

The Relationship Between Cumulative Risk Burden and Offense Types and Recidivism Among Juvenile Offenders

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ABSTRACT

Introduction: Juvenile delinquency is often shaped by cumulative and multidimensional risk exposure rather than isolated risk factors. This study aimed to examine the relationship between cumulative risk burden and both offense types and recidivism among juvenile offenders, and to evaluate the discriminative ability of a behavioral risk factor count for identifying recidivism.

Methods: This cross-sectional observational study was conducted using retrospective records of 982 justice-involved children evaluated between January 1, 2024, and June 30, 2025. Associations between sociodemographic, familial, and educational variables and recidivism were examined using hierarchical logistic regression analyses. The discriminative performance of a behavioral risk factor count—comprising smoking, alcohol/substance use, self-harm, tattoo presence, and child labor—was assessed using receiver operating characteristic (ROC) analysis.

Results: Family criminal history and low educational attainment were strongly associated with recidivism. The behavioral risk factor count demonstrated moderate-to-high discriminative ability in distinguishing children with and without recidivism (area under the curve [AUC]=0.77). Higher risk factor counts were particularly observed among children involved in property-related crimes.

Conclusion: The findings indicate that juvenile delinquency is better understood through a cumulative and multidimensional risk framework rather than single risk indicators. The behavioral risk factor count appears to be a pragmatic tool for early risk screening and stratification, rather than a causal predictor.

Keywords: adolescent behavior, behavioral indicators, forensic psychiatry, retrospective studies, youth justice

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INTRODUCTION

The literature indicates that offending behavior in children and adolescents cannot be explained by a single domain of risk; rather, it emerges through the interplay of risk and protective factors across individual, familial, school, and broader environmental contexts (1,2). Biopsychosocial and developmental-ecological perspectives further suggest that individual vulnerabilities yield more coherent explanatory models when considered alongside family and environmental conditions (3,4). In parallel, person-centered approaches and latent class analyses have shown that assessing multiple risk domains concurrently provides better discrimination of offending behavior and recidivism risk than isolated variables alone (5,6).

A growing body of evidence has also indicated that youth offending is often associated not with discrete risks, but with their cumulative effects. The cumulative burden of adverse childhood experiences has been reported to account indirectly for a substantial proportion of forensic outcomes, while exposure to multiple risks increases both the frequency and persistence of offending behavior (7). Adverse outcomes have likewise been shown to rise markedly among children and adolescents exposed to three or more risk factors (8,9). Within this framework, the cumulative risk approach offers a pragmatic model that summarizes the

Highlights

- Juvenile offending reflects cumulative risk burden more than isolated risks.
- Behavioral risk factor count showed moderate-to-high discrimination for recidivism.
- Cumulative risk burden was higher among youth involved in property offenses.
- Findings support cumulative indicators for pragmatic early risk screening.

overall psychosocial burden to which an individual is exposed in a simple and quantitative manner.

However, the effects of risk factors are not homogeneous across all offense types. Studies have demonstrated that children involved in violent and non-violent offenses display distinct risk profiles, and that

certain domains of risk are more discriminative depending on the type of offense (6,10). This suggests that assessment should be sensitive to offense-specific patterns rather than treating delinquent behavior as a uniform outcome.

Although the cumulative risk framework provides a robust conceptual basis, empirical work remains limited on the extent to which the accumulation of behavioral risk factors can distinguish critical outcomes such as offense type and recidivism. This represents an important gap for early risk stratification.

The present study aimed to examine the association of cumulative risk burden with i) offense type and ii) recidivism among justice-involved children, and to evaluate the discriminative capacity of accumulated behavioral risk factors for these outcomes. Accordingly, the distribution of the number of risk factors across different offense patterns, as well as its performance in distinguishing children with and without recidivism, was examined using ROC analysis, which does not imply causal inference but provides a quantitative estimate of classification performance.

METHODS

Study Design

This study was designed as a cross-sectional, observational, retrospective chart-review study aimed at examining the sociodemographic, familial, and behavioral characteristics of children in conflict with the law within an integrated framework. Reporting of the study was guided by the STROBE statement (Strengthening the Reporting of Observational Studies in Epidemiology), an internationally recognized guideline for observational research.

