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Modeling Multiple Risks During Infancy to Predict Quality of the Caregiving Environment: Contributions of a Person-Centered Approach

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Abstract

The primary goal of this study was to compare several variable-centered and person-centered methods for modeling multiple risk factors during infancy to predict the quality of caregiving environments at six months of age. Nine risk factors related to family demographics and maternal psychosocial risk, assessed when children were two months old, were explored in the understudied population of children born in low-income, non-urban communities in Pennsylvania and North Carolina (N = 1047). These risk factors were 1) single (unpartnered) parent status, 2) marital status, 3) mother's age at first child birth, 4) maternal education, 5) maternal reading ability, 6) poverty status, 7) residential crowding, 8) prenatal smoking exposure, and 9) maternal depression. We compared conclusions drawn using a bivariate approach, multiple regression analysis, the cumulative risk index, and latent class analysis (LCA). The risk classes derived using LCA provided a more intuitive summary of how multiple risks were organized within individuals as compared to the other methods. The five risk classes were: married low-risk; married low-income; cohabiting multiproblem; single low-income; and single low-income/education. The LCA findings illustrated how the association between particular family configurations and the infants' caregiving environment quality varied across race and site. Discussion focuses on the value of person-centered models of analysis to understand complexities of prediction of multiple risk factors.

Keywords

latent class analysis; person-centered; multiple risks; infant development; risk assessment

The identification of risk factors for early cognitive and behavioral development is important because a risk-focused approach provides a framework for understanding etiology

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as well as targeting at-risk individuals in order to improve developmental outcomes (Catalano & Hawkins, 1996; Hawkins, Catalano, & Miller, 1992). Historically, different methods have been used to model risk, each providing a somewhat different framework for understanding the risks associated with children's outcomes. However, most current theories agree that risk occurs in combination, not in isolation. It is this intersection or accumulation of risks, rather than any single risk factor, which accounts for the preponderance of negative developmental outcomes (Appleyard, Egeland, Van Dulmen, & Stroufe, 2005; Deater-Deckard, Doge, Bates, & Pettit, 1998; Flouri & Kallis, 2007; Sameroff, Seifer, Baldwin, & Baldwin, 1993). According to cumulative risk theory, this accumulation of risks may overwhelm the individual's capacity to adaptively negotiate their environment (Gutman, Sameroff, & Cole, 2003; Gutman, Sameroff, & Eccles, 2002; Sameroff et al., 1993). In this view, it is the total number of risks, not the specific combination of risks that is most important in predicting outcomes. This view has come under debate in recent years, however, as more sophisticated methodological techniques have become available and researchers have turned to identifying specific subgroups of individuals in need of preventive interventions.

There are two primary goals of this study. First, we use variable- and person-centered approaches to examine how family/parent risk factors in infancy predict the quality of caregiving environments in the Family Life Project, a large naturalistic study of non-urban children followed from birth. As discussed below, the quality of the caregiving environment in infancy is a key factor in the prediction of child competence later in life (Bradley, Caldwell, & Rock, 1988; Bradley & Corwyn, 2001; Bradley, Corwyn, McAdoo, & Carcia Coll, 2001b; Carlson & Corcoran, 2003; Downer & Pianta, 2006). Here we focus on structural/demographic and maternal psychosocial risks in the earliest months of life that predict the quality of the caregiving environment. Second, we assess the conclusions that can be drawn using different statistical models of risk, highlighting the value of a person-centered approach.

Modeling multiple risks typically involves a variable-centered framework, where the influence of one or more variables on an outcome is assessed. Variable-centered approaches are used to examine the relations between variables and/or to identify processes common to a group of individuals (Laursen & Hoff, 2006). However, these approaches often assume that all individuals at a certain level of the predictor are at equal risk for an adverse outcome regardless of other risk factors or individual characteristics, and that the relation between a risk factor and outcome is the same across the entire population.

A person-centered framework, on the other hand, assumes that development is a result of multiple, interacting factors at various levels of the person-environment system (Bergman & Trost, 2006). Whereas variable-centered analyses describe the mythical "average person," person-centered analyses identify particular constellations of characteristics, in our case risk factors, that describe real sub-groups of children (Lewin, 1931; Magnusson & Bergman, 1990; von Eye & Bogat, 2006). The person-centered approach is vital in studies like the present one where the goals are 1) to understand how constellations of multiple, interacting risk factors are associated with the quality of children's caregiving environments, and 2) to identify groups of children who are at highest risk for later poor outcomes.

Variable-Centered Methods for Modeling Multiple Risks

Three common variable-centered approaches to modeling multiple risks are bivariate methods, multiple regression analysis, and the cumulative risk index. The most straightforward way to explore risk associated with a set of factors is a *bivariate approach* which tests for associations between each risk factor and outcome (e.g., Reinherz, Giaconia, Hauf, Wasserman, & Silverman, 1999). This approach can provide valuable descriptive

information, but falls short in several ways. First, the likelihood of Type I errors of chance findings increases as each variable is considered separately. Second, risk factors are assumed to be equal regardless of how many or which other factors are present (i.e. interactions of risk factors are disregarded). Third, and perhaps most importantly, the variable-centric information produced is difficult to utilize alone because it provides no further insight into a person's true risk based on other risk factors (Bergman & Magnusson, 1997).

Perhaps the most common multivariate approach is *multiple regression analysis*, in which each factor is weighted according to the strength of its relation with the outcome. (e.g., Luthar, Cushing, Merikangas, & Rounsaville, 1998). Although the differential impact of individual risk factors can be examined, interactions are often not examined due to a lack of statistical power. Without interaction terms, a regression approach assumes that risk associated with one factor is homogenous across levels of all other factors. In addition, the high levels of multicollinearity that often exist among risk factors can mask the role of important factors.

Another approach, first introduced by Rutter (1979), is the *cumulative risk index*. In this approach the quantity of risk factors to which a child is exposed is captured by summing across a set of risk factors coded 1 for risk or 0 for no risk (e.g., Lengua, 2002; Seifer et al., 1996). This approach lends itself well to theories of risk where the quantity of risk is emphasized rather than specific risk factors. Findings based on a cumulative risk index have some limitations. First, individual risks often potentiate each other such that the risk of a particular factor is increased when it occurs in conjunction with other factors. A cumulative risk index assigns equal weight to each factor and does not allow for the exploration of interactive effects. Perhaps more importantly, risk factors are seen as interchangeable. For example, an index score of three provides no information about *which* three factors are present for that child; all children with a score of three are assumed to be at equal risk. Finally, because an index score does not describe which risks are present for an individual, this approach is not conducive to developing preventive programs aimed at mitigating specific risk factors. Despite these limitations, numerous empirical studies report that the accumulation of risk rather than any single, specific risk is often a better predictor of a variety of developmental outcomes (Appleyard, Egeland, Van Dulmen, & Stroufe, 2005; Deater-Deckard, Doge, Bates, & Pettit, 1998; Flouri & Kallis, 2007; Sameroff, Seifer, Baldwin, & Baldwin, 1993).

Person-Centered Methods for Modeling Multiple Risks

Although the variable-centered approaches to risk have been informative, the field may benefit from approaches that identify subgroups of individuals who are characterized by particular combinations of factors associated with the highest level of risk and thus might be important subgroups to target with particular intervention programs. In general, person-centered approaches align well with a holistic view of child development as they recognize that a) human development is at least partially a unique process for each individual, b) non-linear relations between variables and higher-order interactions are common, and c) isolating the unique impact of one variable may obscure the way variables work together within developmental processes (Bergman, Cairns, Nilsson & Nystedt, 2000; Cairns, 1979; Lerner, 1984; Lerner, 2006). To date, several person-centered approaches to risk assessment have been used. These are reviewed below.

