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ABSTRACT

Members of a group of hospitalized children under 4 years of age (48 under care for child abuse, 97 for accidents, 41 for failure to thrive, and 23 for ingestions) were matched individually on age, social class, and race with controls suffering from comparable acute medical conditions. A structured maternal and paternal interview yielded 63 significant single-variable comparisons in these domains: child health and development, past and present family disruption and conflict, parental physical and emotional health, and environmental setting. Discriminant function analysis suggested interrelationships among the case groups and an additive mode of pathogenesis, with more severe stresses associated with more severe childhood symptoms. A classification analysis was performed to determine the extent to which equations generated in the discriminant function analyses successfully differentiated between patients in the illness categories and in the control groups. Cluster analysis on a random half-sample identified three cohesive groups, characterized as "ecologic equilibrium," "adversity," and "crisis." This reformulation subsumed respectively increasing proportions of severe symptoms and replicated successfully on the other half-sample. Its elaboration gives a convenient matrix for organizing data from practice and a value-free alternative to the present manifestational classification system. Additionally, a statistical analysis of group profiles was performed, and high-risk families were profiled in nine vital aspects of their lives. In nearly every aspect the crisis group was found to suffer. (RH)

ECOLOGIC REFORMULATION OF PEDIATRIC SOCIAL ILLNESS

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Abstract

Forty-eight children under 4 years hospitalized for child abuse, 97 for accidents, 41 for failure to thrive, and 23 for ingestions were matched individually with controls suffering from comparably acute medical conditions on age, social class, and race. A structured maternal and paternal interview yielded 63 significant single-variable comparisons in these domains: child health and development, past and present family disruption and conflict, parental physical and emotional health, and environmental setting. Discriminant function analysis suggested inter-relationships among the case groups and an additive mode of pathogenesis, with more severe stresses associated with more severe childhood symptoms.

Cluster analysis on a random half-sample identified three cohesive groups, characterized as ecologic equilibrium, adversity, and crisis. This reformulation subsumed respectively increasing proportions of severe symptoms and replicated successfully on the other half-sample. Its elaboration gives a convenient matrix for organizing data from practice and a value free alternative to the present manifestational classification system, which adds insult to injury.

Advances in knowledge of the problem of child abuse suggest three areas in which past knowledge is challenged by newer findings and critical analyses. There are important associations between violence toward children and violence between parents. A unique visibility, if not vulnerability, of poor, socially marginal, and minority children and families cannot be separated from a substantial bias which favors them for child abuse case identification. And there is increasing doubt regarding the usefulness of a too-narrow intervention focus on individual psychopathology. The recent literature leads us to question our commonly accepted notion of child abuse as a discrete entity which can be understood independent of its social and familial context.

The object of this investigation is to broaden the focus of inquiry with respect both to classification (from child abuse to pediatric social illness: child abuse, failure to thrive, ingestions, and accidents) and to risk (from personal pathologies to the family in its life setting). An understanding of pediatric social illness oriented less toward symptoms and more toward causes would, we believe, point the way to a more competent practice.

Subjects

All children under four years of age hospitalized at Children's Hospital Medical Center, Boston, between July 1975 and April 1977 were eligible for selection as cases if they bore the diagnoses of child abuse, accident, ingestion, or failure to thrive. Children hospitalized for comparably acute medical illnesses (such as pneumonia or meningitis) were eligible for selection as controls. Cases and controls were individually matched on three attributes: age, race, and socioeconomic status (determined by the Hollingshead two factor social index). The final sample consisted of 201 cases and 201 controls.

Measures

The principal instrument was a standardized, precoded maternal interview, lasting approximately one hour, conducted by specially trained interviewers at the hospital. Questions focused on a wide range of variables including family structure, housing, employment, finances, availability of relatives and friends, mobility, psychological stresses, child rearing, and the parents' own childhoods. Data on the child included a Vineland Social Maturity Index derived from a maternal report. Carey's (1970) adaptation of the Thomas, Chess and Birch (1969) infant scales was employed to gather and organize mother's perceptions of her child's temperament.

