USING MULTIPLE STATISTICAL METHODS TO ASSESS HOW MATERNAL SOCIODEMOGRAPHIC RISK FACTORS CAN BE USED TO EFFECTIVELY TARGET FAMILIES FOR HOME VISITING PROGRAMS

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ABSTRACT

Given that sociodemographic risk factors commonly used to identify families in need of home visiting interventions differentially relate to maternal and child outcomes and that effective home visiting programs impact different outcomes, efforts need to be made to target specific home visiting programs to families most likely to benefit from the interventions. The present study examined the relationship of sociodemographic risk factors to individual maternal and child outcomes as well as to composite measure of maternal and child well-being. Multiple statistical models were used to examine (a) the association of risk factors and outcomes (b) the independent predictive power of risk factors on the development of outcomes (c) the predictive power of the number of present risk factors on the development of outcomes, and (d) whether effects of risk factors on outcomes were moderated by other risk factors.

Results showed that several risk factors were associated with outcomes, however did not independently predict the outcomes, indicating that home visiting programs shown to affect specific outcomes should be targeted to families with risk factors that independently predict those outcomes and more broad-based home visiting programs should be targeted to families with risk factors that independently predict composite measures of well-being. Furthermore, certain outcomes were not independently predicted by a single risk factor, but were predicted by the number of present risk factors, indicating that programs seeking to change these outcomes should use cumulative risk models to select families. Lastly, interaction results demonstrated that the effects of risk factors on the development of certain poor outcomes were dependent on the presence of other risk factors, indicating that programs shown to affect these outcomes should be more specifically targeted to families with risk profiles that indicate that they are most in need of the interventions.

BIOGRAPHICAL SKETCH

Ayesha Sujan graduated from Tulane University in 2012. She received a B.S. from Tulane University and double majored in Psychology and Art Studio. Currently, Ayesha is completing her M.A. in Human Development at Cornell University. After receiving her M.A., Ayesha will join the Clinical Psychology Ph.D. program at Indiana University, Bloomington.

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In 2010 the Patient Protection and Affordable Care Act established the Maternal, Infant, and Early Childhood Home Visiting Program (MIECHV) to provide $1.5 billion dollars to effective home visiting programs that target at-risk pregnant women or at-risk families with children between the ages of zero and five. MIECHV required 75% of the funds be allocated to home visiting programs with evidence of effectiveness based on rigorous evaluation research. In 2009 the U.S. Department of Health and Human Services (DHSS) contracted Mathematica Policy Research to conduct the Home Visiting Evidence of Effectiveness (HomVEE) review to assess the effectiveness of existing home visiting programs serving at-risk pregnant women or at-risk families with children between the ages of zero and five (U.S. Department of Health and Human Services, Administration for Children and Families, 2013).

The eight outcomes domains assessed by HomVEE were: (1) child health, (2) child development and school readiness, (3) reductions in juvenile delinquency, family violence and crime (4) maternal health, (5) positive parenting practices, (6) reductions in child maltreatment, (7) family economic self-sufficiency, and (8) linkage and referrals to community resources and supports. In order for a program model to meet the DHHS criteria for evidence of effectiveness, either at least one high- or moderate-quality study had to have shown favorable, statistically significant impacts in two or more of the eight outcome domains or at least two high- or moderate-quality studies with non-overlapping samples had to have shown one or more favorable, statistically significant impact in the same outcome domain. Additionally, if programs met the criteria based solely on findings from randomized controlled trials, then at least one favorable, statistically significant outcome had to be maintained for at least one year after program enrollment and one or more favorable, statistically significant outcomes had to be

published in a peer-reviewed journal (U.S. Department of Health and Human Services, Administration for Children and Families, 2013).

The HomVEE review evaluated 35 programs and concluded 14 met the criteria for effective evidence-based programs (U.S. Department of Health and Human Services, Administration for Children and Families, 2013). Of these 14 programs, 12 programs had been evaluated by less than 10 high- or moderate-quality studies. The two programs with the greatest number of favorable outcomes and the greatest number of high- or moderate-quality studies were Nurse Family Partnership, which had been evaluated by 21 studies, and Healthy Families of America, which had been evaluated by 19 studies.

In addition to specifying that home visiting programs must have demonstrated effective results, MIECHV also required that home visiting programs target at-risk families. Home visiting programs tend to select families to serve using risk profile assessments. For example, risk factors used to select mothers to participate in Nurse Family Partnership include income (low-income), maternal age (19 years or less), and maternal marital status (unmarried; e.g., Olds et al., 1997). Healthy Families of America has a two-stage process for assessing familial risk factors. First mothers are identified through a 15-item hospital chart review evaluating sociodemographic risk factors, such as maternal age and income. Then the Kempe Family Stress Inventory (KFSI) is used in a secondary screening process to further assess potential risk for parental childcare giving difficulties. The KFSI is a 10-item scale that assesses parental psychiatric and criminal history, history of childhood care, emotional functioning, attitudes towards and perception of children, discipline of children, and stress level. Information is gathered through a thorough interview process and families are typically labeled as being at-risk if at least one parent's score is classified as high-risk (Korfmacher, 2000).

Although programs have established methods for targeting at-risk families and federal policy has set criteria for desired program outcomes, there are many potential shortcoming of the methods currently employed to assess risk factors and program outcomes. For example, Mathematica did not evaluate the overall effectiveness of each program across all desired outcome domains, but rather created a list comprising multiple individual outcome domains programs should seek to influence. Furthermore, Mathematica did not assess the relationships between risk factors used to select families for programs and the specified outcomes. Because a risk factor may be a predictor of multiple outcomes and any given outcome may be predicted by multiple risk factors (Cicchetti & Rogosch, 1996), it is important to understand how risk factors relate to specific outcomes in order to target particular interventions to participants that are most likely to benefit from them. Current methods programs use to target at-risk families fail to consider the complex relationship between risk factors and outcomes. For example, when selecting participants to target, home visiting programs do not consider the relative importance of each risk factor for predicting outcomes, whether multiple risk factors have a cumulative effect on outcomes, or whether the influence of a risk factor on an outcome is dependent on the presence or severity of another risk factor.

Given the potential limitations of current methods for assessing risk factors to target participants for home visiting program and for evaluating performance of home visiting programs, research needs to assess the relative strengths and weaknesses of various risk and outcome assessment methods in the context of home visiting programs. The present investigation used data from the comparison group of the Nurse Family Partnership home visiting program to illustrate how multiple methods of assessing risk factors predict individual maternal and child outcomes as well as composite measures of maternal and child well-being.

Methods to Evaluate Family Risk

There are several limitations to current methods used by home visiting programs to evaluate familial risk status. Even attempts to evaluate broad-based familial risk profiles, such as the KFSI, may fall short of producing a reliable comprehensive risk evaluation. For example, there is no standardized interview process for conducting the KFSI and inter-rater reliability of independent interviewers has not been assessed (Korfmacher, 2000). A Healthy Families of America site did conduct a study in which independent raters reviewed notes from KFSI interviews and classified each family as low-, medium-, or high-risk (Katzev, Henderson, & Pratt, 1997). However, this study did not evaluate whether families would have received similar scores if different evaluators had conducted the assessments. Furthermore, KFSI cutoff scores for placing families in low-, medium-, or high-risk categories are based on clinical judgment and specific cut-off scores have not been used consistently. Additionally, rigorous studies assessing the predictive validity of the KFSI have not been conducted and due to methodological issues, the limited validity studies that have been conducted have not provided conclusive results (Korfmacher, 2000).

There are also limitations to a univariate approach that individually assesses risk factors, such as maternal age or income. Univariate assessments of individual risk factors evaluate whether risk factors are associated with outcomes. However, univariate risk assessment methods cannot assess whether certain risk factors impact outcomes over and above other risk factors. Additionally, univariate risk assessment methods cannot assess whether the effect of a risk factor on an outcome is dependent on the presence or severity of another risk factor. Furthermore, univariate risk assessment methods cannot evaluate the potential impact of the number of risk factors present in a family's life.

There are potential alternative statistical methods that may address the limitations of a univariate approach that assesses risk factors individually (see Table 1 for a summary of methods). Multivariate regression models that include multiple risk factors as predictors allow for the examination of the independent predictive power of each risk factor and the relative importance of each risk factor (Burchinal, Roherts, Hooper, & Zeisel, 2000).

Furthermore, using a cumulative risk model that predict outcomes from a count of number of present risk factors yields an estimate of the overall effects of multiple interrelated risk factors in a simple and comprehensive way without requiring large sample sizes to have adequate statistical power (Evans, Li, & Whipple, 2013; Lee & Harris, 2009). Given that risk factors may be additive and it may be that the accumulation of risk factors rather than a single risk factor is more predictive of negative outcomes (Evans, Li, & Whipple, 2013; Rutter, 1979; Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987), cumulative risk models may be superior to a univariate risk assessment approach.

Lastly, because risk factors do not usually occur in isolation (e.g., Evans, 2004) and the entire environment, rather than isolated factors, influences development (Bronfenbrenner, 1994), the relationship between a risk factor and an outcome may be moderated by another risk factor (or a protective factor). Thus, the relationship between a risk factor and an outcome may differ based on the presence or severity of another risk factor. A regression model that includes a term for the interaction of two risk factors allows for an examination of the impact of a risk factor that is dependent on the level of another risk factor.

It is important to note that no method of risk assessment is without limitations. Multivariate regression models with multiple risk factors included as predictors evaluate whether risk factors impact outcomes over and above other measured risk factors and thus assume the

impact of each risk factor on the outcome variable is independent of other risk factors (Burchinal, Roberts, Hooper, & Zeisel, 2000). Hence, multivariate models cannot assess whether a risk factor has an effect that is dependent on the level of another risk factor or whether a risk factor has an effect when it occurs entirely on its own (Rutter, 1979). Furthermore, if risk factors are correlated, multivariate regression models may yield biased parameter estimates and reduced statistical significance, potentially leading to non-significant values for individual risk factors that may actually be predictors of the outcomes (Burchinal, Roberts, Hooper, & Zeisel, 2000; Evans, Li, & Whipple, 2013).

There are also limitations to cumulative risk models. Cumulative risk models assume that risk factors are equivalent (e.g., Lee & Harris, 2009). Furthermore, in order to combine risk variables, variables are typically dichotomized to a present/absent status. Because dichotomizing variables results in a loss of extensive information - specifically, information regarding the severity of each risk factor – cumulative risk analyses may have reduced statistical power (Evans, Li, & Whipple, 2013; Burchinal, Roberts, Hooper, & Zeisel, 2000). Furthermore, because cumulative risk indexes are additive, cumulative risk models cannot detect potential interactions between risk factors (Evans, Li, & Whipple, 2013).

Lastly, there are also shortcomings of evaluating interactions among risk factors. Given that there are numerous potential interactions among risk factors, it would be difficult, in practice, to conduct statistical tests to evaluate all interactions of risk factors. Moreover, given that interactions of more than two variables are often difficult to interpret, are very unstable because of covariation among main effects, and need large sample sizes to evaluate (Evans, Li, & Whipple, 2013), analyses of risk factor interactions for program outcomes would likely need to be limited to two-way interactions.

Table 1

Analytic Approaches to Evaluate Family Risk

	Univariate Risk	Multivariate Risk	Cumulative Risk	Interactions of Risk Factors
Predictor(s)	One risk factor	Multiple risk factors	Cumulative risk score (i.e., the total count of number of risk factors present)	Two risk factors and their interaction
Description	Assesses whether a risk factor is associated with an outcome.	Assesses the independent predictive power and the relative importance of risk factors.	Estimates the overall effects of multiple potentially correlated risk factors.	Assesses whether the impact of an outcome is moderated by another risk factor (i.e., whether the relationship between a risk factor and an outcome is dependent on the level of another risk factor).
Limitations	Does not account for the potential impact of other risk factors.	Cannot assess the impact of a risk factor that occurs entirely on its own. Cannot assess the impact of a risk factor that is moderated by another risk factor. If risk factors are correlated, parameter estimates may be biased and statistical significance may be reduced.	Assumes each risk factor is equally important. Additive model so cannot detect potential moderating effects. Dichotomizing variables results in a loss of information and statistical power.	Interactions can be hard to interpret, especially higher order interactions. Large sample sizes are needed to reliably detect significant results, especially for higher order interactions.

Methods to Evaluate Program Outcomes

There are also strengths and limitations of methods used to evaluate program performance (see Table 2 for a summary of the methods). The HomVEE review specified eight outcome domains home visiting programs should target. The most common approach for evaluating multiple outcomes is to conduct multiple analyses to test each outcome separately (Tyler, Normand, & Horton, 2011). In this approach each outcome is treated as if the other outcomes were not observed and thus correlations between outcomes are effectively ignored, potentially leading to a loss of statistical power (Teixeira-Pinto, Siddique, Gibbons, & Normand, 2009). Moreover, few studies adjust for multiple testing and not adjusting for multiple testing increases the risk of obtaining significant results due to chance (i.e., type 1 errors; Tyler, Normand, & Horton, 2011). However, adjustments to correct for type I errors, such as the Bonferroni adjustment, are likely to yield overly conservative estimates, especially when outcomes are highly correlated (Tyler, Normand, & Horton, 2011; Yoon et al., 2011). Additionally, assessing outcomes separately makes it hard to interpret overall effects (Teixeira-Pinto, Siddique, Gibbons, & Normand, 2009) and if there is missing data, separate analyses of outcomes may lead to the inclusion of different subjects in each analysis (Tyler, Normand, & Horton, 2011), making it unclear whether observed program outcomes relate to one another.