One approach assigns individuals to their *observed risk profiles*, which are formed by cross-tabulating all risk factors under consideration. For example, Greenberg, Speltz, DeKlyen, and Jones (2001) examined all combinations among four risk domains (child characteristics, parenting practices, attachment, and family ecology) in relation to problem behavior.

Configural frequency analysis (CFA; Krauth & Lienert, 1982; von Eye, 1990) has also been used to study all possible combinations of a specified set of risk factors. Observed risk profiles and CFA are limited because the number of possible observed risk profiles grows exponentially as the number of risk factors grows (i.e. 6 risk factors leads to 64 possible profiles). This can present difficulties in summarizing risk exposure and testing hypotheses (see e.g. Bergman, Magnusson, & El-Khoury, 2003). A third person-centered approach, *cluster analysis* (e.g., Sameroff et al., 1993), has great conceptual appeal but deciding on the number of clusters can be somewhat arbitrary. Further, this approach does not allow measurement error to be accounted for, even though individual risk factors do not correspond perfectly with cluster membership.

A final person-centered approach that has been increasingly used is *latent class analysis* (LCA; Goodman, 1974; Lazarsfeld & Henry 1968). LCA has been used with a variety of constructs, including child temperament (Stern, Arcus, Kagan, Rubin, & Snidman, 1995), problem behavior (Lanza, Collins, Schafer, & Flaherty, 2005), depression (Lanza, Flaherty, & Collins, 2003; Sullivan, Kessler, & Kendler, 1998), and substance use (Chung, Park, & Lanza, 2005; Guo, Collins, Hill, & Hawkins, 2000; Lanza & Collins, 2002). More recently, LCA has been used to identify profiles of early risk associated with behavior and academic outcomes (Lanza, Rhoades, Nix, Greenberg, & CPPRG, in press). In LCA each individual's latent class membership is unknown, and inferred from a set of categorical items. This approach allows for the analysis and interpretation of higher-order interactions among the risk factors. In addition, LCA focuses on identifying subgroups characterized by particular types, or combinations, of risks; the risk factors are not treated as interchangeable. LCA is a confirmatory procedure, where the user specifies the number of latent classes and fit statistics are obtained, providing a means for evaluating overall model fit and comparing the fit of competing models. In addition, LCA is a latent variable model, allowing for the estimation of measurement error. LCA typically yields far fewer latent risk classes than the number of observed risk profiles, allowing for a parsimonious description of risks and relatively few problems with sparseness.

We believe the properties of LCA can provide new insights regarding the ways in which multiple risks from multiple ecological levels interact and are related to children's outcomes. In the current study we make direct comparisons between LCA and three commonly-used methods to model risk: a bivariate approach, multiple regression, and a cumulative risk index. We emphasize how each method elucidates associations between early maternal psychosocial and structural/demographic risks and the quality of children's caregiving environments.

Early Maternal and Structural Risks for Children's Caregiving Environments and Later Development

The quality of the early caregiving environment provides a foundation for children's subsequent development in multiple domains, including academic achievement, cognitive ability, and behavior problems and therefore is a key construct in the study of young children's development (Bradley et al., 1988; Bradley & Corwyn, 2001; Bradley et al., 2001b; Carlson & Corcoran, 2003; Downer & Pianta, 2006). The experiences within the caregiving environment, especially during the first few years of life, appear to be particularly important; research has shown important links between the quality of the caregiving environment prior to school entry and developmental outcomes as late as elementary school (Bradley et al., 1989; Bradley et al., 1988; Downer & Pianta, 2006).

Primary caregiver and family characteristics are central sources of risk and/or resilience in children's early development in large part because they are the primary forces that shape young children's early environments and interactions (Shonkoff & Phillips, 2000). Below

we review several studies that demonstrate how such characteristics directly relate to the quality of the caregiving environment, and briefly review the extensive literature documenting associations between these characteristics (including demographic, behavioral, cognitive, and mental health characteristics of the mother and physical characteristics of the household) and subsequent child outcomes. Here we focus on nine commonly cited risk factors for poor quality caregiving environment and future development that were assessed in the Family Life Project: 1) single (unpartnered) parent status, 2) marital status, 3) mother's age at first child birth, 4) maternal education, 5) maternal reading ability, 6) poverty status, 7) residential crowding, 8) prenatal smoking exposure, and 9) maternal depression. This literature is summarized below.

Maternal demographic characteristics associated with the quality of the early caregiving environment and later child outcomes include being single and/or unmarried, being a teen mother, having low education, having a low income, and/or having a low reading ability. For example, lower maternal education, lower reading ability and being a teen mother has been linked to lower quality caregiving environments (Baharudin & Lister, 1998; Burgess, 2005). In general, demographically disadvantaged mothers are more likely to lack essential child development knowledge and parenting skills, live in poorer quality neighborhoods, and have poorer quality interactions with their children (Brooks-Gunn & Duncan, 1997; Brooks-Gunn & Furstenberg, 1986; McAnarney, Lawrence, Ricciuti, Polley, & Szilagyi, 1986; McGroder, 2000; Osofsky, Hann, & Peebles, 1993). Given the lower quality environment these mothers provide, it is not surprising that research has documented associations between maternal demographic characteristics and children's developmental outcomes across several domains including academic and mental health (Auerbach, Lerner, Barasch, & Palti, 1992; Buchholz & Korn-Bursztyn, 1993; Duncan, Brooks-Gunn, & Klebanov, 1994; NICHD Early Child Care Research Network, 2005; Prelow & Loukas, 2003; Rauh, Parker, & Garfinkel, 2003; Wakschlag & Hans, 2000; Whitman, Borkowski, Schellenbach, & Nath, 1987; Yeung, Linver, & Brooks-Gunn, 2002).

In addition, maternal mental health problems and risk-taking behaviors put children at increased risk for poor caregiving environments as they are associated with more limited economic and psychosocial resources that are needed for successfully raising healthy, well-adapted children, particularly in stressful environments (Downey & Coyne, 1990; Goodman & Gottlib, 1999; Kim-Cohen, Moffitt, Taylor, Pawlby, & Caspi, 2005). Additionally, these maternal characteristics are well documented risk factors for poor child outcomes. Children of depressed mothers are at increased risk for behavior problems and cognitive delays (Burt, Hay, Pawbly, Harold, & Sharp, 2004; Dodge, Pettit, & Bates, 1994; Gutman et al. 2003; Gutman et al. 2002; Hair, McGroder, Zaslow, Ahluwalia, & Moore, 2002; Harland, Reijneveld, Brugman, Verloove-Vanhorick, & Verhulst, 2002; Martin, Linfoot, & Stephenson, 2005; Prelow & Loukas, 2003). Prenatal exposure to smoking also has been associated with negative outcomes including ADHD, antisocial behavior, obesity, and substance use (Brennan, Grekin, Mortensen, & Mednick, 2002; Button, Thapar, & McGuffin, 2005; Griesler, Kandel, & Davies, 1998; O'Callaghan et al., 2006; Oken, Huh, Taveras, Rich-Edwards, & Gillman, 2005; Wakschlag, Leventhal, Pine, Pickett, & Carter, 2006).

The actual physical characteristics of the home also contribute to children's caregiving environments and confer risk for associated outcomes. Residential crowding has been shown to directly relate to the caregiving environment quality, particularly as it relates to literacy (Johnson, Martin, Brooks-Gunn, & Petrill, 2008). In addition, controlling for socioeconomic status, residential crowding has been consistently associated with poorer behavioral, academic, and physiological outcomes for children (Evans, Lepore, Shejwal, & Palsane,

1998; Evans, Saegert, & Harris, 2001; Grove, Hughes, & Galle, 1979; Regoeczi, 2003; Supplee, Unikel, & Shaw, 2007).

