Toward a cumulative ecological risk model for the etiology of child maltreatment

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Abstract

The purpose of the current study was to further the integration of cumulative risk models with empirical research on the etiology of child maltreatment. Despite the well-established literature supporting the importance of the accumulation of ecological risk, this perspective has had difficulty infiltrating empirical maltreatment research and its tendency to focus on more limited risk factors. Utilizing a sample of 842 mother-infant dyads, we compared the capacity of individual risk factors and a cumulative index to predict maltreatment reports in a prospective longitudinal investigation over the first sixteen years of life. The total load of risk in early infancy was found to be related to maternal cognitions surrounding her new role, measures of social support and well-being, and indicators of child cognitive functioning. After controlling for total level of cumulative risk, most single factors failed to predict later maltreatment reports and no single variable provided odd-ratios as powerful as the predictive power of a cumulative index. Continuing the shift away from simplistic causal models toward an appreciation for the cumulative nature of risk would be an important step forward in the way we conceptualize intervention and support programs, concentrating them squarely on alleviating the substantial risk facing so many of society's families.

Keywords

cumulative risk; ecological model; transactional model; child abuse and neglect; maltreatment

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1. Introduction

Out of a desire to protect vulnerable children from the harmful consequences associated with child abuse and neglect has grown a substantial body of research aimed at increasing our understanding of the causes of maltreatment (Kotch, Browne, Dufort, Winsor, & Catellier, 1999; MacMillan, 2009; Starr, MacLean, & Keating, 1991). Unfortunately, conceptual frameworks focused on more narrow limited-risk causal models, hampered early research progress on the etiology of maltreatment. This goal of seeking direct causal agents has marked much of the history of behavioral and medical research, even in areas such as mental health or maltreatment where the problem of interest is not easily defined other than through a cluster of symptoms (Dodge & Pettit, 2003). Despite myriad investigations over the last three decades, however, no singularly necessary or sufficient cause of maltreatment has emerged, and there is a growing awareness that we must move beyond simplistic, single risk variable predictor models (Belsky, 1980; Cicchetti & Rizley, 1981; Cicchetti, Toth & Maughan, 2000; Masten & O'Dougherty Wright, 1998; Nair et al., 2003). This shift toward recognition of the multiple transacting factors important to the etiology of child maltreatment has driven the development of multilevel theoretical models better reflective of this inherent complexity (Appleyard, Egeland, van Dulmen, & Sroufe, 2005; Jaffee, Caspi, Moffitt, Polo-Tomas & Taylor, 2007; Masten & O'Dougherty Wright, 1998; National Research Council, 1993; Sameroff & MacKenzie, 2003). An extensive risk literature from the field of developmental psychopathology could serve as a useful example to guide empirical maltreatment research down the path from simple causal models to a fuller elucidation of the etiological processes involved.

Analogous to the evolution of maltreatment research, early studies looking for the roots of psychopathology were able to find single environmental risk factors that were associated with statistically significant differences in child outcomes, but that failed on their own to account for large proportions of outcome variance (Sameroff, Bartko, Baldwin, Baldwin, & Seifer, 1998). Examples including presence in the home of a non-biologically related male or maternal substance use problems may each increase the likelihood of maltreatment, but prospectively these risk factors do not clearly differentiate or predict those who will go on to be maltreated. Such approaches, therefore, provide little to help guide us through the design and effective targeting of intervention programs aimed at ameliorating the impacts of child maltreatment.

Attempts to improve predictive power in developmental psychopathology began with the work of Rutter (1979), who applied principles emerging from epidemiological studies of the etiology of heart disease and argued that it was not any single particular risk factor but the total accumulation of risk factors in a child's background that led to psychiatric disorder. Emerging evidence from the Framingham Heart Study's careful search for "the cause" of cardiovascular disease was demonstrating that the total level of risk differentiated those who were at risk for a coronary event better than high cholesterol, obesity, smoking, family history, or any other single risk factor (Dawber, Meadors, & Moore, 1951). This shift toward a broader definition of causality has had an important impact on intervention approaches for both heart disease and child mental health.

This approach to developmental psychopathology was developed further by the work of Sameroff and colleagues on the Rochester Longitudinal Study who created a cumulative risk index and found strong relations between the total accumulation of ecological risk and both cognitive (Sameroff, Seifer, Barocas, Zax & Greenspan, 1987) and social-emotional outcomes (Sameroff, Seifer, Zax & Barocas, 1987). The cumulative risk perspective, which looks at the total level of adversity faced by families, was necessary to move our understanding of developmental psychopathology beyond simplistic proposals that by changing any one thing in society, we could change the fate of our children (Sameroff et al., 1998). In the time since those pioneering studies of ecological risk, the cumulative risk perspective has been supported across a variety of social and cognitive domains (Belsky & Fearon, 2002; Furstenberg, Cook, Eccles, Elder & Sameroff, 1999; Legault, Anawati, & Flynn, 2006; Liaw & Brooks-Gunn, 1994; Sameroff, Seifer, Baldwin & Baldwin, 1993). It is ironic that only through a seemingly obvious finding; that children reared in families with a large number of negative influences do worse than children with few risk factors, have we been able to move beyond reductionist causal mechanisms and begin to attend to the complexity involved in the etiology of developmental psychopathology. Despite the incorporation of risk indices in Child Welfare casework and explicit theoretical calls for such inclusion in prospective longitudinal studies (Cicchetti & Rizley, 1981; Masten & O'Dougherty Wright, 1998), there have been limited examples of the inclusion of such a cumulative risk perspective in research on the etiology of maltreatment (Brown, Cohen, Johnson, & Salzinger, 1999; Nair et al., 2003).

The current study attempts to address this issue by furthering the integration of cumulative models of ecological risk with prospective longitudinal maltreatment research. In their call for such an integration, Masten and O'Dougherty Wright (1998) expressed some concern that, while providing powerful predictive capacity, cumulative risk indices could shift the focus away from the processes by which environmental risk has its effect. Their concern is warranted and underscores the need to include a framework that can account for the reciprocal impact of multiple factors, from parenting practices and beliefs that have direct influence on the child to more distal community and economic factors that can only impinge on the child through their impact on more proximal actors (Sameroff et al., 1998). The transactional model of child development (Sameroff & Chandler, 1975) is essential to an understanding of the dynamic reciprocal processes by which the different systems in Bronfenbrenner's ecological model (1979) influence each other throughout development. The transactional model views the development of the individual as a product of the continuous dynamic transactions between the individual and the experience provided by the family and the broader social context, and the experiences provided by the environment are not viewed as independent of the individual (Sameroff & MacKenzie, 2003). Explorations of transactions have often focused on transactions between parent and child, but dynamic transactional processes occur across all levels of the ecology. The natural fit of transactional and ecological models for addressing complex processes has been previously articulated in the maltreatment literature.