Combining outcomes into a composite measure addresses problems associated with multiple testing without requiring an adjustment for type I error rate (Freemantle, Calvert, Wood, Eastaugh, & Griffin, 2003; International Conference on Harmonization of Technical Requirements for Registration of Pharmaceutical for Human Use, 1998). However, there are limitations to analyses that assess combined outcomes. In order to create a composite outcome measure, variables must be rescaled to be on the same scale so that they can be summed or

averaged (Yoon et al., 2011). To combine continuous outcome variables, variables can be converted to standard scores (i.e., z-scored) and then combined (Drake et al., 2013; Prochaska, Velicer, Nigg, & Prochaska, 2008). However, if a binary outcome, such as the presence or absence of a symptom, is included as one of the outcomes, in order to combine outcomes, all outcome variables must be dichotomized, which results in a loss of information and statistical power (Drake et al., 2013;Teixeira-Pinto, Siddique, Gibbons, & Normand, 2009). Nonetheless, both methods of rescaling and combining outcome variables assign equal weight to all outcomes and thus assume that all outcomes are of equal importance (Drake et al., 2013; Prochaska, Velicer, Nigg, & Prochaska, 2008). Furthermore, because combined measures do not assess individual outcomes (Yoon et al., 2011), findings may be inaccurately presumed to relate to all outcomes included in the composite measure (Freemantle, Calvert, Wood, Eastaugh, & Griffin, 2003). Combining outcomes also does not address the problem of missing data. In fact, combined measures are extremely sensitive to missing data (Yoon et al., 2011) and if a complete case analysis is adopted, any missing observation on one outcome will reduce the sample size and statistical power (Teixeira-Pinto, Siddique, Gibbons, & Normand, 2009).

Table 2
Analytic Approaches to Assess Program Outcomes

	Multiple Analyses	Composite Score
Description	Separate tests conducted for each outcome.	Variables rescaled and combined to create a composite score that can be evaluated in a single analysis.
Limitations	Correlations between outcomes are ignored, potentially leading to a loss of statistical power. Increased risk for type 1 error rate. Difficult to interpret overall effectiveness of programs.	Rescaling variables may lead to a loss of information and statistical power. Assumes each outcome is equally important. Extremely sensitive to missing data. Individual outcomes not assessed.

Study Aims

Given the relative strengths and weakness of methods to examine risk factors and program outcomes, the present investigation sought to examine the additional information garnered by using multiple statistical methods, rather than a single method, to examine the relationship between risk factors and long-term maternal and child outcomes. Specific research questions addressed are: Are there risk factors that no longer predict individual outcomes once other risk factors are accounted for? Are there risk factors that independently predict individual outcomes? Are there individual outcomes that are not independently predicted by a single risk factor alone, however are predicted by the number of present risk factors? Does the relationship between a risk factor and an individual outcome differ based on the level of another risk factor? Are there individual risk factors that independently predict overall maternal and child well-being? And are there effects of risk factors on overall maternal and child well-being that are dependent on the presence or severity of other risk factors? Recommendations are made regarding how specific home visiting programs can be targeted to families most likely to benefit from the interventions.

Method

Participants

The present study included participants from the control group of the Nurse Family Partnership (NFP) study conducted in and around Elmira, a small semi-rural town in upstate New York with a population of approximately 40,000. Between 1978 and1980, pregnant women who had no previous live births were recruited from health clinics and doctors' offices. Five hundred eligible women were invited to participate in the NFP intervention and 400 enrolled. There were no significant differences in age, education, or marital status between women who

enrolled and women who did not enroll. However, 80% of eligible White women chose to enroll while 96% of eligible African-American women chose to enroll. The 400 women who enrolled were randomly assigned to the intervention group or the control group. See Olds et al. (1997, 1998) for additional details about the original Elmira NFP study. Given that the intervention had several effects on maternal and child outcomes (Olds et al., 1997, 1998) and that the purpose of the present investigation was to examine the relationship of early risk factors to long-term maternal and child outcomes rather than to assess intervention effects, analyses were limited to data from 141 control group families.

Procedure

Intake interviews were conducted with the mothers prior to randomization and 15-year follow-up interviews were conducted both with the mothers and with the children. Additionally, when the children were approximately four years old, a home observation assessment was conducted. Details about intake assessments are specified in early publication (see Olds et al., 1986; Olds, Henderson, & Kitzman, 1994; Olds, Henderson, Tatelbaum, & Chamberlin, 1988) and for 15-year follow assessment details, see Olds et al. (1997, 1998).

Measures

Early risk factors. Familial sociodemographic information was obtained in the intake interview. Sociodemographic risk variables included in this study were maternal age (measured in years), maternal education (i.e., the highest grade the mother had attended), maternal marital status (married or unmarried), and household SES. Household SES was evaluated with the Hollingshead four-factor method, which uses education, occupation, sex, and marital status to estimate household SES (Hollingshead, 2011). A cumulative risk score was computed by dichotomizing each risk factor into a 0/1 variable and summing all dichotomized risk variables.

For maternal age, 19 years or under was coded as 1; for maternal education, less than a high school education was coded as 1; for maternal marital status, unmarried was coded as 1; and for household SES, below the median Hollingshead score was coded as 1.

Child health outcomes. Behaviors related to child health were assessed at the 15-year follow-up interviews and included child self-reported total number of cigarettes smoked in the six-month time period prior to the interview, child self-reported number of drinks consumed in the six-month time period prior to the interview, and mother-reported child anxiety and depression. Child anxiety and depression was evaluated with the anxiety/depression subscale of Child Behavior Checklist, a parent-report measure that assesses child behavior problems occurring in the last 12 months (Achenbach & Edelbrock, 1981; Ivanova et al., 2007).

Child development and school readiness outcomes. Letter grades for seventh through ninth grade English, Science, Math, and Social Studies classes were obtained from school records. Grades were converted to a five-point numeric scale (range = 0 to 4, with higher values indicating higher grades) and averaged to compute an overall academic achievement measure.

Child behavior problem outcomes. Total number of early onset behavior problems, total number of arrests, total number of school suspensions, and recent externalizing behavior problems were evaluated at the 15-year follow-up assessments. Adolescents completed the Achenbach Youth Self-Report of Problem Behaviors measure, which yields an overall score for externalizing behavior problems occurring during the last six months (Achenbach, 1991). Adolescents also self-reported engagement in potentially problematic school and health-related behaviors, involvement in the criminal justice system, as well as age of onset of all reported behaviors. When national data on the normative age of onset was available, age cutoffs for early onset behaviors problems were established based on national data. When national data was not

available, cutoffs were based on frequency distributions of the behaviors in the NFP control group sample. To compute a total count of number of early onset behavior problems for each child, dichotomized variables for each behavior of interest were created and engaging in a behavior before the specified age cutoff was coded as 1 and not engaging in the behavior before the specified age cutoff was coded as 0. All dichotomized variables were summed to create a total early onset behavior problem score. See Eckenrode et al. (2001) for additional details on the measurement of early onset behavior problems.

Maternal mental health outcomes. At the 15-year follow-up assessment mothers completed a self-report measure to assess impairments due to drugs and alcohol and a self-report measure to assess overall mental health. An adapted questionnaire from the National Comorbidity Survey (Kessler, 1995) was administered to evaluate the impact of alcohol and other drug use on major aspects of a mother's life since the birth of her first child. The impact on the following domains of life were assessed: missing work, experiencing trouble at work, having a motor vehicle crash or traffic violation, compromising child care, and receiving treatment. An overall score was computed for each mother that summarized the impact of alcohol and other drug use on all life domains assessed. Mental health was evaluated using the Mental Health Inventory, a self-report measure that assesses anxiety, depression, behavior and emotional control, general positive affect, and emotional ties (Viet & Ware, 1983).

Parenting practices and child maltreatment outcomes. When the children were approximately 46 months old, the quality of their home environments were assessed with the Home Observation for Measurement of the Environment (HOME) inventory (Bradley & Caldwell, 1984). Additionally, at the 15-year follow-up, maternal warmth, maternal hostility, family instability, and child maltreatment was evaluated. At the 15-year child interview, the

Parenting Acceptance Rejection Questionnaire was used to assess children's perceptions of their mothers' warmth and hostility (Rohner, 1986). Family instability occurring between the birth of the child and the 15-year follow-up was evaluated by summing total number of intimate partners reported by the mother, total number of work hour changes reported by the mother, total number of residence changes reported by the mother, and total number of school transfers documented in the child's school records. See Marcynyszyn, Evans, and Eckenrode (2008) for additional information about the measurement of family instability. Additionally, mothers provided consent for research staff to review Child Protective Service (CPS) records and CPS records were used to obtain the total number of maltreatments reports involving the child from the birth of the child to the 15-year follow-up assessment.

Family economic self-sufficiency and maternal life course outcomes. At the 15-year follow-up assessment mothers completed self-report measures as well as a life-history calendar to help them recall major life events, such as births of additional children. Outcomes assessed relating to family economic self-sufficiency and maternal life course were number of subsequent children the mother had, the total number of times the mother was arrested after the birth of her first child, the total number of months the mother had employment since the birth of her first child, an approximate number of months the family was on Aid to Families with Dependent Children (AFDC) since the birth of the first child, the highest grade the mother had attended, and family economic hardship. Family economic hardship was measured with the Economic Hardship Questionnaire, a 12-items measure that focuses on changes in a family's style of living during the past six months (Lempers, 1989). A total economic hardship score was computed by averaging all non-missing items from the Economic Hardship Questionnaire and less than three non-missing items were required to compute a score.

Composite poor outcome measures. A composite poor maternal outcome score and a composite poor child outcome score were computed. All outcome variables were z-scored and child academic achievement, maternal mental health, HOME score, maternal warmth, number of months of maternal employment, and highest grade attended by the mother were reverse coded. Variables related to child health, child development and school readiness, and child behavior problems were summed to create a composite poor child outcome score and variables related to maternal mental health, parenting practice and child maltreatment, and family economic self-sufficiency and maternal life course were summed to create a composite poor maternal outcome score.

Data Analysis

Univariate regression analyses were conducted to predict individual outcomes and composite poor outcome scores from each single risk factor. Additionally, univariate regression analyses were conducted to predict individual outcomes and composite poor outcome scores from cumulative risk scores. Multivariate regression models in which all risk factors were included as predictors in every model were used to assess the independent predictive power of each risk factor on individual outcomes and composite poor outcome scores. Lastly, multivariate regression models in which two risk factors and their interaction were included as predictor terms were used to evaluate whether the impact of risk factors on individual outcomes and composite poor outcome scores were moderated by other risk factor. Influential data points (i.e., cases with a Cook's D values greater than $4/(n-k)$, where n is the number of observations in the data and k is the number of predictors) were removed for analyses that included an interaction term.

Results from univariate regression analyses with single risk factors included as predictors were compared to results from multivariate regression analyses with all risk factors included as predictors to examine whether there were risk factors that no longer predicted outcomes once other risk factors had been accounted for. Significant results from multivariate regression analyses with all risk factors included as predictors were examined to determine whether there were risk factors that independently predicted individual outcome measures and composite outcome scores.

Results from multivariate regression analyses with all risk factors included as predictors were compared to results from univariate regression analyses with cumulative risk score included as the sole predictor to examine whether there were outcomes that were not independently predicted by any single risk factor, but were predicted by the number of present risk factors. Significant results from multivariate regression analyses in which interactions of risk factors were included were examined to assess whether relationships between risk factors and individual outcomes and relationships between risk factor and composite outcome scores differed based on the level of other risk factors.

Results

Correlations Between Predictor Risk Factors

All risk factors were significantly positively correlated (see Table 3). The magnitude of the correlation between intake maternal age and intake maternal education was moderately high ($r = 0.60$, $p < 0.001$). The magnitude of the correlations between intake maternal age and intake maternal marital status, between intake maternal education and intake maternal marital status, and between intake maternal education and intake household SES were moderate ($r = 0.31$, $p < 0.001$, $r = 0.34$, $p < 0.001$, $r = 0.41$, $p < 0.001$, respectively). And the magnitude of the

correlations between intake maternal age and intake household SES and between intake maternal marital status and intake household SES, while still significant, were low ($r = 0.18$, $p = 0.03$, $r = 0.18$, $p = 0.04$, respectively).

Table 3
Correlations Between Predictor Risk Factors

	Maternal age		Maternal education		Maternal marital status [a]	
	r	*p*	*r*	*p*	*r*	*p*
Maternal education	0.60	< 0.001	–	–		
Maternal marital status [a]	0.31	< 0.001	0.34	< 0.001	–	–
Household SES	0.18	0.03	0.41	< 0.001	0.18	0.04

Note. [a] Unmarried was coded as 0 and married was coded as 1.

Outcomes Predicted From Risk Factors

Univariate risk models.

Prediction of individual outcomes. Results of univariate regression analyses with one risk factor included to predict individual outcomes are presented in Table 4.

Intake maternal age. Greater intake maternal age predicted greater child academic achievement ($B = 0.05$, $p = 0.05$), less maternal drugs/alcohol impairment ($B = -0.12$, $p = 0.01$), higher HOME scores ($B = 0.63$, $p = 0.001$), less family instability ($B = -0.27$, $p < 0.001$), fewer subsequent children ($B = -0.11$, $p = 0.001$), fewer mother arrests ($B = -0.08$, $p = 0.01$), more maternal employment ($B = 3.83$, $p = 0.01$), fewer months on AFDC ($B = -3.79$, $p = 0.04$), higher maternal education attainment ($B = 0.14$, $p = 0.003$), and more economic hardship ($B = 0.04$, $p = 0.04$). Additionally, greater maternal age marginally predicted fewer child arrests ($B = -0.02$, $p = 0.10$) and greater maternal warmth ($B = 0.03$, $p = 0.06$).