Importantly, however, children's exposure to various risks, including parenting practices and contextual experiences, may vary by ethnicity above and beyond socioeconomic differences and theory suggests that the meaning, salience and impact of risk factors may vary by children's cultural background (Bradley, Corwyn, McAdoo, & Garcia Coll, 2001a; Feldman & Masalha, 2007; Garcia Coll & Magnusson, 1999; Klimer, Cowen, Wyman, Work, & Magnus, 1998). For example, Bradley et al. (2001a) examined ethnicity and poverty status differences in several indicators of the caregiving environment including learning stimulation, parental responsiveness, spanking, teaching, and the physical environment. As expected, children's likelihood of being exposed to specific experiences in the home varied by ethnicity and income level. In general, Caucasian and Asian American families scored higher across all five indicators as compared to African American and Hispanic American families. However, irrespective of ethnicity group, children in poor families were less likely to have access to learning materials, to be exposed to a variety of enriching places and events outside of the home, to be exposed to verbal stimulation from their mothers, to receive verbal and physical affection from their mothers, to be read to by their mothers, and to live in safe, clutter-free caregiving environments.

In line with these findings, the present study hypothesizes that profiles of risks that include poverty will be associated with poorer-quality caregiving environments in the present study. What is less clear is, however, is how other maternal and structural risks (e.g., single parenthood, maternal education, smoking during pregnancy, maternal depression) in combination with poverty status and ethnicity will be associated with children's early experiences in their homes. Using a person-centered approach, the present study plans to address this gap in the literature.

Despite these established ethnic and economic group differences, quality of the caregiving environment remains one of the most consistent early predictors of later cognitive, academic and behavioral competence. For example, Carlson and Corcoran (2003) found that quality of the caregiving environment was negatively related to children's behavioral problems, above and beyond the effects of maternal demographic characteristics and psychological well-being. Bradley et al. (1989) found that although socioeconomic status significantly predicted children's cognitive development, aspects of the caregiving environment like parental responsivity and availability of stimulating toys were more strongly related to children's outcomes, especially for boys and African Americans. Because of the established link between quality of the early caregiving environment and later developmental outcomes, quality of the caregiving environment at six months is the outcome of interest in the present study.

The Current Study

For the current study, we operationalize maternal and structural risk to include structural characteristics of the home, socioeconomic characteristics of the primary caregiver/household, and exposure to psychosocial qualities of the primary caregiver. The nine risk factors are 1) single (unpartnered) parent status, 2) marital status, 3) mother's age at first child birth, 4) maternal education, 5) maternal reading ability, 6) poverty status, 7) residential crowding, 8) prenatal smoking exposure, and 9) maternal depression. Our primary goal is to compare the conclusions that can be drawn using more traditional variable-centered approaches with the conclusions that can be drawn using a person-centered approach. We examine the results of a bivariate analysis, multiple regression, a cumulative risk index, and LCA to understand how nine risk factors in infancy relate to the quality of the caregiving environment. Given the importance of ethnic differences cited in

the literature above, we also incorporate ethnicity into all models to examine how the prevalence of risks and the relations between risks and later outcomes may vary across ethnic groups.

Method

Procedure

The Family Life Project (FLP) is a community-based study of developmental processes and outcomes in non-urban families. The study population is drawn from Eastern North Carolina (the counties of Sampson, Wayne and Wilson) and Central Pennsylvania (the counties of Blair, Cambria and Huntingdon). These two regions were chosen because they represent two of four major non-urban geographic areas of the US with high poverty rates (Dill, 1999). Specifically, the counties in North Carolina and Pennsylvania were selected to be indicative of the Black South and Appalachia, respectively. Low-income families in both states, and African American families in North Carolina, were oversampled. This design is ideal for the current study, as it increases the power to detect risk groups that may have a low prevalence in the population.

To recruit a representative sample of children whose mothers resided in one of the six counties at the time of the child's birth, a two-stage random sample was drawn from the aforementioned target counties. In the first stage, three of seven hospitals were randomly sampled within each county in Pennsylvania (PA) because there were too many hospitals to permit recruitment at all of them. All hospitals were included in North Carolina (NC). In the second stage, four groups of families in NC and two groups in PA were targeted. In North Carolina, low-income Caucasian, low-income African American, not-low-income Caucasian, and not-low-income African American groups were recruited. In Pennsylvania, low-income and not-low-income groups (the target communities were over 95% Caucasian) were recruited. In total, 5471 (57% NC, 43% PA) women who gave birth to a child during the recruitment period of September 15, 2003 to September 14, 2004 were identified, 72% ($N = 3956$) of which were eligible for the study. Eligibility criteria included residency in target counties, English as the primary language spoken in the home, and no intent to move from the area in the next three years. Of those eligible, 68% ($N = 2691$) were willing to be considered for the study. Of those willing to be considered, 58% ($N = 1571$) were invited to participate using the sampling fractions that were continually updated from our data center to ensure representativeness of the target population described above. Of those selected to participate, 82% ($N = 1292$) of families completed their first home visit, at which point they were considered enrolled in the study.

Data collection began when children were two months old and will continue into elementary school. Measures of risk used in this study were assessed during a home visit when the children were approximately two months old, and the caregiving environment was assessed when the children were approximately six months old. Two trained interviewers went to the families' homes on one occasion for the 2-month visit and on two occasions about one week apart for the 6-month visit. Interviewers collected survey and observational data on the primary caregiver (in our case the biological mother), target child, and when applicable the secondary caregiver (e.g., father, grandmother) during home visits that lasted approximately 2–3 hours. The survey data, which included the risk measures included in the present study, were recorded using laptop computers. For those caregivers who were at an 8th grade reading level or above according to the Kfast literary screener (Kaufman & Kaufman, 1994), some of the surveys were completed using the laptop computer on their own. For those who read below an 8th grade reading level, the questions were read to them.

Participants

Participants of the FLP were 1292 children (635 girls and 657 boys; 736 Caucasian, 549 African American and 7 other ethnicity). For the current study, the sample consisted of families with the biological mother as primary caregiver, who provided data on the risk factors of interest (including household income) and the quality of the caregiving environment, and reported ethnicity of the target child as Caucasian (in PA or NC) or African American (in NC). Based on this selection procedure, the following numbers of families were eliminated: 5 not biological mother, 188 missing data on one or more risk factor, 21 missing caregiving environment data, and 31 missing site-ethnicity data. We chose to use casewise deletion in this study so that the different methods could be more easily compared; in this way, strategies for handling missing data that would otherwise need to be employed are not a factor in conclusions made based on any method under consideration.

The resultant sample for this study comprised $N = 1047$ children who were approximately two months old at the first assessment and six months old at the second assessment. Based on all data available for each variable, this sample did not differ from the deleted sample in terms of gender composition, although the proportion in each site-ethnicity group was slightly different (38.6% PA Caucasian, 20.0% NC Caucasian, and 41.5% NC African American in original sample of 1292 versus 43.6% PA Caucasian, 20.0% NC Caucasian, and 36.4% NC African American in the sample for this study). The deleted sample reported similar rates of exposure to prenatal smoking, significantly lower rates of mood disorder, and significantly higher rates of the remaining seven risk factors: unpartnered mother, unmarried mother, mother had first child at age 19 or younger, low maternal education, mother is a poor reader, low household income, and four or more children in household. In addition, the deleted sample had a significantly poorer quality of caregiving environment. The final sample for this study included 515 girls and 532 boys in the following three site-race groups: 457 PA Caucasian, 209 NC Caucasian and 381 NC African American.

