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**Child Maltreatment, Family Characteristics, and Educational Attainment:  
Evidence from Add Health Data**

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## **Child Maltreatment, Family Characteristics, and Educational Attainment**

### **Abstract**

This paper examines the long-term impact of child maltreatment (CM) on children's human capital accumulation. We estimate the effect of CM experience on the children's subsequent high school graduation outcome by applying structural estimations, which control for potential endogeneity of CM, on data from the National Longitudinal Study of Adolescent Health (Add Health) study. We find that experiencing physical neglect (physical abuse) increases the likelihood of dropout by 7 percentage points and 6 percentage points while sexual abuse has no significant effect on high school graduation. This finding agrees with some social workers' claim that neglect, among other types of CM, has significant long-term impacts on children's development. Living without biological parents increases the probability of all types of CM while neglect is more prevalent among children with less-educated caregivers. These findings shed light on how parents' behavior toward children might influence their long-term outcomes as well as the types of households to which CM prevention programs can be targeted.

## **I. Introduction**

Child maltreatment, which includes both child abuse and child neglect, is widely regarded as a serious social and public health problem that affects large numbers of children in the United States. In 2013, U.S. state and local child protective services (CPS) agencies investigated 3.2 million children being abused or neglected. Among them, 678,932 children were classified by CPS as being maltreated and about 1,520 children ages 0 to 17 died from abuse and neglect (USDHHS, 2015).

There is increasing evidence that exposure to child maltreatment can lead to many emotional, behavioral, and physical health problems. Associated emotional and behavioral problems include aggression, conduct disorder, delinquency, antisocial behavior, intimate partner violence, teenage pregnancy, anxiety, depression, and suicide (Fang and Corso, 2007; Runyan et al. 2002; Repetti, Taylor and Seeman, 2002). Moreover, children who are maltreated have been linked to health risks such as smoking and substance abuse and health problems such as obesity, diabetes, ischemic heart disease, and sexually transmitted diseases (Repetti, Taylor and Seeman, 2002; Felitti et al. 1998). The total lifetime economic burden resulting from new cases of fatal and nonfatal child maltreatment in the United States in 2008 is approximately \$124 billion (Fang et al., 2012). However, little is known about whether child maltreatment has a significant influence on the victim's educational attainment, and whether child maltreatment mediates the effects of family background factors on the victim's educational outcomes. In addition, few studies have addressed the relative impacts of different types of maltreatment—child neglect, physical abuse and sexual abuse—on educational outcomes.

This study is motivated by the high prevalence of child maltreatment in the United States and our limited knowledge about the long-term consequence of maltreatment on children's human capital accumulation. Using the National Longitudinal Study of Adolescent Health (Add Health) data, this paper examines the associations between three forms of child maltreatment (neglect, physical abuse and sexual abuse) and the children's subsequent educational attainment in terms of high school graduation. This paper presents new evidence that some forms of child maltreatment have a negative effect on children's educational attainment. We identify the effects of child maltreatment—physical neglect, physical abuse, and sexual abuse—on children's high

school graduation by applying a number of econometric methods to control for potential endogeneity of child maltreatment to a national sample of adolescents in the United States. The methods used include multivariate probit structural estimations of high school graduation and child maltreatment, propensity score matching, and linear-probability model specifications with instrumental variables. All of these estimations suggest that child neglect, among all types forms of maltreatment, has a statistically significant effect on the children's probability of high school graduation. While we find weakly significant or significant effects of physical abuse depending on different model specifications, we do not find significant effects of sexual abuse on high school graduation. This finding regarding the effects of different forms of maltreatment is consistent with some child psychologists' claim that neglect, though attracting less policy and media attention than physical and sexual abuse, is at least as harmful as they are (Haugaard et al. 1997, Smith and Fong 2004).

Our central question is whether preventing child maltreatment helps reduce the number of high school dropouts. We focus on high school dropout because it poses one of the greatest threats to the nation's economic growth and competitiveness. About 2,500 American high school students drop out every day ((ABC News, November of 2006)). Dropouts are far more likely to spend their lives periodically unemployed, on government assistance, or cycling in and out of the prison system. The economic consequences of leaving high school without a diploma are severe. According to the U.S. Census Bureau (2007), the average annual income of a high school dropout was \$20,100, while a person with a high school diploma averaged \$29,700. The relative wages of high school dropouts to high school graduates (or college graduates) decreased by 14.8% (or 38.2%) in the period between 1963 and 2003 (Autor et al. 2005).

A challenge that we face in addressing this question is that child maltreatment and educational attainment may be influenced by some common factors that are unobservable to researchers. Among other types of maltreatment, physical abuse may be associated with unobserved parental characteristics that may influence children's educational attainment. For example, available measures of maltreatment included in the Add Health dataset (as well as in most other data on child maltreatment) do not distinguish physical abuse and corporal punishment; they are likely to be correlated with family and child characteristics that affect educational attainment such as

parents' or caregivers' strictness and attitudes toward children's welfare, which are not observable to researchers. Parents/caregivers who want their children to behave well at home and school may use physical punishment (which they think is an effective way) to discipline their children. Holding out that attitude and expecting their children to be well-behaved by itself could be helpful for their children to complete high school. For example, parents with that attitude may spend more leisure time on helping their children with homework, encourage their children to attend more after-school learning activities, and better help their children avoid teen pregnancy or antisocial behaviors which are risk factors for high school dropout. Given the presence of such unobservable variables, a reduced-form, single-equation probit regression of high school graduation as the dependent variable and child maltreatment as an explanatory variable may generate a biased estimate of the effect of CM on graduation. In order to overcome this challenge, we employ several empirical methods including recursive multivariate probit structural models of high school graduation and child maltreatment variables where the latter are allowed to be endogenous and propensity score matching. Recursive multivariate probit allows us to structurally estimate the association between high school dropout and CM, taking into account that CM is likely to be correlated with unobserved family and child characteristics that affect high school graduation. The estimation indicates whether a reduced-form, single-equation estimation generates a bias. It also allows us to separate the effects on educational attainment of different types of CM while controlling for their endogeneity.

We find that CM—in particular, physical abuse—is indeed endogenous, and hence the single-equation estimates—where only child neglect is significantly associated with higher high school dropout probability but not the other two types of maltreatment—are likely to be inconsistent. Our multivariate probit estimates suggest that both neglect and physical abuse are negatively associated with high school graduation while sexual abuse is not. The point estimate suggests that that experiencing physical neglect and physical abuse increases the likelihood of dropping out of high school by 7 percentage points and 6 percentage points. Using the life-time earning differences between high school graduates and dropouts in the U.S., these point estimates suggest that the long-term productivity loss associated with child maltreatment will be about \$ 116 billion. However, due to the nature of the data, several factors imply that these point estimates of the effect of CM on high school graduation may be an underestimate. The

estimations under other specifications of the empirical model—propensity score matching estimations, linear probability model specifications with and without instrumental variables, and models with alternative definitions of child maltreatment—indicate that the results regarding the significant effect of neglect and physical abuse are robust.

In what follows, Section II reviews the findings in the relevant literature on child maltreatment, high school dropout, and the possible mechanisms through which child maltreatment may cause dropout. Section III describes the conceptual framework and empirical strategies. Section IV describes the data and the variables used in the analysis. After summarizing the findings in Section V, we conclude the paper in Section VI with discussions contrasting the paper’s findings with the previous findings and policy implications regarding child protection.

## **II. Background and findings from the existing studies**

This section discusses why child maltreatment can cause high school dropout, and how our study fits in the existing studies on the impacts of CM on educational attainment and on the determinants of CM.

### **II.A Why Would Child Maltreatment Cause Dropout?**

The Centers for Disease Control and Prevention (CDC) defines child maltreatment as “any act or series of acts of commission or omission by a parent or other caregiver that results in harm, potential for harm, or threat of harm to a child “(Leeb et al. 2008). There are four major categories of child maltreatment: neglect, physical abuse, psychological/emotional abuse, and sexual abuse.

In the United States, child protective service (CPS) agencies confirmed 678,932 children as being maltreated in 2013 (USDHHS, 2015). This number corresponds to about 1% of all children in the US, but researchers argue that this is a significant underestimate because many maltreatment incidences are not confirmed by CPS (Haugaard et al. 1997, Waldfogel 1998, Hussey et al. 2006).<sup>1</sup> According to previous national surveys based on self report by adult caregivers or children, the prevalence of physical neglect, physical abuse, and sexual abuse range

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from over 25%, 15% to 20%, and 3.3% to 5.7%, respectively (Hussey et al. 2006). Another national, representative study of children and youth ages 2 to 17 years reported that 14 percent of U.S. children experienced some form of child maltreatment in the study year 2002 (Finkelhor et al. 2005).

Neurobiological, behavioral, and social science research has shown that exposure to childhood maltreatment is associated with a wide range of emotional, psychological, and physical health problems, including cardiovascular disease, hypertension, diabetes, anxiety disorders, depression, substance abuse, and antisocial/aggressive behavior. There has been relatively little discussion as to the relationship between child maltreatment and educational attainment and subsequent lifetime economic opportunities. With approximately every nine seconds a student deciding to permanently leave high school prior to graduation in the U.S. (Children's Defense Fund, 2002), high school dropout has become a national problem that requires policy makers and researchers to find effective strategies to reduce students from dropping out of school. Educational and community leaders as well as policy makers have crafted a myriad of intervention programs and strategies targeted toward reducing the dropouts (Currie, 2001; Kemple & Herlihy, 2004; Smink & Schargel, 2004). Unfortunately, many of these efforts have failed to demonstrate effectiveness and/or have proven ineffective at significantly lowering the dropout rate across school, district, and state levels (Alexander, Entwisle, & Kabbini, 2001; Crowder & South, 2003; Hickman, 2006; Rumberger, 2004). One possible reason for the failure is that the majority of dropout intervention programs has been tailored toward secondary education, but ignores many other factors that influence children's development outside the education system. Increasing evidence has shown that health and economic outcomes in later life (adolescence and adulthood) are a function of early childhood experience and development (Heckman, 2006; Karoly, Kilburn, and Cannon, 2005; Currie, 2010). Yet there is little hard evidence available about the effects of child maltreatment on high school graduation. To better understand this link provides us useful policy implications to reduce the dropouts. Exposure to childhood maltreatment may result in dropping out of school through many mechanisms. First, Social Learning Theory proposes that childhood exposure to maltreatment teaches children that violence is legitimate and that violence is an effective way of resolving conflicts (see Widom, 1998; O'Leary 1988; Simons et al. 1995; Straus and Smith 1990). Upon entering kindergarten, maltreated children begin to exhibit conduct



disorder/aggressive behavioral problems. As a result, children who exhibit conduct disorder/aggressive behavioral problems become rejected by their peers/teachers and consequently develop a detachment from school as they find school academically and socially unrewarding. During early adolescence, rejected children begin to congregate to each other for support, forming delinquent/antisocial peer groups. Finally, as this developmental progression unfolds, adolescents develop the propensity to drop out of high school (Patterson, DeBaryshe, & Ramsey, 1989; Hickman, Bartholomew, Mathwig and Heinrich, in press).