Intake maternal education. More maternal education at intake predicted less child cigarette smoking ($B = -148.95$, $p = 0.002$), greater child academic achievement ($B = 0.14$, $p = 0.01$), fewer early onset child behavior problems ($B = -0.23$, $p = 0.02$), higher HOME scores ($B = 1.58$, $p < 0.001$), less family instability ($B = -0.38$, $p = 0.01$), fewer maltreatment reports ($B = -$

0.29, $p = 0.03$), fewer subsequent children ($B = -0.18$, $p = .005$), more maternal employment ($B = 10.54$, $p < 0.001$), fewer months on AFDC ($B = -15.05$, $p < 0.001$), and higher maternal education attainment ($B = 0.67$, $p < 0.001$). Additionally, more maternal education at intake marginally predicted less child drinking ($B = -5.10$, $p = 0.09$), less maternal drugs/alcohol impairment ($B = -0.18$, $p = 0.06$), less maternal hostility ($B = -0.05$, $p = 0.06$), and fewer mother arrests ($B = -0.12$, $p = 0.07$).

Intake maternal marital status. Mothers being married at intake predicted less maternal drug/alcohol impairment ($B = -0.70$, $p = 0.01$), better maternal mental health ($B = 0.24$, $p = 0.02$), higher HOME scores ($B = 3.46$, $p = 0.002$), less family instability ($B = -1.67$, $p < 0.001$), fewer mother arrests ($B = -0.59$, $p = 0.002$), more maternal employment ($B = 29.52$, $p = 0.001$), fewer months on AFDC ($B = -54.71$, $p < 0.001$), and less economic hardship ($B = -0.29$, $p = 0.01$). Additionally, mothers being married at intake marginally predicted fewer child externalizing problems ($B = -2.94$, $p = 0.06$) and higher maternal education attainment ($B = 0.52$, $p = 0.07$).

Intake household SES. Greater intake household SES predicted less child cigarette smoking ($B = -10.04$, $p = 0.01$), greater child academic achievement ($B = 0.01$, $p < 0.001$), higher HOME scores ($B = 0.12$ $p < 0.001$), fewer maltreatment reports ($B = -0.03$, $p = 0.01$), more maternal employment ($B = 0.61$, $p = 0.01$), fewer mothers on AFDC ($B = -1.41$, $p < 0.001$), and higher maternal education attainment ($B = 0.04$, $p < 0.001$). Additionally, greater intake household SES marginally predicted less family instability ($B = -0.02$, $p = 0.07$) and fewer mother arrests ($B = -0.01$, $p = 0.09$).

Prediction of composite poor outcome scores. Results of univariate regression analyses with one risk factor included to predict composite poor outcome scores are presented in Table 4. Greater intake maternal age, more intake maternal education, mothers being married at intake,

and greater intake Hollingshead scores predicted lower composite poor maternal outcome scores (B = -0.59, p = 0.002; B = -1.75, p < 0.001; B = -5.50, p < 0.001; B = -0.11, p < 0.001, respectively). Greater intake maternal age, more intake maternal education, and mothers being married at intake predicted lower composite poor child outcome scores (B = -0.31, p = 0.02; B = -0.68, p = 0.01; B = -1.85, p = 0.02, respectively).

Summary of results from univariate risk models. Univariate risk models showed that all measured risk factors predicted multiple individual outcomes. In all but one case, greater levels of a risk factor predicted poorer outcomes. The exception was younger intake maternal age predicted less economic hardship.

All four measured risk factors (lower maternal age at intake, less maternal education at intake, mother being unmarried at intake, and lower intake household SES) predicted greater composite poor maternal outcome scores. While intake household SES did not predict composite poor child outcome scores, lower maternal age at intake, less maternal education at intake, and being unmarried at intake did predict greater composite poor child outcome scores.

Table 4

Univariate Regression Analyses with One Risk Factor Predictor

	Predictors							
	Maternal age		Maternal education		Maternal marital status [a]		Household SES	
Outcomes	*B*	*p*	*B*	*p*	*B*	*p*	*B*	*p*
Child cigarette smoking	-39.75	0.11	**-148.95**	**0.002**	-226.94	0.13	**-10.04**	**0.01**
Child drinking	-2.27	0.14	**-5.11**	**0.09**	-9.25	0.32	-0.24	0.32
Child anxiety/ depression	-0.10	0.43	-0.08	0.77	-0.86	0.27	0.01	0.50
Child academic achievement	**0.05**	**0.05**	**0.14**	**.01**	0.17	0.27	**0.01**	**< .001**
Early onset child behavior problems	-0.08	0.11	**-0.23**	**0.02**	-0.46	0.13	-0.01	0.45
Child arrests	**-0.02**	**0.10**	-0.03	0.23	-0.11	0.23	-0.00	0.51
Child school suspensions	-0.07	0.91	0.33	0.78	2.81	0.44	-0.05	0.63
Child externalizing problems	-0.42	0.11	-0.61	0.24	**-2.94**	**0.06**	0.00	0.95
Maternal drug/alcohol impairments	**-0.12**	**0.01**	**-0.18**	**0.06**	**-0.70**	**0.01**	-0.01	0.41
Maternal mental health	0.00	0.78	0.02	0.55	**0.24**	**0.02**	-0.00	0.63
HOME score	**0.63**	**0.001**	**1.58**	**< 0.001**	**3.46**	**0.002**	**0.12**	**< 0.001**
Maternal warmth	**0.03**	**0.06**	0.04	0.19	0.13	0.17	0.00	0.36
Maternal hostility	0.01	0.34	**-0.05**	**0.06**	-0.01	0.90	-0.00	0.57
Family instability	**-0.27**	**< 0.001**	**-0.38**	**0.01**	**-1.67**	**< 0.001**	**-0.02**	**0.07**
Maltreatment reports	-0.01	0.87	**-0.29**	**0.03**	-0.30	0.47	**-0.03**	**0.01**
Subsequent children	**-0.11**	**0.001**	**-0.18**	**0.005**	-0.11	0.57	-0.00	0.33
Mother arrests	**-0.08**	**0.01**	**-0.12**	**0.07**	**-0.59**	**0.002**	**-0.01**	**0.09**
Maternal employment	**3.83**	**0.01**	**10.54**	**< 0.001**	**29.52**	**0.001**	**0.61**	**0.01**
Mother on AFDC	**-3.79**	**0.04**	**-15.05**	**< 0.001**	**-54.71**	**< 0.001**	**-1.41**	**< 0.001**
Maternal education attainment	**0.14**	**0.003**	**0.67**	**< 0.001**	**0.52**	**0.07**	**0.04**	**< 0.001**
Economic hardship	**0.04**	**0.04**	-0.03	0.43	**-0.29**	**0.01**	-0.00	0.31
Composite poor maternal outcome score	**-0.59**	**0.002**	**-1.75**	**< 0.001**	**-5.50**	**< 0.001**	**-0.11**	**< 0.001**
Composite poor child outcome score	**-0.31**	**0.02**	**-0.68**	**0.01**	**-1.85**	**0.02**	-0.03	0.11

Note. Significant and marginally significant results are in boldface.

[a] Unmarried was coded as 0 and married was coded as 1.

Multivariate risk models.

Prediction of individual outcomes. Results of multivariate regression analyses with all risk factors included to predict individual outcomes are presented in Table 5.

Intake maternal age. When controlling for intake household SES, intake maternal education, and intake maternal martial status, greater maternal age at intake predicted less family instability (B = -0.22, p = 0.02), fewer subsequent children (B = -0.09, p = 0.03), less maternal education attainment (B = -0.10, p = 0.04), and more economic hardship (B = 0.09, $p < 0.001$).

Intake maternal education. When controlling for maternal age at intake, intake household SES, and intake maternal martial status, greater maternal education at intake predicted higher maternal education attainment (B = 0.72, $p < 0.001$) and marginally predicted less child smoking (B = -117.51, p = 0.08), less maternal hostility (B = -0.06, p = 0.08), fewer maltreatment reports (B = -0.31, p = 0.09), fewer months on AFDC (B = -7.16, p = 0.09), and less economic hardship (B = -0.09, p = 0.07).

Intake maternal marital status. When controlling for maternal age at intake, intake household SES, and maternal education at intake, mothers being married at intake predicted better maternal mental health (B = 0.26, p = 0.02), less family instability (B = -1.28, p = 0.01), fewer mother arrests (B = -0.48, p = 0.02), more maternal employment (B = 20.12, p = 0.03), fewer months on AFDC (B = -43.65, $p < 0.001$), and less economic hardship (B = -0.35, p = 0.003) and marginally predicted less maternal drug/alcohol impairments (B = -0.53, p = 0.08) and higher HOME scores (B = 1.90, p = 0.08).

Intake household SES. When controlling for maternal age at intake, maternal education at intake, and maternal martial status at intake, greater intake household SES predicted greater child academic achievement (B = 0.01, p = 0.01), higher HOME scores (B = 0.09, p = 0.003), fewer

maltreatment reports (B = -0.02, p = 0.05), fewer months on AFDC (B = -1.02, p < 0.001), and more maternal education attainment (B = 0.02, p = 0.01).

Prediction of composite poor outcome scores. Results of multivariate regression analyses with all risk factors included to predict composite outcome scores are presented in Table 5. When controlling for other measured intake risk factors, greater maternal education at intake, mother being married at intake, and greater intake household SES predicted lower composite poor maternal outcome scores (B = -0.99, p = 0.03; B = -4.03, p < 0.001; B = -0.07, p = 0.02, respectively). No measured risk factor independently predicted composite poor child outcome scores.

Summary of results from multivariate risk models. Although multivariate models showed that fewer outcomes were significantly predicted by risk factors than with univariate regression models, there were several outcomes that were significantly predicted by risk factors in multivariate models. In all but two cases greater levels of a risk factor predicted poorer outcomes. The exceptions were younger maternal age at intake predicted less economic hardship and more maternal education attainment.

While intake maternal age did not predict composite poor maternal outcome scores, lower maternal education at intake, being unmarried at intake, and lower intake household SES predicted greater composite poor maternal outcome scores. Composite poor child outcome scores were not independently predicted by any of the measured risk factors.

Table 5

Multivariate Regression Analyses with All Risk Factors Included as Predictors

	Predictors							
	Maternal age		Maternal education		Maternal marital status [a]		Household SES	
Outcomes	*B*	*p*	*B*	*p*	*B*	*p*	*B*	*p*
Child cigarette smoking	7.62	0.81	**-117.51**	**0.08**	-77.98	0.62	-6.12	0.15
Child drinking	-1.08	0.58	-2.89	0.49	-3.58	0.72	-0.10	0.70
Child anxiety/ depression	-0.08	0.63	0.00	0.99	-0.85	0.31	0.02	0.37
Child academic achievement	0.02	0.53	0.05	0.46	0.01	0.97	**0.01**	**0.01**
Early onset child behavior problems	-0.01	0.86	-0.19	0.16	-0.25	0.43	0.00	0.85
Child arrests	-0.02	0.28	0.00	1.00	-0.06	0.50	-0.00	0.80
Child school suspensions	-0.41	0.61	0.86	0.61	3.21	0.42	-0.08	0.47
Child externalizing problems	-0.28	0.40	-0.13	0.85	-2.46	0.14	0.03	0.56
Maternal drug/alcohol impairments	-0.08	0.15	-0.01	0.92	**-0.53**	**0.08**	-0.00	0.92
Maternal mental health	-0.01	0.61	0.02	0.70	**0.26**	**0.02**	-0.00	0.35
HOME score	0.19	0.38	0.67	0.14	**1.90**	**0.08**	**0.09**	**0.003**
Maternal warmth	0.03	0.20	-0.01	0.86	0.08	0.45	0.00	0.62
Maternal hostility	0.00	0.82	**-0.06**	**0.08**	0.05	0.54	0.00	0.83
Family instability	**-0.22**	**0.02**	0.10	0.63	**-1.28**	**0.01**	- 0.01	0.29
Maltreatment reports	0.11	0.20	**-0.31**	**0.09**	-0.04	0.93	**-0.02**	**0.05**
Subsequent children	**-0.09**	**0.03**	-0.09	0.30	0.15	0.46	-0.00	0.96
Mother arrests	-0.06	0.12	0.04	0.65	**-0.48**	**0.02**	-0.01	0.28
Maternal employment	0.55	0.76	6.13	0.11	**20.12**	**0.03**	0.30	0.22
Mother on AFDC	1.89	0.33	**-7.16**	**0.09**	**-43.65**	**< 0.001**	**-1.02**	**< 0.001**
Maternal education attainment	**-0.10**	**0.04**	**0.72**	**< 0.001**	-0.20	0.40	**0.02**	**0.01**
Economic hardship	**0.09**	**< 0.001**	**-0.09**	**0.07**	**-0.35**	**0.003**	-0.00	0.80
Composite poor maternal outcome score	0.05	0.79	**-0.99**	**0.03**	**-4.03**	**< 0.001**	**-0.07**	**0.02**
Composite poor child outcome score	-0.13	0.44	-0.32	0.36	-1.18	0.16	-0.01	0.56

Note. Significant and marginally significant results are in boldface.

[a] Unmarried was coded as 0 and married was coded as 1.

Cumulative risk models.