Measures

Risk—Nine risk factors were included in the latent class model; each was coded 0 for *risk factor not present* and 1 for *risk factor present* when the child was two months old. This coding scheme allows for a direct comparison of the four methods explored in this study. The nine risk factors, along with their probabilities of endorsement, are listed in Table 1. As site and ethnicity differences were of prime interest in the study, all results will be reported for PA Caucasian, NC Caucasian and NC African American groups. Several risk factors indicated structural features of the home, characteristics of the primary caregiver (who in this study was the biological mother), and features of the child's environment. The risk factors are: mother has no live-in partner (spouse or otherwise); mother is unmarried (has no spouse); mother had her first child at age 19 or younger; mother has not obtained a high school diploma or GED; mother is a poor reader (as indicated by scoring 16 or lower on the KFAST literacy screener (Kaufman & Kaufman, 1994)); household income-to-needs ratio (household income divided by the current poverty rate for reported number of people in household) was below 1.5; four or more children under 18 in household; mother smoked while pregnant; mother suffered from depression or other mood disorder (defined here as ever being told by a doctor or other medical professional that she had depression or some other mental illness). The prevalence of all nine risk factors differed significantly across site-ethnicity groups (see Table 1), with more children in the NC African American group exposed to all risk factors except prenatal smoking and maternal depression/mood disorder.

Caregiving Environment—The Home Observation for Measurement of the Environment (HOME) is a widely used, well-established measure of the quality and quantity of

stimulation and support in the child's caregiving environments. We will refer to this construct as the quality of the caregiving environment. The focus of the HOME is on the child *in* the environment, and the child as a recipient of inputs from objects, events, and transactions occurring in connection with the family surroundings. The Infant/Toddler version of the Inventory (IT-HOME; Caldwell & Bradley, 1984) is constructed for use during infancy (birth to age three). It is composed of 45 items clustered into six subscales: Parental Responsivity, Acceptance of Child, Organization of the Environment, Learning Materials, Parental Involvement, and Variety in Experience. As was done in the NICHD Study of Early Child Care and Youth Development (<http://secc.rti.org>) the responsivity, acceptance, and learning materials subscales were used in the FLP. These scales index the degree to which the caregivers are responsive and sensitive in interactions with the child and provide age-appropriate objects that stimulate cognitive skills. For the responsivity subscale, sample items include 'Caregiver responds verbally to child's vocalizations or verbalizations', 'Caregiver's voice conveys positive feelings toward the child', and 'Caregiver kisses or caresses child, at least once.' For the acceptance subscale, sample items include 'Caregiver scolds or criticizes child during visit' and 'Caregiver interferes with or restricts child more than three times during the visit.' For the learning materials subscale, observers note if various items are present in the home (e.g., muscle activity toys or equipment, cuddly toy or role-playing toys). Information used to score the items is obtained during the course of the home visit by means of observation and semi-structured interview. Each item is scored in binary fashion (yes/no); the current study used a standardized (z-scored) sum score with higher scores corresponding to a higher quality environment. All observers attended a centralized training before collecting the data. A total score ($\alpha=.82$) was computed from the three scales: Parental Responsivity, Acceptance of Child, and Learning Materials.

Analytic Procedure

Three variable-centered approaches to examining risk were considered. First, bivariate relations between each risk factor and the outcome were examined. Second, multiple regression was employed, using all nine risk factors as predictors of the outcome. Third, a cumulative risk index was calculated and used to predict the outcome using a single general linear model. In all three sets of analyses, a main effect of site-ethnicity group and the interaction between site-ethnicity group and each risk factor was included. The interaction terms allowed for anticipated site-ethnicity group differences in the relation between risk and the caregiving environment.

Next, the following procedure was used to form a person-centered risk typology based on a set of risk factors. First, descriptive statistics were run to explore the prevalence of each risk factor in the overall sample and in each site-ethnicity group. Factors that were extremely rare or are present for nearly all individuals were dropped at this stage, as they offered no information to differentiate risk classes. Second, several competing latent class models were compared in order to determine the number of risk classes that best described the data in a parsimonious way. Because these models are not statistically nested, we used the Bayesian information criterion (BIC; Schwartz, 1978) and model interpretability to compare models with different numbers of classes. Parameter estimates from the optimal model provided a basis on which we could describe the prevalence and characteristics of each latent class. Third, site-ethnicity was incorporated as a grouping variable and the outcome HOME was added to the model as a covariate. This approach, while perhaps counterintuitive, allowed us to model the relation between latent class membership and the HOME while properly taking into account the uncertainty associated with each individual's latent class membership. A set of logistic regression coefficients provided information about this relation. To demonstrate practical significance and aid interpretation, we converted these

coefficients to odds ratios and created a figure that depicts the relation between membership in the risk classes and the HOME for each site-ethnicity group. All latent class analyses were estimated using PROC LCA (Lanza, Collins, Lemmon, & Schafer, 2007). Technical details about LCA and its extension to include multiple groups and covariates can be found in Collins and Lanza (2010).

Results

Bivariate Analysis of Risk Factors

Table 2 displays the bivariate relations between the total HOME score and the individual risk factors, site-ethnicity group, and the risk factor by site-ethnicity group interaction. Each risk factor was a significant negative predictor of HOME scores. The amount of risk associated with each of the first seven risk factors was significant ($p < .0001$ for each), although the interaction term for each of these risk factors with site-ethnicity was not significant, indicating that risk did not vary across site-ethnicity groups. However, site-ethnicity did moderate the effect of exposure to prenatal smoking (with a significantly stronger effect in the PA Caucasian group than the other two groups) and maternal depression/mood disorder (with this risk factor corresponding to higher HOME scores in the NC Caucasian group and lower HOME scores in the PA Caucasian and NC African American groups).

Multiple Regression Approach

The second variable-centered approach was multiple regression analysis. The initial model included a main effect for site-ethnicity group, main effects for all nine risk factors, and interaction terms for each risk factor by site-ethnicity. Table 3 shows the final regression model used to predict HOME scores. The significant site-ethnicity main effect is driven by lower mean HOME scores among NC African Americans relative to the PA Caucasian or NC Caucasian groups. Site-ethnicity group had a borderline moderator effect of mother being a poor reader ($p = .08$ for the overall test of significance of the interaction terms for poor reader by PA Caucasian and by NC African American), with the strongest negative effect of poor reading among NC African Americans. Also, there was a borderline moderator effect for having four or more children in the household ($p = .06$), such that the strongest negative effect for a crowded household was detected in the NC Caucasian group, a weaker effect found in the NC African American group, and no effect found for PA Caucasians.

Among the remaining seven risk factors, we found a significant negative main effect on the HOME for the following three: mother is unmarried ($p < .01$), low maternal education ($p < .01$), and low household income ($p < .001$). The remaining four risk factors were not significant in this model, primarily due to multicollinearity of the predictors¹.

Cumulative Risk Index

The final variable-centered approach is a cumulative risk index approach. For each child, we summed the number of risk factors present to form a cumulative risk index. Figure 1 shows the distribution of the risk index for each site-ethnicity group. The NC African American group had the highest mean cumulative risk index (3.4), followed by PA Caucasian (2.1) and NC Caucasian (1.8). Figure 2 shows, for each site-ethnicity group, the mean HOME score across levels of the risk index. The drop in HOME scores associated with each additional

¹With nine risk factors under consideration, there are 36 possible unique pairs of risk factors. Chi-square tests of independence of each pair of risk factors (one degree of freedom per test) were conducted to assess the degree of multicollinearity present in the current study. Of these 36 pairwise comparisons, 29 were statistically significant, with 21 of these tests yielding p-values less than .0001.

risk factor appears to be quite linear and similar in slope across groups, although at all levels of the cumulative risk index the NC African American group has a lower average quality of the caregiving environment than the PA Caucasian or NC Caucasian groups.

A general linear model was used to predict HOME scores from a main effect for site-ethnicity group, a main effect for the cumulative risk index, and the interaction between the cumulative risk index and site-ethnicity. The interaction term allowed site-ethnicity group to moderate the effect of the index on HOME scores. Table 4 shows the regression coefficients for this model. Although the effect of the index did not vary across site-ethnicity groups, a significant main effect was detected for both site-ethnicity group and the index. The main site-ethnicity effect was driven by significantly lower HOME scores among NC African Americans relative to NC Caucasians and PA Caucasians ($p < .001$). For every additional risk factor children were exposed to, their expected HOME scores dropped by 0.17 standardized units ($p < .001$).

