompassing both domains of human capital and maternal mental health predicted each respective outcome best. However, in each case, the more salient subset of risk factors (human capital, maternal mental health) captured the lion share of the covariance.

Bronfenbrenner's human development theory (Bronfenbrenner & Evans, 2000; Bronfenbrenner & Morris, 1998) offers a taxonomy for thinking about risk domains according to scale or physical proximity to the child. The microsetting or immediate environment the child inhabits suggests that psychosocial and physical qualities of the home environment are critical for children, particularly early in life. With maturation, other childcare settings such as daycare or school settings will come into play as important contexts for development as the child's orbit of interactions expands across space and time. With the transition into adolescence, the neighborhood takes on greater saliency as a developmental context. The ecological theory of child development also calls our attention to both personal characteristics of the child (e.g., gender, temperament, genetic), physical characteristics of the various settings children inhabit (e.g., noise, structural quality, structure and predictability of routines [chaos]), as well as psychosocial dimensions of settings (e.g., parenting style, control/autonomy, social support) that are capable of affecting child development. Bronfenbrenner's theory further reminds us that children move across different microsettings and are indirectly influenced by larger exosystems inhabited by other influential persons in their lives (e.g., parental work environment). Finally, children as well as their caregivers and the various settings they inhabit are influenced by the larger macro context wherein these various subsystems are embedded (e.g., historical period, culture).

Another approach to considering risk factors comes from work on the developmental implications of evolution. Consideration of evolution forces us to think about the underlying reasons why certain characteristics of the settings in which children develop would have supported adaptive fitness for the species throughout evolution and thus shape what environmental qualities remain salient in modern life (Ellis, Figueredo, Brumbach, & Schlomer, 2009). This life history perspective argues that humans as biological beings must contend with fundamental but competing demands for resource allocation among body maintenance, growth, and reproduction. The allocation of resources to these competing needs will be largely driven by specific dimensions of environmental conditions that throughout evolutionary history contributed to adaptive fitness. According to Ellis et al. (2009), three domains of environmental conditions are critical to the allocation of competing resources among maintenance, growth, and reproduction: energy resources (e.g., nutrition), harshness (e.g., deprivation such as resource scarcity or poverty), and predictability (e.g., degree of stochastic regularity in harshness). Under harsher or more unpredictable conditions, one would expect resource allocation to favor more immediate bodily maintenance and reproduction and relatively less allocation to growth given that survival is less certain and energy investments in the future are less likely to payoff. Recent work shows that from birth through 5 years of age, experiences of greater harshness (e.g., poverty) and elevated unpredictability (e.g., greater instability in maternal partners, residential changes, changes in parental employment) are uniquely related to outcomes such as more premature sexual experiences and other risky behaviors indicative of accelerated life histories (Belsky et al., 2012; Simpson, Griskevicius, Kuo, Sung, & Collins, 2012).

Cross-domain risk. In addition to the challenge of how best to construct risk categories for inclusion in multiple risk exposure metrics such as CR, insufficient thought has been given to different domains or contexts of risk that children confront in their daily lives. As is apparent from scrutinizing Tables A and B in the online supplemental materials, risks at home are combined with those at school, and neighborhood; personal risk factors are combined with physical as well as psychosocial environmental risks. We reviewed several studies above (see Table 3) suggesting that exposure to clusters of risks across different domains may pose greater adaptive demands upon children compared to higher risk exposure within one risk factor domain. As noted above, the strain of dealing with risks that demand different types of physiological (allostatic load theory) or psychological resources (Bronfenbrenner's bioecological theory) may put considerably more pressure on the organism. More conceptual work on meaningful domains of childhood risk can also provide opportunities to leverage the advantages of CR metrics but still allow for some consideration of nonadditive, multiplicative effects of multiple risk exposure. It is possible to create hybrid models of CR that examine main and interactive effects of CR exposures in different domains. Below in the Future Directions section, we discuss a small number of recent studies that have begun to address this issue. As we shall see, the adverse impacts of CR within one domain tend to be exacerbated by CR levels within another domain.

Risk designation. Without a good conceptual understanding of how a risk factor operates, the designation of risk in most CR models is arbitrary, typically based on the statistical distribution (e.g., upper quartile of exposure). As we noted previously, this potentially conflates rarity with severity of risk. Recursive partitioning analytic models offer an alternative approach to risk designation that strengthens the designation of risk among continuous variables. Exposure to each risk factor is determined according to its relative potency as a predictor of the outcome. The best predictor of the outcome is split into two or more subgroups using recursive partitioning (Kraemer et al., 2005). The division of each risk factor into risk exposure subgroups of individuals is determined according to two criteria: risk exposure homogeneity within subgroup, and significant differences between subgroups in terms of the developmental outcome of interest. It is also possible to incorporate information about the relative costs of false positive and false negative risk decisions into each partitioning decision rather than relying solely on statistically significant differences between risk factor exposure subgroups. This process of subgroup partitioning is repeated for each risk factor creating a tree diagram until no more significantly different risk factor exposure subgroups can be generated. An important advantage of this analytic approach to deriving a multiple risk factor metric is that only risk factors that contribute to additional predictive power are incorporated into the final model. Also, the cut point for risk is not based on its relative frequency in the sample. Instead it is based on its power to discriminate between subgroups sharing similar values on the risk variable vis a vis the developmental outcome.