Prediction of individual outcomes. Results of univariate regression analyses with cumulative risk score used to predict individual outcomes are presented in Table 6. Greater cumulative risk predicted more child cigarette smoking ($B = 157.10$, $p = 0.002$), more child drinking ($B = 6.16$, $p = 0.05$), poorer child academic achievement ($B = -0.11$, $p = 0.03$), more early onset child behavior problems ($B = 0.21$, $p = 0.04$), more child arrests ($B = 0.06$, $p = 0.03$), more maternal drug/alcohol impairments ($B = 0.29$, $p = 0.002$), lower HOME scores ($B = -1.81$, $p < 0.001$), more family instability ($B = 0.62$, $p < 0.001$), more subsequent children ($B = 0.15$, $p = 0.02$), more mother arrests ($B = 0.24$, $p < 0.001$), less maternal employment ($B = -11.41$, $p < 0.001$), more months on AFDC ($B = 19.48$, $p = 0.001$), and less maternal education attainment ($B = -0.43$, $p < 0.001$). Additionally, greater cumulative risk marginally predicted less maternal warmth ($B = -0.05$, $p = 0.10$).

Prediction of composite poor outcome scores. Results of univariate regression analyses with cumulative risk score used to predict composite poor outcome scores are presented in Table 6. Greater cumulative risk predicted higher composite poor mother outcome scores ($B = 2.00$, $p < 0.001$) and higher composite poor child outcome scores ($B = 0.77$, $p = 0.004$).

Summary of results from cumulative risk models. Cumulative risk predicted composite poor maternal outcome scores, composite poor child outcome scores, and most of the individual outcomes assessed, such that in all cases more cumulative risk predicted poorer outcomes.

Table 6

Univariate Regression Analyses with Cumulative Risk as the Predictor

	Cumulative Risk	
Outcomes	*B*	*p*
Child cigarette smoking	**157.10**	**0.002**
Child drinking	**6.16**	**0.05**
Child anxiety/ depression	0.11	0.66
Child academic achievement	**-0.11**	**0.03**
Early onset child behavior problems	**0.21**	**0.04**
Child arrests	**0.06**	**0.03**
Child school suspensions	0.02	0.99
Child externalizing problems	0.85	0.11
Maternal drug/alcohol impairments	**0.29**	**0.002**
Maternal mental health	-0.05	0.13
HOME score	**-1.81**	**< 0.001**
Maternal warmth	**-0.05**	**0.10**
Maternal hostility	0.00	0.88
Family instability	**0.62**	**< 0.001**
Maltreatment reports	0.23	0.11
Subsequent children	**0.15**	**0.02**
Mother arrests	**0.24**	**< 0.001**
Maternal employment	**-11.41**	**< 0.001**
Mother on AFDC	**19.48**	**< 0.001**
Maternal education attainment	**-0.43**	**< 0.001**
Economic hardship	0.05	0.17
Composite poor maternal outcome score	**2.00**	**< 0.001**
Composite poor child outcome score	**0.77**	**0.004**

Note. Significant and marginally significant results are in boldface.

Interactions of risk factors.

Prediction of individual outcomes. Interaction results for individual outcomes are presented in Table 7.

Intake maternal age x intake maternal education. The interaction of intake maternal age and intake maternal education was significant for number of subsequent children ($B = 0.07$, $p = 0.001$; Figure 1). For mothers with less than a high school education at intake, younger intake maternal age predicted more subsequent children; however, for mothers with at least a high school education at intake, there was little relationship between intake maternal age and number of subsequent children.

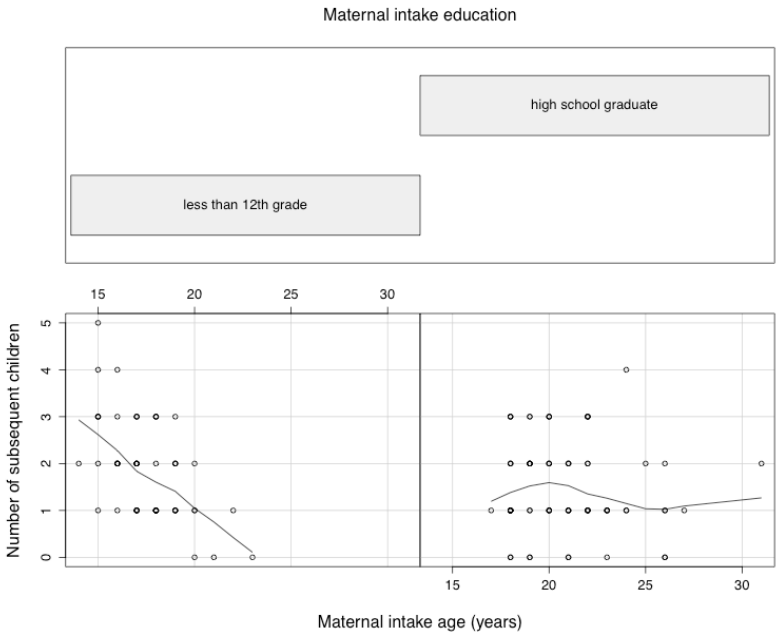

Figure 1. The effect of intake maternal age on subsequent children moderated by intake maternal education level.

Intake maternal age x intake maternal marital status. The interaction of intake maternal age and intake maternal marital status was significant for child cigarette smoking ($B = 66.76$, $p = 0.05$; Figure 2), maternal drug/alcohol impairments ($B = 0.10$ $p = 0.01$; Figure 3), child maltreatment ($B = 0.26$ $p = 0.02$; Figure 4), and number of subsequent children ($B = 0.19$, $p =$

0.01; Figure 5) and marginally significant for early onset child behavior problems ($B = 0.19$, $p = 0.10$; Figure 6), child externalizing problems ($B = 0.99$, $p = 0.07$; Figure 7), economic hardship ($B = -0.08$, $p = 0.08$; Figure 8).

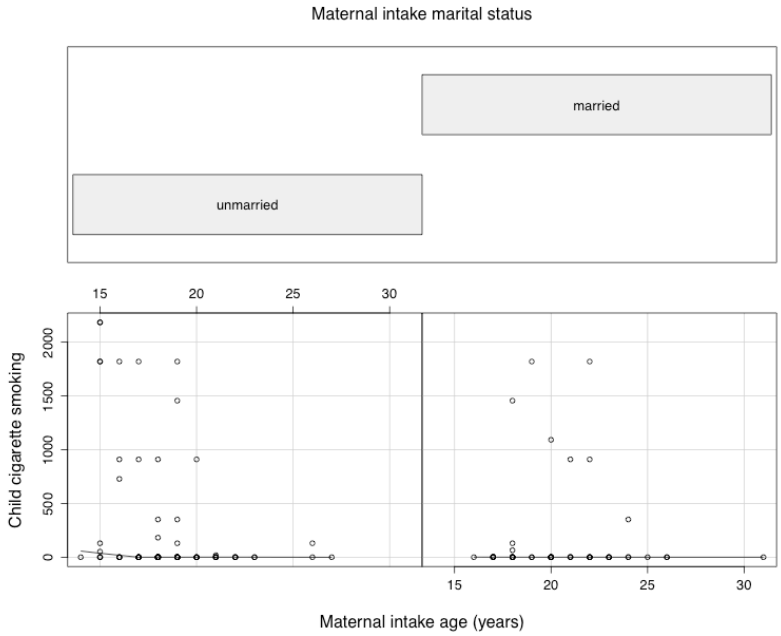

Figure 2. Effect of intake maternal age on child cigarette smoking moderated by intake maternal marital status.

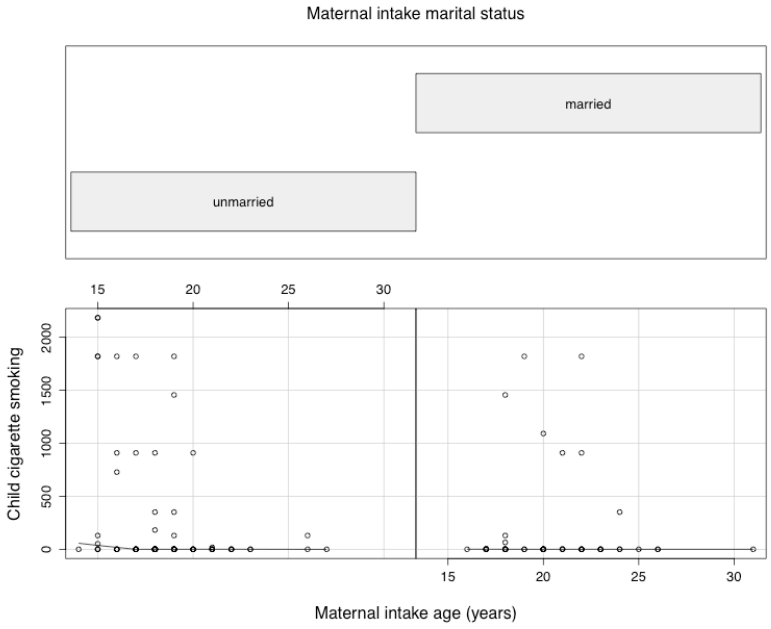

Figure 3. Effect of intake maternal age on maternal drug/alcohol impairment moderated by intake maternal marital status.

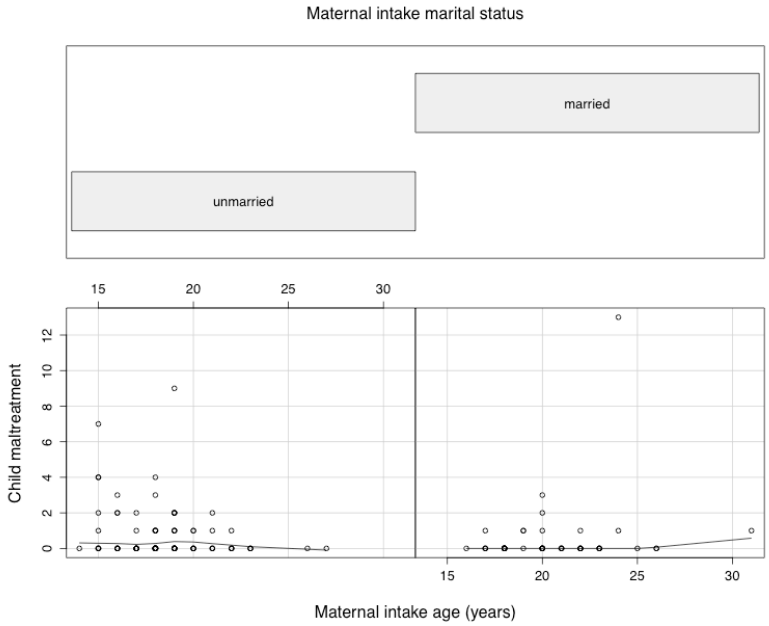

Figure 4. Effect of intake maternal age on child maltreatment moderated by intake maternal marital status.

The general pattern that emerged suggested that the influence of young maternal age on the development of certain negative outcomes was dependent on mothers being unmarried. For example, for mothers who were unmarried at intake, younger intake maternal age predicted more subsequent children; however, for mothers who were married at intake, there was little relationship between intake maternal age and number of subsequent children. Similarly, for families in which mothers were unmarried at intake, young intake maternal age predicted more early onset child behavior problems and more child externalizing problems; however, for families in which the mothers were married at intake, there was little relationship between intake maternal age and early onset child behavior problems and between intake maternal age and child externalizing behavior problems.

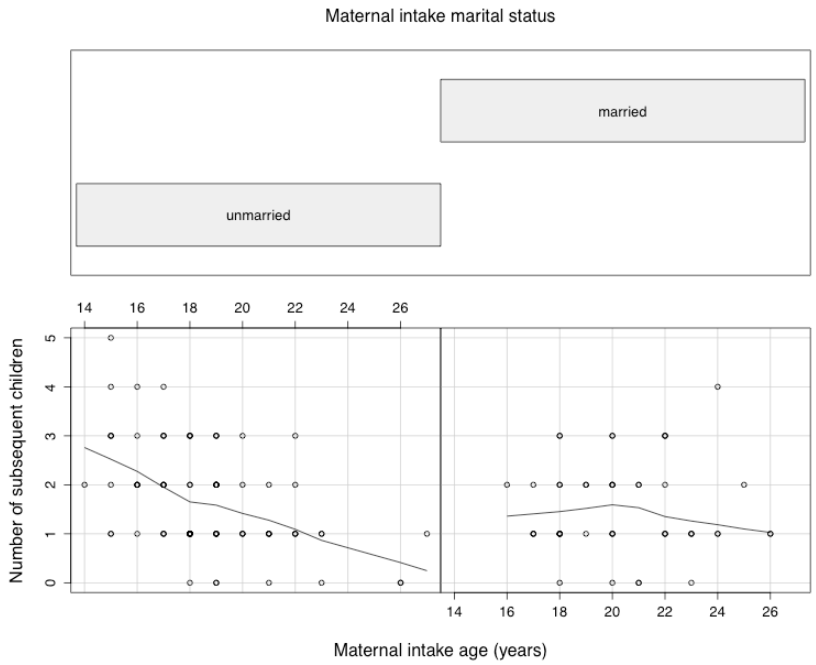

Figure 5. Effect of intake maternal age on subsequent children moderated by intake maternal marital status.