LCA Risk Classes—While only one risk factor is uniquely present for some families, for the majority of families these factors do not exist in isolation. Models with one through six risk classes were compared on the basis of the BIC and model interpretation. The model with five risk classes provided optimal fit ($G^2 = 376.0$, $df = 462$, $BIC = 716.7$) compared to models with one, two, three, four, and six risk classes ($BIC = 1994.8$, 834.7 , 756.0 , 720.2 , and 749.2 , respectively) and had a clear interpretation; the five-class model was selected as the final model of multiple risks.

All LCA models included site-ethnicity as a grouping variable because site-ethnicity group differences in risk exposure were of interest. Table 5 shows the prevalence of the five risk classes among PA Caucasian, NC Caucasian, and NC African American children, and the probability of endorsing each of the risk factor items given latent class. The proportion of children in each risk class varies considerably by site-ethnicity group. Risk Class 1 is the most prevalent class among PA Caucasian and NC Caucasian children. Among NC African American children, Risk Class 4 is the most prevalent class. The item-response probabilities, shown in the bottom pane of Table 5, are similar conceptually to factor loadings in factor analysis, although here they are probabilities ranging from zero to one. Each probability represents the probability of endorsing a risk factor conditional on latent class membership. For example, children in Risk Class 1 have a .004 probability of living in a household with an unpartnered mother and a .073 probability of living with an unmarried mother. A probability greater than .5 for a certain item indicates that individuals in that latent class are likely to report that risk factor (probabilities greater than .5 are marked in bold in Table 5 to facilitate interpretation of the latent classes). For example, children in Risk Class 1 are characterized by a very low probability of exposure to each risk factor. Note that this is the only class where children are not likely to be in a low-income household. Risk Class 2 is primarily characterized by low household income (probability of .738), with a married mother (probability of .000 for unmarried mother). Children in Risk Class 3 have high probabilities of being exposed to the following risk factors: unmarried (but partnered) mother, low household income, exposure to prenatal smoking, and maternal depression/mood disorder. This risk class is unique in that it is the only one marked by high rates of exposure prenatal smoking and maternal depression/mood disorder. Risk Classes 4 and 5 both are characterized by unmarried (and unpartnered) mother, low household income, and a mother who had her first child as a teen. The socioeconomic dimensions of low maternal education and low maternal reading ability differentiate Risk Class 5 from Risk Class 4 (i.e., social status risk in addition to low income).

Table 5 provides the basis on which the five risk classes were labeled. We will refer to Risk Class 1 as *married low-risk*. PA Caucasian and NC Caucasian children are at least four

times more likely than NC African American children to belong in the married low-risk class (56.0% and 54.9% v. 13.6%). We will call Risk Class 2 *married low-income*; 5.1% of PA Caucasian, 19.6% of NC Caucasian and 13.4% of NC African American children are expected to be members of this risk class. Risk Class 3 will be called *cohabiting multiproblem*; PA Caucasian children are most likely to be members of this risk class (25.7% v. 15.3 NC Caucasian and 2.3% NC African American). Risk Class 4, which will be called *single low-income*, is over ten times more prevalent among NC African American children (58.4% v. 3.5% PA Caucasian and 4.0% NC Caucasian). Finally, we will call Risk Class 5 *single low-income/education*. The prevalence of this class is 9.6% among PA Caucasian children, 6.2% among NC Caucasian children, and 13.4% among NC African American children. Clearly, considerable site-ethnicity differences in the prevalence of risk classes emerged, with more than half of the children in Caucasian (PA and NC) groups expected to be in the married low-risk class and more than half of the children in the NC African American group expected to be in the single low-income risk class.

Relation Between Risk Classes and the Quality of the Caregiving Environment

To assess the differential risk across classes, we incorporated the standardized HOME Inventory score in the LCA model as a covariate. The married low-risk class serves as the reference class, so the relation of the HOME is assessed in terms of risk of membership in each risk class relative to the married low-risk class. In general, there is a very strong relation between risk class and HOME scores (see Table 6; $p < .0001$ for likelihood test of overall relation between HOME and latent class membership). All effects are in the same direction, such that lower scores on the HOME (i.e., poorer quality caregiving environment) are associated with a higher probability of membership in each risk class relative to the married low-risk class. For example, among PA Caucasian children, families scoring one standard deviation lower on the HOME have children who are 3.13 times more likely to be in the married low-income class relative to the married low-risk class, 4.35 times more likely to be in the cohabiting multiproblem risk class relative to the low-risk class, and so on. The relation between the HOME and risk class membership is consistent in direction across site-ethnicity group, with the strongest association among children in the NC Caucasian group.

Figure 3 shows, for each site-ethnicity group, the percentage of children expected to belong in each risk class across levels of the HOME (levels from two standard deviations below the mean HOME to two standard deviations above the mean HOME are shown). For example, in the PA Caucasian group, children with HOME scores of -2.0 have about a .75 probability of membership in the cohabiting multiproblem risk class, and a very low probability of membership in the other four risk classes. In contrast, children in this group with HOME scores of 2.0 are almost certainly in the married low-risk class. To summarize the plots, we see that Caucasian children with HOME scores at least one standard deviation above the mean are almost certainly in the married low-risk class, whereas NC African American children with high HOME scores are about equally likely to be in the married low-risk class and the single low-income risk class. Class membership probabilities expected for Caucasian children with low HOME scores differ by site, such that children in PA are extremely likely to be in the cohabiting multiproblem risk class, whereas children in NC are most likely to be in the married low-income risk class, followed by the single low-income/education risk class. Among NC African American children, a high probability of membership in the single low-income/education class is strongly related to low HOME scores. Finally, note that among PA Caucasian children, the probability of membership in all risk classes other than married low-risk declines as the HOME score increases, suggesting a clear relation between higher quality of the caregiving environment and lower probability of membership in any class involving risk factors. This is noticeably different among African

American children, whose probabilities of membership in several risk classes remain constant or increase with higher HOME scores.

Because high HOME scores correspond to approximately equal probability of membership in both the married low risk and the single low-income classes for NC African Americans (see Figure 3), we conducted a follow-up analysis for this group that specified single low-income as the reference class. These results showed that families scoring one standard deviation lower on the HOME have children who were 2.4 times more likely to be in the single low-income/education class relative to the single low-income class. However, membership in the married low-income or cohabiting multiproblem class relative to the single low-income class does not place individuals at risk for lower HOME scores.

Discussion

Risk-focused research can inform our understanding regarding selection of risk subgroups to be targeted for use of limited prevention funds. This study provides a unique opportunity to compare and contrast different methodologies. Interestingly, the percent of variance in the quality of caregiving environment was nearly identical across all multivariate methods (multiple regression, cumulative risk index, and LCA), ranging from approximately 32% to 35%. Thus, the methods are essentially equivalent in terms of predicting the quality of later caregiving environments. They vary considerably, however, in the implications that can be drawn from each method. By shifting focus from a model that maximizes the overall percent of variance explained in an outcome toward a model that permits an examination of how particular risk factors co-occur in individuals/families in context, greater ecological validity can be achieved (e.g., Magnusson & Stattin, 2006). A summary of the implications that can be drawn based on each method is presented in Table 7.

The bivariate analysis confirmed that each of the nine early risk factors significantly predicted the caregiving environment at six months. Conclusions could only be drawn about the mean effect for each risk factor expected among individuals in a particular site-ethnicity group, regardless of the presence or absence of other risk factors. This analysis provided little information that could be used to identify individuals or types of individuals on which to focus intervention resources. Instead, this analysis suggested that low maternal reading and, for PA children, having a mother who smoked while pregnant were particularly important risk factors to target.