Second, Neurobiological research showed that recurrent exposure to the stress associated with maltreatment can lead to potentially irreversible changes in the interrelated brain circuits and hormonal systems that regulate stress. Changes in these brain systems can lead to a premature physiological aging of the body that increases vulnerability to disease and may permanently alter the way that individuals respond to environmental stimuli (See Shonkoff and Phillips, 2000; McEwen and Seeman, 1999; Seeman, Singer, Rowe, Horwitz, and McEwen, 1997; Veltman and Browne, 2001; Cicchetti and Rogosch, 2001). Thus, maltreated children may be more likely to have poor physical and mental health which could be related to higher absenteeism and more problems completing home work (Slade and Wissow, 2005), and develop lower self-efficacy. Low academic self-efficacy along with poor attendance and poor grades may eventually place a child on the pathway to dropping out of school (Alexander et al., 1997; Lehr et al., 2004; Schunk & Pajares, 2001).

Third, previous research has indicated childhood maltreatment increases the risk of behavioral problems such as substance abuse and sexual promiscuity, and therefore increases the risk for teenage pregnancy (Felitti et al., 1998; Herrenkohl, Herrenkohl, Egolf, and Russo, 1998). The demands of parenting may cause a significant number of teen parents to drop out of high school (Cairns, Cairns, and Neckerman, 1989; Mott and Marsiglio, 1985).

Empirical studies on educational attainment have shown that family characteristics, such as family poverty and parental education, are important determinants of high school dropout (e.g. Haveman and Wolfe 1995, Eckstein and Wolpin 1999). They also hint that child maltreatment may indeed influence the victims' attainment: many studies find home environments and

caregivers' ability to be the major determinants of children's educational achievement (Todd and Wolpin 2007, Carneiro et al. 2007). Child maltreatment represents an indicator of home environment and how parents treat children. This argument supports our focus on the effect of child maltreatment on educational attainment.

## **II.B Relation to the literature on child maltreatment and academic performance**

Children's educational attainment, and high school graduation in particular, is associated with both the income of the children's households and the children's subsequent earnings. Though the gap between the dropout rates in low- and high-income families has decreased during the last decade (1995-2005), in 2006, the event dropout rate of students living in low-income families was about four and one-half times greater than the rate of their peers from high-income families (9.0 percent vs. 2.0 percent, Laird et al. 2008, p.5).

Several studies on the determinants of educational attainment have addressed the link between CM and educational outcomes. Using the Early Childhood Longitudinal Study dataset, Freyer and Levitt (2004) found that variables representing spanking by parents<sup>2</sup> are not significantly associated with children's math and English test scores in the first two years of school. In their dataset, the spanking variables are based on parents' self reports. In addition, spanking is assumed to be exogenous in their model though it is possibly correlated with unobservable parent characteristics that might be correlated with educational outcome.

Using a sibling sample from the Add Health dataset, Slade and Wissow (2007) find that CM is likely to result in poor academic performance: more intense childhood maltreatment was found to be associated with greater probability of having a low grade point average and problems completing homework assignments. They focus on the overall effect of multiple types of CM, and do not investigate the possible different effects that different types of CM may have.

Few studies investigate the effects of CM on educational attainment in terms of high school or college graduation. Studying these effects, beyond the effects of CM on grades, is important for

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<sup>2</sup> Freyer and Levitt (2004) used two dummy variables based on survey questions regarding whether parents never spank their child and the number of times parents spanked child in the previous week.

two reasons. First, it is graduation of high school and/or college, not the grades, which mostly affects the life-time earnings of adolescents. Leaving high school without a diploma implies a significant economic consequence. In 2003, the median income of high school dropouts aged 18 and over was \$12,184 while the median income of those aged 18 and over who completed their education with a high school credential (including GED) was \$20,431 (US Census Bureau 2005). According to Autor et al. (2005), the relative wages of high school dropouts to high school graduates (college graduates) decreased by 14.8% (38.2%) in the period between 1963 and 2003. Given that the high school graduation rate has not been improved in the recent decades (Heckman and LaFontaine 2006 and 2007), identifying the link between CM and high school dropout will help policymakers formulate effective policies to enhance educational attainment of children.

Secondly, high school graduation does not necessarily result from low grades. For example, according to a survey on 467 high school dropouts, 88% had passing grades, with 62% having “C’s and above” (Bridgeland et al. 2006). This study found that some dropouts, but not the majority, leave school because of significant academic challenges. It also found that the primary reason that students left school was because they were bored and disengaged from high school. Other major reasons included: feeling unmotivated; personal reasons such as “they had to get a job and make money”, “they became a parent”, or “they had to care for a family member”; and academic challenges. According to data from the 1979 youth cohort of the National Longitudinal Surveys of Labor Market Experience (NLSY79), when a sample of white male youths who had not yet graduated from high school and were not currently attending were asked to choose from a list of reasons for their nonattendance, approximately 30 percent chose the response category “didn’t like school” as the main reason, an additional 14 percent cited “offered a good job, chose to work” and 9 percent “lack of ability, poor grades.” (Eckstein and Wolping 1999).

Among few studies on the link between CM and high school graduation, Boden et al. (2007) uses a longitudinal sample of 1,053 children to analyze the association between physical and sexual abuse and educational attainment. Correlations disappear once family’s socioeconomic characteristics are controlled for. Neglect was not analyzed in their study.

Using a sample of 676 CPS reported victims and 520 unabused children as a control group, McGloin and Widom (2001) found that the high school graduation rates are significantly different between the two groups. But the victims and unabused children were matched only on a small number of observable traits. Moreover, their study relied on administrative data from an era in which mandatory reporting of child maltreatment did not exist and their educational outcomes were based on self-reported measures. Thornberry et al. (2001) also find significant effects of CM on dropout using a convenience sample of 738 children. Both studies didn't investigate the effects of child maltreatment by type of child maltreatment.

However, not all of the literature is in agreement that child abuse stunts educational achievement. Boden et al. (2007) concludes that social, familial, and individual context explain most of the difference between abused and non-abused subjects. With the exception of physically abused victims, who were still less likely to gain a high school certificate after adjustment, none of the associations between abuse and educational outcomes in their analysis remain significant after controlling for social, familial, and individual context. However, their data were based on a birth cohort of 1,265 children born in the Christchurch (New Zealand) urban region (limited generalizability) in mid-1977 and the educational outcomes were self reported. **Thus the existing evidence on the effects of child abuse on educational outcomes mostly depends on small sample with self-reported education data, which may imply limited generalizability and measurement errors on educational outcomes. Building on these studies, our analysis attempts to estimate the effects of child maltreatment on the likelihood of high school graduation by using a nationally representative study with high school dropout information is from official transcripts.**

## **II.C Determinants of educational attainment and child maltreatment**

Because we take child maltreatment to be endogenous when estimating its effect on high school graduation, in our study we consider factors that the literature indicates to influence the occurrence of child maltreatment.

A myriad of familial factors have been shown to be associated with child maltreatment. Brown et al. (1998) found that large family size, low family income, welfare dependence, low maternal education, single parent and maternal youth were significantly associated with greater risk of maltreatment. Research also found that low birth weight children and children with symptoms of attention-deficit/hyperactivity disorder (ADHD) are associated with greater risk of maltreatment (Creighton, 1985; Ouyang et al., 2008).

### **III. Empirical frameworks**

#### **III.A Discrete-choice models of child maltreatment and high school graduation**

We apply a behavioral decision model, which relates high school dropout to child maltreatment and family background characteristics, for an empirical analysis.

#### **Dropping out and child maltreatment as discrete choice**

We take high school graduation as a choice variable that a student chooses, influenced by its own characteristics as well as their family and school environment. In particular, we hypothesize that how parents or caregivers treat children—including CM—may influence both the student's objective function and opportunity set relevant to the schooling decisions. The evidence reviewed in the previous section suggests that CM may make the children pessimistic and discount future utilities more heavily, and that CM may also have a negative impact on children's ability and their determination to graduate from high school. Thus CM may influence the victim's ability (of learning and succeeding in school) as well as the victim's preference regarding finishing school.<sup>3</sup> In an extreme case, children may lose ability to graduate from high school. Let  $U^d$  and  $U^g$  be a child's utility upon dropping out and graduating from high school. The child chooses to drop out if

$$DR^* \equiv U^g - U^d = x_0' \beta + CM' \gamma + u_0 \geq 0, \quad (1)$$

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<sup>3</sup> Social workers and child psychologists may argue against treating graduation as children's choice because caregivers may force children to graduate or drop out of high school. The above framework allows for the case where caregivers reduce the opportunity set of children so that the feasible choice for children is reduced to graduation only or dropout only.

where  $x_0$  includes school, household and individual characteristics,  $CM$  refers to the experience of various types of CM, and  $u_0$  an error term. We only observe an indicator variable

$DR = 1_{DR^* > 0}$ . Similarly, the choice of CM by the caregiver is also characterized as a discrete choice. We consider three types of CM: (physical) neglect, physical abuse, and sexual abuse, indexed by 1, 2, and 3. The caregiver conducts type- $i$  maltreatment if the utility associated with maltreatment,  $V_i^M$ , exceeds that associated with no  $V_i^N$ :

$$\text{Neglect}^* \equiv V_1^M - V_1^N = x_1' \beta_1 + z' \delta_1 + u_1 \geq 0, \quad (2)$$

$$\text{Physicalabuse}^* \equiv V_2^M - V_2^N = x_2' \beta_2 + z' \delta_2 + u_2 \geq 0, \quad (3)$$

$$\text{Sexual abuse}^* \equiv V_3^M - V_3^N = x_3' \beta_3 + z' \delta_3 + u_3 \geq 0. \quad (4)$$

The variables  $x_j$  include household and individual characteristics that may also influence children's dropout decisions. The variables  $z$  consist of the factors associated with CM but not with children's dropout decisions.

The unobserved factors associated with each type of CM ( $u_1, u_2, u_3$ ) may be correlated with other types of CM. For example, parents' attitudes toward parenting that are unobserved may contribute to both neglect and physical abuse. In addition, these unobserved factors may be correlated with the unobserved factors associated with the child's high school graduation. For example, some parents who are strict and serious about children's development may resort to corporal punishment against children, which may escalate to (or perceived by children as) physical abuse. However, such strictness itself may encourage children's willingness for higher educational achievement. Therefore, a reduced-form estimate of the contribution of physical abuse on high school dropout will represent a mixture of these two possibly opposing effects.

The goal of this research is to obtain a consistent estimate of  $\gamma$ , i.e. the effect of various CM on high school graduation. With the possible correlations of unobservables in mind, we used the following methods to estimate  $\gamma$ .

### III.B Estimation methods

We apply the following methods to a data set on child maltreatment and high school graduation:

1. (Single-equation) probit model;
2. Multivariate probit model with and without instrumental variables;
3. Propensity score matching; and
4. Linear probability models

## 1. Probit model

The probit model is:

$$Prob[DR = 1 | X_0] = \Phi_0(x_0' \beta_0 + CM' \gamma, \sigma_2),$$

where  $\Phi_0$  is the cumulative distribution function of normal distribution with mean

$x_0' \beta_0 + CM' \gamma$  and variance  $\sigma_2$ . This probit model may generate an inconsistent estimate if CM and the error term are correlated. Section III.A discussed on some unobservable family or individual factors (e.g. parents' strictness or attitudes towards children's education) that may cause both CM and high school dropout.