Pressman et al. (2012) provided two examples of recursive partitioning to delineate the optimal combination of risk factor exposures to predict 3-year-old children's cognitive performance and behavioral problems within a large sample of low birth weight babies. For behavioral problems at 3 years of age (total Achenbach scores on internalizing and externalizing symptoms), the best risk factor predictor was maternal education partitioned into three subgroups as shown in Figure 2. Each of these subgroups was associated with significantly different levels of behavioral problems at 3 years of age. For the two subgroups of mothers who had graduated from high school or who had some college, no addi-

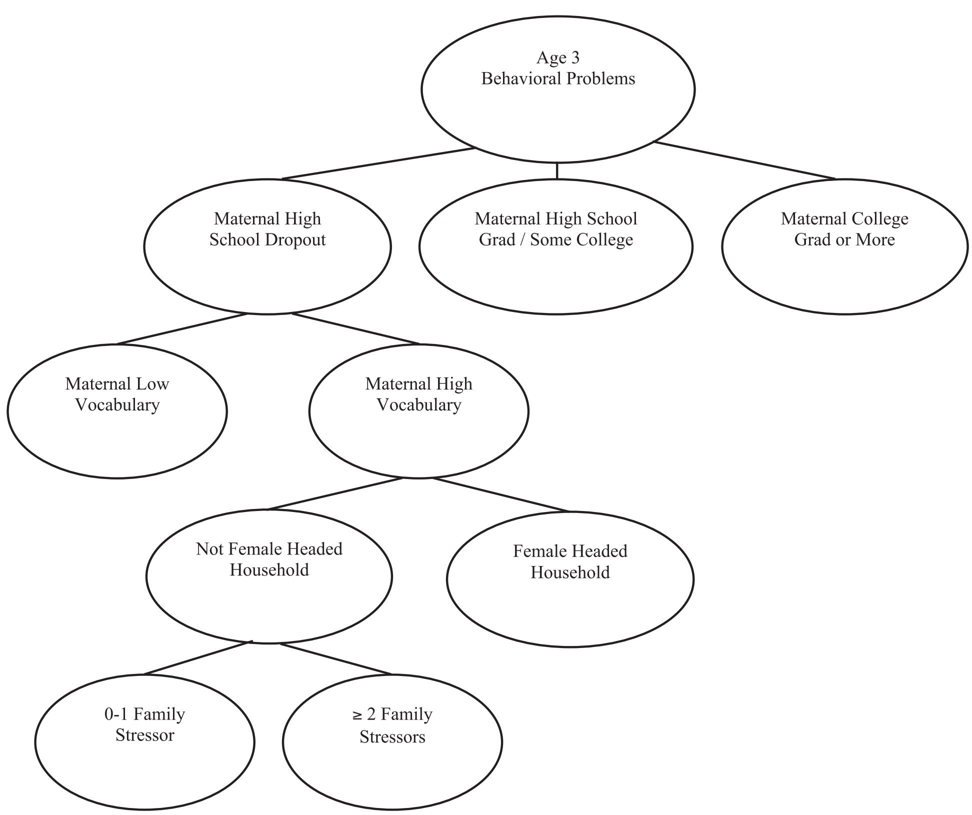

Figure 2. An example of recursive partioning as an analytic technique to calculate multiple risk exposure profiles. Data adapted from Pressman et al. (2012).

tional subgroup differences in behavioral problems could be discerned. But for the subgroup of mothers who did not obtain a high school degree, two additional subgroups emerged with significant differences in terms of their child's behavioral problems at 3 years of age: those with low receptive vocabulary (<65 on the Peabody Picture Vocabulary Test; Dunn, Dunn, Williams, & Wang, 1997) compared to those with average or better receptive vocabulary.