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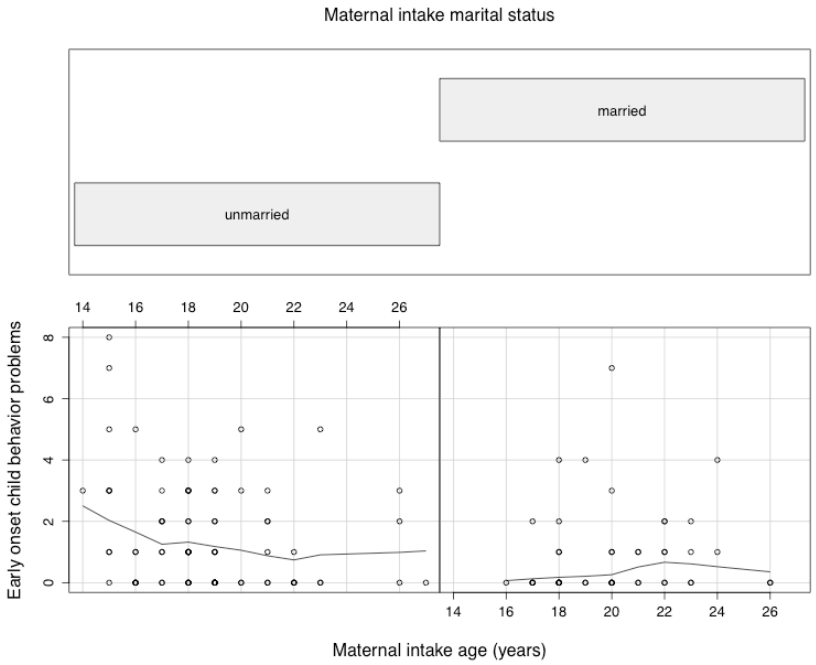

Figure 6. Effect of intake maternal age on early onset child behavior problems moderated by intake maternal marital status.

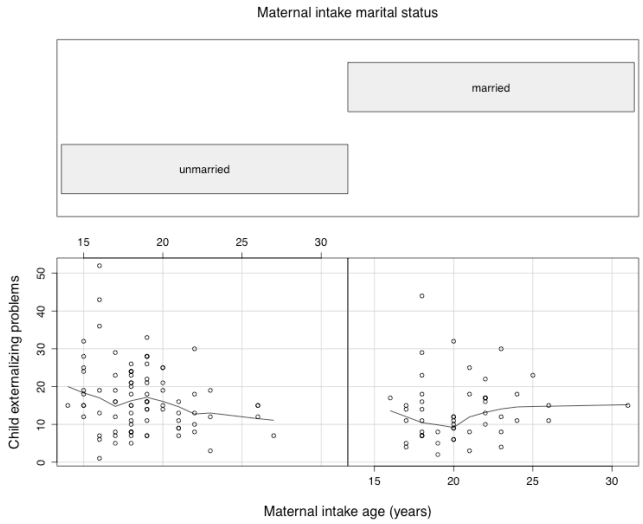

Figure 7. Effect of intake maternal age on child externalizing problems moderated by intake maternal marital status.

An exception to the general pattern was the interaction of maternal intake age and maternal marital status at intake on economic hardship. While there was little relationship between intake maternal age and economic hardship for families with married mothers at intake, for families with unmarried mothers at intake older maternal age predicted more economic hardship.

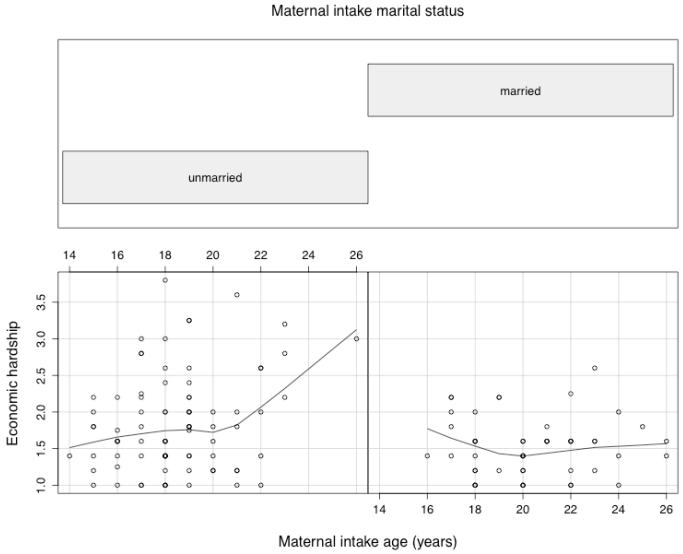

Figure 8. Effect of intake maternal age on economic hardship moderated by intake maternal marital status.

Intake maternal age x intake household SES. The interaction of intake maternal age and intake household SES was marginally significant for maternal employment (B = -0.14, p = 0.08; Figure 9) and maternal education attainment (B = -0.01, p = 0.06; Figure 10). The magnitude of the positive relationship between maternal intake age and maternal employment and the positive relationship between maternal intake age and maternal education attainment was slightly stronger for families with lower levels of household SES than for families with higher levels of household SES, indicating that greater maternal age was slightly more predictive of more education attainment and more employment for lower SES families than for higher SES families.

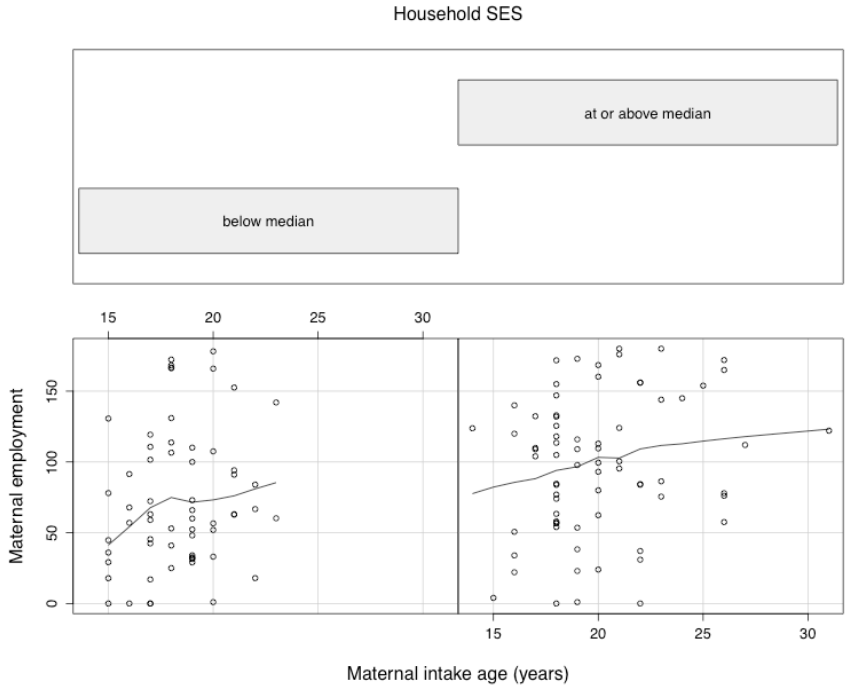

Figure 9. Effect of intake maternal age on maternal employment moderated by intake household SES.

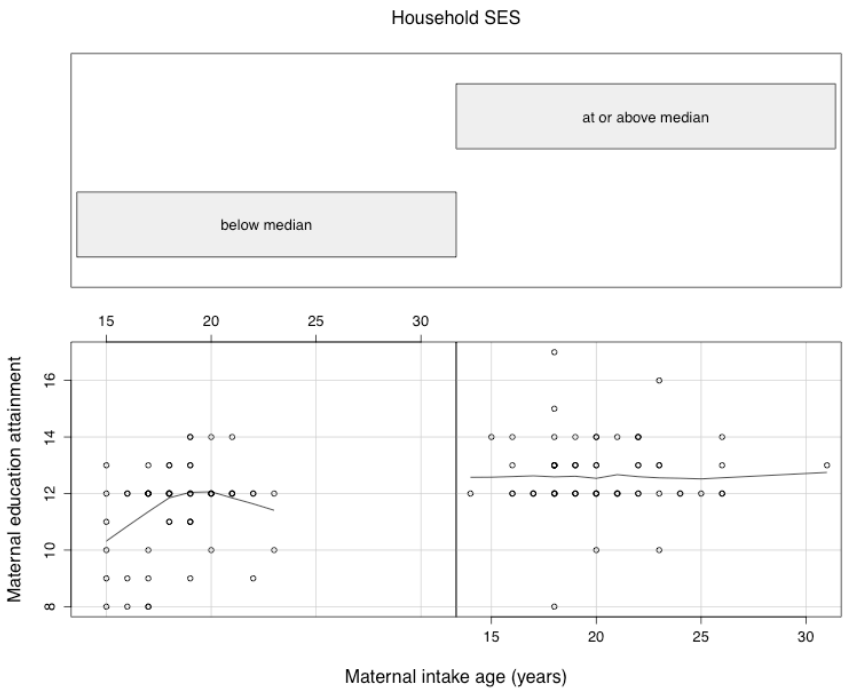

Figure 10. Effect of intake maternal age on maternal education attainment moderated by intake household SES

Intake maternal education x intake maternal marital status. The interaction of intake maternal education and intake maternal marital status was marginally significant for child cigarette smoking ($B = 123.88$, $p = 0.09$; Figure 11), family instability ($B = 0.63$, $p = 0.06$; Figure 12), and number of subsequent children ($B = 0.26$, $p = 0.08$; Figure 13). The patterns of the results were similar and suggested that the impact of lower levels of maternal education was stronger for families with unmarried mothers than for families with married mothers. For example, for families in which mothers were unmarried at intake, less maternal education at intake predicted a greater number of subsequent children; however, for families in which mothers were married at intake, there was little relationship between maternal education at intake and number of subsequent children.

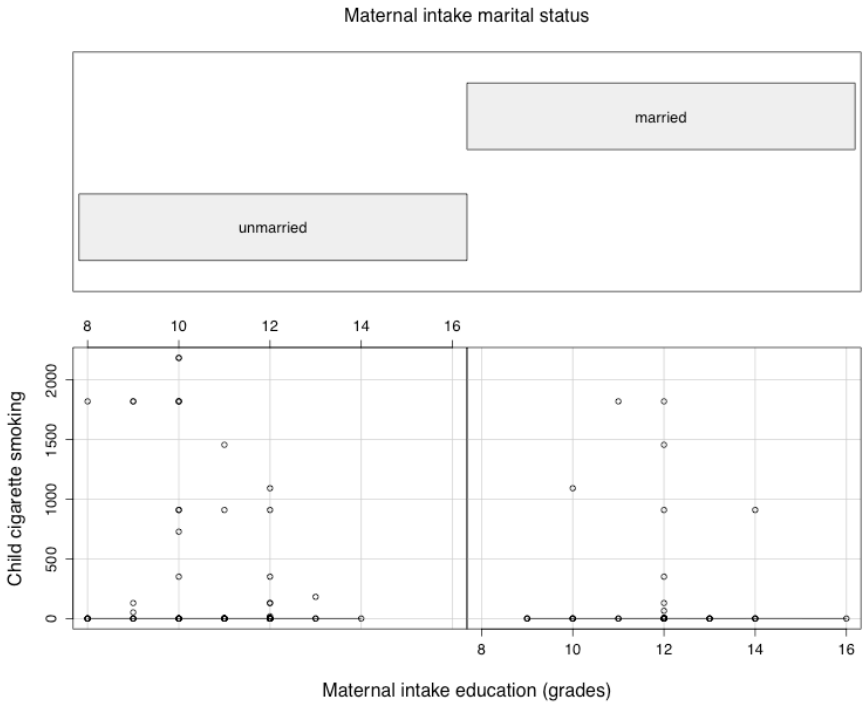

Figure 11. Effect of intake maternal education on child cigarette smoking moderated by intake maternal marital status.

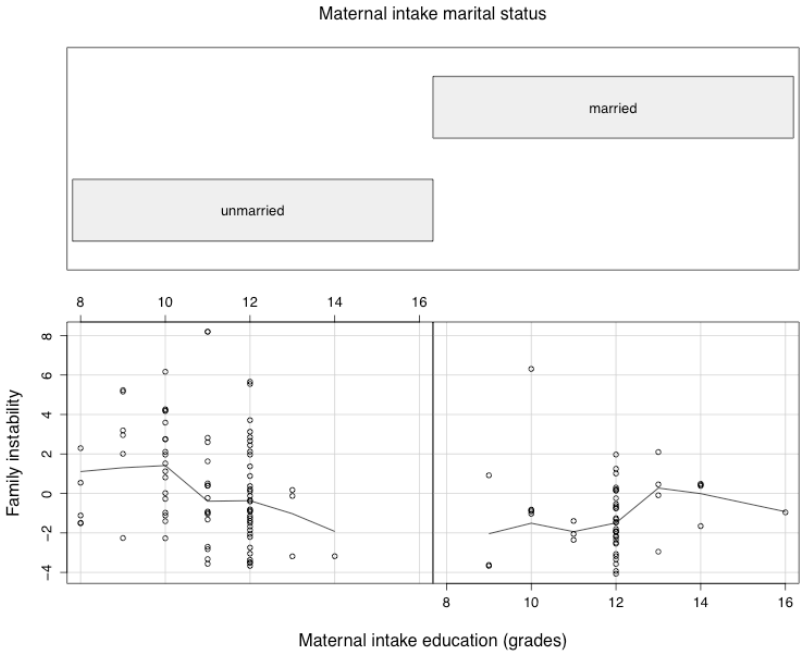

Figure 12. Effect of intake maternal education on family instability moderated by intake maternal marital status.