## 2. Multivariate probit model

In order to address this endogeneity issue, we next use a maximum simulated likelihood approach for a multivariate probit model that estimates a recursive system of equations (1)-(4) for high school dropout, child maltreatment and family background explained in section 3.1.<sup>4</sup> We can characterize the discrete choices by the caregiver (equations 2-4), and subsequently by the child (equation 1), as a multivariate probit model.

$$Prob[DR, CM | X_0, X] = \Phi(x_0' \beta_0 + CM' \gamma, x_1 \beta_1 + z' \delta_1, x_2 \beta_2 + z' \delta_2, x_3 \beta_3 + z' \delta_3, \rho),$$

where  $\Phi$  is the cumulative distribution function of 4-dimensional normal distribution (with mean given by the first four arguments) and  $\rho$  the matrix of correlation of the error terms.

Correlation among the error terms of different CM types implies that the estimator of beta and delta are more efficient when estimated simultaneously. Correlation between the error term of the dropout equation and the CM equations implies that a reduced-form estimation of the dropout

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<sup>4</sup> We used the Stata command "mvprobit" that estimates multivariate probit models by the method of simulated maximum likelihood (SML, Cappellari and Jenkins 2003). The variance-covariance matrix of the cross-equation error terms has values of 1 on the leading diagonal, and the off-diagonal elements are correlations to be estimated ( $\rho_{ji} = \rho_{ij}$  and  $\rho_{ii} = 1$ , for all  $i, j = 1, \dots, M$ ). The command uses the Geweke-Hajivassiliou-Keane (GHK) simulator to evaluate the M-dimensional normal integrals in the likelihood function. For a brief description of the GHK smooth recursive simulator, see Greene (2003, 931-933), who also provides references to the literature.

equation alone will lead to inconsistent estimate of gamma. We will discuss later that these concerns apply to our context.

Under standard conditions, the simulated maximum likelihood estimator for the multivariate probit model (Cappellari and Jenkins 2003) is consistent as both the number of observations and the number of draws tend to infinity and is asymptotically equivalent to the true maximum likelihood estimator as the ratio of the square root of the sample size to the number of draws tends to zero.

Under all specifications, the standard errors are adjusted for school clusters.

### **3. Robustness check: propensity score matching, linear probability model, and alternative definitions of maltreatment**

As discussed in Section IV.D, multivariate probit model assumes a particular functional form of the structure and normality of the error terms. In order to test the robustness of the finding from multivariate probit estimations, we also apply propensity score matching and linear probability model specifications.

We also estimate the effects of CM on high school dropout by constructing CM variables based on alternative definitions of CM.

## **IV. Data**

### **IV.A Data used**

We used three data components of the National Longitudinal Study of Adolescent Health (Add Health) study: Wave I (1994 – 1995), Wave III (2001 – 2002), and the Adolescent Health and Academic Achievement (AHAA) study. The data describing family background characteristics from Wave I were matched with retrospective reports of child maltreatment during Wave III of the Add Health study and the high school exit statuses appearing on Wave III respondents' transcripts available in AHAA.



Unlike Child Protective Services report data that count only those reported CM cases and hence tends to underestimate the prevalence of CM, this data set is based on self report. The survey was designed to minimize the potential bias due to self report (and retrospective answers about CM experience) by employing computer-assisted self interview (CASI) formats (Hussey et al. 2006).

Because Add Health is a school-based survey, those adolescents who had dropped out of school were not interviewed. Those in grades 10-12 in Wave I have different drop-out probability from those in grades 7-9 because the adolescents who had dropped out of high school were excluded from the grades 10-12 respondents. In order to avoid this issue of sample selection, we restricted our sample to those children in grades 7 to 9 at Wave I. This sample restriction (and elimination of the subjects missing key explanatory variables explained below) left us with 5,009 survey participants who were in grades 7 through 9 during Wave I survey and re-interviewed in Wave III survey, and whose official high school transcripts were collected by the AHAA study.

#### *Child maltreatment measures*

The CM measures are based on the following questions in Wave III: “[t]he next set of questions is about your parents or other adults who took care of you before you were in the 6th grade. How often had each of the following things happened by the time you started 6th grade?”

1. “How often had your parents or other adult caregivers not taken care of your basic needs, such as keeping you clean or providing food or clothing?”;
2. “How often had your parents or other adult care-givers slapped, hit, or kicked you?”;
3. “How often had one of your parents or other adult care-givers touched you in a sexual way, forced you to touch him or her in a sexual way, or forced you to have sexual relations?”

These questions were asked in the multiple choice format: never happened, “once,” “twice,” “three to five times,” “six to ten times,” “more than ten times,” and “don’t know.” CASI format.

We defined three CM variables in the following way.

- Neglect = 1 if the answer to 1. is at least once, =0 otherwise;
- Physical abuse = 1 if the answer to 2. is at least three times, =0 otherwise;
- Sexual abuse = 1 if the answer to 3. is at least once, =0 otherwise.

A couple of remarks are in order. This is a retrospective self reporting of CM: adolescents at age 18 or higher would report their CM experience when they were in the fifth grade or earlier. With the above survey, we do not know who the perpetrator of the maltreatment was when the answer involved one or more incidence of maltreatment.

As stated in section I, many researchers argue that CM prevalence data based on CPS is a significant underestimate because many maltreatment incidences are not confirmed by child protective service agencies (Haugaard et al. 1997, Waldfogel 1998, Hussey et al. 2006). Waldfogel (1998) reports that “in 1993, two decades after the passage of reporting laws, over half of the children who died from abuse or neglect were not known to CPS until it was too late” (p.103). The percentage of child fatalities not known to CPS fell from 67 to 55% from the period from 1990 to 1993. Most existing evidence on the prevalence of CM comes from relatively small, cross-sectional samples. Add Health was designed to respond to the National Research Council Panel on Research on Child Abuse and Neglect, which called for including child maltreatment questions in future national surveys to improve the quality of evidence on CM (Hussey et al. 2006).

One criticism against CM data based on self reporting is that subjects with negative outcomes may be more likely to report CM by perhaps trying to blame their childhood experiences for their misfortune. If this were true, then the effects of CM on high school dropout would be over-estimated. Using a twins sample from Add Health data to study the effects of child abuse on adolescents’ criminal behavior, Currie and Tekin (2006) conducted a consistency check by examining the twins’ responses to a series of questions that should have been answered in the same way by both twins (e.g. whether or not the father was in jail at Wave I; how far the two twins lived away from each other; how often the twins saw, talk to, or fought with each other). They found few significant correlations between differences in the twins’ reports about maltreatment and differences in reports about these other variables. They conclude that these findings provide some evidence against the hypothesis that one twin is just “more negative” than the other.

Another concern about retrospective self reporting is that subjects may not remember the experience of CM. Currie and Tekin (2006) also checked whether older people in the sample were less likely to report CM than the younger ones in the sample and found no statistical difference between their responses.

Using a longitudinal survey of children where they were asked about CM experiences more than once at different time periods, Prescott et al. (2000) find that under-reporting is more likely than over-reporting when it comes to retrospective reporting of CM experience.<sup>5</sup> To the extent under-reporting also applies to Add Health survey, our result may be an underestimate of the effect of CM on educational attainment.

Section V.D lists the result using alternative definitions of CM where the cutoff points of the number of CM occurrences are more than once.

#### *Outcome variable*

The outcome variable in this study is a dummy variable representing high school dropout (=1 if dropped out, =0 otherwise). We constructed this variable using the official high school transcripts collected by the Adolescent Health and Academic Achievement (AHAA) study, an extension of the Add Health data. Following Heckman and LaFontaine's findings (2006, 2007), we count students who received General Educational Development (GED) certificates, but not high school diploma, as dropout.<sup>6</sup>

#### *Other explanatory variables*

As explanatory variables in dropout and CM equations, we use variables representing the adolescents' and their parents' characteristics as well as the school characteristics. We construct these variables using Adolescent In-Home Questionnaires, the Parent In-Home Questionnaire, and School Administrator Questionnaire. The adolescents' individual-specific variables include

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<sup>5</sup> "[I]ndividuals who recall four or more types of physical punishment experienced during childhood almost certainly were treated harshly by their parents. Conversely, however, many individuals known to have been treated harshly during childhood did not characterize themselves as having been so treated, a finding consistent with [a previous study]." (Prescott et al. 2000, p.420.)

<sup>6</sup> Cameron and Heckman (1993) and Heckman and LaFontaine (2006, 2008) show that although GED recipients have the same measured academic ability as high school graduates who do not attend college, they have the economic and social outcomes of otherwise similar dropouts without certification.

gender, region (East, West, Midwest, South), area (urban, suburban, rural), race, and grade cohort. In addition, we used two variables representing the presence of attention deficit hyperactive disorders (ADHD) in the adolescents—“hyperactivity” and “inattention,” and another variable representing the adolescents’ IQ at the time of Wave I (based on Add Health Peabody Picture Vocabulary test scores).<sup>7</sup> We also used the adolescents’ caregivers’ household income and education as control variables in both dropout and child maltreatment equations. (In Add Health, a caregiver refers to the person who lived with the adolescent and was in charge of taking care of the adolescent in the survey. In most cases, a caregiver is a biological mother.) Following previous studies’ approach (e.g. Currie and Tekin 2006), in order to maintain the sample size as large and representative as possible, we use a dummy variable for “missing category” for the variables for which at least one observation was missing due to any reason.

Our sample from the Add Health dataset does not have variables representing county or state level social and economic characteristics.<sup>8</sup> Chantala et al. (2004) estimated the bias remaining in the Wave III sample after estimates are adjusted with the final sampling weights on 67 variables from Wave I. They found the bias remaining to be over one percentage point on only the estimate of percent living with both biological parents at Wave I. That is, the Wave III sample adequately represents the same population as the Wave I sample when final sampling weights are used to compute population estimates—except that the percent living with both biological parents is higher in Wave III than in Wave I. This finding indicates that, when it comes to the family structure, attrition in Wave III may have been non-random: those without biological parents had a higher chance of non-response in Wave III. This sample attrition implies that the estimated effects of child maltreatment on high school dropout may be an underestimate.

#### **IV.B Identification**

Probit estimation assumes that the unobserved factors are independent of the covariates including CM. As discussed in section III.A, this assumption may be violated because parental strictness toward children (unobserved to the researchers) may influence both the occurrence of

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<sup>7</sup> To address the possibility that subjects with low IQ might have difficulty understanding the computer-assisted self interview (CASI) questions, interviewers were present and able to read the questions to the respondents if they requested assistance (personal communication with Joyce Tabor (2008), Add Health Data Manager).

<sup>8</sup> As for neighborhood, the findings by Solon et al. (2000) from the Panel Study of Income Dynamics suggest a limited role for neighborhood factors in accounting for inequality in educational attainment.

maltreatment and children's educational attainment. Given endogeneity of child maltreatment, a next alternative is a structural estimation of high school dropout decisions and child maltreatment decisions. We apply the multivariate probit model specification because both of these variables (high school dropout and three types of CM) are dichotomous.

