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The use of risk assessment to predict recurrent maltreatment: A classification and regression tree analysis (CART)

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Abstract

Research has suggested that recurrent maltreatment may be best predicted by a combination of factors that vary across families. The present study set out to determine whether a pattern-centered analytic approach would better predict families at high risk for recurrence when compared to logistic regression methods. Archival data from substantiated investigations during 2003 were collected from a Connecticut Department of Children and Families county branch. Families ($n=244$) with a substantiated index case were followed for 18 months to identify the presence of additional substantiated cases within the CPS system. Classification and Regression Tree (CART) analyses revealed that prior CPS involvement was the best predictor of recurrent maltreatment. Further, risk items that were associated with recurrence were different for families with and without previous CPS investigations. Families with only prior unsubstantiated CPS investigations *and* poor child visibility within the community were at high risk for recurrence. Families without prior CPS involvement that were not actively involved in case planning *and* had a history of domestic violence were at high risk for recurrence. These findings suggest that pattern-centered analyses may be a useful approach to informing site-specific predictors of maltreatment recurrence by creating clear decision points that delineate high risk subgroups.

Keywords

child abuse and neglect; recurrent maltreatment; risk assessment; classification and regression tree analysis

The primary goal of child protective services (CPS) is to reduce the likelihood of child maltreatment and its recurrence by providing appropriate services to families (Brookes & Webster, 1999); however, approximately 1/3 to 1/2 of families will have a recurrent episode of maltreatment with subsequent reentry into the CPS system (DePanfilis & Zuravin, 1998; DePanfilis & Zuravin, 1999; Fluke, Shusterman, Hollinshead, & Yuan, 2005; Inkelas & Halfon, 1997). Risk assessment instruments were developed to aid caseworkers in identifying children who were at high risk for future abuse and neglect (Cash, 2001; Jagannathan & Camasso, 1996; Johnson & L'Esperance, 1984; Pecora, 1991). Although these assessments are now routinely administered during CPS investigations in 42 states (US Department of Health and Human Services, 2003); there remains no standard risk assessment model that clearly informs caseworker case planning and management (Schwalbe, 2004).

Risk assessments are composed of a list of variables that typically fall under five domains: child characteristics (e.g. age, disability), caretaker characteristics (e.g. substance use, access to the child, parenting skills), maltreatment characteristics (e.g. severity), environment (e.g. social support, housing and financial stability), and level of family cooperation with CPS (Camasso & Jagannathan, 1995; Fluke et al., 2005; Hindley, Ramchandani, & Jones, 2006; Johnson & L'Esperance, 1984; Marks & McDonald, 1989; McDonald & Marks, 1991). Families are classified as low, moderate, or high risk for recurrence based on caseworker ratings of these items. An early review comparing eight risk assessment instruments (McDonald & Marks, 1991) found that perpetrator access predicted recurrent maltreatment in three prospective studies (Baird, 1988; Johnson & L'Esperance, 1984; Weedon, Torti, & Zunder, 1988) and a large family size predicted reabuse in two prospective studies (Baird, 1988; Johnson & L'Esperance, 1984). Other risk assessment items that have been predictive of recurrent maltreatment include prior CPS involvement, parenting skills and expectations, parental substance use/abuse, parent/child relationship, treatment cooperation, history of domestic violence, and child's age/ability (Hindley et al., 2006; Lyons, Doueck, & Wodarski, 1996).

Ecological theories claim that a combination of factors at the child, family, and environmental levels interact to predict child maltreatment (Belsky, 1993; Cash, 2001; Cicchetti & Toth, 1995; Garbarino, 1977). When applied to risk assessment, researchers have argued that maltreatment occurrence and recurrence may be best predicted by risk item combinations that identify unique population subgroups similarly at risk for recurrence (Hoving, Wodarski, Kurtz, & Gaudin, 1989; McDonald & Marks, 1991; National Research Council, 1993; Pecora, 1991). For example, one family may be categorized as high risk due to poor parenting skills and ability whereas another family may be considered high risk due to poor housing conditions and a child's developmental disability. Identifying subgroups at similar risk for recurrence may increase prediction accuracy and better inform caseworker decisions such as the types of services families may need (Shlonsky & Wagner, 2005).