Data Analysis

First, chi-square analyses and t-tests were conducted to determine which of the variables discriminated ($p < .05$) between each group of pediatric social illness cases and their matched controls. Next, the statistically significant variables were used jointly in discriminant function analyses to determine whether and how a weighted combination of variables might predict the classification of families in the entire sample as cases or matched controls.

Hierarchical cluster analysis then was employed to search for homogeneous groups, irrespective of diagnosis, in a random half-sample of the entire population and replicated on the other half-sample.

Results of Discriminant Function Analysis

The most important results of the discriminant function analyses can be seen on the following five tables which summarize the variables emerging as the most powerful discriminators between each case category and its controls. As can be seen in the first table, characteristics of the children serve in all instances to differentiate between cases and controls.

Discriminant Function Analysis

Variables Discriminating Between Each Case Category and Its Controls

1. Attributes of Child

Accident	Ingestion	Failure to Thrive	Abuse
Healthy****	Low Vineland Social Maturity Score***	Unhealthy****	Difficult**
Few medical visits in last year****	Health***	Reactive to visual and auditory changes***	Low Vineland Social Maturity Score***

Key

**** $p < .001$
*** $p < .01$
** $p < .05$
* $p < .15$

Current Stresses

While there is evidence that all categories of pediatric social illness are characterized by some isolation of case families from their kin and communities, nowhere is this isolation more pervasive than in the abuse families. Of 19 variables entering the abuse discriminant function equation at a significance level of .15 or better, seven directly reflect the mother's current social isolation. An eighth variable, recent death of a family member, may contribute to isolation as well as general stress.

The sheer number of stresses differentiating between mothers of abused children and their controls is remarkable. These mothers generally see their relatives less often, feel that no one is interested in their problems, often have experienced a recent death in the family, have little help with child care, disagree with their husbands concerning discipline and childrearing, don't see their relatives enough, have few relatives to count on, few relatives in Boston, and they see themselves, more than mothers in the other case categories, as unconnected to others.

Discriminant Function Analysis

Variables Discriminating Between Each Case Category and Its Controls

2. Current Stresses

Accident	Ingestion	Failure to Thrive	Abuse
Advocacy needs higher**	Extended family unavailable**	M sees relatives less often per week**	M sees relatives less often per week****
Relatives seen less often*	M gets away by self less often*	M gets away by self less often**	M feels no one interested in problems**
Less access to shopping and recreation*	Advocacy needs higher*	M watches TV more**	Recent death in family**
		Advocacy needs higher*	Little help with child care**
		M has fewer adult relatives in Boston*	M and F disagree on discipline***
		M less likely to have own car*	M doesn't see relatives enough***
		When M and F disagree, more likely to hit and throw*	M has fewer relatives in Boston**
			M and F disagree on child-rearing*
			M less likely to have own ca

Key

**** $p < .001$
*** $p < .01$
** $p < .05$
* $p < .15$

Past Stresses

Only ingestion and abuse cases' past stresses entered the discriminant function at significant levels. Especially of interest is the history of violence in the mothers' own childhoods, which the mothers of abuse victims saw as especially unhappy.

Discriminant Function Analysis

Variables Discriminating Between Each Case Category and Its Controls

3. Past Stresses

Accident	Ingestion	Failure to Thrive	Abuse
	As child, M was more often spanked with objects*		M's childhood unhappy****
			M spanked more often other than on hands and bottom***

Key

**** $p < .001$
*** $p < .01$
** $p < .05$
* $p < .15$

Parent-Child Interaction

Both accident and abuse victims' reports of parent-child interaction entered at significant levels. Paradoxically, the mothers of abuse victims reported spanking their children less. Although it is possible that this is an untruthful report, betrayed by the diagnosis, and forced by the hospital context in which the interview was conducted, this is not the only hypothesis which flows from this finding.