Ecological models of maltreatment have been outlined that served to incorporate the various levels of the child's environment into any discussion of etiology (Belsky, 1980; Garbarino, 1976; Garbarino & Crouter, 1978). This was followed by an application of the transactional

model to child maltreatment in order to elucidate the reciprocal mechanisms by which characteristics of the caregiver, environment, and child reciprocally and dynamically contribute to the etiology and associated consequences of maltreatment (Cicchetti & Rizley, 1981). These two adaptations were formally incorporated by Cicchetti and Lynch (1993) with their proposal for a combined ecological-transactional model. This dynamic framework recognizes the complexity of family systems and allows for an examination of the processes involved in both the etiology and outcomes associated with child maltreatment. It is within such a process-oriented systems framework that an appreciation for the cumulative nature of risk must be situated (Cicchetti et al., 2000). While this more dynamic ecological-transactional perspective has provided the opportunity for progress, we suggest that challenges remain in capturing the central dynamic component of such theories in research designs (See review by Sameroff & MacKenzie, 2003). What is needed is an appreciation for the role that factors at all levels of the ecology play in mutually conspiring to create a milieu that either protects against or fosters parent-child relationship disturbances and maltreatment.

The primary aim of the current study was to increase our understanding of the etiology of maltreatment by examining the extent to which characteristics identified soon after birth are risk factors for child maltreatment across the first sixteen years of life. A prior study designed to test the ecological model of child maltreatment, found evidence for risk factors from several ecological levels that were predictive of reported maltreatment during the first year of life (Kotch, Ringwalt, Stewart, Ruina, Holt, Lowman, & Jung, 1995). The current study represents an attempt to reconceptualize that earlier analysis of infancy risk factors within a cumulative ecological risk framework in order to examine the cumulative effects of those unique correlates of maltreatment over a longer period of time. This longitudinal investigation of mothers interviewed shortly after giving birth lends itself to a prospective comparison of the capacity of single risks and a cumulative risk index to predict maltreatment throughout childhood. A ten-factor cumulative risk index was developed based on the cumulative risk literature (Sameroff et al., 1998) and variables that were practically available from an ongoing longitudinal investigation (Kotch et al., 1995). Each child in the study was assigned a total risk score, and logistic regression was used to test the capacity of the individual risk variables and the total cumulative risk score to predict maltreatment through age 16 years.

Cicchetti et al. (2000) proposed that such an ecological-transactional multilevel perspective will militate against the search for simple causal explanations and focus preventive effort at ameliorating risk at all levels of the child's ecology. We first explored the association between the cumulative level of ecological risk facing the families in the newborn period and other measures of family social-emotional functioning and child cognitive outcomes. We predicted that the cumulative risk model, even assessed during the first weeks of life, would be strongly associated with family and child functioning and provide powerful insight into the environment in which some children find themselves. Several of these measures of family functioning could themselves be considered risk factors and were selected to highlight that no cumulative risk index is meant to be exhaustive and that a broad range of risk factors intersect to influence family processes important to the etiology of maltreatment. We next turned to determining whether a cumulative risk perspective can inform questions

of etiology. Specifically, it was expected that the cumulative risk score would be more predictive of later maltreatment than any individual risk factor. The recognition of the cumulative nature of risk for maltreatment represents a potentially significant step forward in our ability to understand the complex etiology and consequences of child abuse and neglect.

2. Method

2.1. Sample Characteristics

The participants for this analysis were drawn from a sample of participants in the Stress, Social Support and Abuse & Neglect in High Risk Infants Study (SSS), a prospective investigation, which focused on the etiology of child maltreatment in the context of the ecological model. Eight hundred and forty-two mother-infant dyads were recruited between 1985 and 1987 from hospitals and health departments. In order to oversample for families at risk for maltreatment, four out of every five infants recruited had at least one risk factor that qualified them for the State's High Priority Infant Program (HPIP). Study eligibility criteria included factors such as low birth weight (< 2,500 g.), young maternal age (less than 18 years), congenital abnormalities, birth defects, maternal impoverishment, maternal substance abuse, maternal mental illness, or other significant infant medical problems or maternal social problems. The remaining 20% of the infants had none of the above risk factors. For a more complete description of the study design and sampling procedures for this sample at high risk of child maltreatment see Kotch et al. (1995). The sample of children was 45.3% male, with 44.9% of the mothers having less than a high school education, and 62% earning less than $15,000 per year. The sample of children was 35.8% Caucasian, 63% African American and 1.2% Multi-racial. 38.7% of the parents were married, 44% single, and 17.3% separated, divorced or widowed. A subsample of 243 mothers and their children were recruited from within the larger initial sample for the Longitudinal Studies of Child Abuse and Neglect project (LONGSCAN) and assessed at age 4 with the Peabody Picture Vocabulary Test-Revised (PPVT-R) at age four.

2.2. Procedure

After obtaining the approval of the Institutional Review Board for the Protection of Human Research Subjects of a Public University in the Southern United States, the sample was recruited from hospitals in 42 geographically diverse counties in the region. Informed consent was obtained from each mother at which point she was referred to a trained interviewer for follow-up after both the mother and infant were discharged from the hospital. Primary caregivers (overwhelmingly mothers) were interviewed at home an average of 7 weeks (range = 1 – 29 weeks) after their infants were discharged from the hospital. The questionnaire contained items hypothesized to be relevant to the ecological model of child maltreatment from the individual, family, social, and parenting behavior domains (Howze & Kotch, l984). These items included: mother's exposure to intrafamily violence as a child; mother's mental health and psychosomatic symptoms; mother's report of her parents' behaviors; mother's self-esteem; mother's physical health; mother's parenting beliefs; infant's health status; infant's temperament; social support/social networks; life event stress; and everyday stress. In addition to these items, the questionnaire

contained items pertaining to marital status, household structure, receipt of cash and in-kind public support, and respondent's views about the safety and friendliness of, and her satisfaction with, her neighborhood.