Current risk assessment models do not take constellations of risk factors into account. Consensus-based risk assessments are derived from expert clinical judgment and previous exploratory research and calculate risk by summing item scores (Gambrill & Shlonsky, 2000). However, simple summation scores equally weight all items and ignore potential interactions among items (Fuller, Wells, & Cotton, 2001; Jagannathan & Camasso, 1996; Pecora, 1991). Further, individual items may be redundant and aggregating item scores could actually overestimate risk (Murphy-Berman, 1994). Actuarial assessments improve on consensus-based models by empirically deriving risk assessments that are site-specific, including only the items that continue to predict recurrence while adjusting for the contribution of all other items, and weighting items based on their predictive contribution to the outcome of interest (Gambrill & Shlonsky, 2000; Shlonsky & Wagner, 2005). Although research has suggested that actuarial models are more accurate at risk classification compared to consensus-based models (Baird & Wagner, 2000), the probability of correctly identifying recurrent maltreatment cases (sensitivity) remains low (Gambrill & Shlonsky, 2000). Though both types of risk assessments provide caseworkers with risk classifications they fail to explain *why* families are actually at risk (Schwalbe, 2004). Schwalbe (2004) argues that this failure to provide a 'story' ultimately leads to the underutilization of risk assessments in actual case planning and management, and suggests that future assessments be based on theory in order to translate classification findings into clinical decision-making.

Risk assessment research has generally relied on variable-centered statistical techniques (e.g. logistic regression and multiple regression) that measure the relationship between a group of risk factors or total risk scores and maltreatment recurrence to determine *average* associations within the population (Lyons, Doueck, & Wodarski, 1996). Unless specified within the model,

these methods do not test for complex interactions among risk factors nor the consideration of risk constellations that may lead to recurrence (Wald & Woolverton, 1990). Pattern-centered statistical techniques provide a different approach to using risk assessments to determine risk classification. Pattern-centered approaches identify subgroups within a sample that share similar characteristics, allowing for an examination of constellations of risk factors *within* families as opposed to identifying variables that predict risk across all families (Bates, 2000; Magnusson, 1998). Segmenting populations into subgroups that share similar characteristics may more directly inform site-specific case management by highlighting the special needs of the high risk subgroup as opposed to the average need of all high risk families (Lemon, Roy, Clark, Friedmann, & Rakowski, 2003).

One type of pattern-centered statistical approach is classification and regression tree (CART) analysis. CART is a nonparametric data mining technique that generates a decision tree used to classify a dataset based on a given outcome (Breiman, Friedman, Ohlsen, & Stone, 1984). Tree-based techniques have become popular within the medical field due to their ability to produce simple clinical decision rules allowing practitioners to easily classify new cases as low or high risk (Lewis, 2000). CART analysis selects the most important predictors and their interactions from a large number of variables generating unique constellations of variables that most accurately predict low- and high-risk groups (Johnson, Brown, & Wells, 2002).

Risk assessment research needs to consider both 1) the presence of unique risk subgroups and 2) the utility with which risk classification can be applied to decision-making. The present study set out to determine whether CART (pattern-centered) analysis would better predict families at high risk for recurrence and provide a more informative risk narrative when compared to commonly used logistic regression methods. The present study used case characteristics and a consensus-based risk assessment to predict recurrent maltreatment among 244 families involved with the Connecticut Department of Children and Families (CT DCF).