Previous study of the interaction of abuse victims with their parents disclose interaction patterns in which there is both a high degree of permisiveness and a great amount of punitiveness. Indeed, the frequency of hitting may be smaller, but the child's provocations may be met with more severe violence. It is this parenting style which, in the Sears, Maccoby, and Levin (1957) study of childrearing patterns was associated with the most frequent expression of serious aggression in children's observed play.

The significant case-control distinctions between the accident victims' mothers' reports of striking the child on vulnerable parts of the body and the age at which a child could reasonably be expected to be toilet trained are also provocative. The findings suggest that the propensity for accidents in preschool children may be increased by a child's inability to internalize his or her self-protection, even as the child is not protected by the parent; the possibly exaggerated expectations of the child may indicate a diagnostic overlap with child abuse in more than a few cases.

Discriminant Function Analysis

Variables Discriminating Between Each Case Category and Its Controls

4. Parent - Child Interaction

Accident	Ingestion	Failure to Thrive	Abuse
C spanked more often other than on hands and bottom**			M reports spanking C less***
M estimates young age for toilet training**			

Key

****	$p < .001$
***	$p < .01$
**	$p < .05$
*	$p < .15$

Life Context

Mothers of both accident and abuse victims were more frequently from urban areas, and specified their religions less often. They diverged with respect to contact with social agencies. The mothers of abuse victims were in contact with substantially more social agencies than their controls or the mothers of the accident victims.

Discriminant Function Analysis

Variables Discriminating Between Each Case Category and Its Controls

5. Life Context

Accident	Ingestion	Failure to Thrive	Abuse
M's family residence in urban area***			Fewer months since M had last job*
Religion specified less often***			Religion specified less often*
Fewer social agencies*			More social agencies**
M less likely to be born in U.S.*			M's family residence in urban area**

Key

**** p .001
*** p .01
** p .05
* p .15

Classification Analysis

To determine the extent to which equations generated in the discriminant function analyses successfully differentiate between patients in each of the pediatric social illness categories and patients in the control groups, a classification analysis was performed. The results are displayed on the following table. Application of the abuse equation to the abuse sample and its controls results in correct classification of 92% of the abuse cases and 90% of their controls. Application of the failure to thrive equation to be failure to thrive cases and their controls results in correct classification of 76% of the FTT cases and 88% of their controls. The ingestion equation yields correct classification of 87% of the ingestion cases and 87% of their controls, and the accident equation yields correct classification of 76% of the accident cases and 71% of their controls.

Correct and Incorrect Classification of Cases From Discriminant Function Analysis

Actual Group	Predicted Group	
	Cases	Controls
Accident		
Cases (n=97)	76%	24%
Controls (n=97)	29%	71%
Ingestion		
Cases (n=23)	87%	13%
Controls (n=23)	13%	87%
Failure to Thrive		
Cases (n=41)	76%	24%
Controls (n=41)	12%	88%
Abuse		
Cases (n=48)	92%	8%
Controls (n=48)	10%	90%

This study of how pediatric social illness categories differentiated and overlapped led us next to address whether there might be a more natural, logical grouping of cases and controls than is suggested by the diagnoses in the traditional pediatric classification.

Hierarchical Cluster Analysis

Hierarchical cluster analysis was used to explore how families might sort into homogeneous groups.

Mathematically, hierarchical cluster analysis is an iterative algorithm for reducing by one the clusters at each step, beginning with n clusters of single families. At step 0, there are n clusters of 1; at step 1, n-1 clusters; at step j, n-j clusters; at step n, 1 cluster of n.

The similarity matrix which is used for joining the most similar two clusters is initially a matrix of order n. After any amalgamation, the similarity between the cluster just formed and all other clusters must be recomputed, reducing by one the order of the similarity matrix.

The sample of 418 was randomly halved and a few redundant controls were discarded because they had been matched against more than one case.