The more common approach of multiple regression analysis provided information about the relative strength of prediction from each risk factor. Table 3 shows that maternal marital status, maternal education, and household income are the strongest unique predictors of lower-quality caregiving environment. This approach can be used to target intervention resources to groups exposed to the risk factors most predictive of poor outcomes. However, as with the bivariate approach, these results provide no information about what is expected when multiple risks co-occur (which is the case for over 90% of NC African American children). In other words, conclusions can be made about variables, but not about individuals. Multicollinearity of risk factors also has an important impact on conclusions that are drawn using this statistical approach. If one is interested in the overall predictive ability of a set of independent variables, then having highly correlated variables is not problematic. However, multicollinearity can substantially affect any conclusions based on the regression coefficients and corresponding hypothesis tests. The coefficients will be highly sensitive to particular data sets, and the standard errors will be too large. For example, in the bivariate analyses we found that maternal reading ability was the strongest single predictor of the caregiving environment, yet the multivariate regression analysis

reported in Table 3 suggested that this is not a statistically significant risk factor. Thus, these results could lead one to develop an inappropriate intervention program.

A cumulative risk index was utilized to take into account the number of risks to which each individual was exposed. While this approach was useful in examining site-ethnicity group differences in overall levels of risk, all information about the specific type or different combinations of risk factors was lost. To be more specific, among those with just one risk factor ($n = 164$), a wide variety of different risk factors were reported (e.g., 12% unmarried, 20% teen mother, 21% low income, 9% four or more children, 12% exposure to prenatal smoking, 18% depression/mood disorder). Importantly, this approach relied on the (likely implausible) assumption that all children exposed to any one risk factor (of the nine risk factors under consideration) were at an equal level of risk for a particular developmental outcome; in other words, the risk factors were exchangeable. Although this analysis indicated that fewer risks were associated with better future outcomes, supporting theories suggesting that the accumulation of risk may be more important than a single risk in predicting outcomes, it provided no information about the types of risk factors that should be targeted. In addition, it is not possible to examine the differential impact of two highly correlated risk factors versus two independent risk factors.

LCA was shown to be an important and complementary alternative to more traditional variable-centered approaches. The results presented in Table 5 provided a parsimonious picture of this sample of children from low-income, non-urban communities. From the item-response probabilities, a sense of subgroups that exist in the population emerged. For example, we detected a large group of children (particularly among Caucasian families) who showed low levels of risk across the board. We also identified a group of children in low-income households with a young mother, but little other risk. The third group was made up of children with mothers who were most likely unmarried, low income, smoked, and suffered a mood disorder, but fared well on the other dimensions of risk. The fourth group consisted of children in low-income households with unpartnered, young mothers, but exposure to the other numerous risk factors was low. The final group included children of unpartnered, young mothers with low-income/education standing; yet compared to the third group, these children fared better in terms of exposure to smoking or mood disorders. These 'pictures' of typical individuals/families provided a richer understanding of the intersection of risks in the population.

By assigning each individual to a latent class based on their posterior probabilities, we were able to calculate the mean cumulative risk index for each latent class. Not surprisingly, Risk Classes 1 and 5 had the lowest (0.6) and highest (5.6) mean scores, respectively. It makes sense that individuals characterized by particularly low-risk and high-risk environments could be identified using either the cumulative risk index or LCA. The benefits of LCA are very apparent, however, in the middle range of risk exposure. Risk classes 2, 3, and 4 each had mean cumulative risk index between 3.0 and 3.9. However, exposure to similar levels of risk takes a considerably different form for individuals in these three groups.

Early Risks and Child Development

An important strength of this study was the timing of risk assessment at two months, which helps rule out many developmental factors that can influence outcomes during the first year of childhood. Substantively, the results here replicate previous research which found that being poor, regardless of ethnicity, was associated with lower home quality. The present study extends these findings by illuminating the role that other maternal and structural risks play in predicting quality of the caregiving environment. For instance, being single and low-income did not confer the same level of risk across the profiles for NC Caucasians, despite some overlap in their risk factors. We found that compared to the married low risk class,

having a lower home quality was associated with a 25-fold increase in the likelihood of membership in the single low-income/education, but only a 5- to 6-fold increase in the likelihood of membership in either the cohabiting multiproblem or single low-income classes.

It is also interesting to note that, within some site-ethnicity groups, certain risk classes were unrelated to the quality of the caregiving environment (as indicated by roughly horizontal lines in Figure 3). For example, the probability of membership in the cohabiting multiproblem risk class was unrelated to caregiving environment in the NC African American group. This is in stark contrast to the strong relation seen among PA Caucasian families. Although these findings are interesting, it is important to remain cautious when interpreting them, as we did not specify hypotheses about these particular groups a priori. Future studies are needed to determine if these null findings hold in other samples.

A plethora of variable-centered studies have highlighted the link between structural characteristics of the home, socioeconomic characteristics of the primary caregiver/household, and exposure to psychosocial qualities of the primary caregiver and children's adverse outcomes (e.g. Brooks-Gunn & Duncan, 1997; Evans et al., 1998; Prelow & Loukas, 2003). However, in most variable-centered analyses, these risk factors are so strongly correlated that it is difficult to tease out the diverse experiences of higher-risk families (Foster & Kalil, 2007). The person-centered approach demonstrated here advanced our understanding of how maternal and structural risks relate to children's development by providing a more nuanced look at higher-risk families. For instance, in comparison to single-parent families, children from married low-income families are at similar levels, and in some cases at increased levels of risk (e.g., NC Caucasian) for providing their children with a lower quality caregiving environment. Therefore, children from families with married parents are not immune from the risks associated with having a lower income and thus, similar to single low-income families, are an important population to target for interventions. Similar to other variable-centered research, we found mother's level of education to be a key factor in predicting children's outcomes (Auerbach et al., 1992). It appears to be particularly important for children of poor, single, young mothers. Although these children are at increased risk for poor outcomes overall compared to children from married low-risk families, it appears that those mothers who attain a certain level of education despite being poor, single and young, are able to provide their children with a higher quality caregiving environment than those with similar characteristics but lower levels of education. This finding supports interventions such as Head Start and Chicago Parent-Child Centers that focus on increasing parental education as much as children's skills in an effort to enhance the future outcomes of young children (Reynolds, 2000; Zigler & Muenchow, 1992).

Differences Across Site-Ethnicity Groups

The substantial differences in the prevalence of risk classes across site-ethnicity groups is a reflection of the enormous differences in exposure to the various risk factors (Wilson, Hurtt, Shaw, Dishion, & Gardner, 2009). For example, over 70% of mothers in NC African American families are unmarried, compared to less than 40% of the Caucasian families. Thus, we fully expected risk classes characterized by married mothers (married low-risk and married low-income) to be much less common among the NC African American group. Because of these large differences, we were careful to examine risk classes first within each site-ethnicity group to ensure that variability in risk *within* each group was sufficiently described in our final model.

We also found important site-ethnicity differences in the association between the risk classes and the caregiving environment. For NC African American children, lower-quality

caregiving environment was strongly related to membership in the single low-income/education group, whereas for PA Caucasian children lower quality was strongly related to membership in the cohabiting multiproblem group. In contrast, in the NC Caucasian group lower quality was associated with membership in the married low-income or the single low-income/education groups. These findings suggest that PA Caucasian, NC Caucasian and NC African American families may have made different adaptations to their situations, and so what appears to be the same situation within each site-ethnicity group may have different meanings. These results support previous findings that exposure to and impact of risk factors varies across ethnicity and socio-cultural groups (Bradley et al., 2001a; Garcia Coll & Magnusson, 1999; Kilmer et al., 1998). This information is important for prevention scientists who wish to target specific population subgroups.