Methods

Sampling procedures

Data were obtained from a DCF branch of a middle income county in CT. This study was approved by the Institutional Review Boards of Wesleyan University and the CT DCF. Case characteristic and risk assessment data were abstracted from the DCF LINKS computerized database and individual case files. Data from all substantiated investigations between January 1, 2003 and December 31, 2003 were collected and each family's first 2003 investigation served as the index case. The study sample was restricted to children age 17 or younger in 2003 because victims over age 17 could not be followed for the entire follow-up period due to aging out of the CPS system at age 18. In addition, two families were excluded due to missing risk assessment forms. The final sample included 244 families with a substantiated investigation who were followed forward for 18 months to identify the presence of additional substantiated maltreatment cases within the DCF system. Maltreatment was broadly defined as any form of abuse (i.e. physical, sexual, and emotional) or neglect (i.e. physical, medical, educational, and emotional). Similar to prior research (Fryer & Miyoshi, 1994; Lipien & Forthofer, 2004; Wolock, Sherman, Feldman, & Metzger, 2001), a recurrent maltreatment case was operationally defined as any subsequent substantiated case for a family. Research assistants received training in data collection and all investigations occurring between January 2003 and June 2003 were quality checked to ensure reliable coding.

Measures

Case Characteristics—Case characteristics that have been previously linked to maltreatment recurrence that were not measured by the standardized risk assessment were also

examined. These variables included the family's demographic characteristics (i.e. family type, family size, age of primary caretaker), most vulnerable child's demographic characteristics (i.e. gender, race), and initial type of maltreatment (i.e. neglect only, abuse only, multiple types) (Fluke, Yuan, & Edwards, 1999; Fryer & Miyoshi, 1994; Fuller et al., 2001; Levy, Markovic, Chaudhry, Ahart, & Torres, 1995; McDonald & Marks, 1991). In the present study, the number of children involved in an investigation served as a proxy measure for family size. In addition, perpetrator demographic information (i.e. age, gender, role) were also included as potential predictors of recurrence.

Risk Assessment—Caseworkers completed a structured 24-item risk assessment inventory for the most vulnerable child for each family during intake. The CT risk assessment is a variant of the original risk assessment instrument developed by the State of Illinois (the Child Abuse and Neglect Tracking System, CANTS 17B). The risk assessment covers five areas that have been previously related to recurrent maltreatment including abuse/neglect severity, child influences, caretaker influences, environmental influences, and intervention cooperation. Each item was scored on a combined 4-point quantitative and qualitative scale (see Table 1). Given our small sample size and poor interrater reliability of risk assessments due to the subjectivity of the qualitative ratings (Knoke & Trocme, 2005; Rycus & Hughes, 2003), response categories were collapsed into two levels: no risk and any risk (rating of low, moderate, or high risk). Since all children were 17 or younger, the risk assessment item concerning child's age was scored as: less than 5 (high risk), 5 to 9 (moderate risk), and 10 to 17 (no/low risk).

Analytic Plan—The unit of analysis for the present study was the family since risk assessments were completed for the most vulnerable child within each family for each investigation. First, a series of bivariate logistic regression analyses were conducted to examine the relationship between each case characteristic/risk assessment item and recurrent maltreatment. The case characteristic/risk assessment item served as the predictor variable and recurrent maltreatment served as the outcome variable. Next, all significant predictors from the bivariate analyses were included in one multivariate logistic regression model predicting recurrent maltreatment. Finally, CART analyses were performed to test linear and nonlinear relationships among the case characteristics and risk assessment items predicting future maltreatment (Breiman et al., 1984; Steinberg & Colla, 1997).