This approach to risk factor designation differs from the traditional CR metric in three respects. First, instead of specifying risk for continuous variables by a portion of the distribution (typically upper quartile) as done in CR, risk factor designation in recursive partitioning is based on its actual covariation with the developmental outcome of interest. Second, instead of all risks defined in dichotomous terms (0|1), each risk factor is defined by significant differences between homogeneous subgroups in terms of the outcome variable (e.g., three levels of maternal education differ in terms of child behavioral problems at 3 years of age). When only two subgroups are so defined, then the designation of risk is the same as in the CR model. Third, patterns or domains of risk emerge revealing that certain combinations of risk factor exposures are important in predicting the outcome. Note that the latter findings challenge the additivity assumption of the traditional CR metric in the same sense that some cluster or profile multiple risk indices have done as reviewed earlier.

Robustness of risk factors. Another drawback of defining risk in continuous risk factor exposures by the frequency of occurrence in the sample (e.g., upper quartile) is that the operationalization of risk may not generalize to other samples. As an illustration, a sample of predominantly low-income children could lead to different risk factor cutoffs for many variables (e.g., housing quality, family turmoil, maternal responsiveness) compared to the risk designations that might emerge from specifying risk = 1 for the upper quartiles in a more affluent sample. The degree of stability of what constitutes a risk factor across samples is an important shortcoming in the CR literature. Although some degree of risk stability is likely given use of extreme cutoff values for risk designation (e.g., upper quartile), the issue of risk invariance across samples has not been adequately addressed in multiple risk factor research. This problem can best be addressed by use of larger, more representative samples in conjunction with sensitivity analyses to determine what range of a continuous risk factor indeed predicts disorder (Kraemer et al., 2005).

Additive model. As we have already noted, CR is an additive model and thus precludes examination of possible synergistic, or interactive effects among risk factors. This is an important limitation because we know from many studies that the influence of one risk factor on an individual can be moderated by other variables functioning either to accentuate or to temper the adverse outcome. As is apparent in Tables 2 and B, there are also several factors, most notably gender, parent–child interactions, and personal characteristics, indicative of vulnerability that moderate the CR–outcome relationship. As indicated in our summary of studies in Table A in the online supplemental materials, it is also apparent that the function between number of risks and various developmental outcomes is not always linear. As a reminder, linearity in the multiple risk:outcome function has rarely been formally tested. We had to draw conclusions about linearity in most cases by inspecting means.

The shape of the nonlinear CR: outcome function warrants more attention. An accelerating function suggests that as the number of risks experienced rises, the developmental outcomes are worse, indicating possible synergistic impacts. When this function instead appears to asymptote, this implies some steeling or adaptation may be happening. As children experience risks they develop some degree of immunity. Caution is necessary, however, in drawing such conclusions for at least two reasons. First, scaling effects may be operating when high levels of outcome severity are approached (i.e., ceiling effects). Thus, measurement sensitivity is lost and residual increases in the outcome measure are not readily seen. Second, an accelerating function could masquerade for more severe reactions to a particular risk factor. So rather than exposure to additional risk factors increasing the levels of adverse outcomes, exposure to a particularly toxic risk factor could markedly increase adversity. Schilling, Aseltine, and Gore (2008) explored this explanation for an accelerating CR and mental health outcome function among a sample of young adults. They categorized each risk factor as low, moderate, or high given its zero order correlation with several mental health outcomes. For each of these outcomes the nonlinear, accelerating CR function was primarily due to greater exposure to higher risk factors. Risk factors that are correlated to those in the model but not explicitly measured could also lead to a nonlinear CR:outcome function. This may be especially true when risk factors such as poverty or ethnic minority status, which have a wide range of associated risk factors, are part of the CR metric (Obradovic, Shaffer, & Masten, 2012).

Loss of information on risk factor intensity. Another weakness of the CR metric is the loss of information. Because CR reduces continuous risk factors down to a risk|no risk dichotomy, information about degree of risk exposure is lost. Dichotomization of continuous variables rarely improves prediction (MacCallum, Zhang, Preacher, & Rucker, 2002), often rendering estimates of covariation less sensitive. It can also mask nonlinear functions. Furthermore, by defining risks in a dichotomous manner, we are unable to examine dose-response functions for singular risks.

Lack of attention to temporal parameters (e.g., age at exposure, duration of exposure). A final drawback of the CR metric is that temporal parameters are typically ignored. The unfolding of temporally interdependent risk factors is typically not part of CR metrics. Some risk exposures lead to a cascade of other risk factor occurrences (Pearlin, Menaghan, Lieberman, & Mullan, 1981)—for example, teenage pregnancy often triggers changes in educational attainment. Family dissolution is a precursor to poverty and associated multiple risks accompanying lack of financial resources. The lack of careful consideration of the sequential timing of risk factor exposure in CR metrics also aligns with the concern above regarding mediating mechanisms. How risk begets risk can provide clues about underlying psychological and biological processes that account for risk factor impacts. The chronicity of each risk variable itself (e.g., family turmoil vs. parental hospitalization) is typically ignored in most CR investigations as well. By focusing on the intensity of the risk factor, we are often left with no understanding of the dynamics of the risk to outcome relationship. Thus, the duration and stochastic timing of the risk factor are not reflected in the CR metric. For many risk factors, adverse outcomes increase with longer duration of impact as well as with unpredictable, aperiodic exposures (Bronfenbrenner & Evans, 2000; S. Cohen, Evans, Stokols, & Krantz, 1986).