In the present study child maltreatment was assessed by regularly reviewing the State Central Registry of Child Abuse and Neglect. Access to the Central Registry was obtained with parental consent and the permission of the Director of the Division of Social Services of the State. Any report of child abuse or neglect, whether or not substantiated, was considered to constitute a case. Hussey et al. (2005) examined the issue of pooling reports regardless of substantiation status and found that substantiation status was not significantly associated with any of the child outcomes they examined. For the current study the registry was checked at 1, 4, and 16 years of age.

2.3. Ecological Risk Analysis Strategy

A cumulative index of ten binary risk variables was developed based on prior investigations of this sample (Kotch et al., 1995; 1999) and the established cumulative risk literature (Sameroff et al., 1998). Maltreatment is a complex developmental phenomenon that is a prime example of equifinality, where multiple causal risk pathways can be involved in leading to one outcome (Ammerman, 1990; Belsky, 1993). The current analysis is also grounded in the supposition that maltreatment is also an example of developmental multifinality, where ecological risk operates in a manner with many possible probabilistic outcomes being associated with any one risk factor. This analysis strategy argues that maltreatment is just one of many probabilistic developmental outcomes that can be associated with these risk index variables. Sameroff (2005) demonstrated in the Rochester Longitudinal Study that a cluster analysis of risks that commonly occurred together in their cumulative index did not produce different outcomes.

The definitions of the 10 binary environmental risk variables can be seen in Table 1: (1) minimal maternal education, (2) large family size, (3) family structure, (4) maternal age, (5) maternal childhood history of abuse, (6) any social assistance, (7) low family income, (8) maternal depression, (9) low maternal self-esteem, and (10) unsafe neighborhood. Based on the information provided during the infancy interview on the 10 risk constructs, each family was assigned a cumulative risk score that was the total summed number of risk factors present for each individual family. Risk scores ranged from 0 to 10. As in Sameroff et al. (1998), families were also subdivided into three risk categories: low (0–2 risks), medium (3–5 risks), and high (6 or more risks). Our approach is a conservative one, such that if a family had not completed the CES-D for example, they could not have a risk added for maternal depression. To the extent that higher risk families are at a greater likelihood of having missing data, our data would error against our hypothesis by lowering the risk scores of some high-risk families and thus underestimating the overall effects of risk we find in our analysis. The cumulative risk index used in this current study was not meant to be an exhaustive one. There are certainly other risk factors that could have been included in the model, but the central point of the cumulative risk approach is that it is less important which individual risk factors are present or measured and more important to a population approach to attend to the overall load of risk operating within a family.

The cumulative risk scores were first examined for correlations with measures of family social network strength, stressful life events, perceived maternal health, maternal perception of her pregnancy and child temperament, and child cognitive outcomes. To compare the capacity of the individual, family, social and behavioral risk factors and a cumulative risk index to predict reports of child maltreatment by age one, four, and sixteen years-of-age, a binary logistic regression strategy was utilized. First, each of the ten binary risk variables that comprise our cumulative risk index were entered individually to understand their association with maltreatment report at the three ages. We then repeated the predictive analysis for each single risk factor while also entering the total number of other risks present. This step was carried out in order to get a more accurate picture of the risk attributable to each of the ten individual risk factors, through controlling for the clustered nature of risk factors. To the extent that some risk factors appear to be stronger individual predictors than others it is possible that it is due not to the specific risk factor itself, but to the larger proportion of risks that typically accompany that factor.

2.4. Measures

A complete list of variables used and an overview of the questionnaire have been described previously (See Kotch et al., 1995). Descriptions of the instruments used to measure maternal depression, stress, social support, self esteem, health, parenting attitudes, and child temperament, the principal variables of interest in this analysis, follow. The questionnaire included items pertaining to each mother's history, health and mental health, sociodemographic background, family composition, parenting attitudes and behaviors, social networks and support. Missing data and attrition were mitigated by the unique design of the study. Since all parents were interviewed by trained interviewers in the home soon after giving birth missing data was limited in the initial data collection, such that 9 of the 10 risk factors that comprise our index had under 1% missing data. Family income was the only risk variable that crossed this 1% missing threshold with 83 of the 842 (9.86%) families choosing to withhold reporting income to the interviewer. Any other family factors we used to correlate with the overall risk score that have more than 1% missing data are indicated below. The effects of attrition were also limited in the current study because longitudinal follow-up only involved checks of the central registries of child abuse and neglect eliminating the need to track down parents for subsequent interviews.

2.4.1. Center for Epidemiologic Studies—Depression (CES-D)—The CES-D (Radloff, 1977) is a self-report measure of depressive symptomatology. This 20-item questionnaire asks respondents to rate the frequency and duration of certain feeling states during the last week. Devins and Orme (1985), in an extensive review, conclude that the CES-D has adequate psychometric properties. A cut-off point of 16 correlates well with clinically diagnosed depression (Weissman, Sholomskas, Pottenger, Prusoff, & Locke, 1977). In the current sample alpha's ranged at various waves of administration in the longitudinal study from .90 to .92.

2.4.2. Life Experiences Survey (LES)—The LES is a 57-item self-report measure of life events that have occurred in the past year. For each of 38 events, respondents indicate whether or not they experienced the event and the extent to which they viewed the event as

positive or negative. Test-retest correlations for the instrument are moderate (Sarason, Johnson, & Siegel, 1978). Sarason and colleagues (1978) standardized the instrument on a population of college students. Some items required adaptation to the experiences of a low-income population. LONGSCAN shortened and modified Sarason's first 50 life events (including eliminating the student only section) to increase its utility and relevance for a higher risk population. For example, foreclosure of a mortgage was replaced with eviction due to failure to pay rent, and the seven-point scale was reduced to a five-point scale to simplify the instrument. In the current analysis the total events score was utilized.

2.4.3. Autonomy and Relatedness Inventory (ARI)—The ARI assesses the quality of the mother's relationship with the individual she has identified as her primary intimate. The instrument has eight subscales (acceptance, autonomy, control, hostility, listening, detachment/rejection, relatedness, and support) with internal consistency reliabilities in the .70 to .80 range (Schaefer & Edgerton, 1982). The cumulative score, used in the research reported here, was found to have a Cronbach's alpha of .75 by Hall (1983). In the current sample, alphas on the 6 subscales ranged between .74 for detachment and .84 for hostile control. This variable pulls for the respondent to identify a primary intimate raising the possibility that it would have missing data, but only 27 of the 842 mothers (3.2%) were not able to complete this measure.