CART uses binary recursive partitioning to systematically search for the best variable (i.e. primary splitter) out of all possible predictors that splits the dataset into the "purest" low-risk and high-risk groups with respect to the outcome variable (Breiman et al., 1984; Lewis, 2000). In addition, all possible separations (categorical variables) or cutpoints (continuous variables) are examined for each variable to determine which splits are the best at predicting the outcome. CART builds a decision tree consisting of parent nodes that are further split into child nodes based on the next best variable and split criteria. Splitting of the child nodes continues until no further splits maximize purity of the terminal nodes, thus resulting in an overgrown or overfit tree. A cross-validation procedure is used to determine the optimal tree by randomly splitting the complete dataset (i.e. learning dataset) into N subsets of data and then repeating the tree-growing process N times (Steinberg & Colla, 1997). A misclassification rate for each possible tree in the full-sample tree sequence is computed for the learning sample tree and test sample tree. The use of cross-validation allows the researcher to estimate the future performance of the tree model without the need of an independent dataset (Lewis, 2000).

Further, for each primary splitter in the tree, CART also reports alternative splits (surrogate variables) that would mimic the primary splitter. These surrogate variables are then used in place of the primary splitter when data points are missing, as a result CART does not discard cases with missing data (Lewis, 2000; Steinberg & Colla, 1997). In the present study, the minimal number of cases in a terminal node was set to 5, the GINI criterion was used to

determine the best split at each node, and a 10-fold cross validation procedure was employed. Since we were more interested in missing potentially recurrent cases, a misclassification cost for classifying recurrent cases as non-recurrent (false negative) was increased to 1.5. A misclassification cost of 1.5 more heavily penalizes false negatives, thus generating a decision tree that favors the correct classification of recurrent compared to non-recurrent cases (Steinberg & Colla, 1997). In order to evaluate the utility of the multivariate logistic regression and CART models in predicting recurrence, sensitivity (probability of correctly identifying recurrent maltreatment cases) and specificity (probability of correctly identifying non-recurrent maltreatment cases) were also calculated (Brown & Hollander, 1977; Lyons et al., 1996).

Results

Sample Characteristics

Table 2 presents sample characteristics. The majority of the sample (63%) was Caucasian (21% African American, 13% Hispanic, 3% Asian/Other) with 68% of families having one child involved in the investigation. The average age for the most vulnerable child in the family was 7.35 (SD = 5.07). Seventy-five (31%) families had a recurrence following their index case. Physical neglect (n=115, 48%) was the most common type of maltreatment and multi-type maltreatment was the second most common (n=52, 21%). Twenty-seven (11%) cases involved physical abuse only and 15 (6%) involved sexual abuse only. The remaining 35 (14%) cases involved psychological maltreatment or medical/educational neglect only.

Logistic regression analyses

Tables 2 and 3 display the descriptive statistics (i.e. frequencies and means) and logistic regression statistics (i.e. odds ratios and confidence intervals) for recurrent and non-recurrent cases based on case characteristics and risk assessment items. Bivariate logistic regression analyses revealed that no individual case characteristic significantly predicted recurrent maltreatment (see Table 2). Further, bivariate regression analyses revealed that 9 out of 24 risk assessment items significantly predicted recurrent maltreatment (see Table 3). These items included reports of any risk on prior CPS history (#4), child's visibility (#7), perpetrator access (#10), caretaker's physical/mental limitations (#11), parenting skills/knowledge (#13), parent/child relationship (#14), caretaker's abuse history (#15), domestic violence (#18), and family social support (#21). Next, a multivariate logistic regression was conducted with all nine significant risk assessment items included as predictors. Results revealed that only prior CPS history (odds ratio [OR]= 4.7, 95% confidence interval [CI]= 1.8-12.4) continued to predict recurrent maltreatment after adjusting for the other eight significant predictors. For the multivariate model, sensitivity (probability of correctly identifying recurrent maltreatment cases) was 37% and specificity (probability of correctly identifying non-recurrent maltreatment cases) was 87%.

Classification and regression tree analyses

For the CART analyses, all 24 risk assessment items and case characteristics were included in the model predicting recurrence. The optimal tree consisted of 1 node with a primary split on the risk assessment item measuring the presence of prior unsubstantiated and substantiated cases (#4). Sixty-six (38%) families with a prior substantiated or unsubstantiated case had a recurrent maltreatment case whereas only 9 (13%) families without a CPS history experienced recurrent maltreatment. The model correctly identified 88% of the recurrent cases (sensitivity) and 36% of the non-recurrent cases (specificity).