Of critical importance to developmentalists, the age of the child at risk factor exposure and whether the risk continues throughout development are not typically captured in CR metrics. The timing and duration of risk factor exposure are also valuable in thinking about the emergence of psychological and physical disorders that emerge later in life (Miller, Chen, & Parker, 2011; Shonkoff, Boyce, & McEwen, 2009). As noted in discussing moderator findings from Tables 2 and B, few investigators have examined the developmental timing of multiple risk exposure. At this point, little can be said about critical periods wherein windows of vulnerability to multiple risk exposure exist and then become embedded in the organism. In their recent article on harshness and unpredictability during childhood and young adult risky behaviors, Simpson et al. (2012) found that a composite index of childhood unpredictability at ages birth to 5 years impacted several indicators of risky behaviors in 23-year-olds, whereas unpredictability between the ages of 6 and 16 years was inconsequential. This developmental pattern suggesting that early childhood CR exposure is more consequential than later exposure is consistent with a few prior developmental CR studies among young children (Appleyard, Egeland, van Dulmen, & Sroufe, 2005; Garbarino & Kostelny, 1996; Schoon et al., 2002). What little CR work exists on developmental timing among adolescents, however, hints at the opposite pattern, with later CR exposure more important than earlier exposure for adolescent outcomes (Blanz, Schmidt, & Esser, 1991; Gassman-Pines & Yoshikawa, 2006; Josie, Greenley, & Drotar, 2007; Newcomb, Bentler, & Fahy, 1987; Newcomb et al., 1986).

We also currently have insufficient understanding about what happens when the organism must contend with repeated exposure to multiple risks throughout childhood—is it the timing of multiple risk factor exposure that matters or the duration of exposure, or both? This is not only a matter of theoretical importance, as knowledge about multiple risk timing and developmental trajectories has profound implications for policy and practice. Using two, large, representative United Kingdom birth cohort data sets, Schoon et al. (2002) investigated linkages between parental social class at birth and both CR and educational attainment during early childhood, late childhood, and adolescence. They also examined a longer term index of adult social attainment. Parental social class affected material deprivation at each age but the effects of material deprivation on attainment at each age period were compounded by subsequent deprivation. Early disadvantage carried forward into future attainment, but subsequent material disadvantage added to additional loss of attainment. The strongest predictor of eventual social attainment was the cumulative effect of social disadvantage throughout life beginning at birth.

Strengths

Prediction of developmental adversity. Perhaps the major strength of CR assessments is that they predict a wide array of adverse developmental outcomes (see Tables 1, 2, 3, A, and B). Moreover, they outperform singular risk factors when this has been evaluated. Despite the assumption of additivity and the reduction of continuous variables into dichotomous risk factors, the fact remains that CR metrics outperform singular risk factors in predicting developmental outcomes. One of the reasons for this may be that, albeit a crude index of multiple risk exposure, CR may do a better job at capturing the type of risk factor exposure that really matters given human adaptive limitations. The human organism has difficulty when it must cope with a high level of demands that tax a variety of resource capacities. Human beings are relatively adept at handling singular environmental demands, even if rather severe, as long as they are not of overly long duration. However, when we are confronted with multiple demands that require different types of adaptive responses or coping processes, the system appears more likely to break down. Only exposures to relatively high levels of risk factors contribute to the CR index. CR metrics are constructed of a priori documented risk factors (e.g., maternal high school dropout) or by virtue of using high cutoff values (typically upper quartile), thus yielding estimates of exposure to multiple factors at levels sufficiently high that they produce pathology. Unlike many of the alternative multiple risk indices we describe herein, low and medium levels of risk do not contribute to the CR metric.

Unweighted risk factors. Another strength of the CR metric is its composition of unweighted risk factors, thus making no assumptions about the relative strength of different risk factors. Given the scant amount of research on the relative impacts of multiple risk factors on development, we lack sufficient knowledge in many cases to estimate the relative importance of multiple risk factors. Without a good theoretical model of why or how risks are affecting a particular developmental outcome, it is difficult to justify prioritizing a particular subset of risks over others. Although more work needs to be done, as discussed above, several investigators have shown that the particular constellation of risk factors in a multiple risk metric does not seem to matter much. What seems to be important is the quantity not the quality of risk factor exposures. Furthermore, unitary weights tend to be more robust than weighted predictors and are rarely outperformed by weighted models in predicting outcomes (J. Cohen et al., 2003; Farrington & Loeber, 2000; Flouri, 2008; Wainer, 1976). Unitary weights are also less sensitive to multicollinearity (J. Cohen et al., 2003; Myers & Wells, 2003). Many of the alternative multiple risk metrics summarized in the text depend upon sample specific weights for each risk factor that are subject to the above problems.