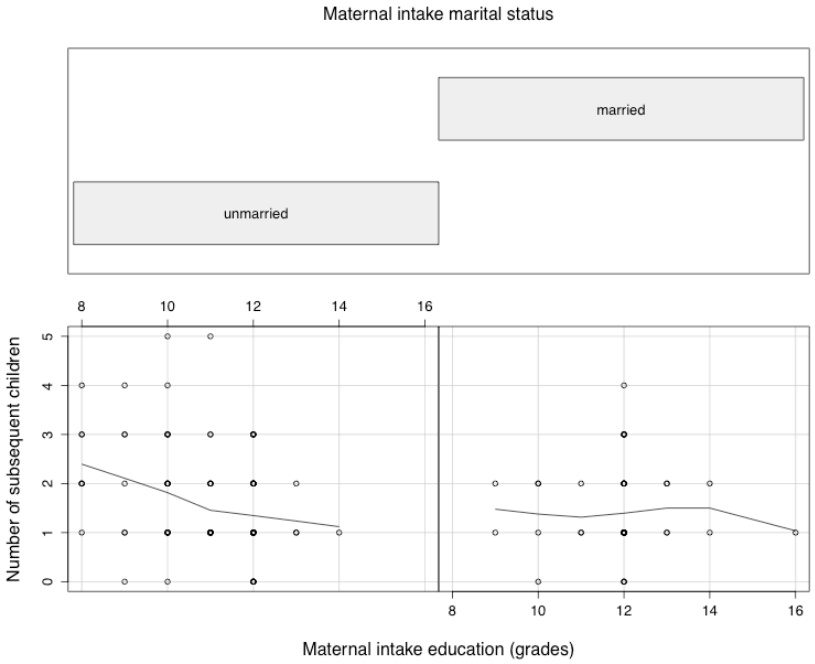

Figure 13. Effect of intake maternal education on number of subsequent children moderated by intake maternal marital status.

Intake maternal education x intake household SES. The interaction of intake household SES and intake maternal education was significant for child anxiety/depression (B = -0.03, p = 0.02; Figure 14), child academic achievement (B = 0.01, p = 0.03; Figure 15), maternal employment (B = -0.33, p = 0.03; Figure 16), months on AFDC (B = 0.35, p = 0.05; Figure 17), and economic hardship (B = -0.01, p = 0.004; Figure 18) and marginally significant for child externalizing problems (B = -0.05, p = 0.09; Figure 19) and family instability (B = -0.01, p = 0.09; Figure 20).

Intake household SES was more predictive of certain outcomes for families with mothers with at least a high school education at intake than for families with mothers with less than a high school education at intake. However, intake household SES was more predictive of other outcomes for families with mothers with less than a high school education at intake than for

families with mothers with at least a high school education at intake. Higher levels of intake household SES were more predictive of less family instability and better child academic achievement for families with mothers with more than a high school education at intake than for families with mothers with less than a high school education at intake. However, lower levels of intake household SES were more predictive of less maternal employment, more months on AFDC, and less maternal education attainment for families with mothers with less than a high school education at intake than for families with mothers with at least a high school education at intake. Furthermore, higher levels of intake household SES were predictive of more child depression/anxiety and child externalizing problems for families with mothers with less than a high school education at intake. However, for families with mothers with at least a high school education at intake there was little relationship between intake household SES and child anxiety/depression and a slight negative relationship between intake household SES and child externalizing problems.

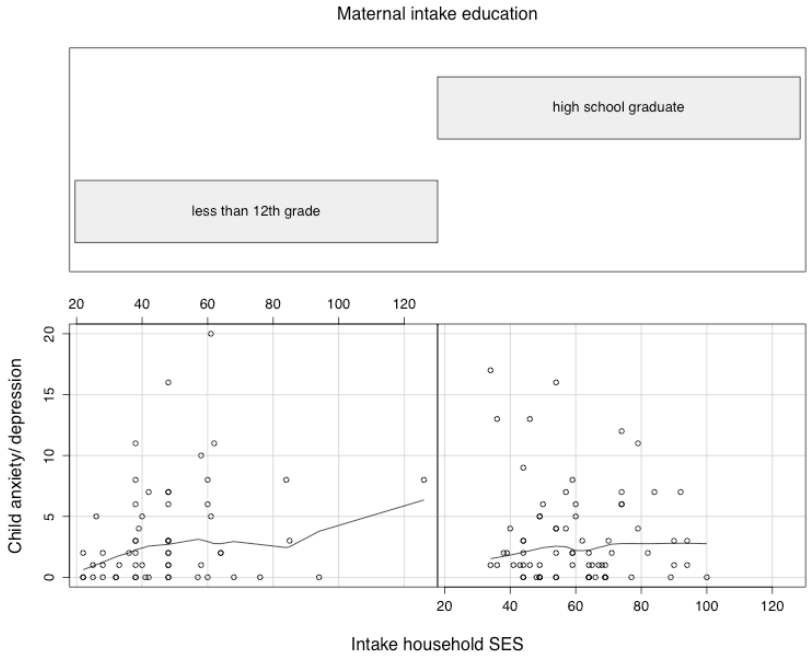

Figure 14. Effect of intake household SES on child anxiety and depression moderated by level of intake maternal education.

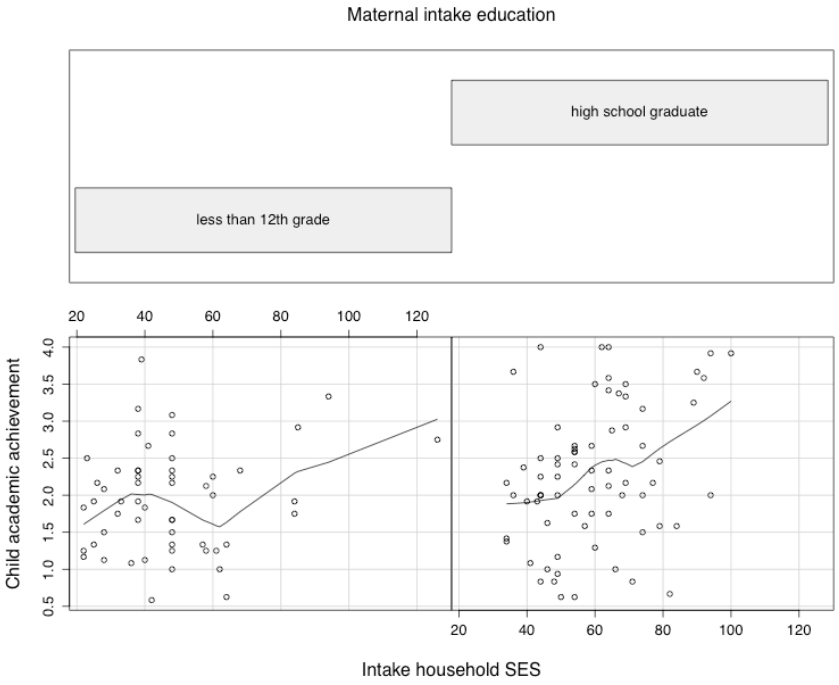

Figure 15. Effect of intake household SES on child academic achievement moderated by level of intake maternal education.

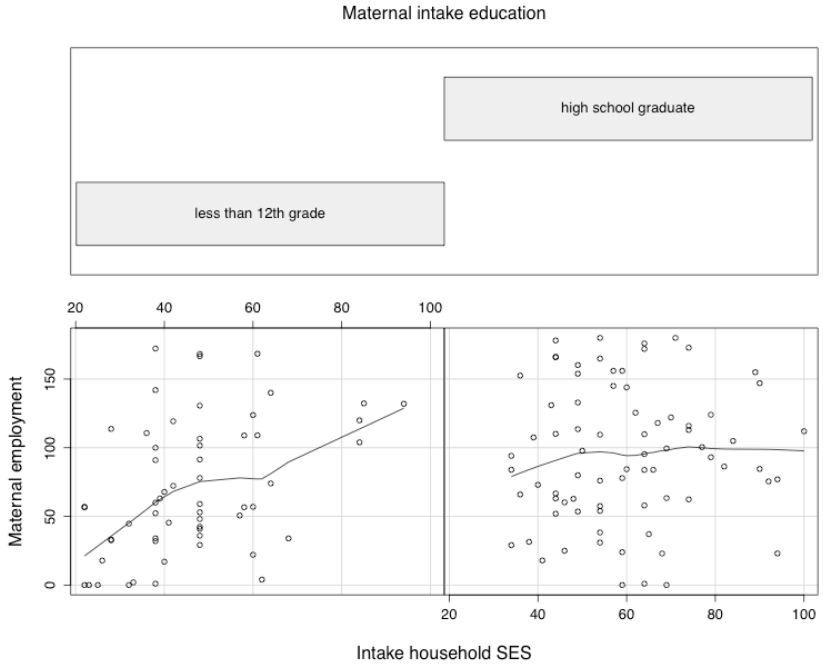

Figure 16. Effect of intake household SES on maternal employment moderated by level of intake maternal education.

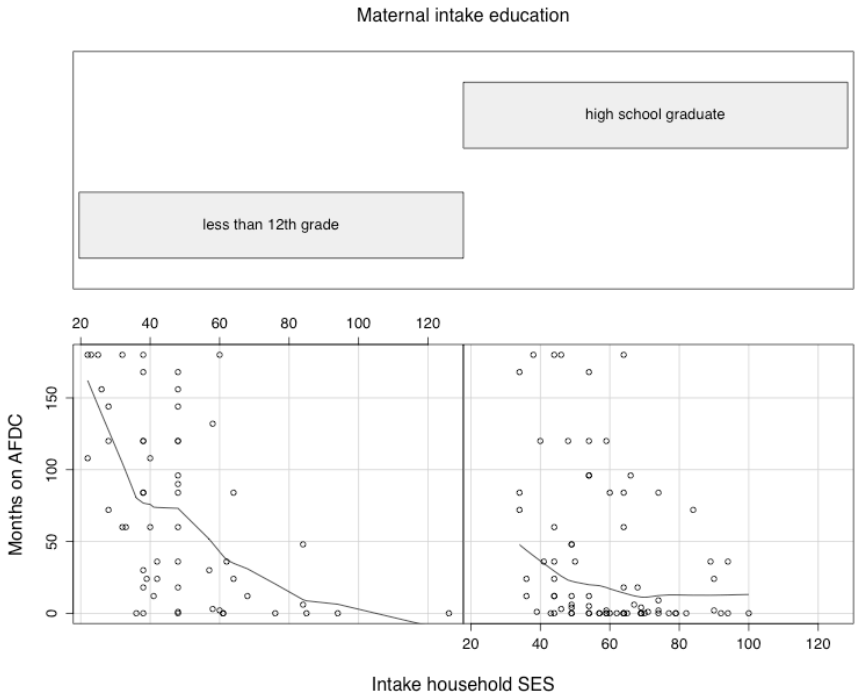

Figure 17. Effect of intake household SES on months on AFDC moderated by level of intake maternal education.

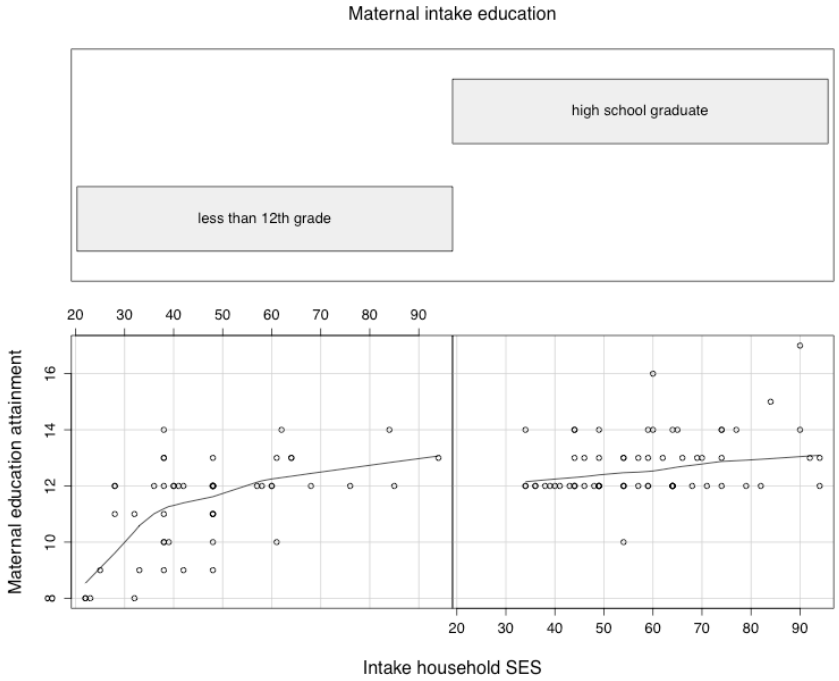

Figure 18. Effect of intake household SES on maternal education attainment moderated by level of intake maternal education.

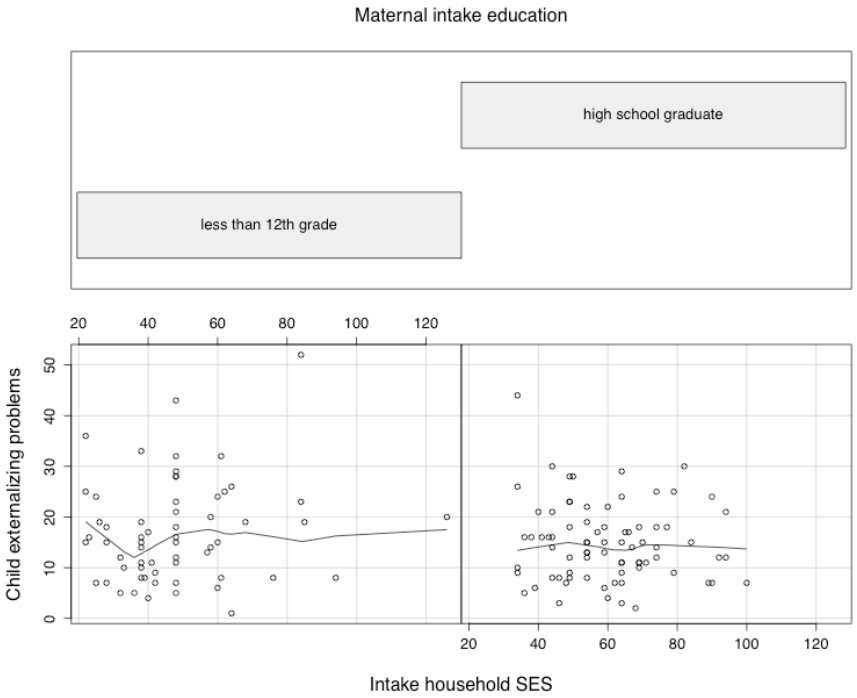

Figure 19. Effect of intake household SES on child externalizing problems moderated by level of intake maternal education.