A number of clustering methods were then tried on this sample. The method that yielded the best results in terms of tightness and size of clusters was hierarchical, using a similarity matrix of Euclidean distance on a set of sixty three variables, and employing furthest distance between clusters as the amalgamation criterion. Furthest distance means that the two clusters are amalgamated at a particular step whose most distant families are closer than the most distant families in every other pairing of clusters not yet amalgmated.

The sixty three variables upon which the half-sample was clustered was the set that best discriminated cases from controls within each of the pediatric social illness categories as well as families bearing the abuse

diagnosis from families bearing the accident diagnosis. Before entering into the calculation of Euclidean distance, each of the variables was standardized to have mean of zero and variance of unity within the half-sample.

The outcome was six cohesive clusters from which three families were excluded because they fit into no cluster well. Clustering was halted at the point where amalgamation of the next two clusters would cause the new cluster to be heterogeneous relative to the two clusters that would have been swallowed. Out of 209 families, 202 had been successfully clustered.

Now we turned to replication. The random half-sample held in reserve was now clustered. The yield was six clusters totaling 199 families. Our task was now to attempt to find which of the six clusters in the original half-sample was a near-replica with one or more of the six clusters from the reserve half-sample.

We designed a three-fold test. First, to be paired two clusters must distribute identically, within sampling fluctuation, over the five diagnostic outcomes. Second, a comparison of mean values for two clusters across the sixty-three variables should yield few statistical differences. Third, the two clusters should have sizes not statistically different.

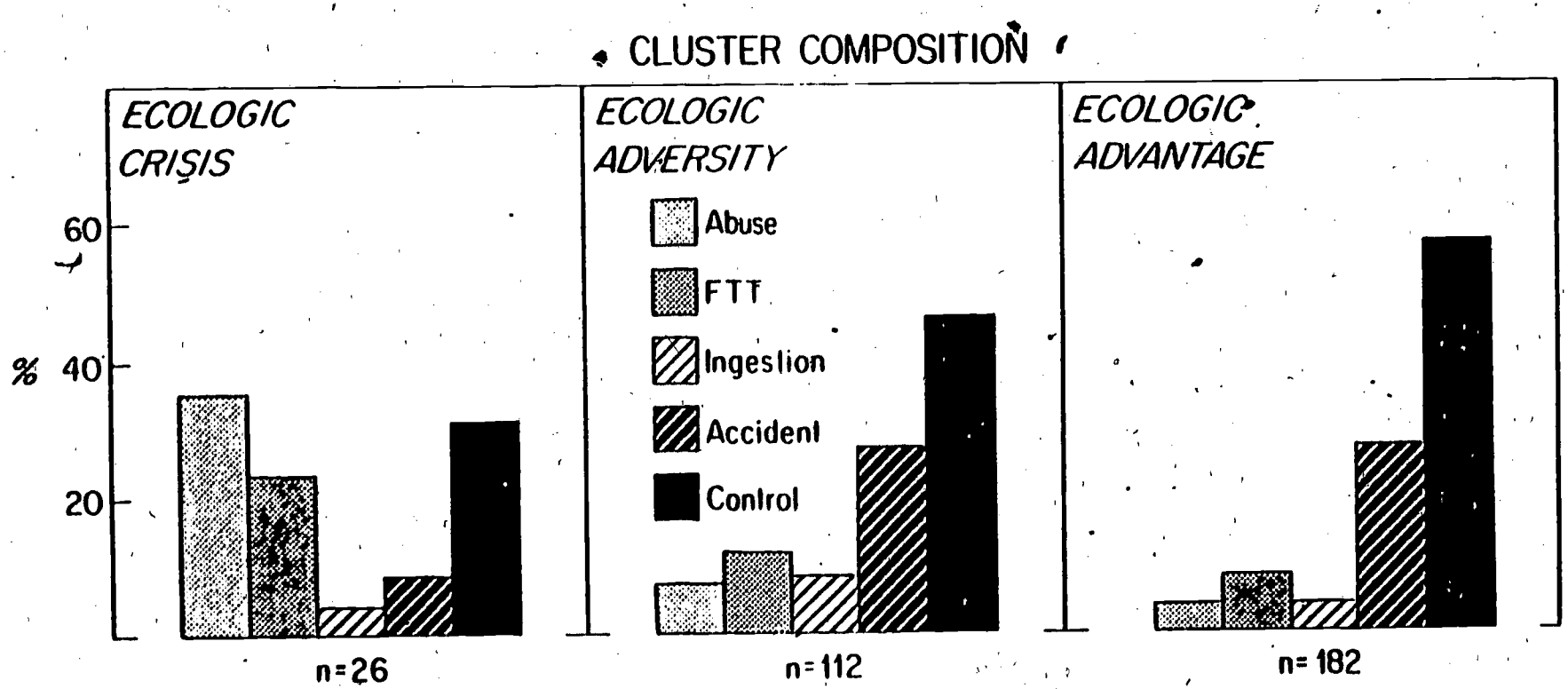
Two clusters paired handsomely. Their distributions on diagnoses were very close; on 59 of the 63 cluster variables means did not significantly differ; and they had similar sizes, 90 and 92. This group of 182 turned out to be our group at lowest risk for abuse or failure to thrive. We called this the "ecologic advantage group."