Insensitive to risk collinearity. The CR metric is also insensitive to the degree of covariation among risk factors. Some multiple risk metrics (e.g., summary score, factor scores, latent variables) are derived based upon the intercorrelations among the various risk factors (Ghiselli et al., 1981; Nunnally, 1978). Uncorrelated risk factors are rejected from the composite score. This means that potentially important risk factors are not included in the multiple risk metric. The CR metric can readily incorporate independent as well as interdependent risk factors. As suggested by our earlier discussion (see also Table 3), when children confront multiple risk factors across different domains, this appears to be particularly challenging.

Parsimonious. The CR metric is parsimonious. In one value, it represents exposure to a large number of risk factors rather than relying on multiple indicators of risk factor exposure. This enables a large number of risk factors to be accommodated by the CR metric without requiring huge sample sizes. Many of the alternative multiple risk metrics we review require large numbers of subjects both to obtain reliable estimates of the multiple risk composite and then to test its covariation with developmental outcomes. Furthermore, the degree of collinearity between risks does not distort estimates of multiple risk impact in the CR index as can happen with indices such as OLS regression or factor analyses derived from the General Linear Model (J. Cohen et al., 2003; Myers & Wells, 2003).

Statistical power. As an additive model, CR provides a reasonable alternative to the three major liabilities of multiple risk models that include statistical interaction terms. Higher order interaction terms require very large sample sizes because of the low statistical power of interaction terms (J. Cohen et al., 2003). Furthermore, as interaction terms incorporate more factors they rapidly become incomprehensible (Rutter, 1983) and are very unstable because of covariation among main effects (Myers & Wells, 2003).

Policy. Because of its simplicity (simply count the number of risk factors), the CR metric is readily understood and easily communicated to laypersons and policymakers. Counting the number of risk factor exposures and then relating the total developmental outcomes has intuitive appeal—it makes sense to many people. Clarity of understanding CR exposure and developmental outcomes may be especially apparent when the adverse impacts of CR are communicated in terms of odds ratios or the relative risks of important developmental outcomes. As illustrated in the introductory section of this article (e.g., "Four-year-old children exposed to five or more risk factors have nearly a threefold elevation in psychological distress relative to their peers exposed to zero or one risk factor compared to their peers exposed to one or no risks"), people can readily understand the notion that with a given increment in the number of risks encountered, the odds of a specific outcome happening change by a given amount.

A more subtle aspect of risk factor intervention and policy is the challenge of knowing how many risk factors need to be ameliorated in order to help a child. Multifaceted interventions are more expensive and obviously tend to involve greater logistical challenges. Sensitivity analyses can provide guidance for cost effective interventions for children confronting multiple risk factors. As an illustration, Lucio, Hunt, and Bornovalova (2012) used a signal detection tool, Receiver Operating Characteristics (ROC), to determine the most efficient threshold of multiple risk factor exposures in a CR model of academic failure among high school students. Setting the thresholds for false negative and false positive decisions at 60% and 80%, respectively, they demonstrated that the best cutoff was exposure to two or more risk factors in predicting academic failure among high school students. Students with two or more risk factors were correctly identified 81% of the time as individuals with a failing grade-point average (GPA). Students with two or more risk factors were incorrectly screened as failing 34% of the time. Signal detection analyses enabled these investigators to compare the probabilities of false negative and positive decisions at different risk accumulation thresholds.

Future Directions

In this section, we offer some conceptual and analytic avenues for further development in the study of multiple risk factors and child development.

Defining Risk

Although some risk variables are inherently binary (e.g., single parent status), most require a decision for what level of a continuous risk factor should be categorized as "risk." Most researchers have relied upon the upper quartile or 1 *SD* above the mean for this designation. However, a better alternative to designate risk would be to use nationally representative data on risk factor exposure to estimate high levels worthy of risk designation. For continuous risk variables, ideally one would choose a statistical cutoff known to reliably predict adverse outcomes (Kraemer et al., 2005). This also avoids the potential problem of equating rarity (only in upper tail) with risk. If we know or have good reason to suspect a particular variable is a risk factor, designation that a high degree of exposure to that risk factor counts toward the CR metric adds to the validity of the CR metric. On the other hand, if we designate some level of a variable as a risk factor simply because it occurs relatively infrequently, then the validity of the metric is problematic. This is also why a common occurrence in CR metrics is the inclusion of some categorical risk factors that are a priori defined as risky based on prior research rather than because of a statistical sampling of relative exposure frequency (e.g., upper quartile). Examples of some common a priori risk factors used in the CR and developmental literature are household poverty, single parent, parental high school dropout, teenage mother, and child abuse. In each of these cases, sufficient data exist to assign any level of exposure as risky.