2.4.4. Social Well-being Index (SWI)—The SWI is a 10-item measure assessing a person's social contacts/activities and her social resources. Through extensive psychometric analysis with a large sample (*N* 4,603), Donald and Ware (1982) derived two subscales: social contacts and group participation. The two subscales had adequate reliability and homogeneity coefficients. Construct validity studies showed that the social well-being measures are distinct from other dimensions of health (e.g., mental health) and positively related to each other, suggesting an underlying dimension (Donald & Ware, 1982). Only the social contact scale score was used in the present study, which includes visits with friends and relatives and home visits by friends.

2.4.5. Social Network Index (SNI)—The structural aspects of subjects' social networks were measured by items concerning marital status, numbers of close friends and relatives, frequency of contacts, and church and group memberships. The scoring method developed by Berkman & Syme rates social networks from few to many social ties. Using the SNI, researchers have predicted from strong social networks to reduced mortality in a random sample of 6298 adults over a 9-year period (Berkman & Syme, 1979) and have found a strong negative correlation with both depressive and psychosomatic symptoms among a group of mothers with kindergarten-aged children (Hall, 1983). Scores ranged from 1 to 4 (Mean = 1.84, SD = .912).

2.4.6. Health Opinion Survey (HOS)—The HOS (MacMillan, 1957) is a 20-item scale dealing with the amount of bother caused by various psychophysiological symptoms (e.g., upset stomach, dizziness, heart beating hard). It has been found in a number of epidemiologic studies to discriminate reliably between groups with and without psychiatric

disorders (Reichle, 1976). MacMillan (1957) reported test-retest reliability of .87 for a small sample. The current sample had a Cronbach's alpha of .84.

2.4.7. Self-Esteem Scale—The Self-Esteem Scale developed by Rosenberg (1965) asks subjects to rate 10 items related to how much a respondent likes or dislikes himself or herself (e.g., "I feel that I have a number of good qualities") on a 4-point scale from "strongly agree" to "strongly disagree." Thus, all of the items are linked to and seem to focus on self-acceptance (Robinson & Shaver, 1970). A test-retest correlation of .85 and considerable information regarding construct validity have been reported by the author (Rosenberg, 1965).

2.4.8. Infant Characteristics Questionnaire (ICQ)—This widely used maternal report of infant temperament is made up of 24-items, each rated on a 7-point scale specific to the content of the item. Of the four factors found in the scale, "fussy-difficult" is the most reliable and has the best validity. Although the ICQ ratings have moderate correlations with other temperament scales and modest validity when compared with objective observations of specific events, they nevertheless may be a surrogate for parental perception of infant temperament (Bates, Freeland, & Lounsbury, 1979). In the current sample the Fussy/Difficulty (1.66% missing data), Unadaptable (2.49% missing data), and Unpredictable (0.36% missing data) subscales are used, with corresponding alphas of .79, .75, and .56.

2.4.9. Adult-Adolescent Parenting Inventory—This measure (Bavolek, 1984) of maternal child-rearing beliefs includes items pertaining to four constructs often related to child maltreatment: appropriate expectations for child development, rejection of physical punishment, empathy for the child's needs, and assumption of appropriate parent-child roles. Each of these constructs is represented by items rated on a 5-point scale from strongly disagree to strongly agree and had displayed good reliability and content and construct validity (Bavolek, Kline, McLaughlin, & Publicover, 1979). In the current sample alphas for the various subscales ranged from a low of .75 for rejection of physical punishment to a high of .91 for appropriate family roles.

2.4.10. Peabody Picture Vocabulary Test-Revised (PPVT-R; Dunn & Dunn, 1981)—This measure of receptive vocabulary of children aged 2.5 and older was given to the children in the longitudinal sample at age 4. The instrument consists of 175 items of increasing difficulty, organized as plates containing four pictures per plate. Participants are asked to choose the picture that corresponds to the stimulus word. The PPVT-R was standardized on a representative national sample of 4,200 youth and 828 adults (Dunn & Dunn, 1981). Split-half coefficients were generated to assess internal consistency and for children and youth, coefficients ranged from .67 to .88.

3. Results

Based on the presence or absence of risk factors from several levels of the ecology, cumulative environmental risk scores were calculated for each family. The resulting range was from a minimum of 0 risks to a maximum of 10, with a mode of 5 out of a possible 10 risk factors (Mean = 4.64, S.D. = 2.05). These cumulative risk scores were then associated

with several measures of family and child functioning to determine if our risk index intersects with other potential correlates of family difficulty and child maltreatment.

3.1 Neonatal Cumulative Risk and the Early Childrearing Milieu

As can be seen in Table 2, an increase in the total level of risk facing a family was found to be associated with significantly lower maternal ratings of her social network ($r(839) = -.40$, $p < .001$). A similar significant relation to cumulative risk was found for maternal ratings of social well-being ($r(840) = -.21$, $p < .001$) and of satisfaction in the support offered by her intimate partner ($r(813) = -.26$, $p < .001$). A picture of the impact of environmental factors on the emotional capacity of mothers begins to take shape with the additional findings that the cumulative risk score is also significantly associated with both poor maternal physical health ratings ($r(839) = .39$, $p < .001$) and the number of negative life events experienced in the past year ($r(840) = .19$, $p < .001$).

Further evidence for the additive negative impact of ecological risk on the healthy functioning of the mother-infant dyad comes from measures of maternal perceptions of her new role (Table 2). Mothers facing higher levels of ecological risk reported being significantly less happy about their pregnancy ($r(817) = -.29$, $p < .001$). After the birth of their infant these negative attributions of the infant seem to carry forward and the cumulative risk score was found to be associated with maternal perceptions of the newborns. This included the amount of empathy the mothers reported toward their infant ($r(839) = -.42$, $p < .001$), holding inappropriate expectations for child development ($r(839) = -.22$, $p < .001$), and exhibiting signs of child-parent role reversal ($r(839) = -.33$, $p < .001$). To compound matters further, higher risk environments were related to difficult child temperament in the unadaptable ($r(819) = .17$, $p < .001$), unpredictable ($r(837) = .16$, $p < .001$), and fussiness ($r(826) = .12$, $p < .01$) domains.

At four years of age we found that the cumulative risk score, as assessed during the neonatal period, was significantly related to scores on the Peabody Picture Vocabulary Test (PPVT: $r(216) = -.30$, $p < .001$). Each additional risk factor was associated with an approximate 5 point decrease in preschooler receptive verbal ability (Figure 1).