As Wilde (2000) shows, no exclusion restriction applies to recursive multivariate probit models as long as variations in covariates exist. However, the validity of this exclusion restriction rests on the functional form specification of multivariate probit. In fact, many studies applying multivariate probit use instrumental variables (e.g. Maddala 1983, Jones et al. 2007, Balia and Jones 2008). We estimate the multivariate probit models with and without instrumental variables. Four instrument variables are used to predict child maltreatment: ADHD (inattention), whether father has been in jail, parental religion (conservative protestant), and whether living with both biological parents. We discuss the rationale for the use of these variables as instruments.

#### *Rationale for each instrumental variable*

##### Inattention

Though studies have found an association between hyperactivity and academic performance, little is known about the link between inattention and academic performance. We argue that inattention does not directly cause high school dropout, but is related to CM. Inattention may be a cause for lower grades, but dropout does not necessarily occur due to low grades.<sup>9</sup>

##### Father has been in jail

We hypothesize that the fact that father has been in jail would not have a direct effect on high school graduation, but may influence the household environment that in turn affects high school graduation. In our model, CM represents the household environment in which adolescents grow up. Therefore, we argue that father in jail is excluded from the dropout equation, but may be associated with the likelihood of CM.

##### Parental religion (conservative protestant)

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<sup>9</sup> According to a survey of 467 dropouts, 88% had passing grades, with 62% having "C's and above" (Bridgeland, et al. 2006, pp. 2-3).

Studies have found that conservative Protestants tend to support the use of corporal punishment to discipline children (Ellison and Sherkat 1993) and are indeed more likely than others to use corporal punishment (Ellison et al. 1996). We hypothesize that the caregivers' belief in conservative Protestantism does not influence adolescents' high school graduation directly. We use a dummy variable for the caregiver's belief in conservative protestant to instrument physical abuse.

Previous studies have found that parents' religiosity may influence the children's educational attainment (Dehejia et al. 2007). Therefore, we control for religiosity (i.e. the degree to which the caregivers practice their religions, as opposed to their particular religious affiliations with conservative Protestantism) in the dropout equation. We use a dummy variable based on the question "how often do you go to church?".

#### Family structure

We use a variable representing the family structure of the children: whether a child lived with two biological parents. Astone and McLanahan (1991) found students in one-parent households are less likely to graduate high school than those in two-parent households are. Taking into account the potential unobservable factors influencing both family structure and children's educational attainment, Manski et al. (1992) find that living in an intact family increases the probability that a child will graduate from high school.

Are these four instrumental variables properly excluded from the high school dropout equation? Probit estimations of dropout using our sample indicate that they are. Without controlling for welfare receipt, income levels and child maltreatment, we find that high school dropout is significantly associated with family structure: the probit estimates of the coefficients of family structure are negative. However, once these omitted characteristics are controlled for, family structure becomes insignificant (Table A). Whether or not these characteristics are controlled for, the other three instruments (inattention, father-in-jail, and conservative religion) are not associated with high school dropout. Therefore, we hypothesize that living with biological parents, father-in-jail, and inattention would not have a direct effect on high school graduation but may affect it indirectly through the household environment for adolescents.

See section V.C for tests of statistical validity of these four instrumental variables.

## **V. Results**

### **V.A Summary statistics**

Table 1 lists the summary statistics of the variables used in the analysis. The list includes the variables of family and children's characteristics as well as the characteristics of the high schools attended by the children.

[Table 1]

[Figure 1]

In the sample of 5,009 adolescents, about 23.5% of the subjects reported at least one incidence of CM (see Table 1 and Figure 1). The most prevalent is physical abuse (13.5%), followed by physical neglect (12%) and sexual abuse (4.6%). These prevalence levels are consistent with other surveys of CM based on self reporting (Hussey et al. 2006).

As Figure 1 indicates, many subjects who reported CM experiences report multiple types of CM. In particular, more than 80% of sexual abuse reports (183 out of 228) are associated with reporting of other types of maltreatment. As discussed later, co-occurrence of maltreatment implies that analyzing the effects of CM by looking at each CM type in isolation may lead to misleading conclusions.

About 12 % of the subjects dropped out of high school, a number close to the national high school status completion rates according to the National Center for Education Statistics (NCES, Laird et al. 2008).<sup>10</sup>

The means of the other variables of children's and parents' characteristics are largely similar to the national average, [

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<sup>10</sup> Unlike the completion rate used in Laird et al. (2008), the sample mean dropout rate 12% treats those who did not graduate but received General Educational Development (GED) certificates as dropouts following Heckman and LaFontaine (2007). However, the number of GED recipients is quite small in the sample.

## V.B Probit and multivariate probit estimates

The probit and multivariate probit estimates do imply that different types of maltreatment may have different impacts on the victims' educational attainment. With the probit model, among the three CM measures, physical neglect is significantly associated with high school dropout while physical and sexual abuses are not (Table 2). Other variables that are significantly associated with dropout include the school type (dropout is less likely in private schools), male (having higher dropout probability), subjects' IQ and hyperactivity, the caregiver's education, and the caregivers' income.

[Table 2 (on mvprobit without IV)]

[Table 3 (on mvprobit with IV)]

With multivariate probit model where no exclusion restrictions are imposed, physical neglect becomes weakly significant (Table 3). Neglect remains to be significant while sexual abuse remains to be insignificant.

If the error terms of the dropout equation and the other CM equations are correlated, then the probit approach gives inconsistent estimates of the parameters (Maddala 1983). The tests for the null hypotheses of no correlation between the error terms of the dropout equation and the other CM equations ( $H_0: \rho_{jl}=0, j=2$  (neglect), 3 (physical abuse), 4 (sexual abuse)) indicate that the error for the physical abuse equation is negatively associated with the error for the dropout equation (i.e.  $H_0: \rho_{31}=0$  is rejected). This finding suggests that physical abuse is endogenous, and hence the probit estimate is inconsistent.<sup>11</sup> The error terms of the CM equations are also significantly related with each other. Hence, there are efficiency gains from simultaneous estimations of the three types of CM.

The results of the multivariate probit estimates are similar whether or not we use instrumental variables (Table 3 and Table 4) except that both physical neglect and physical abuse are more

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<sup>11</sup> Knapp and Seaks (1998) argue that a likelihood-ratio test of the correlation coefficient of the residuals can be used as an endogeneity test, instead of a Hausman test, for bivariate probit models.



strongly associated with dropout when the instruments are used (Table 4). Section V.C discusses the statistical validity of the instrumental variables.

### **Propensity score matching**

Consistent with the estimates based on the previous two models, neglect and physical abuse are significantly associated with dropout while sexual abuse is not.

### **Effects of different types of maltreatment**

As for physical abuse, the multivariate probit estimates are significant while the single-equation probit estimates are not. We can interpret this result in terms of unobserved parental characteristics. Though some parents may abuse their children physically out of hostility or lack of caring, others may conduct corporal punishment, out of goodwill, in order to discipline their children and encourage to do well in school. The effect of such different parental characteristics is considered in multivariate probit models, but not in simple probit models. The negative sign of the estimated correlation between the error terms for the dropout equation and the physical abuse equation implies that an unobserved factor that tends to increase physical abuse is negatively associated with dropout. This result is consistent with the conjecture that parents' enthusiasm that leads some of them to discipline children may work to reduce high school dropout even though the pure effect of physical abuse on high school graduation is negative.

### **Average partial effects of maltreatment**

Table X lists the average partial effects of CM and other variables on high school dropout under probit, multivariate probit, and linear probability model specifications. In order to compute the average partial effects based on multivariate probit estimates, we applied the methods developed by Jones et al. (2007) and Balia and Jones (2008) where the effects are evaluated at the sample mean. Our preferred estimates, based on the above discussions about alternative model specifications, are based on the multivariate probit model with instrumental variables. With this specification, experiencing physical neglect (physical abuse) increases the probability of high school dropout by 6.3%, (5.6%) for an average adolescent. These are relatively large in magnitude compared to the average partial effects of other variables. Being in a private school increases the probability of high school graduation by 6.5%. Compared to a children with a

caregiver who did not graduate from high school, a children with a caregiver with a high school diploma (a college degree) has a 5.2% (8.2%) higher probability of high school graduation.

Why is it plausible that CM has large effects on high school dropout? As reviewed in Section II, CM is likely to cause antisocial behavior, which in turn leads to delinquency and negative sentiments against schools and teachers, a frequent cause of high school dropout.

Role of IQ: High IQ may cause parents to have increased expectations, and that may lead to corporal punishment.

Welfare and poverty: note that receiving welfare is a choice. Controlling for poverty, whether low-income households receive welfare or not may depend on parents' preferences toward independence.

Why is physical abuse significant under MV probit but not under LPM? Note that full-information maximum likelihood leads to gains in efficiency. That may be why MV probit estimate is more significant than the estimates with other model specifications. (Cf. Read Greene's paper on bivariate probit vs two-stage estimation in the context of feminist economics course offering.)

LPM treats endogenous variables (phy abuse in particular) as continuous variables. So standard errors tend to be high though the point estimate of phy abuse turns out to be large as well. (in fact comparable in magnitude to MVProbit estimates!!)

Note about how to interpret "mom is immigrant": controlling for income and ethnicity, a child with an immigrant mother has a lower probability of dropping out of high school. Perhaps parents try hard to make sure their children graduate from high school?

Here is a list of other findings.

- Family poverty (especially family income) seems more related to dropout than child maltreatment.

- Living with two biological parents is more related to child maltreatment than dropout—a finding consistent with, for example, Case et al. (2001) on nonbiological mothers' low investments in child education.
- Caregiver's education is more related to dropout than CM (except for neglect). Caregiver's education is negatively associated with neglect.
- IQ's association with CM in CM equations: positive with physical abuse, negative with neglect and sexual abuse.
- ADHD: While hyperactivity is associated with dropout, it is inattention that is associated with child maltreatment.

A number of papers have examined the factors behind different prevalence of CM across US states. Using state-level panel data, Paxson and Waldfogel (2002) find that increases in the fraction of children with absent fathers and working mothers in a state is associated with increases in reported incidence of CM. Our finding of significance association between family structure and CM, based on individual-level panel data, is consistent with the above finding by Paxson and Waldfogel.

### **V.C Statistical validity of instruments**

The validity of the instruments depends on two conditions: whether the instrumental variables are sufficiently correlated with child maltreatment, and whether the instrumental variables are legitimately excludable from the dropout equation (1). Section IV.B discussed the rationale for our choice of instrument variables and presented a probit result indicating that they are not associated with dropout once household income and CM are controlled for. Here we present additional statistical tests. We first assess the strength of the correlation between the instruments and different types of child maltreatment. We test whether these instruments were significant predictors of child maltreatment and found that for each form of child maltreatment (neglect, physical abuse and sexual abuse) they are jointly significant at the 0.001 level. To investigate the validity of exclusion restrictions, we estimate both an unrestricted multivariate probit model with all of the instruments included in the dropout equation and a restricted multivariate probit model excluding all of the instruments in the dropout equation. We then use a likelihood ratio test to test the null hypothesis that the coefficients of the four instruments are jointly equal to zero. The

test generates a chi-square value of 3.1 for 4 degrees of freedom, which was insignificant (p value = 0.54). The results supported the validity of exclusion restrictions.

## V.D Other specifications

-Findings are robust against different definitions of child maltreatment.