Another recommended criterion for risk designation, where practical, would be to rely on diagnostic criterion (e.g., scale value above clinically designated depression threshold on a standard index such as the Center for Epidemiological Studies Depression Scale [Radloff, 1977] or the Beck Depression Inventory [Beck, Ward, Mendelson, Mock, & Erbaugh, 1961]). Use of larger data sets or clinical diagnostics to set risk cutoffs for continuous risk variables will increase the robustness of CR risk metrics, enhance their validity, and avoid the potential pitfall of equating risk with rarity. This approach to risk designation would also help allay concerns about CR measurement invariance across samples. Use of only high levels of continuous risk exposure to yield values of 1 compared to 0 helps the stability of risk designation across samples, but the use of normatively derived cutoff values would yield even greater stability.

Temporal Issues

Research that either delineates different types of CR (acute vs. chronic) and/or tries to tease apart their sequential dependencies (chronic risks such as poverty often provoke acute risks such as criminal victimization) would broaden theoretical contributions of CR scholarship (Kraemer et al., 2005). Developmental timing of CR exposure as well as duration of CR exposure are critical areas for a developmental perspective on CR. We do not have a good understanding of sensitive periods of CR exposure nor do we know much about the role of the duration of CR exposure in affecting outcomes over the life course.

The preponderance of evidence for CR effects is from cross-sectional studies and thus is subject to concerns about causal interpretations. Although all of the major correlates of CR have also been revealed in longitudinal studies (see Tables 1, 2, A, and B), more work needs to be done with stronger research designs, particularly prospective longitudinal designs and intervention studies wherein children are randomly assigned to reductions in CR exposure. Several recent behavioral genetic studies of chaos also point to the importance of more carefully considering the potential inheritability of CR exposure.

Mediation and CR Effects

Investigators interested in CR effects on children need to more thoroughly conceptualize what factors constitute aspects of multiple risk exposures and what mediating variables are likely to help explain how/why CR adversely influences development. If mechanisms of CR impact are shared, then one would expect to see strong mediation with the inclusion of a particular set of underlying mediators. In addition, inclusion of alternative mediators should not significantly attenuate explanatory power as long as they represent alternative, underlying constructs. Thus, one should ideally conduct mediational tests of CR effects with indices of different mediating constructs in order to discern if there is one or more shared underlying mechanism(s) capable of explaining CR effects on the outcome.

An interesting way to extend the above discussion of underlying, mediating processes to account for adverse CR impacts on children is to consider how CR could also alter the ecological context of children's development through its impact on other important persons in children's lives. As an illustration, Kochanska, Aksan, Penney, and Boldt (2007) showed that parental CR at 7 months influenced parenting behavior two and half years later. High CR was linked to less parental warmth in mothers and fathers and to greater assertion of power among fathers only.

Additivity

All CR investigators should begin with an assessment of CR, statistically controlling for each singular risk factor to ensure that the CR term is not simply reflecting the operation of one powerful, singular risk factor. Although many studies find linearity in the CR:outcome function, thus indicating little risk interaction, it does not make sense to ignore possible interactions among risk factors, particularly when they are not collinear. Investigators of CR should statistically evaluate the linearity of the CR function in relation to each outcome variable and report these results. We would also recommend that when nonlinearity is found, further investigation is warranted to determine if one or a subset of singular risk factors is driving this nonlinearity. This could indicate that one or more of such variables should not be part of the CR metric, instead being treated as a moderator variable. As indicated in Table B in the online supplemental materials, several variables—including some that have been part of additive CR metrics (e.g., male gender, nonwhite ethnicity)—in fact statistically interact with additive CR metrics.

CR Domains

A small number of studies reveal that when CR is experienced in more than one domain, more adverse outcomes typically happen than when exposed to high CR in only a single domain (see Table 3). Use of CR across different domains shows considerable promise and should be pursued in future CR studies. We believe a hybrid CR model that also allows for synergistic effects among multiple CR metrics warrants further investigation. This approach would enable investigators to leverage the advantages of the additive CR metric but to examine interactions among CR domains that might reasonably be expected to have synergistic impacts. By aggregating multiple risk factors into a small number of domains, the challenges of large sample size requirements and incomprehensibility of higher order interaction terms are also avoided.