The data were then subset to families without prior substantiated cases (new cases) to examine whether additional variables may best classify these families. Again, all 24 risk assessment

items and case characteristics were included in the model predicting recurrence. In addition, risk assessment item #4 was limited to no risk (no prior CPS involvement) and low risk (prior unsubstantiated cases) response categories. Figure 1 presents an illustration of both models. For new cases, the optimal tree consisted of four parent nodes with primary splits on risk assessment items measuring the presence of prior unsubstantiated cases (#4), child visibility within the community (#7), CPS treatment plan cooperation (#20), and a current and/or history of domestic violence (#18). The first pathway included families with prior unsubstantiated cases and with any risk endorsed on the child visibility item. In this branch, 50% (25/50) of cases were recurrent which accounted for 71% (25/35) of all recurrent cases. The second pathway included families without prior unsubstantiated cases (n=70). This pathway was further split into those who fully cooperated with treatment planning (n=45) and those who did not (n=25). For families who did not fully cooperate and had a history of domestic violence, 38% (6/16) were recurrent cases. This branch classified an additional 17% (6/35) of recurrent cases. The overall model for new cases correctly identified 87% of the recurrent cases (sensitivity) and 65% of the non-recurrent cases (specificity). The cross-validation procedure estimated that the model would correctly identified 74% of the recurrent cases (sensitivity) and 64% of the non-recurrent cases (specificity) when applied to an independent dataset. For the combined model, the overall sensitivity was 95% (71/75) and the specificity was 39% (66/169).

Discussion

The present study was designed to explore the use of pattern-centered (i.e. CART) statistical approaches to predict recurrent maltreatment based on routinely administered risk assessments that may better inform site-specific CPS intervention. Similar to prior research, physical neglect was the most common initial maltreatment type (Knoke & Trocme, 2005; Lipien & Forthofer, 2004; Rittner, 2002). Further, recurrence rates (31%) were comparable to prior research that employed similar time frames and definitions of recurrence (Lipien & Forthofer, 2004; Rittner, 2002). Several risk assessment items (i.e. prior CPS involvement) were predictive of maltreatment recurrence in both statistical approaches; however, the pattern-centered approach provided better sensitivity compared to the variable-centered approach.

Similar to previous research (Baird, 1988; DePanfilis & Zuravin, 1999; English, Marshall, & Orme, 1999; Fuller et al., 2001; Hindley et al., 2006; Marshall & English, 1999; Wood, 1997), prior substantiated and unsubstantiated investigations were the most sensitive predictors of recurrent maltreatment using both analytic techniques. In CART analyses CPS history accounted for 53% of all recurrent cases. It has been argued that predictors of recurrence should be examined separately for families with first reports to CPS (Marshall & English, 1999). Results of the present study supported this argument when a CART model examining predictors of recurrence was limited to families without a prior substantiated investigation. Two pathways emerged: families with prior unsubstantiated cases and poor child visibility were likely to recur (50%) and families without prior unsubstantiated cases, poor involvement in case planning and a history of domestic violence were also likely to recur (37.5%).

The overall CART model correctly predicted 95% of recurrent cases (sensitivity); however, 61% of non-recurrent cases were *incorrectly* classified (specificity= 39%). In contrast, the multivariate logistic regression model had poor sensitivity (37%) but good specificity (87%). The high sensitivity in the CART model is due, in part, to more heavily penalizing incorrectly classified recurrence cases (i.e. misclassification cost = 1.5). A general emphasis on sensitivity estimates reflects the acceptable tradeoff between sensitivity and specificity when selecting youth for intervention (Kraemer, 1992). In this area of research missing potentially recurrent cases is much more problematic than misclassifying non-recurrent cases since prediction error could result in inadequate case management and future abuse and/or neglect (Camasso & Jagannathan, 1995; Knoke & Trocme, 2005; Lyons et al., 1996). As a result, statistical

approaches with the ability to build models favoring sensitivity may ultimately be more beneficial to CPS case planning and management. Further, the final CART model consisted of only 4 variables (out of a possible 32) that best predicted recurrence. This tree-based model provided a more parsimonious risk assessment tool while still clearly presenting the factors that increase a family's risk.