Sample

The target population comprised children who underwent forensic evaluation due to alleged offending behavior between January 1, 2024, and June 30, 2025, at the relevant forensic unit operating in Konya, Türkiye. In the retrospective review based on forensic reports issued during this period, records of 1,003 children were initially considered eligible for inclusion. Cases with missing data on key sociodemographic, familial, or behavioral variables deemed critical for the analyses were excluded. Exclusion criteria were defined as the complete absence of age information, missing core demographic data such as sex or educational level, or the identification of duplicate records. After 21 records (2.1%) were excluded because of missing data, the final analytic sample consisted of 982 children. The sample size was determined by including all eligible records available within the predefined study period, thereby using the accessible population in full. Although no *a priori* sample size calculation was performed, the final sample size was considered statistically adequate for the planned comparative analyses. The exclusion of some cases because of missing data was nevertheless acknowledged as a potential source of selection bias.

Data Sources and Measures

All data used in this study were not collected prospectively for research purposes; rather, they were obtained from standardized forensic assessment forms and official institutional archives that had been systematically maintained as part of routine forensic evaluation procedures to support clinical and legal decision-making. This context enhances the ecological validity of the data by reflecting real-world clinical forensic practice.

The independent variables examined included age, sex, educational level, migration history, family structure, parental cohabitation status, family history of offending, and a range of behavioral risk factors. Behavioral risk

factors were defined as cigarette use, history of alcohol or substance use, self-injurious behavior, presence of tattoos, and child labor status; each was coded as a binary variable indicating presence or absence. These variables were assessed in a broadly comparable manner across cases, providing a basic level of measurement standardization. Conceptually, they also correspond to behavioral and psychosocial risk domains frequently reported in the literature on child and adolescent offending (7,11).

The primary outcome variables were offense type and recidivism status (present/absent). Recidivism was coded as present when more than one forensic record was available for the same child within the study period or when institutional archive records documented a prior forensic history. For analytic purposes, offense types were classified into three main categories consistent with conceptual frameworks commonly used in the literature: offenses against persons, property offenses, and other offenses. The number of risk factors, a study-specific variable, was calculated for each child by summing the behavioral risk factors present and was treated as a continuous/ordinal indicator quantitatively reflecting the child's cumulative risk burden.

Given the retrospective and record-based nature of the study, some heterogeneity in data entry was anticipated. To minimize the impact of such variation, the dataset was carefully screened before analysis for coding consistency, logical errors, and outliers, and recoding was performed where necessary. During data extraction, researchers processed the data without knowledge of the outcome variables.

Statistical Analysis

All statistical analyses were performed using IBM Statistical Package for Social Sciences (SPSS) program version 29.0 for Windows. In descriptive analyses, categorical variables were presented as frequencies (n) and percentages (%). The distribution of continuous variables was evaluated for normality using visual methods (histograms and Q-Q plots) and the Shapiro-Wilk test; normally distributed continuous variables were reported as mean $\pm$ standard deviation.

Hierarchical logistic regression models were constructed to evaluate factors associated with recidivism, with careful assessment of multicollinearity, influential observations, and model fit. At the multivariable analysis stage, certain categories were collapsed on theoretical grounds to increase statistical power, reduce model instability arising from sparse cell frequencies, and minimize the risk of multicollinearity.

Because the number of behavioral risk factors was expected to show a strong and linear association with recidivism, potentially reducing coefficient stability in some subgroups, its discriminative performance was additionally examined using receiver operating characteristic (ROC) analysis. The area under the curve (AUC), 95% confidence intervals, and Youden index were calculated. This analysis was interpreted not as a causal prediction model, but as a quantitative assessment of the utility of the number of risk factors for early risk screening and stratification.

Ethical Considerations

The study was approved by the Non-Interventional Research Ethics Committee of Tokat Gaziosmanpaşa University Faculty of Medicine (Decision Date: December 2, 2025; Decision No: 25-MOBAEK-417). Because the research was conducted retrospectively using institutional archive records, the requirement for individual informed consent was waived by the ethics committee. The study was carried out in accordance with the principles of the Declaration of Helsinki. In addition, the necessary institutional permission for conducting the study was

obtained from the Education and Scientific Research Commission of the Council of Forensic Medicine (Decision dated August 12, 2025, No. 21589509/2025/935).

RESULTS

A total of 982 children in conflict with the law were included in the study. The sample was predominantly male, with a mean age of 13.34 ± 0.90 years. More than half of the participants had completed 6–8 years of education. Examination of familial characteristics showed that approximately one quarter of the children had separated parents, more than one third had experienced parental loss, and nearly one third had a family history of offending. A migration history was present in roughly one quarter of the sample. Most children were living in nuclear family households, while more than half did not have a room of their own. The sociodemographic and familial characteristics of the sample are presented in Table 1.