## V.E Estimate of the effect of CM on productivity loss

- Assume APE = 6%, work an average of 45 years, 1 out of 8 children are CM victims annually, 3% annual discount rate
- Preventing one case of CM may prevent future loss of productivity (\$10,000 per year)
  - Discounted value: \$ 15,153
- Lifetime productivity loss of CM (say in 2008, given US population by age)
  - Discounted value: \$ 115.6 billion (about 0.8% of GDP)

We came up with this number based on the following analysis.

| disc factor = 3% |                     |                      |                          |  |   |               |
|------------------|---------------------|----------------------|--------------------------|--|---|---------------|
|                  | Total<br>Population | CM victim,<br>1 in 8 | years to<br>become<br>18 | discount factor<br>for years to<br>become 18 | PV of<br>productivity<br>loss per<br>person | total         |
| 0                | 4317910             | 539,739              | 18                       | 0.587  | 8,901                                       | 4,804,101,533 |
| 1                | 4275882             | 534,485              | 17                       | 0.605  | 9,168                                       | 4,900,061,467 |
| 2                | 4234239             | 529,280              | 16                       | 0.623  | 9,443                                       | 4,997,909,743 |
| 3                | 4138697             | 517,337              | 15                       | 0.642  | 9,726                                       | 5,031,690,247 |
| 4                | 4114891             | 514,361              | 14                       | 0.661  | 10,018                                      | 5,152,830,135 |
| 5                | 4101952             | 512,744              | 13                       | 0.681  | 10,318                                      | 5,290,726,226 |
| 6                | 4058852             | 507,357              | 12                       | 0.701  | 10,628                                      | 5,392,189,613 |
| 7                | 4095104             | 511,888              | 11                       | 0.722  | 10,947                                      | 5,603,560,950 |
| 8                | 4035108             | 504,389              | 10                       | 0.744  | 11,275                                      | 5,687,109,003 |
| 9                | 3891733             | 486,467              | 9                        | 0.766  | 11,614                                      | 5,649,586,350 |
| 10               | 3948192             | 493,524              | 8                        | 0.789  | 11,962                                      | 5,903,493,682 |
| 11               | 3913493             | 489,187              | 7                        | 0.813  | 12,321                                      | 6,027,158,668 |
| 12               | 3982405             | 497,801              | 6                        | 0.837  | 12,690                                      | 6,317,288,525 |
| 13               | 4080879             | 510,110              | 5                        | 0.863  | 13,071                                      | 6,667,702,752 |
| 14               | 4106862             | 513,358              | 4                        | 0.888  | 13,463                                      | 6,911,460,769 |
| 15               | 4178963             | 522,370              | 3                        | 0.915  | 13,867                                      | 7,243,783,939 |
| 16               | 4283696             | 535,462              | 2                        | 0.943  | 14,283                                      | 7,648,087,177 |
| 17               | 4316578             | 539,572              | 1                        | 0.971  | 14,712                                      | 7,937,998,354 |
| 18               | 4439447             | 554,931              | 0                        | 1.000  | 15,153                                      | 8,408,867,549 |
|                  | 78514883            | 9,814,360            |                          |  |   | 1.15576E+11   |
|                  |                     |                      |                          |  | in billion USD                              | 115.5756067   |

US GDP 2008

\$14,200.3 billion

Population data source: US Census Bureau National Population Estimates for the 2000s, Monthly Postcensal Resident Population, by single year of age, sex, race, and Hispanic origin. I just assumed that one in eight children is a CM victim in each age and the effect is the same for cm at all age (not sure if these are good assumptions...).

## **VI. Discussion**

We find that child maltreatment does result in a lower probability of high school graduation, and the effect differs among different types of maltreatment. In particular, neglect has a significantly negative impact on high school graduation: experiencing neglect increases the probability of high school dropout by 7 percent.

### **Points to make 1: why neglect being significant is plausible (why this evidence is compelling)**

Neglect and education of caregiver: refer to the JEP study:

The strong association between high school dropout and neglect Using the American Time Use Surveys, Guryan et al. (2008) find that higher-educated parents spend more time with their children despite larger amounts of time working outside and higher opportunity costs of time.

### **Points to make 2: why physical abuse is not significant in probit and it is in MVprobit—address endogeneity**

### **Points to make 3: why sexual abuse is not significant.**

Our finding of no statistical association between high school graduation and physical and sexual abuse is consistent with some previous studies on reduced-form associations between CM and educational attainment (e.g. Boden et al. 2007).

There are several factors that imply that we may underestimate the effects of child maltreatment on high school graduation.

#### **1. Sample attrition at Wave I, and from Wave I to Wave III**

Those children who died or ran away due to maltreatment are not in the survey or may have dropped out of the sample after Wave I. In particular, as discussed in Section IV, children living without a biological parent are more likely to have dropped out from the Wave III sample than those with biological parents.

#### **2. Definition of child maltreatment in the survey**

Note that the maltreatment measures in Add Health refer to abuses for children before the sixth grade. Studies have found that xxx (Haugaard et al. 1997?) In particular, sexual abuse after the sixth grade is likely to have a larger impact on the adolescents' development than sexual abuse before the sixth grade.

### 3. Retrospective reporting of maltreatment

At the time of Wave III when the subjects were 18 years old or older, they may not be able to recall child maltreatment when they were very small (ages between 0 and 5). However, studies have found that maltreatment of infants and toddlers may have a strong negative impact later on).

The finding that physical neglect is associated with a higher probability of high school dropout, while sexual abuse is not, may be counterintuitive given media attention to sexual abuse and public belief that sexual abuse may be the most traumatic of all types of maltreatment. Two remarks are in order regarding the interpretation of our finding about sexual abuse. First, child maltreatment in the survey is defined to have taken place by the time the subjects reached the sixth grade. Sexual abuse that occurs later in adolescents' lives is likely to have more severe consequences. Second, our finding regarding neglect is consistent with some of the studies in child psychology. In fact, there is conflicting evidence in child psychology literature regarding which type of maltreatment produces the most severe outcomes (Haugaard et al. 1997). A group of studies, including those by Smith and Fong (2004), find that neglect appears to cause the most serious negative consequences among others. According to Haugaard et al. 1997, at least one study suggests that sexually abused children exhibit higher rates of self-injurious and suicidal behavior than physically abused or neglected children. On the other hand, several studies have found that of all victim types, sexually abused children are actually most likely to report healthy levels of social competence and the absence of problematic consequences or symptoms altogether. In fact, after reviewing the proposition of literature devoted to research and treatment focusing on physical abuse, sexual abuse, and neglect, respectively, Haugaard et al. (1997) conclude that because "physical abuse and neglect can be just as damaging, if not more damaging, than sexual abuse, it is unclear why there is such little emphasis on therapy with physically abused and neglected children" (p.89). Smith and Fong (2004) raise a similar question about neglected children, arguing that the consequences of neglect are at least as serious as the consequences of physical and sexual abuse.

Our finding is somewhat inconsistent with some previous studies that find sexual abuse as the most serious cause for negative outcomes. For example, Currie and Tekin (2006) estimate the effects of experiencing maltreatment on adolescents' criminal behavior using the Add Health data and find that "[s]exual abuse appears to have the largest negative effects [compared to neglect and physical abuse], perhaps justifying the emphasis on this type of abuse in the literature." Hussey et al. (2006), also using the Add Health data, find that the associations between childhood sexual abuse and adolescent health risks were particularly strong compared to those between other maltreatment and the health risks. Most of these studies tend to analyze each CM type in isolation and find that sexual abuse is more strongly associated with negative outcomes than other abuse types are. We argue that this approach may not allow us a legitimate comparison of CM types. As in Figure 1, most sexual abuse reports are accompanied by the reporting of other CM types: less than 20% of sexual abuse (or 45 out of 228 observations reporting sexual abuse) is reported without any other CM. This implies that looking at the association between sexual abuse and outcome in isolation, without controlling for other maltreatment types, would not reveal the pure effect of sexual abuse.

Physical abuse may occur as an escalated form of corporal punishment or physical disciplining of children, which parents may conduct to encourage children to do better in school. As a result, the net effect of physical abuse on children's educational attainment is not clear. Our probit and multivariate probit estimation results are consistent with this conjecture. While the probit estimate suggests a weak association between physical abuse and high school graduation, the multivariate probit estimates, which allow unobserved caregivers' strictness to be correlated with both high school dropout and child maltreatment, suggest a stronger effect of physical abuse on high school dropout. This result is consistent with the conjecture that parents' enthusiasm that leads some of them to discipline children may work to reduce high school dropout even though the pure effect of physical abuse on high school graduation is negative.

Our policy implications echo the following statement about the relation between parental behavior and child health:

“[W]hile health insurance coverage and advances in medical treatment may be important determinants of children’s health, they cannot be the only pillars: Protecting children’s health also calls for a broader set of policies that target parents’ health-related behavior.” (Case and Paxson 2002, p.164.)

Our finding provides a statistical support regarding the potential long-term effects of child maltreatment on children’s human capital accumulation in terms of educational attainment. The relationship between CM and educational attainment reveals another level of cost-effectiveness of CM prevention.



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Table 1 Summary statistics. (N = 5,009)