The present results should be considered exploratory and interpreted within the context of study limitations. First, the small sample size prohibited the creation of separate CART models for different types of maltreatment (i.e. abuse vs. neglect). There is some controversy as to whether factors predicting recurrent neglect differ from those predicting reabuse (Hamilton & Browne, 1999; Higgins & McCabe, 2000; Knoke & Trocme, 2005; National Research Council, 1993), however, future research applying CART analysis should determine whether separate models predicting physical abuse and neglect would increase accuracy. Further, different types of maltreatment tend to co-occur both cross-sectionally (e.g. one episode involves physical abuse and neglect) and longitudinally (e.g. first episode was neglect and recurrent maltreatment was abuse) (Higgins & McCabe, 2001). Large scale prospective studies such as the National Survey of Child and Adolescent Well-Being (NSCAW) may help to identify the best classification scheme for co-occurring maltreatment types (Lau et al., 2005; Litrownik et al., 2005) as well as disentangle the predictors of abuse and neglect recurrence. Second, the scoring of the risk assessment items (no risk/any risk) may have also impacted our findings; however, risk ratings are highly subjective and ratings vary widely from caseworker to caseworker (i.e. poor interrater reliability; Knoke & Trocme, 2005; Rycus & Hughes, 2003). Due to the subjectivity of ratings and the small sample size we took a conservative approach to scoring the risk items by aggregating responses into no risk vs. any risk. We did explore other scoring methods (e.g. none, low, moderate, high; high risk/all others, none/low vs. moderate/high); however, the no risk vs. any risk provided the most accurate tree with regards to sensitivity and specificity. Third, the present study focused on the risk assessment that was completed at intake following maltreatment substantiation. Risk assessments are performed multiple times throughout the course of a case and predictors of risk at intake may differ from predictors of risk at case closing.

Despite these limitations, the goal and strength of the present study was to apply a different type of methodological approach to an existing consensus-based risk assessment tool. Though risk assessments were designed to aid in caseworker decision making, their utility in guiding decision making within CPS remains unclear (Schwalbe, 2004). By using CART analysis, we were able to simplify the risk assessment by focusing on the few items that were predictive of recurrent maltreatment as well as clearly describe subgroups of families that are the most likely to reenter the CPS system. Data-mining analyses like CART may be quite useful in CPS settings due to their ease of use in creating clear decision points that delineate high-risk subgroups. Instead of merely supplying a risk classification of low, moderate, or high, a decision tree may better inform caseworkers by providing more information as to why families are considered high risk (e.g. prior unsubstantiated cases, poor involvement in case planning). Although the significant predictors retained in the final CART model are similar to prior research, future research is necessary to determine whether CART models are site-specific or would generalize to similar jurisdictions. More importantly, future research is needed to determine whether caseworkers would be more likely to incorporate this type of tree-based model into case planning as opposed to current models of risk classification.

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Figure 1.
Combined CART models using risk assessment items to predict recurrence for families with and without prior CPS involvement.