3.2. Cumulative Risk and the Prediction of Child Maltreatment

We next explored the usefulness of a cumulative risk index for the prediction of child maltreatment by the age of one, four, and sixteen. Using Logistic Regression we compared the predictive capacity of individual risk factors to that of the total level of ecological risk facing the families.

In Table 3 we see that 7 of the 10 individual risk factors that comprise our index significantly predicted maltreatment during the first year of life. It was important, however, to determine how much of that predictive capacity was provided by the risk factor itself and how much was provided by the other risk factors that all too often accompany each other. For example, how much of the effect for maternal education comes from not finishing high school per se, and how much is the result of all of the other risks that often accompany poor maternal educational outcomes, such as lower income and poor health? To this end, after

controlling for the total number of other risk factors present, only two risk factors, unsafe neighborhood and large family size, remained as significant individual predictors, but neither provided odds ratios as powerful as the impact of the cumulative risk scores. There is a significant increase in the percentage of children maltreated in the first year as one moves from the low risk condition (0 to 2 risks) to the medium (3 to 5 risks) or high risk condition (6 or more risks), with a 2.72 fold increase in the risk for maltreatment for each incremental increase in risk group. The relative risk for maltreatment increased from 2.4% in the low risk group to 16% in the high-risk group, a relative risk ratio of 6.7 to 1.

The next step was to determine if the risk index assessed in the neonatal period would remain as a predictor of maltreatment over the first four years-of-life. The odds ratio analysis presented in Table 4 demonstrates that 6 of the 10 individual neonatal risk factors continue to significantly predict maltreatment, but again, after controlling for the total number of other ecological risk factors present, just two, unsafe neighborhood and maternal history of abuse in her own childhood, remained at levels of significance. The cumulative level of risk remained a better predictor of maltreatment over the first four years than any of the single factors, with a 2.39 fold increase in risk for maltreatment with each move from low to medium to high risk (Table 4). Again there was a significant increase in the percentage of children maltreated during that time period, from 11.1% in the low risk group to 53% in the high-risk group, a relative risk ratio of 4.8 to 1.

This finding remained as we extended the analysis across childhood out until the children reached sixteen years of age. Over this period 9 of the 10 individual risk factors were found to be significant predictors of child maltreatment (Table 5). After controlling for the total number of other risks, just four individual factors maintained significant odds ratios; maternal age at the subject's birth, receipt of social assistance, low household income, and unsafe neighborhood. But none of these were as powerful as the cumulative level of risk, with a 2.15 fold increase in the rate of maltreatment as one moves across each level of cumulative risk group. A comparison of the low-and high-risk groups shows an increase in rates of maltreatment from 17.1% to 56.6%, producing a relative risk ratio of 3.3 to 1.

4. Discussion

Research on the predictors of child maltreatment would benefit from a continuing shift in focus away from limited and single risk factor causal models and toward the integration of more dynamic ecological and transactional theoretical models into empirical research. As Masten & O'Dougherty Wright (1998) point out, even the few studies that have included multiple correlates of maltreatment have tended to not examine the joint/additive effects of those risk factors. To the extent that a cumulative perspective of risk has been used in maltreatment research, the focus has been on the cumulative impact of risks, including maltreatment and failure-to-thrive, on later child adjustment rather than on the etiology of maltreatment itself (Appleyard et al., 2005; Kerr & Black, 2000; Kim & Cicchetti, 2010). The elegant work of Appleyard and colleagues (2005) highlights the *multifinality* aspect of maltreatment, where the experience of abuse can lead to very different behavioral trajectories in youth depending on their particular mix of risk and protective factors. Maltreatment, however, is also a complex social problem that is a prime example of

equifinality, where multiple causal pathways can be involved (Ammerman, 1990; Belsky, 1993). This necessitates a multidisciplinary perspective that addresses the impact of the accumulation of risk on the ability to parent in a growth-promoting manner. The central aim of the present study was to address some of these issues in a prospective longitudinal study and move forward our understanding of maltreatment as complex process. The core hypotheses find strong support in the resulting analyses.

First, the cumulative level of ecological risk facing the families was found to be associated with several other indicators/predictors of disrupted family functioning. The findings paint a disturbing picture of the adversity facing parents in high-risk environments as they transition into the role of parent. The difficult task of caring for a newborn infant and setting the stage for a well-regulated parent-child relationship is only made more challenging by limited social support and poor physical and emotional health and well-being. The potential for hostile attributions toward the child that lend themselves so easily to maltreatment (Bugental et al., 2003) is compounded by unhappiness about the pregnancy and lack of empathy toward the "difficult" child's plight. These correlational findings, while not pointing to direct causality, certainly suggest that with increasing amounts of risk at various levels of the ecology the task of being consistently emotionally available and nurturing to a newborn becomes even more daunting. This may be especially true in instances where the infant presents an atypical challenge to the dyad, such as in the case of prematurity, physical anomaly, high levels of fussiness, or difficult temperament.

That mothers facing higher levels of ecological risk perceive their pregnancies in a more negative light and feel less empathetic toward their infants whom they perceive as temperamentally difficult is worrisome indeed for the ability of the early dyadic transactions to foster a health promoting developmental course. The potential worrisome impact of this toxic milieu on the healthy cognitive development of the child is highlighted by the strong and negative associations between cumulative risk and receptive verbal capacity over the transition to school age. Garbarino was among the first to view maltreatment as intimately linked with limitations in support systems and resources and to focus attention on the need to intervene by improving those supports through education, income support and child care (Garbarino, 1976; Garbarino & Crouter, 1978). This approach is in keeping with Bronfenbrenner's ecological model, in that distal risk factors only impinge on the child's development to the extent that they impact more proximal factors (Masten & O'Dougherty Wright, 1998).

We need to more fully understand the impact of risk across generations and at all levels of the ecology on the quality of family functioning and parental attributions and perceptions of the child. Mothers in high-risk environments faced more stressful life events than those in low-risk environments, and did so with smaller social networks and a lower sense of physical health and social well-being. This may in part account for conditions in which mothers are less likely to be happy about their pregnancies and find it more difficult to be empathic and take their newborn infants' perspective. Compounding this picture in what is most probably both a cause and consequence of dyadic stress, mothers in high-risk environments also end up with infants that they perceive as having a more difficult temperament. This appears to be a situation ripe for maltreatment and poor cognitive and

social outcomes that can be long lasting. At a minimum, this analysis demonstrates the powerful negative effects of the accumulation of environmental risk and highlights a need for more process-focused prospective research aimed at elucidating the relationship pathways by which risk impacts the social-emotional functioning of the family.