| Variable name                       | Variable definition  | From     | Mean   | S.D.  |
|-------------------------------------|--|----------|--------|-------|
| Dropout                             | 1 if drops out of high school or gets GED, 0 if gets high school diploma | AHAA     | 0.121  | 0.326 |
| <u>Child maltreatment</u>           |  |          |        |       |
| Neglect                             | 1 if had been neglected before starting 6th grade, 0 otherwise           | Wave III | 0.120  | 0.325 |
| Phyabuse                            | 1 if had been physically abused before starting 6th grade, 0 otherwise   | Wave III | 0.135  | 0.342 |
| Sexabuse                            | 1 if had benn sexually abused before starting 6th grade, 0 otherwise     | Wave III | 0.046  | 0.208 |
| <u>Race/Ethnicity</u>               |  |          |        |       |
| Hispanic                            |  | Wave I   | 0.120  | 0.325 |
| Non-Hispanic white                  |  | Wave I   | 0.618  | 0.486 |
| Non-Hispanic black                  |  | Wave I   | 0.211  | 0.408 |
| Non-Hispanic asian                  |  | Wave I   | 0.036  | 0.187 |
| Non-Hispanic native                 |  | Wave I   | 0.008  | 0.088 |
| Non-Hispanic other                  |  | Wave I   | 0.007  | 0.082 |
| <u>Region</u>                       |  |          |        |       |
| Rural                               |  | AHAA     | 0.191  | 0.393 |
| Suburban                            |  | AHAA     | 0.477  | 0.499 |
| Urban                               |  | AHAA     | 0.332  | 0.471 |
| West                                |  | Wave I   | 0.188  | 0.391 |
| Midwest                             |  | Wave I   | 0.267  | 0.443 |
| South                               |  | Wave I   | 0.407  | 0.491 |
| Northeast                           |  | Wave I   | 0.137  | 0.344 |
| <u>School/Grades</u>                |  |          |        |       |
| Private                             |  | AHAA     | 0.066  | 0.248 |
| Grade 7                             |  | Wave I   | 0.320  | 0.466 |
| Grade 8                             |  | Wave I   | 0.289  | 0.453 |
| Grade 9                             |  | Wave I   | 0.391  | 0.488 |
| <u>Individual characteristics</u>   |  |          |        |       |
| Male                                |  | Wave I   | 0.449  | 0.497 |
| IQ                                  |  | Wave I   | 101.0  | 14.5  |
| Hyperactivity                       |  | Wave I   | 0.056  | 0.230 |
| Inattention                         |  | Wave I   | 0.051  | 0.219 |
| Low birthweight                     |  | Wave I   | 0.086  | 0.280 |
| Low birthweight missing             |  | Wave I   | 0.099  | 0.299 |
| <u>Parental education</u>           |  |          |        |       |
| <High school                        |  | Wave I   | 0.141  | 0.348 |
| High school                         |  | Wave I   | 0.309  | 0.462 |
| Some college                        |  | Wave I   | 0.292  | 0.455 |
| College or more                     |  | Wave I   | 0.258  | 0.438 |
| <u>Parental religion</u>            |  |          |        |       |
| Conservative religion               |  | Wave I   | 0.056  | 0.230 |
| Religiosity                         |  | Wave I   | -0.023 | 0.855 |
| <u>Family Wealth</u>                |  |          |        |       |
| Welfare receipt                     |  | Wave I   | 0.218  | 0.413 |
| Income>4*poverty line               |  | Wave I   | 0.213  | 0.410 |
| Income<4*poverty line               |  | Wave I   | 0.443  | 0.497 |
| Income<2*poverty line               |  | Wave I   | 0.195  | 0.396 |
| Income<poverty line                 |  | Wave I   | 0.149  | 0.356 |
| <u>Family Structure</u>             |  |          |        |       |
| Two biological parents              |  | Wave I   | 0.509  | 0.500 |
| Two non-biological parents          |  | Wave I   | 0.217  | 0.412 |
| Single parent or other              |  | Wave I   | 0.274  | 0.446 |
| <u>Other family characteristics</u> |  |          |        |       |
| Teenage mom                         |  | Wave I   | 0.078  | 0.269 |
| Teenage mom missing                 |  | Wave I   | 0.172  | 0.378 |
| Mom non-immigrant                   |  | Wave I   | 0.884  | 0.320 |
| Jailed father                       |  | Wave I   | 0.143  | 0.350 |
| Jailed father missing               |  | Wave I   | 0.063  | 0.242 |
| # of children                       |  | Wave I   | 2.51   | 1.19  |



**Table 2: Reduced-form probit model. (N=5009)**

Dependent variable: high school dropout

| Variable                     | Coeff. | S.E.     |
|------------------------------|--------|----------|
| Child maltreatment           |        |          |
| Neglect                      | 0.282  | 0.073 ** |
| Phyabuse                     | 0.026  | 0.085    |
| Sexabuse                     | -0.054 | 0.114    |
| Race/Ethnicity               |        |          |
| Hispanic                     | 0.184  | 0.093 *  |
| Non-Hispanic black           | 0.057  | 0.106    |
| Non-Hispanic asian           | -0.106 | 0.179    |
| Non-Hispanic native          | 0.455  | 0.264 +  |
| Non-Hispanic other           | 0.461  | 0.251 +  |
| Region                       |        |          |
| Suburban                     | -0.039 | 0.158    |
| Urban                        | 0.086  | 0.155    |
| Midwest                      | 0.079  | 0.136    |
| South                        | 0.022  | 0.126    |
| Northeast                    | -0.197 | 0.163    |
| School/Grades                |        |          |
| Private                      | -0.450 | 0.148 ** |
| Grade 8                      | -0.056 | 0.065    |
| Grade 9                      | -0.006 | 0.066    |
| Individual characteristics   |        |          |
| Male                         | 0.184  | 0.046 ** |
| IQ                           | -0.011 | 0.002 ** |
| Hyperactivity                | 0.234  | 0.101 *  |
| Inattention                  | 0.119  | 0.136    |
| Low birthweight              | -0.112 | 0.092    |
| Low birthweight missing      | 0.115  | 0.091    |
| Parental education           |        |          |
| High school                  | -0.302 | 0.068 ** |
| Some college                 | -0.351 | 0.076 ** |
| College or more              | -0.538 | 0.082 ** |
| Parental religion            |        |          |
| Conservative religion        | 0.048  | 0.109    |
| Religiosity                  | -0.080 | 0.028 ** |
| Family Wealth                |        |          |
| Welfare receipt              | 0.154  | 0.061 *  |
| Income<4*poverty line        | 0.171  | 0.074 *  |
| Income<2*poverty line        | 0.234  | 0.088 ** |
| Income<poverty line          | 0.362  | 0.090 ** |
| Family Structure             |        |          |
| Two non-biological parents   | 0.098  | 0.070    |
| Single parent or other       | 0.066  | 0.069    |
| Other family characteristics |        |          |
| Teenage mom                  | 0.041  | 0.081    |
| Teenage mom missing          | 0.148  | 0.081 *  |
| Mom non-immigrant            | 0.323  | 0.113 ** |
| Jailed father                | 0.022  | 0.070    |
| Jailed father missing        | 0.117  | 0.100    |
| # of children                | -0.097 | 0.055 +  |
| Constant                     | -0.491 | 0.291 +  |

Significance levels: \*\*: 1%, \*: 5%, †: 10%. Standard errors are adjusted for school clusters.

**Table 3 Multivariate probit model without instrumental variables (Wilde's approach).**  
(N=5,009)

| Variable                     | Eq.1 Dropout |          | Eq.2 Neglect |          | Eq.3 Physical abuse |          | Eq.4 Sexual abuse |          |
|------------------------------|--------------|----------|--------------|----------|---------------------|----------|-------------------|----------|
|                              | Coeff.       | S.E.     | Coeff.       | S.E.     | Coeff.              | S.E.     | Coeff.            | S.E.     |
| Child maltreatment           |              |          |              |          |                     |          |                   |          |
| Neglect                      | 0.313        | 0.123 *  |              |          |                     |          |                   |          |
| Phyabuse                     | 0.282        | 0.153 +  |              |          |                     |          |                   |          |
| Sexabuse                     | 0.018        | 0.191    |              |          |                     |          |                   |          |
| Race/Ethnicity               |              |          |              |          |                     |          |                   |          |
| Hispanic                     | 0.168        | 0.094 +  | 0.181        | 0.105 +  | 0.201               | 0.078 *  | 0.146             | 0.124    |
| Non-Hispanic black           | 0.054        | 0.107    | 0.123        | 0.076    | 0.032               | 0.070    | -0.009            | 0.083    |
| Non-Hispanic asian           | -0.124       | 0.176    | 0.209        | 0.144    | 0.325               | 0.111 *  | -0.016            | 0.167    |
| Non-Hispanic native          | 0.470        | 0.261 +  | -0.028       | 0.353    | -0.448              | 0.203 *  | 0.136             | 0.254    |
| Non-Hispanic other           | 0.432        | 0.248 +  | 0.510        | 0.253 *  | 0.377               | 0.213 +  | 0.322             | 0.334    |
| Region                       |              |          |              |          |                     |          |                   |          |
| Suburban                     | -0.036       | 0.159    | -0.193       | 0.075 *  | 0.024               | 0.080    | -0.155            | 0.084 +  |
| Urban                        | 0.086        | 0.156    | -0.194       | 0.098 *  | 0.072               | 0.084    | -0.145            | 0.098    |
| Midwest                      | 0.082        | 0.137    | 0.022        | 0.087    | -0.015              | 0.080    | -0.186            | 0.101 +  |
| South                        | 0.033        | 0.126    | -0.092       | 0.077    | -0.208              | 0.079 ** | -0.097            | 0.091    |
| Northeast                    | -0.205       | 0.162    | 0.018        | 0.106    | 0.132               | 0.084    | -0.089            | 0.101    |
| School/Grades                |              |          |              |          |                     |          |                   |          |
| Private                      | -0.449       | 0.148 ** |              |          |                     |          |                   |          |
| Grade 8                      | -0.057       | 0.065    | 0.030        | 0.055    | 0.040               | 0.057    | -0.051            | 0.084    |
| Grade 9                      | -0.007       | 0.066    | -0.145       | 0.054 ** | 0.058               | 0.059    | -0.083            | 0.072    |
| Individual characteristics   |              |          |              |          |                     |          |                   |          |
| Male                         | 0.181        | 0.047 ** | 0.280        | 0.049 ** | 0.029               | 0.048    | -0.065            | 0.067    |
| IQ                           | -0.012       | 0.002 ** | -0.010       | 0.002 ** | 0.008               | 0.002 ** | -0.006            | 0.003 *  |
| Hyperactivity                | 0.227        | 0.101 *  | 0.219        | 0.102 *  | 0.090               | 0.101    | 0.170             | 0.144    |
| Inattention                  | 0.104        | 0.138    | 0.271        | 0.114 *  | 0.143               | 0.118    | 0.332             | 0.132 *  |
| Low birthweight              | -0.115       | 0.090    | -0.016       | 0.074    | 0.045               | 0.093    | 0.185             | 0.092 *  |
| Low birthweight missing      | 0.116        | 0.091    | 0.244        | 0.098 *  | -0.094              | 0.101    | 0.063             | 0.138    |
| Parental education           |              |          |              |          |                     |          |                   |          |
| High school                  | -0.301       | 0.068 ** | -0.062       | 0.069    | 0.013               | 0.073    | -0.008            | 0.087    |
| Some college                 | -0.352       | 0.075 ** | -0.024       | 0.079    | 0.018               | 0.077    | 0.073             | 0.092    |
| College or more              | -0.535       | 0.081 ** | -0.227       | 0.092 *  | -0.048              | 0.089    | 0.104             | 0.116    |
| Parental religion            |              |          |              |          |                     |          |                   |          |
| Conservative religion        | 0.027        | 0.111    | -0.055       | 0.118    | 0.288               | 0.092 ** | 0.297             | 0.120 *  |
| Religiosity                  | -0.077       | 0.029 ** | -0.030       | 0.030    | -0.057              | 0.030 +  | -0.035            | 0.040    |
| Family Wealth                |              |          |              |          |                     |          |                   |          |
| Welfare receipt              | 0.144        | 0.061 *  | 0.159        | 0.057 ** | 0.120               | 0.063 +  | 0.080             | 0.084    |
| Income<4*poverty line        | 0.167        | 0.074 *  | -0.032       | 0.069    | 0.116               | 0.058 *  | 0.076             | 0.103    |
| Income<2*poverty line        | 0.227        | 0.088 ** | 0.073        | 0.078    | 0.130               | 0.072 +  | 0.204             | 0.104 +  |
| Income<poverty line          | 0.354        | 0.089 ** | 0.007        | 0.105    | 0.105               | 0.087    | 0.176             | 0.142    |
| Family Structure             |              |          |              |          |                     |          |                   |          |
| Two non-biological parent    | 0.058        | 0.068    | 0.180        | 0.067 ** | 0.122               | 0.065 +  | 0.227             | 0.100 *  |
| Single parent or other       | 0.086        | 0.070    | 0.221        | 0.064 ** | 0.175               | 0.064 ** | 0.293             | 0.087 ** |
| Other family characteristics |              |          |              |          |                     |          |                   |          |
| Teenage mom                  | 0.037        | 0.081    | 0.068        | 0.081    | 0.063               | 0.079    | -0.086            | 0.097    |
| Teenage mom missing          | 0.145        | 0.080 *  | -0.098       | 0.086    | 0.103               | 0.085    | -0.132            | 0.112    |
| Mom non-immigrant            | 0.326        | 0.113 ** | 0.136        | 0.095    | -0.099              | 0.079    | 0.170             | 0.149    |
| Jailed father                | -0.005       | 0.074    | 0.189        | 0.067 ** | 0.356               | 0.058 ** | 0.307             | 0.077 ** |
| Jailed father missing        | 0.110        | 0.099    | -0.013       | 0.100    | 0.109               | 0.091    | -0.089            | 0.122    |
| # of children                | -0.106       | 0.054 +  | 0.034        | 0.050    | 0.153               | 0.050 ** | 0.102             | 0.069    |
| Constant                     | -0.470       | 0.285 +  | -0.411       | 0.279    | -2.382              | 0.255 ** | -1.464            | 0.336 ** |
|                              |              |          | rho21        | S.E.     |                     |          | rho41             | S.E.     |
|                              |              |          | -0.035       | 0.064    |                     |          | -0.064            | 0.080    |
|                              |              |          |              |          | rho31               | S.E.     |                   |          |
|                              |              |          |              |          | -0.141              | 0.062 *  |                   |          |
|                              |              |          |              |          | rho32               |          | rho42             |          |
|                              |              |          |              |          | 0.174               | 0.033 ** | 0.587             | 0.033 ** |
|                              |              |          |              |          |                     |          | rho43             |          |
|                              |              |          |              |          |                     |          | 0.354             | 0.042 ** |