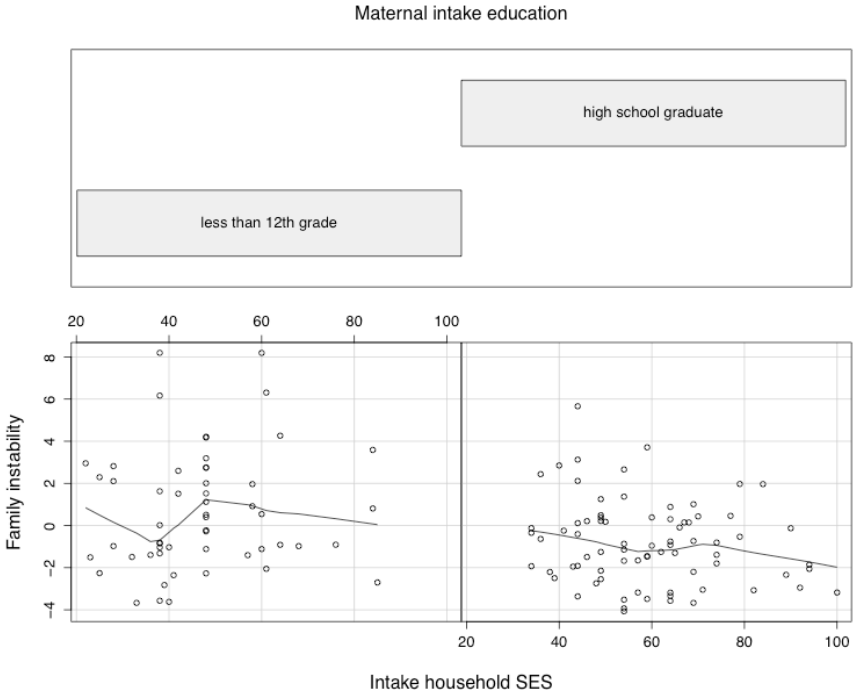

Figure 20. Effect of intake household SES on family instability moderated by level of intake maternal education.

Intake maternal marital status x intake household SES. The interaction of intake household SES and intake maternal marital status was significant for family instability (B = 0.07, p = 0.01; Figure 21) and marginally significant for months on AFDC (B = 0.98, p = 0.09; Figure 22). For families in which mothers were unmarried at intake, there was a strong negative relationship between intake household SES and family instability and between intake household SES and number of months on AFDC, such that lower levels of intake household SES predicted more family instability and more months on AFDC. However, for families in which mothers were married at intake, there was a weak negative relationship between intake household SES and months on AFDC and a slight positive relationship between intake household SES and family instability, such that higher levels of SES predicted more family instability.

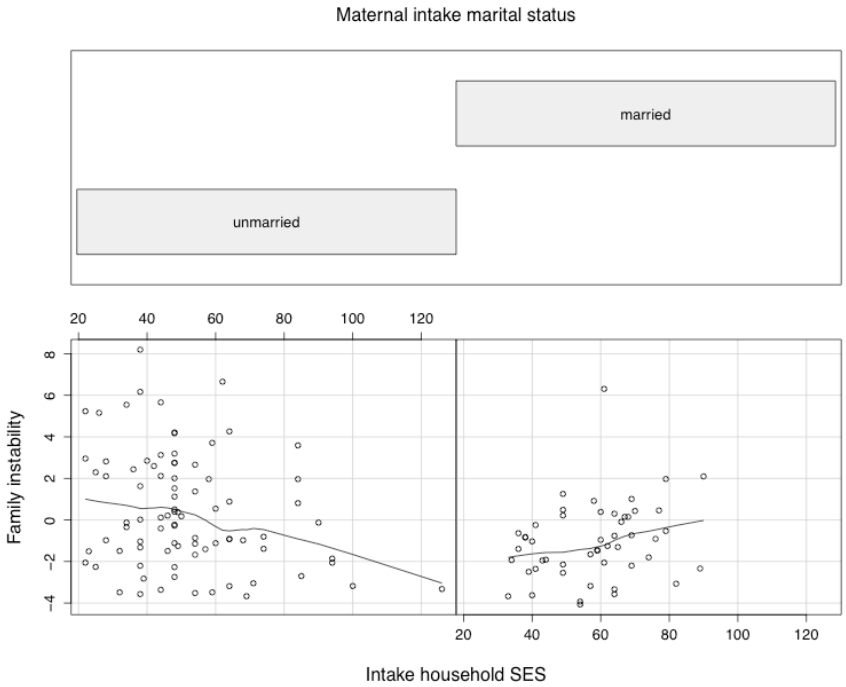

Figure 21. Effect and intake household SES on family instability moderated by intake maternal marital status.

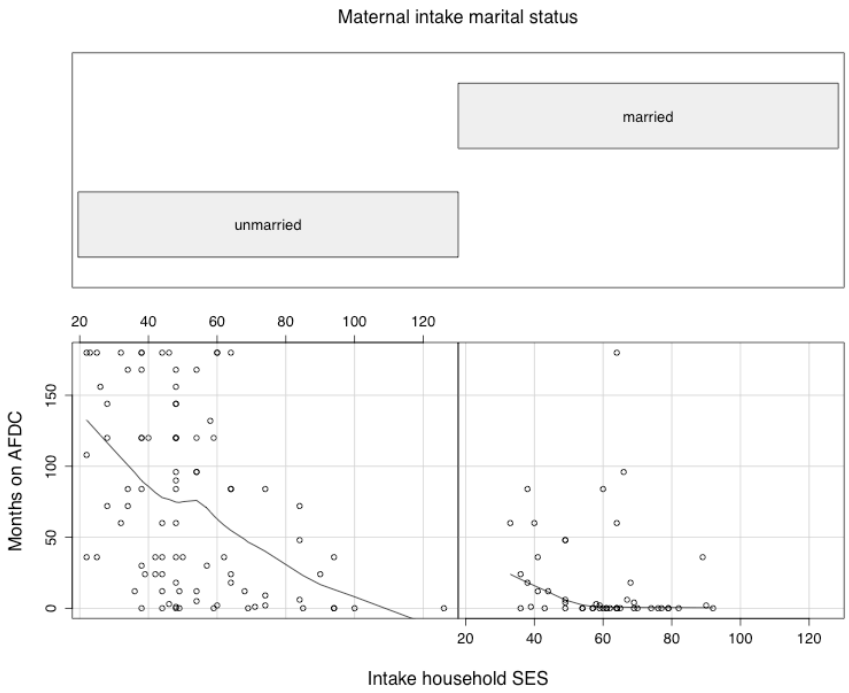

Figure 22. Effect and intake household SES on months on ADCD moderated by intake maternal marital status.

Prediction of composite poor outcome scores. Interaction results for composite poor outcome scores are presented in Table 7. The interaction of intake maternal age and intake maternal marital status was significant for composite poor child outcome scores ($B = 0.60$, $p = 0.04$; Figure 23). Additionally, the interaction of intake maternal marital status and intake maternal education was marginally significant for composite poor child outcome scores ($B = 1.10$, $p = 0.06$; Figure 24). No interactions were significant for composite poor maternal outcome scores. For families in which mothers were unmarried at intake, younger intake maternal age and lower levels of maternal education predicted higher composite poor child outcome scores. However, for families in which mothers were married at intake, there was little relationship between intake maternal age and composite poor child outcome scores and between intake maternal education and composite poor child outcomes scores.

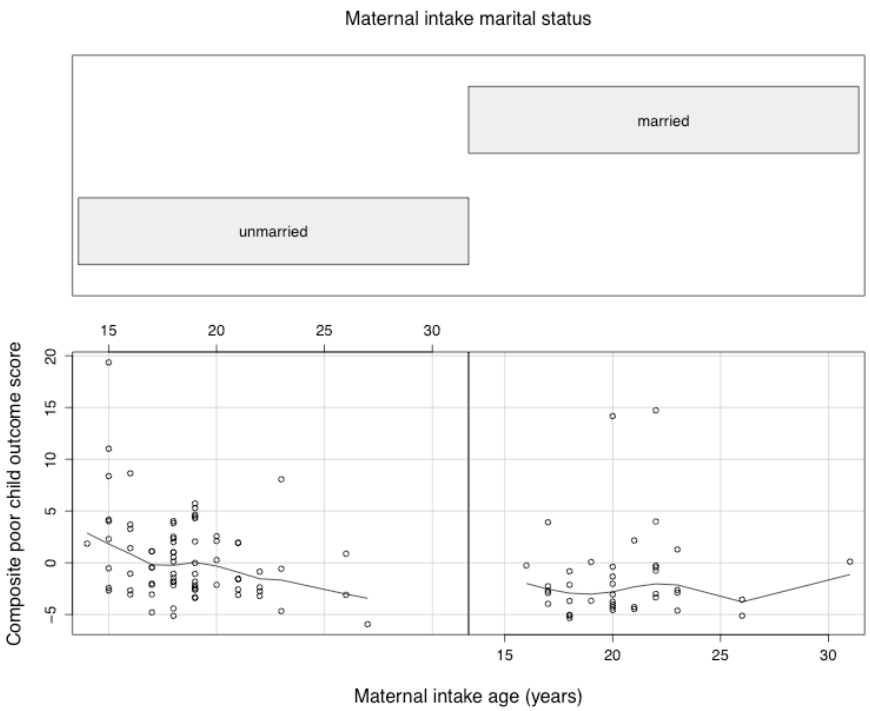

Figure 23. Effect of intake maternal age on composite poor child outcome scores moderated by intake maternal marital status.

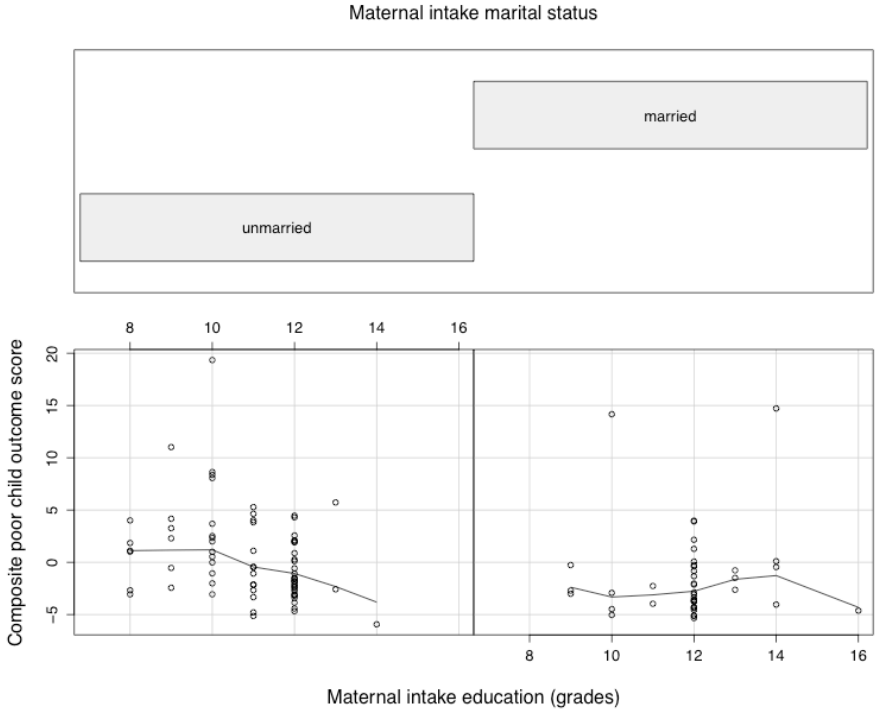

Figure 24. Effect of intake maternal education on composite poor child outcome scores moderated by intake maternal marital status.

Summary of interaction results. For the most part, interaction results showed that the effects of risk factors on certain outcomes were stronger in the presence of other risk factors. For example, the influence of young maternal age on the development of certain negative outcomes was dependent on mothers having lower levels of education at intake, on mothers being unmarried at intake, or on families having lower levels of household SES.