Table 1

Connecticut DCF risk assessment form

	None	Low	Medium	High
Severity of Abuse/Neglect				
1. Abuse	No visible injury	Superficial injury requiring no medical treatment	Significant injury which may require treatment; indicators of sexual abuse	Serious physical injury requiring treatment; sexual abuse
2. Neglect	needs adequately met	needs usually met	needs marginally met	substantiated abuse/neglect
3. Use of Implement	No use of an implement	Implements used, no marks	Implement used, marks	Implement used on head or abdomen or used on infant
4. History	No prior reports	Unsubstantiated prior reports	Previous substantiated reports	Multiple previous substantiated reports
5. Medical Care	Adequate routine and crisis care provided	Failure to provide routine care	Failure to provide care for injury or illness	Failure to provide treatment for a critical or life-threatening condition
Child influence				
6. Age	18 or over	10 to 17 years old	5 to 9 years old	less than 5 years old
7. Visibility to others	visible daily and extensively	visible to teachers and others on a daily basis	visibility is sporadic	not at school, daycare, place where outsiders can observe
8. Physical/mental/developmental disability	None	Mild	Moderate	Profound
9. Fear of caretaker	content and comfortable with caretakers and others in the home	Mild discontent but not fearful of returning home	Evidences anxiety and is hesitant to return home	Extremely fearful of caretaker/others in home and refuses to return home
Caregiver influence				
10. Perpetrator access	Has no access to child — incarcerated or deceased	out of home and caretaker is able to deny access	in/out of home with limited access to child;	in/out of home with easy access to child,
11. Physical/mental limitation	no limitation; seems mature and able to cope	some limitation with little evidence of negative impact	limited with negative impact	severely impaired and cannot care for child
12. Substance abuse	No past or present substance abuse	No evidence of abuse or successfully completed treatment program	Known abuser in treatment	Suspected or known abuser not in treatment
13. Parenting skills/knowledge	Understands and attends to child's needs	Most often understands and attends to needs	some unrealistic expectations; limited understanding of needs	no understanding of child's needs; unrealistic expectations
14. Parent/child relationship	attachment and mutual responsiveness	Attachments are obvious and extensive	Parent responds negatively to child	Complete lack of attachment or positive interaction
15. Abuse history	no abuse/neglect or family violence during childhood	Isolated incidents of abuse/neglect/family violence during childhood	Intermittent abuse/neglect/family violence during childhood	chronic and/or severe abuse/neglect or family violence during childhood
16. Assaultive behavior history	No assaultive behavior	Isolated incident of assaultive behavior	Sporadic incidents of assaultive behavior with	Repeated incidents of assaultive behavior with major

	None	Low	Medium	High
17. Presence of other parent	stabilizing influence	in the home; assumes only minimal caretaking	minor injury in the home on inconsistent basis or has disruptive influence	injury Is the alleged perpetrator
18. Domestic violence	No current or history of domestic violence	Past but not current domestic violence	recent violent relationship, but perp out of home; history of repeated violent relationships	Current and frequent domestic violence
Intervention Influence				
19. Investigation cooperation	Is appropriately responsive	Offers some resistance	Cooperates reluctantly; displays some hostility	Openly hostile and uncooperative, or unwilling to permit worker access to child
20. Treatment plan cooperation	Readily acknowledges problem; is actively involved in case planning	Recognizes problem exists; involved in services but does not take initiative	Limited understanding of problem; fails to accept responsibility	Denies problem, actively resists any agency contact, involvement, or services
Environment Influence				
21. Family social support	available when needed	Support is usually available	Few outside supports available or helping	No supports involved
22. Health and safety of home	No concerns	Minor concerns	Moderate hazards	Serious health/safety hazards
23. Housing stability	stable housing for at least one year; no present risk of relocation	frequent moves which has caused mild disruption	Numerous moves within the past year causing significant disruption	Pending/current homelessness; children suffering for lack of stable housing
24. Financial stability	Regular source of income	Temporary disruption in income	Unreliable/insufficient source of income	No income, unable to meet any basic financial needs

Table 2

Bivariate logistic regressions: Case characteristics predicting recurrence (n=244)