When the distribution of offense types was examined, violence/assault emerged as the most frequently reported offense category. This was followed by offenses related to theft or violation of residential or workplace inviolability. Threats, insults, stalking, or disturbing the peace; sexual offenses; property damage; robbery/aggravated robbery; drug-related offenses; and other offenses were observed at lower frequencies. The detailed distribution of offense types is presented in Table 2.

For analytic purposes, offense types were grouped into three categories: offenses against persons, property offenses, and other offenses. Comparisons across offense categories revealed significant differences in sex, educational level, migration status, and family history of offending. The property offense group showed higher proportions of male sex, lower educational attainment, migration history, and family history of offending than the other groups. By contrast, the proportion of girls was relatively higher among those involved in offenses against persons. The distribution of key sociodemographic and familial variables by offense type is shown in Table 3.

In the hierarchical logistic regression analysis conducted to identify factors associated with recidivism, age and sex were not significantly associated with recidivism in the first block, which included demographic variables. After familial and environmental variables were added to the model, family history of offending showed a strong association with recidivism. In the third block, which incorporated educational and socioeconomic variables, lower educational attainment was significantly associated with recidivism. In the full model, family history of offending, lower educational level, and the presence of at least one risk factor remained positively associated with recidivism, whereas committing the offense as part of a group was inversely associated with the likelihood of recidivism. Detailed results of the hierarchical logistic regression analysis are presented in Table 4.

Model fit indices indicated that the explanatory power of the model increased as successive blocks of variables were entered. The Nagelkerke R^2 value increased from 0.020 in the initial model containing demographic variables to 0.357 in the full model. The Hosmer–Lemeshow test for the full model indicated acceptable model–data fit, and the model correctly classified 73.6% of cases. Model fit statistics by hierarchical block are provided in Table 5.

The discriminative performance of the number of risk factors in distinguishing children with and without recidivism was further evaluated using ROC analysis. The number of risk factors showed moderate-to-high discrimination for recidivism ($AUC=0.77$; 95% $CI=0.74$ – 0.80 ; $p < 0.001$). This finding suggests that the number of risk factors may serve not as

Table 1. Sociodemographic and familial characteristics of the study sample (n=982)

Variable	n	%
Sex		
Female	154	15.7
Male	828	84.3
Age, years	Mean $\pm$ SD	
	13.34 $\pm$ 0.90	
Educational level		
0–5 years	122	12.4
6–8 years	549	55.9
9–12 years	311	31.7
Grade repetition		
No	826	84.1
Yes	156	15.9
Parental separation		
Absent	740	75.4
Present	242	24.6
Parental loss		
Absent	634	64.6
Present	348	35.4
Stepparent status		
Absent	926	94.3
Father	37	3.8
Mother	19	1.9
Family history of offending		
Absent	665	67.7
Present	317	32.3
Migration status		
None	749	76.3
Internal migration	113	11.5
International migration	120	12.2
Household composition*		
Mother	208	21.2
Father	45	4.6
Nuclear family	633	64.5
Extended family/other	55	5.6
State care/foster care	40	4.1
Housing status		
Unknown	39	4.0
Own home	493	50.2
Rented home	450	45.8
Own room		
No	566	57.6
Yes	416	42.4
Father's occupation*		
Not working/unemployed/incarcerated/unable to work	112	11.4
Retired	26	2.6
Wage laborer/unskilled–semi-skilled worker	350	35.6
Agriculture/livestock	65	6.6
Tradesman/small business owner	168	17.1
Transportation/driving/freight work	57	5.8
White-collar/public sector	62	6.3
Unknown	141	14.4
Mother's occupation		
Unknown	80	8.1
Homemaker	717	73.0
Worker	139	14.2
White-collar	30	3.1
Tradeswoman/small business owner	16	1.6
Number of children in the family	Mean $\pm$ SD	
	3.74 $\pm$ 2.03	

*Detailed category information was missing for one participant for each of the household composition and paternal occupation variables (valid n=981 for each).

Table 2. Distribution of offense types

Offense type	n	%
Violence/assault	437	44.5
Theft/violation of residential or workplace inviolability	196	20.0
Threats / insults / stalking / disturbing the peace	84	8.6
Sexual offenses	76	7.7
Other offenses (traffic offenses / official documents / deprivation of liberty/personal data)	73	7.4
Property damage/damage to public property/damage to places of worship or cemeteries	61	6.2
Robbery / aggravated robbery	32	3.3
Drug-related offenses	23	2.3
Total	982	100.0

a definitive or causal indicator of individual-level prediction, but as a pragmatic marker for early risk screening and stratification.