The clusters that formed what became our group at highest risk for abuse or failure to thrive also paired well with one exception. They too distributed themselves very similarly over the diagnoses, but with very

low counts for most diagnoses, and their means did not differ on 56 out of the 63 cluster variables. However, sample sizes were statistically discrepant. The cluster from the original sample had eight families and the cluster from the reserve sample had eighteen families. No other similar cluster could be found in the original sample that would bring the sample sizes of the clusters into balance between the original and reserve half-samples.

We were able to find an additional cluster--this time in the reserve sample--to form our third group, the one we call ecologic adversity. Although all three groups exhibited good agreement in their diagnostic distributions, neither reserve cluster conformed as well to the original cluster when it came time to contrast on cluster variables. In one comparison fifty-two out of sixty-three means were the same within statistical tolerance; in the other comparison only forty-five of the means were the same. Furthermore, this latter reserve cluster had more means in common with the original cluster that became one half of our lowest-risk group. Despite these problems we decided to combine the original cluster of fifty-seven with the reserve clusters of 26 and 29 to form the group of 112.

The following figure shows histograms of diagnoses for each of the three risk groups. Recall that these clusters were formed without knowledge of the diagnosis.


CLUSTER COMPOSITION
ECOLOGIC CRISIS
ECOLOGIC ADVERSITY
ECOLOGIC ADVANTAGE
Abuse
FTT
Ingestion
Accident
Control
60
40
20
%
n=26
n=112
n=182

Note the distribution of abuse and failure to thrive among the three groups. While 35% of families in the ecologic crisis cluster were diagnosed as abusive, only 7% of families in the adversity and advantage clusters were so diagnosed. Thus the prevalence of abuse in the families in ecologic crisis is five times what it is in the combination of the other two groups. While 23% of children in the crisis cluster were diagnosed as failure to thrive, 13% of families in the other two groups were so diagnosed. Thus, the prevalence of failure to thrive in families in ecologic crisis is about 1.5 times the rate in the groups we called ecologic adversity and advantage.

The picture is reversed for accidents and acute medical conditions. Only 8% of children in the crisis group were classified as accidents, whereas 37% of the children in the adversity and advantage groups were identified as accidence. This prevalence is about 4.5 times what it is in the crisis cluster. The prevalence of acute medical conditions is 2.3 times as great in the adversity and advantage groups as in the crisis group.

A PROFILE OF HIGH RISK FAMILIES

We next describe the statistical analyses used to profile the clusters. Then we present a more detailed picture of family function for each group within nine critical areas of family life.