Some candidates for risk domains are apparent from the on line supplement, Table 3 and from developmental theory more generally. One obvious demarcation of risk domains is individual and environmental, and the latter can be further broken down by proximity to the child. In the individual domain, biological factors such as genetics, and birth weight, along with temperament or personality are salient risk factor domain candidates. One can also consider sociodemographic factors such as poverty, family structure, gender, and race or ethnicity as a potentially relevant risk domain. Bronfenbrenner's (1979) bioecological model of human development is a good starting point for thinking about salient levels of environmental settings ranging from the immediate settings children occupy (e.g., home, daycare, or school) to the larger macrosetting or historical/cultural societal context wherein the child and their family are embedded. G. W. Evans (2006) also provides a framework for thinking about different physical characteristics of the settings salient to children's development (e.g., housing, noise, crowding, school building quality). Models of stress and resilience also reveal some candidates for risk domains. Characteristics of parenting, particularly responsiveness and warmth are important to consider. Additionally parental psychopathology, especially depression, social support, and control, are all salient developmental factors relevant to thinking about domains of risk. Finally, earlier we discussed how evolutionary biology provides insight about formulating domains of risk in terms of their relative salience for resource allocation among body maintenance, growth, and reproduction (Ellis et al., 2009).

One of the advantages of thinking about risk domains, is that creating them affords opportunities to examine main and interactive risk domain effects on children. This would enable investigators to leverage the advantages of CR as an index of multiple risk factor exposure but also begin to address two essential limitations of the CR metric: the additivity of risk assumption and the absence of a clear theoretical rationale for the constellation of the risk composite. Below, we summarize a few studies that have examined main and interactive effects of domains of CR on children's development.

Ackerman, Schoff, Levinson, Youngstrom, and Izard (1999) calculated CR metrics for various microsetting domains among low-income, 6- and 7-year-olds. Their CR clusters included family instability (e.g., residential changes), parental adjustment (e.g., psychiatric illness), and family structure (e.g., single parent status). Main effects of instability CR and parental adjustment CR were found on externalizing and internalizing symptoms, respectively. Of particular interest in thinking about interrisk domain interactions, the adverse effects of instability CR on internalizing symptoms were exacerbated by higher family structure CR.

Brennan, Hall, Bor, Najman, and Williams (2003) examined the main and interactive effects between two different domains of CR in relation to aggression at 5, 14, and 15 years of age among a sample of children whose mothers were depressed. One CR metric consisted of various social risk factors including parenting attitudes and behaviors, low SES, and high family transitions. The second CR metric consisted of various biological factors including perinatal complications, difficult temperament, low IQ, and poor executive functioning. They used each of these CR metrics alone and in a multiplicative form to predict three types of aggression patterns: early onset and persistent, adolescent onset, and a non-aggressive group. CR_{social} discriminated between early onset persistent aggressive and nonaggressive youths, between adolescent onset aggressive and nonaggressive youths, and between early versus adolescent onset aggressive. $CR_{biological}$ did not significantly predict any of the three patterns of aggressive behavior. The authors also found two significant $CR_{social} \times CR_{biological}$ interactions that discriminated between early onset and non-aggressive youths and between early onset and adolescent onset aggression. In both cases high levels of CR for both social and biological risks elevated aggression the most.

Mrug, Loosier, and Windle (2008) were interested in the cumulative effects of violence exposure within home, neighborhood, and at school. Within each domain different types of violence exposures were additively summed to create three CR indices. The investigators found main effects of home violence CR on anxiety, depression, aggressive fantasies and behaviors, and delinquency. School violence CR influenced anxiety, depression, and aggressive fantasies, whereas neighborhood violence was marginally associated with aggressive fantasies. Of particular interest to multiplicative domain impacts, the adverse impacts of home violence CR on anxiety and depression were accentuated in low violence neighborhoods. Lower levels of neighborhood violence CR were also associated with stronger adverse impacts of school violence CR on aggressive fantasies and delinquency.

Recently, investigators examined interactive relations among CR domains using school as the unit of analysis rather than the individual child. Whipple, Evans, Barry, and Maxwell (2010) examined the interaction between school level CR (e.g., teacher turnover rates) and neighborhood level CR index (e.g., poverty rates) as related to school wide academic achievement among elementary schools in New York City. Not only were there significant main effects for both CR indices, but the two school- and neighborhood-level CR metrics interacted. The adverse impacts of school cumulative risk factors on school wide achievement scores were exacerbated in riskier neighborhoods.