DISCUSSION

The findings of this study are broadly consistent with the current literature indicating that risk among children in conflict with the law is shaped not by isolated variables, but by a cumulative and multidimensional burden. The concurrent and accumulating presence of familial vulnerabilities, educational disadvantage, and behavioral risks appears to play a marked role not only in differentiating offense types, but also in distinguishing recidivism. Taken together, these findings suggest that youth offending should not be conceptualized as a phenomenon confined to individual-

Table 3. Distribution of key sociodemographic and familial predictors by offense type

Variable	Offenses against persons n=597 (60.8%)	Property offenses n=289 (29.4%)	Other offenses n=96 (9.8%)	χ^2 (df)	p
Sex				38.91 (2)	<0.001
Female	127 (21.3)	15 (5.2)	12 (12.5)		
Male	470 (78.7)	274 (94.8)	84 (87.5)		
Educational level				61.38 (4)	<0.001
0–5 years	44 (7.4)	59 (20.4)	19 (19.8)		
6–8 years	337 (56.4)	176 (60.9)	36 (37.5)		
9–12 years	216 (36.2)	54 (18.7)	41 (42.7)		
Migration status				19.22 (2)	<0.001
No	476 (79.7)	194 (67.1)	79 (82.3)		
Yes	121 (20.3)	95 (32.9)	17 (17.7)		
Family history of offending				71.08 (2)	<0.001
Absent	463 (77.6)	144 (49.8)	58 (60.4)		
Present	134 (22.4)	145 (50.2)	38 (39.6)		

Table 4. Hierarchical logistic regression analysis examining factors associated with recidivism (N=982)

Variable	B	SE	Wald	p	OR	95% CI for OR
Block 1: demographic factors						
Age at offense	0.004	0.097	0.002	0.964	1.00	0.83–1.21
Male sex	0.322	0.222	2.10	0.148	1.38	0.89–2.13
Block 2: familial and environmental factors						
Parental loss	1.533	0.819	3.51	0.061	4.63	0.93–23.1
Parental separation	0.049	0.297	0.03	0.870	1.05	0.59–1.88
Presence of a stepparent	-0.016	0.358	0.00	0.965	0.98	0.49–1.98
Family history of offending	1.613	0.186	75.30	<0.001	5.02	3.49–7.23
Household composition	0.229	0.187	1.49	0.222	1.26	0.87–1.81
Migration history (present)	0.311	0.320	0.95	0.330	1.37	0.73–2.56
Block 3: educational and socioeconomic factors						
Low educational level	0.842	0.284	8.80	0.003	2.32	1.33–4.05
Grade repetition	0.200	0.214	0.87	0.350	1.22	0.80–1.86
Low paternal socioeconomic status	0.192	0.182	1.12	0.289	1.21	0.85–1.74
No room of one's own	-0.294	0.158	3.46	0.063	0.75	0.55–1.02
Block 4: clinical and offense-related factors						
≥1 Risk factor	0.818	0.178	21.15	<0.001	2.27	1.60–3.22
History of psychiatric treatment	-0.136	0.480	0.08	0.778	0.87	0.34–2.23
Weapon use	0.037	0.232	0.03	0.872	1.04	0.66–1.64
Group offending	-0.428	0.157	7.45	0.006	0.65	0.48–0.88

Table 5. Model fit statistics by hierarchical block

Model	-2 Log Likelihood	Cox & Snell R ²	Nagelkerke R ²	Hosmer-Lemeshow p	Correct classification (%)
Block 1 (Demographic)	1344.81	0.015	0.020	0.768	54.4
Block 2 (+ Familial)	1111.14	0.224	0.299	0.857	71.8
Block 3 (+ Educational)	1089.09	0.241	0.322	0.561	71.9
Block 4 (Full model)	1054.23	0.268	0.357	0.473	73.6

level pathology; rather, it should be evaluated in relation to the aggregate influence of the ecological, relational, and social contexts in which the child is embedded.

In the literature, impaired family functioning, inadequate parental supervision, and adverse childhood experiences have consistently been identified as among the most robust risk domains for offending in children and adolescents (12,13). In the present study, the strong association between family history of offending and recidivism is consistent with multidimensional theoretical models of intergenerational transmission of offending. This association is unlikely to reflect solely genetic or biological vulnerability; rather, it may capture the cumulative effects of environmental and relational mechanisms, including social learning processes, the internalization of norms, and the quality of parent-child interactions (14,15).