Statistical Analyses of Group Profiles

For each of the 63 variables that defined interfamilial distance and together formed the three clusters, we executed a one-way ANOVA followed by a Duncan Multiple Range Test. The F-test and R-square from the ANOVA answer the question of how well each variable differentiates the three groups. The Duncan Test answers a more refined question: for the variable under study and for each of the three possible pairings of two groups, are the two groups different at or below the 0.05 level of significance.

For any set of three tests of a variable based on three pairings, the

probability of not erroneously declaring a random difference significant is .95. However, across the entire set of 189 Duncan tests, this probability drops to 0.04. It is therefore reasonably certain that one or more of the findings we subsequently report are wrong. However, the probability is .99 that no more than seven significant results are false. What we may say from the foregoing analysis of error rates is that while a few of the differences set forth below are likely to be spurious, the bulk of them are not.

Mother's Childhood

The parents of mothers in families in ecologic crisis often disagreed about childrearing, according to the mother. These mothers remember being disciplined more severly than mothers in the other groups. They were more often hit with objects as well as on parts of the body other than hands or buttocks. Physical discipline continued into adolescence for many of them.

When asked to summarize their childhoods, mothers in the crisis group gave a neutral assessment in contrast to other mothers who felt they were "somewhat happy" as children.

Mother's Attainments

The more skilled the mother's occupation is, there appears to be less risk of her child becoming abused or undernourished. In order from highest to lowest risk groups, mothers' occupations are: unskilled or semi-skilled labor, skilled labor, and clerical work.

This pattern repeats for education. Among families in crisis, mothers have rarely finished high school; more education is associated significantly with a more favored ecologic state.

Father's Background

Where most fathers of families in ecologic crisis were raised in rural locations, most fathers in the two other groups were raised in urban

locations. There are also slightly higher rates of broken marriages between parents of fathers in families in crisis.

Distribution of Family Attributes Within Clusters

Area	Variable Description	Group: Crisis	Group: Adversity	Group: Equilibrium	Statistical Significance (.05): C-26	A=112	E=182
M's childhood	M's parents agree child-rearing	No	Yes	Yes	C	A	E
	M appropriately disciplined	No	Yes	Yes	C	A	E
	M hit with objects	Occasionally	Never/Rare	Never/Rare	C	A	E
	M hit vulnerable body parts	Occasionally	Never/Rare	Never/Rare	C	A	E
	M hit in adolescence	Occasionally	Never/Rare	Never/Rare	C	A	E
	How happy M's childhood?	Neutral	Somewhat happy	Somewhat happy	C	A	E
M's Attainments	M's Occupation	Semi/unskill	Clerical	Skilled	C	A	E
	M's Education	h.s. drop out	h.s. grad	h.s./some coll.	C	A	E
F's background	%Fs raised in rural location	69%	33%	27%	C	A	E
	%Fs with separated parents	41%	28%	18%	C	A	E

Note:
Any group within a box is statistically different from group or groups not in that box and in another box

Family Wealth

Families in crisis are poor. Their income is only $96 per family member. Note also that the families in the other groups were by no means affluent. Two hundred dollars per week works out to $9,600 per year for a family of four. The annual income of families in crisis, however, is about half that, or $4,800.

Data with respect to welfare dependency reinforces the income picture. Where seven of eight families in the crisis cluster are dependent on welfare, only one out of three of the "advantaged" families and one out of six of the families in the adversity cluster are dependent on welfare.

Mothers' State

Mothers in the crisis cluster report minor to moderate health problems while other mothers voice few health complaints. Coupled with health problems, many high-risk mothers sometimes find it hard to get going in the morning. This is borne out by their reports of watching an average of 7½ hours of television per day. Mothers in the other clusters watch 3½ and 3 hours of T.V. per day respectively.

Not only do mothers in the crisis cluster appear to be more beset by physical and psychological problems (not to mention the problem of severe poverty). They are more likely to feel, at least some of the time, that no one cares what happens to them. In addition, only slightly more than half describe themselves as happy. Over 80% of mothers in the lower-risk groups feel they are happy.