Table 7
Multivariate Regression Analyses with Interaction Terms

	Maternal age x maternal education		Maternal age x maternal marital status		Maternal age x household SES		Maternal education x maternal marital status		Maternal education x household SES		Maternal marital status x household SES	
Outcomes	*B*	*p*	*B*	*p*	*B*	*p*	*B*	*p*	*B*	*p*	*B*	*p*
Child cigarette smoking	12.90	0.20	**66.76**	**0.05**	1.36	0.12	**123.88**	**0.09**	1.67	0.37	7.72	0.17
Child drinking	0.06	0.89	0.97	0.51	0.04	0.31	3.61	0.20	-0.03	0.64	0.09	0.71
Child anxiety/ depression	-0.05	0.53	0.17	0.52	-0.01	0.32	-0.49	0.37	**-0.03**	**0.02**	-0.01	0.83
Child academic achievement	-0.00	0.84	-0.01	0.84	0.00	0.96	-0.01	0.93	**0.01**	**0.03**	0.01	0.56
Early onset child behavior problems	0.02	0.62	**0.19**	**0.10**	0.00	0.81	0.23	0.29	-0.00	0.38	0.01	0.74
Child arrests	0.00	0.78	0.02	0.22	-0.00	0.73	0.04	0.19	-0.00	0.29	0.00	0.55
Child school suspensions	-0.13	0.47	-0.27	0.66	0.01	0.71	-0.64	0.66	-0.04	0.24	0.01	0.94
Child externalizing problems	-0.03	0.86	**0.99**	**0.07**	0.00	0.86	1.09	0.35	**-0.05**	**0.09**	-0.04	0.67
Maternal drug/alcohol impairments	0.00	0.97	**0.10**	**0.01**	0.00	0.74	0.03	0.73	-0.00	0.21	0.00	0.61
Maternal mental health	0.01	0.42	-0.00	1.00	-0.00	0.29	0.06	0.51	-0.00	0.98	0.00	0.65
HOME score	-0.08	0.43	-0.10	0.81	-0.00	0.78	0.03	0.96	-0.03	0.12	0.01	0.92
Maternal warmth	0.00	0.78	-0.03	0.31	-0.00	0.99	-0.07	0.36	0.00	0.68	0.00	0.98
Maternal hostility	-0.00	0.80	-0.01	0.74	0.00	0.27	-0.01	0.93	-0.00	0.74	0.00	0.41
Family instability	-0.05	0.35	-0.00	1.00	-0.00	0.28	**0.63**	**0.06**	**-0.01**	**0.09**	**0.07**	**0.01**
Maltreatment reports	0.02	0.48	**0.26**	**0.02**	0.00	0.13	0.17	0.42	0.00	0.78	0.01	0.66
Subsequent children	**0.07**	**0.001**	**0.19**	**0.01**	0.00	0.43	**0.26**	**0.08**	-0.00	0.65	-0.00	0.97
Mother arrests	0.02	0.12	0.06	0.20	0.00	0.58	0.05	0.59	-0.00	0.68	0.01	0.29
Maternal employment	0.01	0.99	-0.27	0.93	**-0.14**	**0.08**	-0.73	0.91	**-0.33**	**0.03**	0.11	0.85
Mother on AFDC	0.63	0.62	1.86	0.63	0.10	0.29	8.26	0.27	**0.35**	**0.05**	**0.98**	**0.09**
Maternal education attainment	0.03	0.24	-0.12	0.29	**-0.01**	**0.06**	0.05	0.78	**-0.01**	**0.004**	0.01	0.75
Economic hardship	-0.02	0.15	**-0.08**	**0.08**	-0.00	0.61	-0.10	0.20	-0.00	0.60	-0.00	0.58
Composite poor maternal outcome score	0.04	0.73	0.22	0.56	0.01	0.32	0.76	0.31	0.02	0.37	0.05	0.38
Composite poor child outcome score	0.10	0.25	**0.60**	**0.04**	0.00	0.80	**1.10**	**0.06**	-0.01	0.31	0.05	0.30

Note. Significant and marginally significant results are in boldface.

Discussion

Comparisons of the Different Statistical Methods Used to Predict Individual and Composite Outcomes From Risk Factors

Univariate models versus multivariate models. There were several risk factors that significantly predicted individual outcomes in univariate regression models, which included a single risk factor as a predictor; but which did not predict individual outcomes in multivariate regression models, which included multiple risk factors as predictors. This shows that risk factors that are associated with outcomes do not necessarily independently predict the outcomes. Targeting families with a risk factor that is associated with a specific outcome, but does not independently predict that outcome, would likely not be an effective strategy to select families most in need of an intervention targeting that specific outcome.

For example, a univariate regression model with only intake maternal age included as a predictor showed that intake maternal age significantly predicted fewer mother arrests; however, a multivariate regression model, which included multiple risk factors as predictors, showed that intake maternal age did not predict the number of mothers arrests when level of maternal education, maternal marital status, and level of household SES were controlled. This suggests that using maternal age as a sole selection criterion for programs aimed at reducing maternal criminal behavior would likely not be an effective strategy to reduce the rates of criminal behavior in the population.

Independent predictive power of risk factors. Unlike univariate regression analyses in which a single risk factor was included as the predictor, multivariate regression analyses with multiple risk factors included as predictors showed which risk factors independently predicted outcomes after controlling for other measured risk factors. Thus, results from multivariate

regression analyses with multiple risk factors included as predictors indicated which outcomes would likely be particularly important to target for families with a specific risk factor.

For example, the results showed that younger maternal age independently predicted more subsequent children and more family instability, indicating that families with young mothers would be especially likely to benefit from prevention programs that seek to reduce family instability and the number of subsequent children. Younger maternal age also independently predicted more maternal education attainment and less economic hardship, possibly because maternal age inversely related to grandmother support ($r = -0.39$, $p < 0.001$) and grandmother support inversely related to economic hardship ($r = -0.17$, $p = 0.04$). Regardless of why younger maternal age predicted greater education attainment and less economic hardship, the results suggest that, compared to older mothers, younger mothers are likely less in need of interventions aimed at increasing maternal education attainment and reducing economic hardship. Thus, targeting young mothers with these types of interventions would probably not be an effective use of resources.

Furthermore, the results suggested that families with mothers with lower levels of education would be especially likely to benefit from interventions aimed at increasing maternal education attainment and reducing child smoking, maternal hostility, child maltreatment, reliance on AFDC, and economic hardship. Additionally, families with unmarried mothers would be particularly likely to benefit from interventions that seek to reduce maternal drug and alcohol problems, maternal criminal behavior, family instability, reliance on AFDC, and economic hardship and seek to improve maternal mental health, the quality of the home environment, and maternal employment rates. Lastly, lower SES families would be particularly likely to benefit from interventions aimed at improving child academic achievement, the quality of the home

environment, and maternal education attainment and reducing child maltreatment and reliance on AFDC.

Cumulative risk models. A comparison of cumulative risk analyses, which examined the predictive power of the number of risk factors present, and multivariate regression analyses, which examined the independent predictive power of single risk factors, showed that there were outcomes that were not independently predicted by a single risk factor, but were predicted by the number of present risk factors. Child drinking, early onset child behavior problems, child arrests, and maternal warmth were not independently predicted by any single risk factor, but were predicted by the number of present risk factors, indicating that targeting families with multiple risk factors, rather than targeting family with a specific risk factor, would likely be the most effective method to impact these outcomes.

Interactions of risk factors. Results from multivariate regression analyses, which included interaction terms, showed that the influence of risk factors on the development of certain poor outcomes was dependent on families having higher levels of another risk factor. Examining interactions of risk factors rather than risk factors individually allowed for a more precise assessment of the specific types of families most in need of particularly interventions. For example, the interaction of intake maternal age and intake maternal marital status on number of subsequent children showed that for mothers who were unmarried at intake, there was a negative relationship between maternal age and number of subsequent children; however, for mothers who were married at intake, there was little relationship between intake maternal age and number of subsequent children. Furthermore, younger unmarried mothers were more likely to have more subsequent children than younger married mothers. There were fewer older mothers in the sample; however, the data suggested that older married mothers may be more

likely to have more subsequent children than older unmarried mothers. Nonetheless, the results suggest that targeting pregnancy prevention programs to young unmarried mothers would likely be more impactful than targeting pregnancy prevention programs to older unmarried mothers or married mothers.

Risk factors and risk profiles to target to improve overall maternal and child well-being. Results from multivariate regression analyses examining the independent predictive power of individual risk factors on composite poor maternal outcome scores indicated that mothers with lower levels of education, unmarried mothers, and mothers with lower household SES are likely in need of broad-based interventions targeting multiple outcomes relating to maternal well-being. Results from multivariate regression analyses with interaction terms included showed that there were no interactions of risk factors that were significant for composite poor maternal outcome scores.

Results from multivariate regression analyses, which examined the independent predictive power of individual risk factors on composite poor child outcome scores, showed that there were no risk factors that independently predicted composite poor child outcome scores. However, results from multivariate regression analyses with interaction terms included showed the interaction of maternal age and maternal marital status and the interaction maternal education and maternal marital status were significant for composite poor child outcome scores.

The interactions showed that children of unmarried teenage mothers had higher composite poor child outcome scores than children of married teenage mothers and children of unmarried mothers with less than a high school education had higher composite poor child outcome scores than children of married mothers with less than a high school education. As maternal age and maternal education increased, composite poor outcome scores decreased for

children of unmarried mothers. However, as maternal age and maternal education increased, composite poor outcome scores remained fairly constant for children of married mothers. Thus, the results suggest that children of young unmarried mothers are more in need of broad-based interventions aimed at improving overall child well-being than children of older unmarried mothers and children of married mothers. Additionally, children of unmarried mothers with less than a high school education are more in need of broad-based interventions aimed at improving overall child well-being than children of unmarried mothers with more than a high school education and children of married mothers.

Illustration of Information Garnered From Different Methods Using the Risk Factor of Young Maternal Age as an Example

In this section one risk factor predictor (i.e., young maternal age) will be highlighted to make a comparison between the information garnered by using different statistical methods to examine the relationship between risk factors and outcomes. Univariate regression models, which included maternal age as the sole predictor, showed that younger maternal age predicted poorer child academic achievement, more child arrests, more maternal drug and alcohol impairments, lower HOME scores, less maternal warmth, more family instability, more subsequent children, more maternal arrests, less maternal employment, more months on AFDC, lower maternal education attainment, and less economic hardship.

However, several outcomes that were significantly predicted with univariate regression models were no longer significantly predicted with multivariate regression models that controlled for intake level of maternal education, maternal marital status at intake, and the level of intake household SES. Multivariate regression models, which included multiple risk factors as predicators, showed that younger maternal age only independently predicted more family

instability, more subsequent children, more maternal education attainment, and less economic hardship. Thus, although there were several negative outcomes that were associated with young motherhood, when other risk factors were accounted for, the only negative outcomes predicted by young maternal age were more family instability and a greater number of subsequent children. These findings indicate that families with young mothers would be especially likely to benefit from pregnancy prevention programs and interventions aimed at promoting family stability.

The results from multivariate regression models with interaction terms included showed that the effect of intake maternal age on number of subsequent children was moderated by level of maternal education at intake. Additionally the effect of maternal age on child cigarette smoking, early onset child behavior problems, child externalizing problems, maternal drug and alcohol impairments, child maltreatment, number of subsequent children, and economic hardship was moderated by intake maternal marital status. Furthermore, the effect of intake maternal age on maternal employment and maternal education attainment was moderated by level of household SES. Examining the nature of the interactions allowed for a closer inspection of what families may be particularly likely to benefit from specific interventions. For example, the interaction of maternal intake age and maternal intake marital status on early onset child behavior problems showed that rates of early onset child behavior problems were low for families of mothers who were married at intake and there was little relationship between early onset child behavior problems and intake maternal age for families of mothers who were married at intake. However, there was a negative relationship between intake maternal age and early onset child behavior problems for families of mothers who were unmarried at intake, indicating that families of young unmarried mothers are likely more in need of interventions aimed at

reducing child behavior problems than families of older unmarried mothers or families of married mothers.

In terms of composite poor outcome scores, univariate regression models showed that maternal age predicted composite poor maternal outcome scores and composite poor child outcome scores. However, multivariate regression results showed that maternal age no longer significantly predicted composite poor outcome scores once other risk factors were controlled for. This suggests that, in general, families with young mothers are likely to benefit more from interventions that target specific outcomes rather than from broad-based interventions that target overall maternal and child well-being. However, the interaction of maternal age and maternal marital status was significant for composite poor child outcome scores and suggested that children of unmarried young mothers were more in need of broad-based interventions aimed at improving overall child well-being than children of unmarried older mothers or children of married mothers.

Study Limitations

There were several limitations to the present study. The sample size was relatively small which may have limited the statistical power to detect significant results. Furthermore, because the sample consisted of participants from a semi-rural region of upstate New York, it is possible that the findings may not generalize to other populations, such as more ethnically or racially diverse populations. Lastly, outcomes assessed in this study were primarily evaluated at one time point (i.e., at the 15 year follow-up assessment) and thus the study did not evaluate whether any of the outcomes assessed could themselves be risk factors for the development of future negative outcomes.

Policy Implications.

Current methods home visiting programs use to select at-risk pregnant women and at-risk families with young children do not evaluate who would benefit most from specific prevention programs. Because programs impact different outcomes and because risk profiles relate differently to outcomes, programs should be specifically targeted to families with risk profiles that relate to the outcomes targeted with the selected intervention.

Specifically, determining what risk factors independently predict individual outcomes and what interactions of risk factors are significant for individual outcomes in the target population would allow for interventions that have been shown to affect specific outcomes to be targeted to families with risk profiles that are most in need of the interventions. Furthermore, determining what outcomes are predicted by number of present risk factors and not independently predicted by a specific risk factor would show that for programs targeting those outcomes families should be selected based on an assessment of number of risk factors rather than on a specific risk factor. Lastly, determining what risk factors independently predict overall maternal well-being and overall child well-being and what interactions are significant for overall maternal well-being and overall child well-being would indicate what families would be most likely to benefit from more broad-based interventions. Thus, selecting families for broad-based interventions or interventions that target specific outcomes should be based on knowledge of whether the intervention targets the outcomes that are predicted by a family's risk profile, whether that be based on a specific risk factor, a set of two interacting risk factors, or the number of present risk factors.

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