Two groups of investigators found no CR domain interactions. Carta et al. (2001) examined the main and interactive effects of a CR index for prenatal substance abuse and a CR index consisting of several SES related factors such as poverty, single parenthood, high school dropout, large family size, and non-White ethnic status. Each of these CR metrics influenced both the intercept and slope of trajectories of developmental status from ages 1 month to 36 months. Not surprisingly given the composition of the two CR metrics (prenatal substance abuse and low SES factors), the two domains were significantly correlated and no interactive effects of the two CR domains were found. Candelaria et al. (2011) were interested in main and interactive effects of three domains of risk among preterm, African American infants. The three domains of CR consisted of health (e.g., birth weight, prematurity), SES (e.g., income, maternal education), and psychosocial risk (e.g., maternal depression, parenting stress). The authors found main effects of SES and psychosocial risk on attachment security at age one but no interactions among any of their CR domains. Unlike Carta et al. (2001) the different CR domains were not correlated in the Candelaria study. One possible explanation for the absence of any interactive CR effects may have been the relatively small sample size ($n = 112$) in conjunction with the use of a sample of uniformly high risk factor exposure.

Conclusions

The concept of CR has obtained considerable traction within developmental science because of the robust finding that exposure to multiple risk factors predicts more severe, adverse developmental consequences compared to singular risk factor exposure. Furthermore, as shown in Tables A and B in the online supplemental materials, there is good evidence for a dose-response function—as the number of risk factors encountered increases, the severity of impact rises. The CR metric also has construct validity. The human organism is resilient, capable of withstanding a wide range of personal and environmental limitations. However, when confronted with a multitude of divergent demands at the same time or in close succession, our adaptive capabilities are strained beyond capacity and the system begins to breakdown. CR is drawing heightened interest among developmentalists because of the recognition that multiple risk exposure may provide insight into why structural factors such as poverty, race, and culture are so important to a host of developmental outcomes.

Despite its popularity, greater care in CR modeling is needed. More thought is required about the presumption of risk factor additivity. Combining singular risk factors into domains would enable examination of the main and interactive effects of CR domains. More consideration of CR mediators would also help explore in more depth the additivity assumption of some shared, underlying quality of risk in the CR metric that drives the child outcome. If each risk factor has a unique, underlying pathway to child outcomes, then the fundamental presumption of CR additivity is void. Note the value in this context, of testing for multiple, competing mediators. Mediational analyses also speak to a fundamental conceptual weakness in CR research. Showing that a multivariate CR metric predicts adverse outcomes more strongly than singular risk factors begs the question, why? If multiple risk factors share some common mechanism of impact (e.g., weaken parent–child bonds; increase harsh, punitive parenting), the combination of risks that each affects the same underlying mechanism ought to cause greater dysregulation.

Given that multiple risks have more adverse impacts on children than singular risks and that ecological covariation exists among many childhood risks, it behooves us to develop more psychometrically sound and ecologically valid indices of multiple risk exposure. The most pressing challenge facing scholars interested in multiple risk factor exposure and human well-being is the development of a theoretical framework to delineate developmentally salient risk domains in order to better understand why the accumulation of risk factor exposures leads to worse developmental outcomes compared to singular risk exposures.

Finally, it is worth reiterating that there are important policy and practice implications of CR impacts on children. As indicated in Figure 1, many children confront multiple risk factors early in life. For subsets of the child and youth population (e.g., those in poverty, children of color, new immigrants), risk factors tend to cluster together. A low-income child who is having difficulty at school more often than not is facing a host of adaptive challenges outside the schoolyard gate. Children and youths confronted by higher amounts of CR are more likely to suffer adverse cognitive and socioemotional consequences. Thus, CR is an important tool for targeting children for interventions. If it is correct that the accumulation of exposure to multiple risk factors is more harmful than exposure to a smaller number of risk factors, then developmental interventions that isolate only one risk factor are less likely to work than those that are multifaceted—a common pattern in the intervention literature (Brooks-Gunn, 2003; Sameroff, 2006; Yoshikawa, Aber, & Beardslee, 2012).

This proposition is also consistent with the extension of CR to cumulative resources or cumulative advantage. A much smaller number of studies, including several with at risk children, suggest that as resources/assets accumulate, the benefits of multiple assets accrue, leading to more positive outcomes (Crosnoe et al., 2010; Furstenberg et al., 1999; Runyan et al., 1998). Furthermore, as noted in Tables 2 and B, several investigators have shown that indices of cumulative advantage can attenuate some of the ill effects of CR (Ackerman, Schoff, et al., 1999; Dunst & Trivette, 1994; Ostaszewski & Zimmerman, 2006; Spencer, 2005). Although it is important to attenuate adverse outcomes from high CR exposure, we should be mindful that both endogenous resilience factors (e.g., high IQ, good temperament) as well as interventions rarely if ever explain as much variance in developmental outcomes as exposure to multiple risk factors (Gutman, Sameroff, & Cole, 2003; Pollard, Hawkins, & Arthur, 1999; Sameroff & Rosenblum, 2006). The best intervention for children's welfare is to reduce the amount of risk factors they are exposed to in the first place.

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