Mother and Men

In almost all families in crisis, the mothers are single, separated, or divorced. This diminishes with greater advantage; the married state significantly differentiates among the groups. In homes in crisis, there

is either no man or there is a man who does not live there all the time. More often than not, advantaged mothers are almost always living with a man, to whom, most frequently, they are married.

Distribution of Family Attributes Within Clusters

(continued)

Area	Variable Description	Group: Crisis	Group: Adversity	Group: Equilibrium C=26 A=112 E=182	Statistical Significance (.05)
Family Wealth	Per capita income per month	$96	$196	$175	C A E
	% Families on welfare	85%	19%	38%	C A E
Mother's State	M's health problems	minor/moderate	none/minor	none	C A E
	M can't get going in morning	rarely/some	never/rare	never/rare	C A E
	Hours M watches TV per day	7.3 hrs.	3.0 hrs	3.5 hrs	C A E
	M feels no one interested in her	rare/some	rare	rare	C A E
	% Ms who say they are happy	58%	78%	86%	C A E
Mother and Men	M single, separated, divorced	most	half	few	C A E
	Man present in home	unclear	yes	unclear/yes	C A E

Mother and Kin

The data suggest that the more kin one has available, the greater the ecologic advantage.

Mother and Child

Mothers in the crisis cluster claim they spank no more than mothers in the other two groups. These mothers do, however, find their children more difficult to manage than lower-risk mothers.

Child

The evidence of the child's state comes from the mother's impression after admission of the child to the hospital as a patient. Her interview response might be colored by her reactions to doctors, nurses, or social workers who have conferred with her about the child.

Mothers in the crisis group appraise their child's usual health as less favorable than mothers in the other groups.

The Vineland Social Maturity Score was also calculated from information given by the mother. The more advantaged children enjoyed higher scores.

The hematocrits of children in the crisis cluster may be slightly lower than the hematocrits of children in the other two groups, but not so low that these children, as a group, could be called anemic.

There is uniformity among children in the three groups on reactivity to visual and auditory changes and to distractability during fussy periods.

Distribution of Family Attributes Within Clusters

(continued)

Area	Variable Description	Group: Crisis	Group: Adversity	Group: Equilibrium	Statistical Significance (.05) C=26 A=112 E=182
Mother and Kin	Avg # of M's relatives in area	2.6	2.4	3.1	C A E
	Avg # of relatives M counts on	2.3	2.3	3.2	C A E
	Avg # of visits per week to relatives	2.0	2.0	2.5	C A E
	% of Ms who see relatives enough	81%	73%	94%	C A E
Mother and Child	# of times per wk M spanks C	1 to 2	2 to 3	2 to 3	C A E
	% of Cs described as difficult	65%	21%	17%	C A E
Child	C's usual health	fair/good	good/excellent	good/excell	C A E
	% of Cs socially immature	20%	14%	1%	C A E
	Avg Hematocrit	32.5%	33.5%	34.4%	C A E
	Reactivity visual/ auditory change	somewhat/ variable	somewhat/ variable	somewhat/ variable	C A E
	How distractable when fussy	somewhat easily	somewhat easily	somewhat easily	C A E

Summary of High-Risk Families

We have profiled high-risk families in nine vital aspects of their lives: mother's childhood, mother's attainments, father's background, family wealth, mother's state, mother and men, mother and kin, mother and child, and child's state. In nearly every domain, the crisis cluster appears to suffer.

Whether or not abuse or undernourishment has occurred in these families, they usually have terrible trouble in intimate relationships and woefully inadequate financial means. For the mother, her whole life has often been emotionally impoverished as well, puncuated by violence and abandonment.

Conclusion

These three clusters give a matrix for organizing data from families whose children suffer pediatric social illnesses. Rather than to imply judgement of the adequacy of a parent, they focus on specific aspects of family functioning. We believe practice will improve when, with compassion and respect, we can systematically identify and address the strengths and weaknesses of parents and children.