(# draws = 5)

Significance levels: \*\*: 1%, \*: 5%, †: 10%. Standard errors are adjusted for school clusters.

**Table 4 Multivariate probit model with instrumental variables (Maddala's approach).**  
(N=5,009)

| Variable                     | Eq.1 Dropout |          | Eq.2 Neglect |          | Eq.3 Physical abuse |          | Eq.4 Sexual abuse |          |
|------------------------------|--------------|----------|--------------|----------|---------------------|----------|-------------------|----------|
|                              | Coeff.       | S.E.     | Coeff.       | S.E.     | Coeff.              | S.E.     | Coeff.            | S.E.     |
| Child maltreatment           |              |          |              |          |                     |          |                   |          |
| Neglect                      | 0.338        | 0.126 ** |              |          |                     |          |                   |          |
| Phyabuse                     | 0.307        | 0.144 *  |              |          |                     |          |                   |          |
| Sexabuse                     | 0.051        | 0.190    |              |          |                     |          |                   |          |
| Race/Ethnicity               |              |          |              |          |                     |          |                   |          |
| Hispanic                     | 0.169        | 0.094 +  | 0.182        | 0.105 +  | 0.201               | 0.078 *  | 0.147             | 0.124    |
| Non-Hispanic black           | 0.065        | 0.104    | 0.122        | 0.076    | 0.031               | 0.069    | -0.010            | 0.083    |
| Non-Hispanic asian           | -0.128       | 0.178    | 0.210        | 0.144    | 0.325               | 0.111 ** | -0.016            | 0.168    |
| Non-Hispanic native          | 0.454        | 0.257 +  | -0.026       | 0.352    | -0.446              | 0.203 *  | 0.140             | 0.252    |
| Non-Hispanic other           | 0.436        | 0.248 +  | 0.509        | 0.253 *  | 0.376               | 0.212 +  | 0.321             | 0.335    |
| Region                       |              |          |              |          |                     |          |                   |          |
| Suburban                     | -0.030       | 0.159    | -0.194       | 0.075 *  | 0.024               | 0.080    | -0.156            | 0.084 +  |
| Urban                        | 0.094        | 0.158    | -0.195       | 0.099 *  | 0.072               | 0.084    | -0.146            | 0.098    |
| Midwest                      | 0.083        | 0.136    | 0.022        | 0.087    | -0.015              | 0.080    | -0.186            | 0.100 +  |
| South                        | 0.033        | 0.126    | -0.092       | 0.077    | -0.208              | 0.078 ** | -0.097            | 0.091    |
| Northeast                    | -0.206       | 0.162    | 0.019        | 0.106    | 0.132               | 0.084    | -0.088            | 0.101    |
| School/Grades                |              |          |              |          |                     |          |                   |          |
| Private                      | -0.450       | 0.147 ** |              |          |                     |          |                   |          |
| Grade 8                      | -0.057       | 0.064    | 0.030        | 0.055    | 0.040               | 0.057    | -0.050            | 0.084    |
| Grade 9                      | -0.005       | 0.066    | -0.145       | 0.054 ** | 0.058               | 0.059    | -0.083            | 0.072    |
| Individual characteristics   |              |          |              |          |                     |          |                   |          |
| Male                         | 0.177        | 0.046 ** | 0.280        | 0.049 ** | 0.029               | 0.048    | -0.066            | 0.067    |
| IQ                           | -0.012       | 0.002 ** | -0.010       | 0.002 ** | 0.008               | 0.002 ** | -0.006            | 0.003 *  |
| Hyperactivity                | 0.273        | 0.088 ** | 0.218        | 0.102 *  | 0.087               | 0.101    | 0.169             | 0.143    |
| Inattention                  |              |          | 0.273        | 0.114 *  | 0.150               | 0.117    | 0.335             | 0.131 *  |
| Low birthweight              | -0.110       | 0.091    | -0.017       | 0.074    | 0.044               | 0.093    | 0.184             | 0.092 *  |
| Low birthweight missing      | 0.123        | 0.091    | 0.244        | 0.098 *  | -0.094              | 0.101    | 0.063             | 0.138    |
| Parental education           |              |          |              |          |                     |          |                   |          |
| High school                  | -0.300       | 0.068 ** | -0.062       | 0.069    | 0.013               | 0.073    | -0.008            | 0.087    |
| Some college                 | -0.349       | 0.075 ** | -0.024       | 0.079    | 0.018               | 0.077    | 0.072             | 0.092    |
| College or more              | -0.530       | 0.082 ** | -0.227       | 0.092 *  | -0.048              | 0.089    | 0.103             | 0.116    |
| Parental religion            |              |          |              |          |                     |          |                   |          |
| Conservative religion        |              |          | -0.055       | 0.119    | 0.290               | 0.091 ** | 0.299             | 0.120 *  |
| Religiosity                  | -0.079       | 0.028 ** | -0.030       | 0.030    | -0.057              | 0.030 +  | -0.035            | 0.040    |
| Family Wealth                |              |          |              |          |                     |          |                   |          |
| Welfare receipt              | 0.151        | 0.059 *  | 0.159        | 0.057 ** | 0.120               | 0.063 +  | 0.079             | 0.084    |
| Income<4*poverty line        | 0.171        | 0.074 *  | -0.032       | 0.069    | 0.116               | 0.058 *  | 0.076             | 0.103    |
| Income<2*poverty line        | 0.242        | 0.086 ** | 0.073        | 0.078    | 0.129               | 0.072 +  | 0.202             | 0.104 +  |
| Income<poverty line          | 0.377        | 0.085 ** | 0.007        | 0.105    | 0.103               | 0.087    | 0.174             | 0.142    |
| Family Structure             |              |          |              |          |                     |          |                   |          |
| Two non-biological parents   |              |          | 0.181        | 0.067 ** | 0.124               | 0.065 +  | 0.228             | 0.100 *  |
| Single parent or other       |              |          | 0.222        | 0.064 ** | 0.179               | 0.064 ** | 0.295             | 0.087 ** |
| Other family characteristics |              |          |              |          |                     |          |                   |          |
| Teenage mom                  | 0.047        | 0.083    | 0.068        | 0.081    | 0.063               | 0.079    | -0.087            | 0.097    |
| Teenage mom missing          | 0.171        | 0.076 *  | -0.099       | 0.086    | 0.102               | 0.085    | -0.133            | 0.113    |
| Mom non-immigrant            | 0.334        | 0.112 ** | 0.136        | 0.095    | -0.100              | 0.079    | 0.170             | 0.150    |
| Jailed father                |              |          | 0.188        | 0.067 ** | 0.355               | 0.059 ** | 0.306             | 0.077 ** |
| Jailed father missing        | 0.128        | 0.095    | -0.013       | 0.100    | 0.108               | 0.091    | -0.090            | 0.122    |
| # of children                | -0.120       | 0.053 *  | 0.034        | 0.050    | 0.154               | 0.050 ** | 0.102             | 0.069    |
| Constant                     | -0.446       | 0.281    | -0.411       | 0.279    | -2.384              | 0.255 ** | -1.463            | 0.336 ** |
|                              |              |          | rho21        | S.E.     |                     |          | rho41             | S.E.     |
|                              |              |          | -0.049       | 0.063    |                     |          | -0.080            | 0.079    |
|                              |              |          |              |          | rho31               | S.E.     |                   |          |
|                              |              |          |              |          | -0.153              | 0.058 ** |                   |          |
|                              |              |          |              |          | rho32               |          | rho42             |          |
|                              |              |          |              |          | 0.174               | 0.033 ** | 0.587             | 0.033 ** |
|                              |              |          |              |          |                     |          | rho43             |          |
|                              |              |          |              |          |                     |          | 0.354             | 0.042 ** |

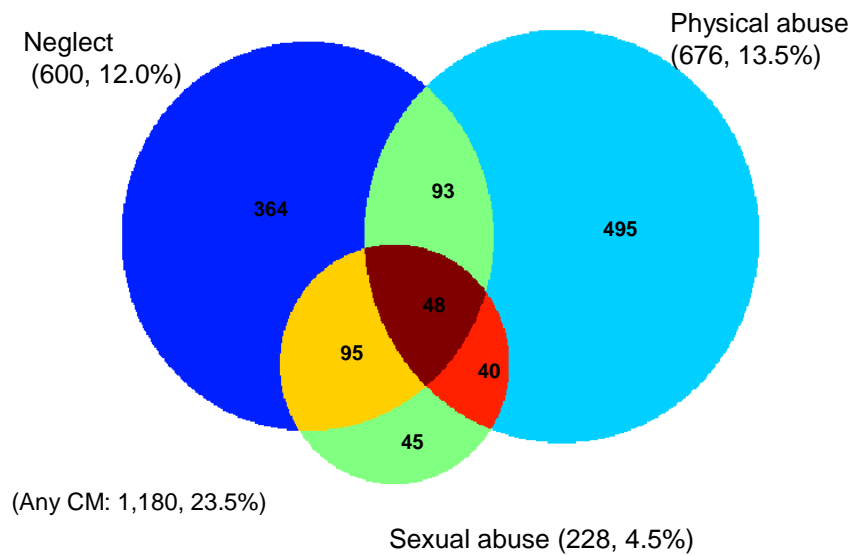
(# draws = 5)

Significance levels: \*\*: 1%, \*: 5%, †: 10%. Standard errors are adjusted for school clusters.