Second, we find strong support for our prediction that no single risk factor in our index would provide as powerful a capacity for predicting maltreatment as the cumulative total of risk facing the family. This finding held true for the prediction of maltreatment by age one, four, and sixteen. We suggest that this finding carries with it important implications for this field of research and practice, especially as it pertains to attempts to find causes of maltreatment. It is probably not helpful to compare odds ratios across samples in different studies, and we recognize that several researchers have found strong single predictors of maltreatment. We would simply caution that this may reflect the fact that single predictors are actually indicators of the total level of risk that children in impoverished environments are exposed to, and we propose that researchers attempt to address risk more broadly in their models. Our analysis suggests, at least for the predictors that comprise our index, that the cumulative model of ecological risk provides enhanced predictive capacity and should concentrates our public policy intervention and support programs squarely on understanding the relationship processes at work and alleviating the substantial level of risk faced by many families and improving their support structure through policy initiatives.

The task of providing a consistent and nurturing home to a new baby is not an easy one. This is true even for families marked by strong interpersonal relationships, a reliable support network and sufficient emotional and financial resources. Unfortunately, for an increasing number of families in our society, those resources are lacking, and there exist limited mechanisms for outside support to help buffer these families from the stress and uncertainty associated with the difficult transition to parenthood. Under periods of stress, as new parents face not only external burdens but also the daily hassles and pressures that accompany a new infant, the potential for problematic parent-child interactions, and in extreme cases escalation to child maltreatment, is very real (MacKenzie & McDonough, 2009). The current findings highlight the negative relationship trajectories that can take root for families facing very high levels of risk in their lives. Cumulative risk was associated with maternal perceptions and attributions, from how happy the mothers were about the pregnancy to how difficult and unpredictable they viewed their newborn's behavior to be. High-risk parents were marked by low levels of social support and negative perceptions of infant behavior and in separate analyses were also found to be significantly more likely to maltreat their children in the first few years of life. Social support may be particularly important not in times of low-stress, but when families are facing a high degree of challenge, such as that presented by an infant viewed as difficult (Boukydis et al., 1986).

The difficulties in caregiving that arise from the failure of parents to distinguish between their own emotional reactions to the child and the child's actual behavior have the potential to contribute to the etiology of later behavior problems. In this case focusing on changes in the parents' perception of the child (Sameroff and Fiese, 2000), appears to be one potential strategy for affecting change in the family system. An example of such a transactional intervention would focus on redefining parents' inappropriate interpretations of children's

behavior. While recognizing the importance of reframing negative maternal perceptions of their infants to family outcomes (e.g., Bugental et al., 2002), we must also strive to address the ecological risk factors and mental health issues which conspire to create a situation where negative perceptions can develop in the first place.

There are some limitations, however, in the conclusions that can be drawn from the current analysis. First, some of the risk factors lend themselves to clear cut-points (e.g., one either graduates high school or not), while other risk points that were selected based on the existing literature or data structure. Examples include family size (Brown et al., 1998; Sameroff et al., 1998) or maternal age less than 18 or older than 35, which emerged in the data structure of our current sample with a curvilinear relationship between age and maltreatment risk as well as some early work on reduced derived maternal gratification in the older age group during the infancy period (Mercer, Hackley, & Bostrom, 1984). There were still others set using percentile cut scores (e.g., unsafe neighborhood), which are sample dependent. In other words, in a higher risk sample such as this one, there may be those who would be in the low-risk portion of our sample, but who might end up in the high-risk condition in another sample. This calls for caution in making risk score comparisons across samples and underscores the need to increase our understanding of the operation of these perhaps more dimensional risk factors across different populations. It will also be important to determine whether these same associations between risk and family processes hold up in less burdened families. The study design provided some protection from the issue of retention since the child maltreatment outcomes were from periodic State Registry reviews for maltreatment reports rather than requiring subsequent interview participation. That said, families who have moved from the State would be showing up in our analysis in the unreported group. Fortunately, from the biannual interviews that occurred for the longitudinal sample, attrition rates in LONGSCAN have been limited. There is also likely to be some overlap between risk factors included in the index, such as maternal depression, and some of our measures of the early caregiving environment, such as happiness about pregnancy, and there is also some potential for shared reporter bias from maternal reports. Since we were using maltreatment reports as our outcome, we also elected to pool maltreatment across sub-type. When looking at maltreatment reports one has limited capacity to know if the report truly captures the breadth of typologies actually occurring, such that simply because neglect was reported does not mean that physical abuse was not also present. Future work using different measures of maltreatment typology could benefit from an exploration of potentially unique risk pathways to different forms of maltreatment as suggested by the work of Brown et al. (1998).

It is also important to note that while the risk index was calculated in the infancy period and predicted maltreatment throughout childhood and adolescence, we are not arguing that it is the risk exposure in the neonatal period alone that is predicting family outcomes and maltreatment. While ecological risk factors are frustratingly stable, risk is not static across development and operates dynamically as families transact and shift over time. Sameroff (2005), for example, shows correlations of .77 between environmental risk scores from early childhood through adolescence. So, that we measure risk in early infancy and it predicts maltreatment through 16 does not say this is an infancy effect on later behavior, rather we would argue that it highlights that the risks are stable and exert their toxic influence across

the life course. This also highlights the importance of assessing early risk and capitalizing on this early port of entry for intervention and support. A more in depth study of how risk is influencing parent-infant interactions and intervention may also help us to enrich the survey data in order to further elucidate some of the mechanistic pathways whereby stress influences caregiver cognitions in a manner that impacts subsequent caregiving behavior and maltreatment potential (Luthar, Suchman, & Altomare, 2007).

This study cannot resolve the conceptual debate about whether cumulative risk should be best conceived of as a simple additive effect or reflecting a qualitative shift or threshold effect beyond which outcomes worsen. We make the conceptual argument that at the level of the individual family there are likely threshold effects operating, such that once the level of risk surpasses a particular family's set of supports and coping capacities a shift in negative outcome is seen. Our review of the literature, however, does not point to consistent thresholds or number of risks that hold true across even those studies that demonstrate an apparent qualitative shift in outcome at a specific number of risk factors. We find it likely that thresholds will vary across families to the extent they differ in their mix of supports and coping capacities, such that at the population level risk will exhibit an additive effect, even if there are unique and dynamic thresholds operating at the individual level.