Much of the research concerning the link between types of intimate unions in low-income families and children's development considers only family structure. However, recent research finds few significant linkages between family structure and children's development and suggests that there is substantial diversity in the developmental contexts of children living in the same family structure (Foster & Kalil, 2007). The findings from the present study help illuminate the diversity of contexts and family structures that constitute risk for specific site-ethnicity groups. For instance, it is interesting that among Caucasian children, higher home quality was associated with membership in the married low-risk class, but this is not true for children of African American families. For them, high home quality was associated with membership in both the married low-risk class and the single low-income (but not the single low-income/education) group. This suggests that the African American families have found ways to buffer themselves from these risks (being unpartnered; low income) and preserve better caregiving environments, while the Caucasian families have not. These results may also suggest that the same risks are associated with multiple outcomes in different subgroups (i.e., multifinality; Cicchetti & Rogosch, 1996). Although some research documents that children growing up with two biological married parents show better social and academic outcomes (McLanahan & Sandefur, 1994), recent work has shown poorer outcomes for children in mother-only households for Caucasian children, but not for African-American children (Dunifon & Kowaleski-Jones, 2002).

Limitations of the Current Study

Any model of multiple risks is sensitive to the choice of specific risk factors under consideration. By including additional child characteristics such as temperament and family characteristics such as harsh parenting, more detailed profiles of risk may have been identified. However, with the addition of risk factors, increased complexity of the models can cause problems with estimation and interpretation. Further, while the addition of father-reported risk factors would strengthen the study in terms of assessing early risks, the absence of fathers from many households (particularly in NC African American households) would have severely limited our sample size and the generalizability of findings. Specifically, the proportion of families in the current study where the biological father provided data when the child was 6 months old is 75% among PA Caucasian families, 67% among NC Caucasian families, and 28% among NC African American families.

In the Family Life Project, the study design confounds ethnicity and site. While comparisons can be made between the two sites (PA and NC) among Caucasian families, all African American families were in NC and therefore we can say nothing as to how African American families in PA might fare. This confounding is impossible to disentangle, however, because the participants in this study reflect the lack of ethnic diversity in rural PA. The advantage of studying these populations despite this confounding is that we were able to clearly delineate the relation between maternal and structural risks and later quality of the caregiving environment in geographically isolated populations of Caucasian and

African American families. In addition, as with any study it may not be possible to generalize these findings to other populations. While it is likely that other rural regions in the United States may be characterized by similar risk classes, an important extension of this study would be to conduct similar analyses in an urban sample.

In the current study, only binary risk factors were considered. This was primarily because the definition of risk was categorical in nature for nearly all factors (e.g., marital status, possession of high school diploma, exposure to prenatal smoking). In some studies, the set of risk factors may be more optimally measured using a numeric metric. In such cases, dichotomizing the continuous variables may result in important loss of information about individual differences (see e.g. MacCallum, Zhang, Preacher, & Rucker, 2002). However, in some cases applying cut-offs for those variables may yield more intuitive results and better inform targeting of prevention and intervention resources.

Conclusions

Despite these limitations, a person-centered framework provides unique insight into common profiles of risk in the population under study. The identification of key *subgroups of family configurations* which place children at highest risk, as opposed to key *individual risk factors*, provides a more holistic understanding of the ways in which multiple risks converge within individuals' lives and together predict an adverse outcome. The LCA approach revealed the importance of both the quantity of risk and the specific combinations of risk factors in predicting child outcomes, thus contributing to our overall knowledge about the theoretical nature of risk. In the extreme groups the mere quantity of risk may be sufficient to differentiate outcomes, but in moderate risk groups it is the combination of specific risk factors that is likely to be important. One recent study proposed using risk classes in conjunction with a risk index to maximize predictive ability (Copeland, Shanahan, Costello, & Angold, 2009). Although we would not recommend using LCA as the single standard approach to modeling multiple risks, we argue that its use can provide a new lens through which we can identify important intersections of multiple risks.

In summary, there is a need to understand how risk factors co-occur and how different patterns of co-occurrence can predict the quality of environments that young children experience and how these environments subsequently affect child outcomes. The present study indicated that LCA provided added value in understanding this process and that somewhat different patterns of risk factors were predictive of home environmental quality in non-urban families of different ethnicities. This may be one piece of information necessary to better target particular family configurations and characteristics in order to improve the quality of family environments and support child development.

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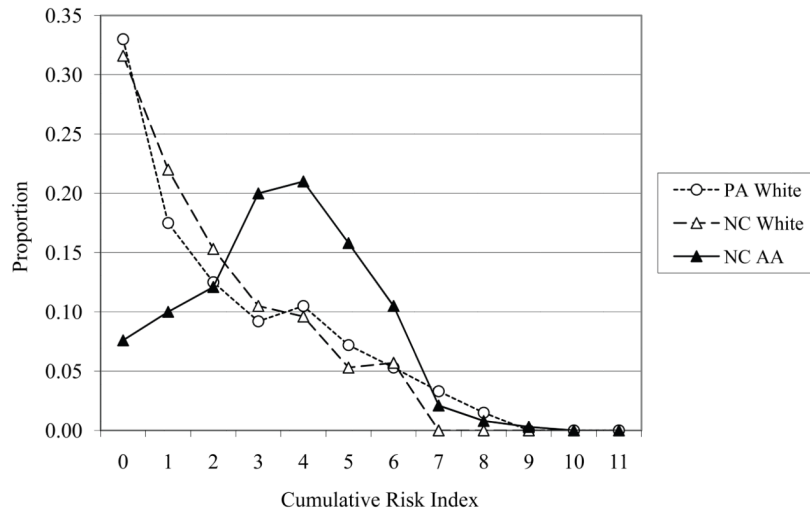


Figure 1. Distribution of cumulative risk index: Number of risk factors reported for each site-ethnicity group.

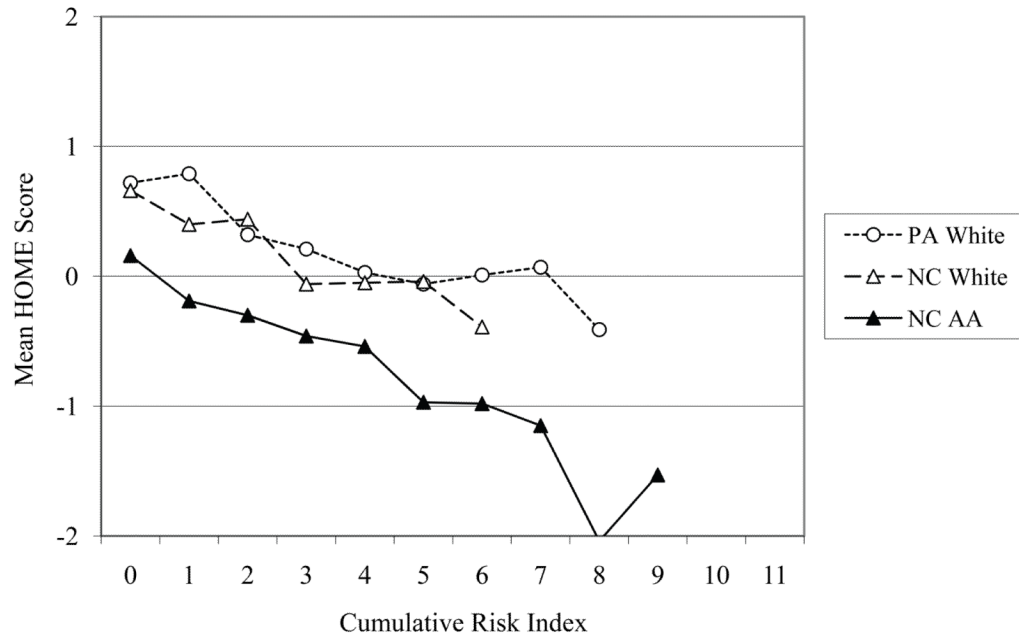


Figure 2. Mean standardized HOME score across cumulative risk index for each site-ethnicity group.