Case Characteristic	Frequency/Mean (sd)		OR (95% CI)
	Non-recurrent	Recurrent	
Gender			
Male	81	32	reference
Female	88	43	1.2 (0.7-2.1)
Race			
Caucasian	106	47	reference
African-American	33	18	1.2 (0.6-2.4)
Hispanic	24	8	0.8 (0.3-9.8)
Asian	1	0	0.0 (0.0-0.0)
Other	5	2	0.9 (1.7-4.8)
Family type			
Two-parent household	52	19	reference
Blended family/step-parent/single parent with unrelated	43	15	1.0 (0.4-2.1)
Guardian/nonrelated caretaker/relative/unknown	5	2	1.1 (0.2-6.1)
Single parent (male or female)	69	39	1.6 (0.8-3.0)
Type of maltreatment			
Neglect only	120	54	reference
Abuse only	35	15	1.0 (0.5-1.9)
Multiple types	14	6	1.0 (0.4-2.7)
Perpetrator Gender			
Male only	52	20	reference
Female only	68	36	1.4 (0.7-2.7)
Both sexes	49	19	1.0 (0.5-2.1)
Perpetrator Role			
Not primary caretaker	48	22	reference
Primary caretaker	121	53	1.0 (0.5-1.7)
Number of children per investigation, mean (sd)	1.4 (0.7)	1.5 (0.9)	1.1 (0.8-1.6)
Age of primary caretaker, mean (sd)	34.8 (9.9)	35.4 (9.0)	1.0 (0.9-1.0)

Note: OR=Odds Ratio, CI=Confidence Interval; Gender and race are of most vulnerable child in the family.

Table 3

Bivariate logistic regressions: Individual risk assessment items predicting recurrence

Item	Frequency (%)	OR (95% CI)
1. Severity of abuse	68 (28)	1.6 (0.9-2.9)
2. Severity of neglect	202 (83)	2.0 (0.9-4.6) ⁺
3. Use of implement	38 (16)	1.9 (0.9-3.9) ⁺
4. History of abuse/neglect	174 (71)	4.1 (1.9-8.9) [*]
5. Medical care	49 (23)	1.3 (0.7-2.5)
6. Child's age		
5-9 (moderate risk)	69 (28)	0.9 (0.5-1.9)
10-17 (low risk)	96 (39)	1.3 (0.7-2.4)
7. Child's visibility	164 (67)	2.4 (1.3-4.6) [*]
8. Child's disability	81 (34)	1.4 (0.8-2.6)
9. Child's fear of caretaker	51 (23)	1.6 (0.8-3.1)
10. Perpetrator access	129 (57)	2.3 (1.3-4.2) [*]
11. Caregiver limitations	96 (42)	1.8 (1.0-3.1) [*]
12. Substance abuse risk	133 (56)	1.2 (0.7-2.0)
13. Parenting skills	185 (78)	2.3 (1.1-4.8) [*]
14. Parent/child relationship	107 (46)	2.4 (1.4-4.2) [*]
15. Caregiver Abuse/Neglect History	69 (47)	1.1 (0.6-2.2)
16. Assaultive behavior history	98 (41)	1.8 (1.1-3.2) [*]
17. Presence of other parent	107 (50)	0.9 (0.6-1.7)
18. Domestic Violence	145 (62)	2.1 (1.1-3.8) [*]
19. Investigation cooperation	104 (43)	1.7 (0.9-2.9) ⁺
20. Treatment plan cooperation	82 (42)	1.3 (0.7-2.5)
21. Family support	108 (47)	1.9 (1.1-3.3) [*]
22. Health/safety of home	48 (22)	1.3 (0.7-2.6)
23. Housing stability	61 (27)	1.8 (0.9-3.3) ⁺
24. Financial Stability	54 (24)	1.6 (0.8-3.0)

Note: OR = odds ratio, CI = Confidence Interval; Reference group = no risk, statistics shown are for the any risk group.

^{*} p<.05,

⁺ p<.08