For clinical and direct practice approaches, it will be important in future research to recognize this cumulative ecological-transactional risk perspective and begin to move towards elucidating the mechanisms by which environmental risk leads to maltreatment. Zuravin (1989) has previously highlighted this need to move beyond "simple co-variation between ecological factors and maltreatment," toward a more complete understanding of the process. This would help to provide new direction for intervention and prevention efforts. Given the link between adversity and maltreatment, our primary focus must be on alleviating the tremendous risk facing such families, but this will be no easy task. Nonetheless, even if faced with limited ability to eliminate social risk, an understanding of pathways to maltreatment will allow for programs to mitigate the effects of ecological risk through strategically targeted supports and intervention. The cumulative ecological risk model of child maltreatment will be useful in highlighting multiple ports of entry in our efforts to select appropriate early intervention and prevention strategies. It is in this effort that we must succeed if we ever hope to turn the tide in the battle to protect our most vulnerable children and families.

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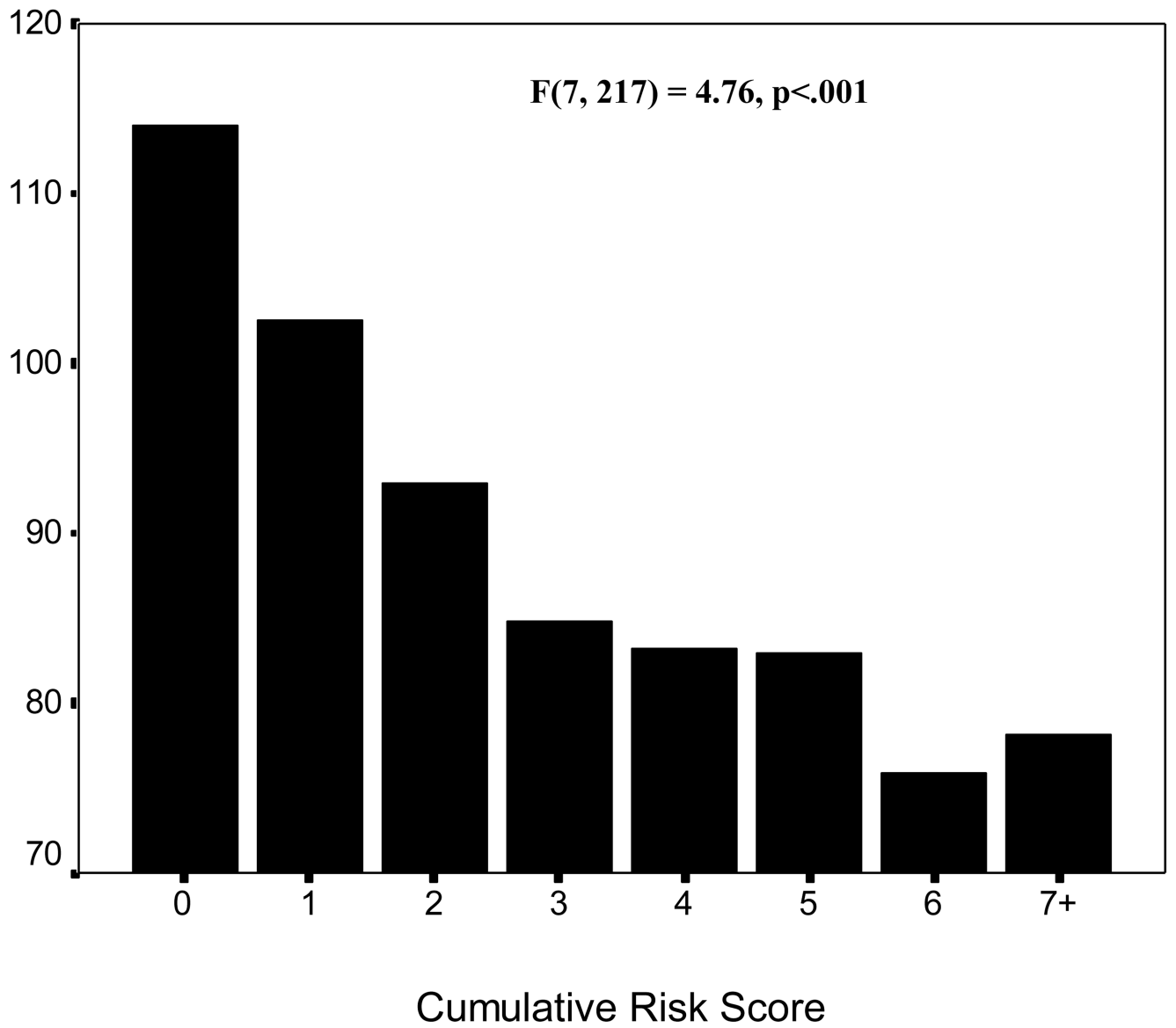
Figure 1.
Relation of infant cumulative risk score to Peabody Picture Vocabulary Test (PPVT) score at age 4.

Table 1

Cumulative risk index variables and description of the high and low risk condition.

Risk Variables	Low Risk	High Risk	% families with risk	Number of other Risks Mean (S.D.)
1. **Maternal education**	High school	No high school	54%	5.64 (1.59)
2. **Family size**	0–2 children	3 or more children	15.1	5.81 (2.01)
3. **Family structure**	Mother married	Mother unmarried	65.9	5.41 (1.62)
4. **Maternal age**	Mother 18–35	Mother <18 or >35	61.4	5.52 (1.54)
5. **Maternal abuse history**	Not abused	Abused as child	32.1	5.43 (2.12)
6. **Social assistance**	No assistance	Medicaid/WIC/AFDC	79	5.25 (1.64)
7. **Low household income**	> $15,000	$15,000	77.6	5.32 (1.61)
8. **Maternal depression**	< 16 on CES-D	16 on CES-D	42.8	5.91 (1.70)
9. **Low self esteem**	Top 75%ile	Lowest 25%ile	17.4	6.72 (1.48)
10. **Unsafe neighborhood**	Top 75%ile	Lowest 25%ile	26.2	5.94 (1.95)

Table 2

Bivariate correlations between the cumulative risk index score and characteristics of the early child-rearing environment.