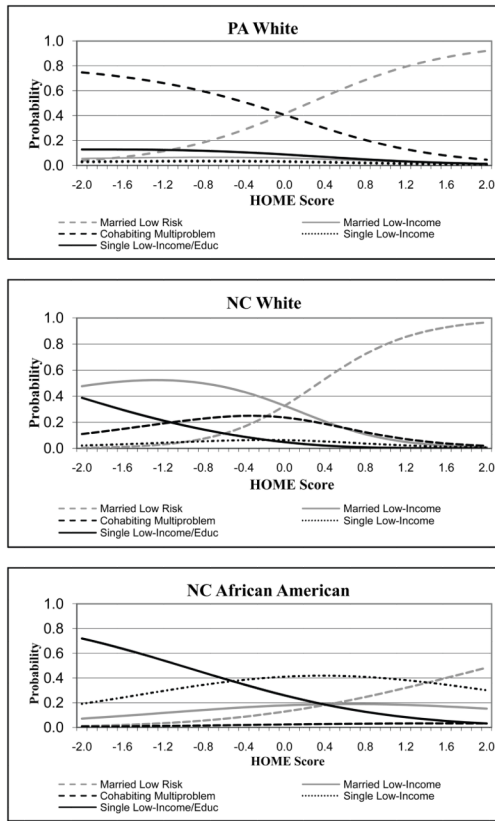


Figure 3. Risk classes and the HOME. For each site-ethnicity group, the probability of membership in each of the five risk classes is plotted across level (from -2.0 to 2.0) of the quality of the home environment.

Table 1

Prevalence Rates of Risk Factors for Each Site-Ethnicity Group

Risk factor	Group			p-value ^I
	PA Caucasian (N = 457)	NC Caucasian (N = 209)	NC AA (N = 381)	
Mother has no partner or spouse	.166	.110	.588	***
Mother is unmarried	.370	.249	.717	***
Mother had first child at age 19 or younger	.306	.316	.522	***
Mother has no high school diploma or GED	.147	.177	.218	*
Mother is poor reader	.118	.129	.291	***
Household income-to-needs below 1.5	.355	.368	.711	***
4 or more children under 18 in household	.099	.096	.155	*
Child exposed to prenatal smoking	.300	.258	.160	***
Mother has depression/mood disorder	.289	.129	.068	***

⁺ p<.10,

* p<.05,

** p<.01,

*** p<.001

^I P-value based on chi-square test of independence between each risk factor and site-ethnicity group.

Note. AA = African American.

Table 2

Bivariate Analysis: For Each Risk Factor, Calculated Effect of Factor on Quality of Home Environment for Each Site-Ethnicity Group

Risk factor	Group			Interaction p-value ²
	PA Caucasian	NC Caucasian	NC AA ¹	
Mother has no partner or spouse	-0.43	-0.48	-0.38	ns
Mother is unmarried	-0.55	-0.36	-0.42	ns
Mother had first child at age 19 or younger	-0.42	-0.40	-0.36	ns
Mother has no high school diploma or GED	-0.64	-0.67	-0.48	ns
Mother is poor reader	-0.66	-0.72	-0.77	ns
Household income-to-needs below 1.5	-0.48	-0.58	-0.54	ns
4 or more children under 18 in household	-0.10	-0.69	-0.27	+
Child exposed to prenatal smoking	-0.44	-0.09	-0.12	*
Mother has depression/mood disorder	-0.22	0.28	-0.13	*

⁺ p<.10,

^{*} p<.05

¹ AA = African American.

² P-value for overall test of moderation of site-ethnicity on effect of risk factor on HOME, based on linear regression analysis (*df* = 2).

Note. Negative coefficients indicate that the presence of the risk factor corresponds to lower HOME scores.

Table 3

Multiple Regression Analysis: Effects of Nine Risk Factors on Quality of Home Environment

Effect	β
Intercept	0.64 ^{***}
<i>Site-ethnicity (reference: NC Caucasian)</i>	
PA Caucasian	0.05
NC African American	-0.55 ^{***}
<i>Risk Factor</i>	
Mother has no partner or spouse	-0.07
Mother is unmarried	-0.19 ^{**}
Mother had first child at age 19 or younger	-0.05
Mother has no high school diploma or GED	-0.20 ^{**}
Mother is poor reader	-0.31 ⁺
Household income-to-needs below 1.5	-0.25 ^{***}
4 or more children under 18 in household	-0.52 ^{**}
Child exposed to prenatal smoking	-0.11 ⁺
Mother has depression/mood disorder	0.06
<i>Site-ethnicity × Risk Factor</i>	
PA Caucasian × Poor reader	0.02
PA Caucasian × 4 or more children	0.55 [*]
NC African American × Poor reader	-0.29
NC African American × 4 or more children	0.33

⁺ p<.10,

^{*} p<.05,

^{**} p<.01,

^{***} p<.001

Note. Only interaction terms with significant overall effect (across all three site-ethnicity groups) were included in final model.

Table 4

Effect of Cumulative Risk Index on Quality of Home Environment

Effect	β
Intercept	0.64***
<i>Site-ethnicity (reference: NC Caucasian)</i>	
PA Caucasian	0.10
NC African American	-0.53***
Cumulative Risk Index	-0.17***
<i>Site-ethnicity \times Cumulative Risk Index</i>	
PA Caucasian \times Index	0.03
NC African American \times Index	-0.02

+ p<.10,

* p<.05,

** p<.01,

*** p<.001

Table 5
Prevalence of Five Risk Classes by Site-Ethnicity Group and Probability of Reporting Risk Factors Given Latent Class

	Risk Class				
	1	2	3	4	5
<i>Proportion in each latent class:</i>					
PA Caucasian	.560	.051	.257	.035	.096
NC Caucasian	.549	.196	.153	.040	.062
NC African American	.136	.134	.023	.584	.134
<i>Item-response probabilities for each risk factor given latent class:</i>					
Mother has no partner or spouse	.004	.036	.262	.803	.719
Mother is unmarried	.073	.000	.764	.967	.956
Mother had first child at age 19 or younger	.102	.590	.471	.515	.875
Mother has no high school diploma or GED	.001	.255	.198	.120	.902
Mother is poor reader	.012	.251	.119	.282	.652
Household income-to-needs below 1.5	.095	.738	.600	.786	.914
4 or more children under 18 in household	.061	.306	.061	.120	.230
Child exposed to prenatal smoking	.090	.148	.752	.148	.389
Mother has depression/mood disorder	.119	.143	.516	.011	.320

Table 6

Odds Ratio for Relation Between Home Environment and Risk Class for Each Site-Ethnicity Group

Risk class	Group		
	PA Caucasian	NC Caucasian	NC AA
1. married low-risk	--	--	--
2. married low-income	3.13	11.11	2.13
3. cohabiting multiproblem	4.35	6.25	1.67
4. single low-income	3.23	5.26	2.27
5. single low-income/education	4.00	25.00	5.56

Note. AA = African American.

Note. Dashes indicate the quantity was not estimated; corresponding latent class selected as reference class in multinomial logit model; odds ratios represent increased odds of membership in risk class relative to married low-risk class corresponding to one standard deviation *decrease* in HOME.

Table 7

Summary of Prevention Implications in Current Study Based on Each Methodological Approach

Methodological Approach	Prevention Implications
<i>Variable-Centered Approaches</i>	
Bivariate Analysis	Target low reading PA Caucasian: target prenatal smoking
Multiple Regression Analysis	NC AA is most at-risk group NC Caucasian: target residential crowding
Cumulative Risk Index	NC AA is most at-risk group NC AA are more likely to have multiple risks Decrease number of risks for all groups
<i>Person-Centered Approach</i>	
Latent Class Analysis	NC & PA Caucasian: married low risk are at the lowest risk NC AA: married low risk and single low-income are at the lowest risk PA Caucasian: cohabiting multi-problems are most at-risk NC Caucasian: married low-income and single low income/education are most at-risk NC AA: Single Low Income/Education are most at-risk