**Table 5 Average treatment effects**

| Variable                     | Probit model |       | MVProbit (Wilde) |       | MVProbit (Maddala) |       | Linear prob. With IV |       |
|------------------------------|--------------|-------|------------------|-------|--------------------|-------|----------------------|-------|
|                              | APE          | S.D.  | APE              | S.D.  | APE                | S.D.  | APE                  | S.E.  |
| Child maltreatment           |              |       |                  |       |                    |       |                      |       |
| Neglect                      | 0.056        | 0.027 | 0.063            | 0.030 | 0.069              | 0.032 | 0.063                | 0.020 |
| Phyabuse                     | 0.005        | 0.002 | 0.056            | 0.028 | 0.062              | 0.030 | 0.065                | 0.168 |
| Sexabuse                     | -0.009       | 0.005 | 0.003            | 0.002 | 0.009              | 0.005 | -0.021               | 0.050 |
| Race/Ethnicity               |              |       |                  |       |                    |       |                      |       |
| Hispanic                     | 0.035        | 0.018 | 0.032            | 0.017 | 0.032              | 0.017 | 0.031                | 0.021 |
| Non-Hispanic black           | 0.010        | 0.006 | 0.010            | 0.005 | 0.012              | 0.006 | 0.013                | 0.022 |
| Non-Hispanic asian           | -0.018       | 0.010 | -0.021           | 0.012 | -0.022             | 0.012 | -0.011               | 0.028 |
| Non-Hispanic native          | 0.101        | 0.044 | 0.105            | 0.046 | 0.101              | 0.045 | 0.127                | 0.075 |
| Non-Hispanic other           | 0.102        | 0.045 | 0.095            | 0.043 | 0.096              | 0.043 | 0.080                | 0.066 |
| Region                       |              |       |                  |       |                    |       |                      |       |
| Suburban                     | -0.007       | 0.004 | -0.006           | 0.004 | -0.005             | 0.003 | -0.006               | 0.032 |
| Urban                        | 0.016        | 0.008 | 0.016            | 0.008 | 0.017              | 0.009 | 0.013                | 0.031 |
| Midwest                      | 0.014        | 0.008 | 0.015            | 0.008 | 0.015              | 0.008 | 0.018                | 0.024 |
| South                        | 0.004        | 0.002 | 0.006            | 0.003 | 0.006              | 0.003 | 0.006                | 0.023 |
| Northeast                    | -0.033       | 0.018 | -0.034           | 0.020 | -0.034             | 0.020 | -0.029               | 0.025 |
| School/Grades                |              |       |                  |       |                    |       |                      |       |
| Private                      | -0.064       | 0.039 | -0.065           | 0.040 | -0.065             | 0.040 | -0.043               | 0.014 |
| Grade 8                      | -0.010       | 0.005 | -0.010           | 0.006 | -0.010             | 0.006 | -0.009               | 0.012 |
| Grade 9                      | -0.001       | 0.001 | -0.001           | 0.001 | -0.001             | 0.001 | -0.002               | 0.012 |
| Individual characteristics   |              |       |                  |       |                    |       |                      |       |
| Male                         | 0.033        | 0.018 | 0.033            | 0.018 | 0.032              | 0.017 | 0.031                | 0.009 |
| IQ                           | -0.002       | 0.001 | -0.002           | 0.001 | -0.002             | 0.001 | -0.002               | 0.000 |
| Hyperactivity                | 0.046        | 0.023 | 0.045            | 0.022 | 0.055              | 0.027 | 0.056                | 0.021 |
| Inattention                  | 0.022        | 0.012 | 0.020            | 0.010 |                    |       |                      |       |
| Low birthweight              | -0.019       | 0.010 | -0.020           | 0.011 | -0.019             | 0.011 | -0.018               | 0.016 |
| Low birthweight missing      | 0.021        | 0.011 | 0.022            | 0.011 | 0.023              | 0.012 | 0.034                | 0.022 |
| Parental education           |              |       |                  |       |                    |       |                      |       |
| High school                  | -0.051       | 0.030 | -0.052           | 0.031 | -0.052             | 0.031 | -0.084               | 0.019 |
| Some college                 | -0.059       | 0.034 | -0.059           | 0.034 | -0.059             | 0.034 | -0.094               | 0.020 |
| College or more              | -0.082       | 0.045 | -0.083           | 0.046 | -0.082             | 0.046 | -0.111               | 0.020 |
| Parental religion            |              |       |                  |       |                    |       |                      |       |
| Conservative religion        | 0.009        | 0.005 | 0.005            | 0.003 |                    |       |                      |       |
| Religiosity                  | -0.014       | 0.008 | -0.014           | 0.008 | -0.014             | 0.008 | -0.014               | 0.005 |
| Family Wealth                |              |       |                  |       |                    |       |                      |       |
| Welfare receipt              | 0.029        | 0.014 | 0.027            | 0.014 | 0.028              | 0.014 | 0.037                | 0.015 |
| Income<4*poverty line        | 0.031        | 0.017 | 0.030            | 0.017 | 0.031              | 0.017 | 0.018                | 0.011 |
| Income<2*poverty line        | 0.045        | 0.023 | 0.043            | 0.022 | 0.047              | 0.024 | 0.029                | 0.016 |
| Income<poverty line          | 0.073        | 0.033 | 0.072            | 0.033 | 0.077              | 0.035 | 0.072                | 0.020 |
| Family Structure             |              |       |                  |       |                    |       |                      |       |
| Two non-biological parents   | 0.012        | 0.006 | 0.011            | 0.006 |                    |       |                      |       |
| Single parent or other       | 0.018        | 0.009 | 0.016            | 0.008 |                    |       |                      |       |
| Other family characteristics |              |       |                  |       |                    |       |                      |       |
| Teenage mom                  | 0.007        | 0.004 | 0.007            | 0.004 | 0.009              | 0.005 | 0.007                | 0.021 |
| Teenage mom missing          | 0.028        | 0.014 | 0.027            | 0.014 | 0.032              | 0.017 | 0.027                | 0.018 |
| Mom non-immigrant            | 0.050        | 0.030 | 0.051            | 0.031 | 0.052              | 0.032 | 0.062                | 0.019 |
| Jailed father                | 0.004        | 0.002 | -0.001           | 0.000 |                    |       |                      |       |
| Jailed father missing        | 0.022        | 0.011 | 0.021            | 0.011 | 0.024              | 0.013 | 0.021                | 0.023 |
| # of children                | -0.017       | 0.009 | -0.019           | 0.010 | -0.022             | 0.012 | -0.020               | 0.012 |

Notes: The average effects measure the change in the probability of high school dropout when the corresponding child maltreatment dummy variable changes from zero to one. The estimates are based on the multivariate probit estimation with instrumental variables.



Note: Based on the Add Health survey sample (N=5,013).

Figure 1 Prevalence and cooccurrence of child maltreatment

|                                 |               |   |        |
|---------------------------------|---------------|---|--------|
| Probit regression               | Number of obs | = | 5009   |
|                                 | Wald chi2(32) | = | 409.00 |
|                                 | Prob > chi2   | = | 0.0000 |
| Log pseudolikelihood = -1657.66 | Pseudo R2     | = | 0.1009 |

| (Std. Err. adjusted for 757 clusters in grad_aid) |           |                  |       |       |                      |           |
|---|-----------|------------------|-------|-------|----------------------|-----------|
| dropout   | Coef.     | Robust Std. Err. | z     | P> z  | [95% Conf. Interval] |           |
| s_suburban  | -.0808851 | .1570688         | -0.51 | 0.607 | -.3887344            | .2269641  |
| s_urban   | .048329   | .1553995         | 0.31  | 0.756 | -.2562485            | .3529065  |
| s_private   | -.477623  | .1550667         | -3.08 | 0.002 | -.7815481            | -.1736979 |
| bio_sex   | .2069152  | .0455358         | 4.54  | 0.000 | .1176666             | .2961637  |
| grade_8   | -.062011  | .0654702         | -0.95 | 0.344 | -.1903303            | .0663083  |
| grade_9   | -.0240332 | .0655245         | -0.37 | 0.714 | -.1524588            | .1043924  |
| midwest   | .0971741  | .137889          | 0.70  | 0.481 | -.1730834            | .3674317  |
| south   | .0394419  | .1272804         | 0.31  | 0.757 | -.210023             | .2889068  |
| northeast   | -.164595  | .1634538         | -1.01 | 0.314 | -.4849585            | .1557685  |
| black   | .105317   | .1051452         | 1.00  | 0.317 | -.1007638            | .3113977  |
| asian   | -.0572276 | .1769382         | -0.32 | 0.746 | -.40402              | .2895649  |
| native  | .5199623  | .2557965         | 2.03  | 0.042 | .0186104             | 1.021314  |
| other   | .4707348  | .2496729         | 1.89  | 0.059 | -.0186151            | .9600847  |
| hispanic  | .222173   | .0934718         | 2.38  | 0.017 | .0389716             | .4053743  |
| parent_1  | .2118341  | .0652389         | 3.25  | 0.001 | .0839682             | .3397     |
| parent_2_nb                                       | .1116683  | .0675563         | 1.65  | 0.098 | -.0207395            | .2440762  |
| high  | -.3705395 | .0698308         | -5.31 | 0.000 | -.5074054            | -.2336735 |
| some_college                                      | -.4438865 | .0761852         | -5.83 | 0.000 | -.5932066            | -.2945663 |
| college   | -.6946924 | .081691          | -8.50 | 0.000 | -.8548038            | -.534581  |
| teen_mom_1  | .0738988  | .0786833         | 0.94  | 0.348 | -.0803178            | .2281153  |
| teen_mom_m  | .105242   | .0783862         | 1.34  | 0.179 | -.0483921            | .2588761  |
| m_immigran~1                                      | .3304425  | .1102664         | 3.00  | 0.003 | .1143244             | .5465606  |
| f_jail  | .058925   | .0680848         | 0.87  | 0.387 | -.0745187            | .1923687  |
| f_jail_m  | .1399286  | .0994342         | 1.41  | 0.159 | -.0549589            | .3348162  |
| ah_pvt  | -.012409  | .0020054         | -6.19 | 0.000 | -.0163395            | -.0084785 |
| adhd_i  | .1458913  | .1352287         | 1.08  | 0.281 | -.119152             | .4109347  |
| adhd_h  | .2458204  | .1006078         | 2.44  | 0.015 | .0486327             | .443008   |
| low_bw_1  | -.1021605 | .0892006         | -1.15 | 0.252 | -.2769904            | .0726694  |
| low_bw_m  | .1194818  | .0881544         | 1.36  | 0.175 | -.0532975            | .2922612  |
| child_log   | -.0192852 | .0531231         | -0.36 | 0.717 | -.1234045            | .0848341  |
| con_relig   | .0435346  | .1080998         | 0.40  | 0.687 | -.1683372            | .2554064  |
| relig_i   | -.0856264 | .0277199         | -3.09 | 0.002 | -.1399565            | -.0312963 |
| _cons   | -.1371892 | .2751793         | -0.50 | 0.618 | -.6765308            | .4021524  |

|                                   |               |   |        |
|-----------------------------------|---------------|---|--------|
| Probit regression                 | Number of obs | = | 5009   |
|                                   | Wald chi2(39) | = | 550.45 |
|                                   | Prob > chi2   | = | 0.0000 |
| Log pseudolikelihood = -1635.2585 | Pseudo R2     | = | 0.1131 |

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