Variables	r	(df)
Measures of maternal stress and social support		
Social Network Index	−.40***	(839)
Social Well-being Index	−.21***	(840)
Health Opinion Survey Total Score	.39***	(839)
Sarason: Number of negative life events	.19***	(840)
ARI: Total score of Intimate Partner Rating	−.26***	(813)
Measures of maternal perceptions of pregnancy and newborn infant		
Happy with pregnancy	−.29***	(817)
AAPI: Empathy for the child's needs	−.42***	(839)
AAPI: Inappropriate expectations for child development	−.22***	(839)
AAPI: Parent-child Role Reversal	−.33***	(839)
Bates Temperament: Unadaptable	.17***	(819)
Bates Temperament: Unpredictable	.16***	(837)
Bates Temperament: Fussy	.12**	(826)

**
$p < .01$

***
$p < .001$

Table 3

Logistic regression analysis with the 10 individual risk factors (with and without controlling for total other risk factors present) and a cumulative risk index predicting maltreatment during the first year of life.

| Predictor | Percentage Reported for Maltreatment | | | | Controlling for Total Other Risks | |
Variables	Risk Present	Risk Absent	O.R.	95% C.I.	O.R.	95% C.I.
Maternal Education	12 %	5.7 %	2.27**	(1.36 – 3.79)	1.28	(0.70 – 2.32)
Family Size	16	8	2.16**	(1.25 – 3.74)	1.97*	(1.13 – 3.45)
Family Structure	9.7	8	1.24	(0.74 – 2.06)	0.83	(0.48 – 1.41)
Maternal Age	11	6.8	1.64	(0.98 – 2.75)	1.17	(0.69 – 2)
Mother Abuse History	10	8.6	1.24	(0.76 – 2.01)	1.14	(0.69 – 1.88)
Social Assistance	11	3	3.93**	(1.56 – 9.88)	2.34	(0.9 – 6.09)
Low Household Income	9.7	4.1	2.5*	(1.12 – 5.58)	1.47	(0.63 – 3.41)
Maternal Depression	12	7.1	1.79*	(1.11 – 2.87)	1.21	(0.73 – 2)
Low Maternal Esteem	16	7.8	2.22**	(1.31 – 3.75)	1.48	(0.85 – 2.58)
Unsafe Neighborhood	16	6.5	2.83***	(1.75 – 4.58)	2.38**	(1.46 – 3.90)
More than 2 vs. 0–1 risks	10	2.4	4.59*	(1.42 – 14.79)		
Cumulative Risk Groups			2.72***	(1.81 – 4.09)		
Low Risk (0 to 2)	2.4%					
Medium Risk (3 to 5)	6.6					
High Risk (6 or more)	16					

*
p<.05

**
p<.01

***
p<.001

Child Youth Serv Rev. Author manuscript; available in PMC 2014 May 08.

Table 4

Logistic regression analysis with the 10 individual risk factors (with and without controlling for total other risk factors present) and a cumulative risk index predicting maltreatment by age 4.

Predictor	Percentage Reported for Maltreatment				Controlling for Total Risk Score	
Variables	Risk Present	Risk Absent	O.R.	95% C.I.	O.R.	95% C.I
Maternal education	46.2 %	31.6 %	1.86*	(1.08 – 3.2)	0.82	(0.41 – 1.63)
Family size	47.4	39.2	1.4	(.7 – 2.8)	1.12	(0.54 – 2.30)
Family structure	45.7	27.5	2.21*	(1.21 – 4.06)	1.85	(0.98 – 3.47)
Maternal age	42.5	36.6	1.28	(.74 – 2.22)	0.99	(0.55 – 1.77)
Maternal abuse history	52.6	34.9	2.07*	(1.19 – 3.59)	1.78*	(1.00 – 3.16)
Social assistance	41	33.3	1.39	(.46 – 4.19)	0.63	(0.19 – 2.09)
Low household income	44.6	16.7	4.03**	(1.48 – 10.98)	2.72	(0.96 – 7.76)
Maternal depression	47.4	34.1	1.74*	(1.04 – 2.92)	1.22	(0.7 – 2.14)
Low esteem	48.9	38.5	1.53	(.81 – 2.91)	0.92	(0.46 – 1.85)
Unsafe Neighborhood	57.1	34.8	2.49**	(1.39 – 4.49)	2.21*	(1.21 – 4.05)
More than 2 vs. 0–1 risks	42.9 %	11.1 %	5.98*	(1.35 – 26.61)		
Cumulative Risk Groups			2.39***	(1.51 – 3.79)		
Low Risk (0 to 2)	11.1%					
Medium Risk (3 to 5)	34.7					
High Risk (6 or more)	53					

*
 p<.05

**
  p<.01

***
  p<.001

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Table 5

Logistic regression analysis with the 10 individual risk factors (with and without controlling for total other risk factors present) and a cumulative risk index predicting maltreatment by age 16.

Predictor Variable	Percentage Maltreated				Controlling for Total Other Risks	
	Risk Present	Risk Absent	O.R.	95% C.I.	O.R.	95% C.I.
Maternal education	51.9 %	36.4 %	1.89***	(1.43 – 2.49)	1.07	(.77 – 1.50)
Family size	53.5	43.2	1.51*	(1.04 – 2.21)	1.41	(.95 – 2.08)
Family structure	48.8	36.9	1.63**	(1.22 – 2.18)	1.17	(.85 – 1.6)
Maternal age	50.6	35.7	1.84***	(1.39 – 2.45)	1.36*	(1.00 – 1.85)
Maternal abuse history	48.9	42.8	1.28	(.96 – 1.71)	1.24	(.91 – 1.67)
Social assistance	49.7	24.4	3.06***	(2.09 – 4.49)	2.00**	(1.32 – 3.03)
Low household income	49.8	25.9	2.84***	(1.94 – 4.14)	1.86**	(1.23 – 2.82)
Maternal depression	49.7	41.1	1.42*	(1.08 – 1.87)	.99	(.73 – 1.33)
Low esteem	55.5	42.5	1.69**	(1.18 – 2.42)	1.12	(.76 – 1.64)
Unsafe neighborhood	54.8	41.2	1.73**	(1.27 – 2.36)	1.46*	(1.06 – 2.02)
More than 2 vs. 0–1 risks	49.5%	17.1	4.76***	(2.91 – 7.79)		
Cumulative Risk Groups			2.15***	(1.73 – 2.68)		
Low Risk (0 to 2)	17.1 %					
Medium Risk (3 to 5)	44.9					
High Risk (6 or more)	56.6					

*
p<.05

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p<.01

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p<.001

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