It should also be emphasized, however, that the intergenerational transmission of offending is not a deterministic process. Previous research has shown that protective parenting practices, such as consistent discipline, warm parent-child relationships, and positive monitoring, may attenuate the impact of familial offending even in high-risk contexts (16,17). Accordingly, the present findings should not be interpreted as indicating that family history of offending is an isolated causal factor, but rather as suggesting that it represents a strong contextual marker of a high cumulative risk profile.

One of the notable findings of this study was that the number of behavioral risk factors provided meaningful discrimination for recidivism. The substantially higher number of risk factors observed among children with recidivism, together with the moderate-to-high discriminative performance demonstrated in the ROC analysis, indicates that reoffending cannot be reduced to the effect of a single factor. This finding is consistent with large-sample studies showing that a high burden of adverse childhood experiences exerts a strong influence on forensic outcomes through indirect and cumulative mechanisms (7,18).

The cumulative risk approach posits that simultaneous exposure to multiple domains of risk incrementally increases both the frequency and persistence of offending behavior. Indeed, having three or more risk factors has been associated with substantially poorer outcomes than more limited risk profiles (8,9). In this context, the number of risk factors may be regarded not as a measure that captures the severity or developmental timing of each risk in detail, but as a simple, quantitative summary of the child's overall behavioral burden, with pragmatic value for clinical and forensic practice.

Analyses by offense type also showed that risk profiles were not homogeneous. In particular, the higher number of risk factors among children involved in property offenses suggests that these offenses may be more closely linked to the accumulation of socioeconomic disadvantage, educational problems, and behavioral risks. The literature similarly indicates that cumulative risk burden may play a more pronounced role in non-violent offending, whereas specific individual and relational risk domains may be more discriminative in violent offenses (6,10). These findings support the view that children in conflict with the law do not constitute a uniform risk group and underscore the need for offense-sensitive assessment approaches.

The association between educational disadvantage and youth offending should likewise be interpreted not as a stand-alone causal explanation, but as an important component of the broader cumulative risk context. Lower educational attainment has previously been shown to increase the risk of antisocial behavior through difficulties in self-control and parenting processes, while school disengagement may function both as an indicator of existing risk and as a process that facilitates involvement in offending

(19,20). In the present study, the limited but significant contribution of educational level in the multivariable analyses is consistent with this multidimensional explanatory framework.

From a methodological perspective, the use of ROC analysis represents one of the important contributions of this study. The hierarchical logistic regression models constructed for sociodemographic and familial variables associated with recidivism yielded statistically stable results. However, inclusion of the number of behavioral risk factors in these models introduced certain technical limitations because of its strong and linear association with recidivism. Therefore, ROC analysis was selected to evaluate the extent to which behavioral risk burden could distinguish children with and without recidivism. This approach does not aim to establish causal inference, but rather quantifies classification performance. It highlights the potential utility of the number of risk factors for early risk screening and stratification, rather than as a definitive individual-level predictive indicator (21,22).

The findings should be considered in light of several limitations. The cross-sectional and retrospective design of the study precludes causal interpretation of the associations between variables. Reliance on forensic and institutional archive records may have introduced non-standardized measurement and potential information bias. Although cases with missing data were excluded, the possibility of selection bias cannot be fully ruled out. In addition, while the number of risk factors provides a practical summary of behavioral risk burden, it does not capture detailed information regarding the severity, duration, or developmental timing of these risks. Finally, because the study was conducted using data from a single geographical region, the generalizability of the findings to different cultural and forensic contexts may be limited.

In conclusion, this study demonstrates that cumulative risk burden plays a central role in both the differentiation of offense types and the discrimination of recidivism among children in conflict with the law. The discriminative performance of the number of behavioral risk factors, supported by ROC analysis, suggests that this indicator may have pragmatic value as an early screening tool in forensic and clinical settings. The findings further indicate that youth offending is not a phenomenon confined to individual pathology, but a multilayered process shaped by the cumulative effects of family context, educational disadvantage, and behavioral risks. Within this framework, child justice systems should prioritize assessment and intervention strategies grounded in multidomain, integrated risk profiles rather than approaches based on isolated risk indicators.

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Informed Consent: Because the research was conducted retrospectively using institutional archive records, the requirement for individual informed consent was waived by the ethics committee.

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