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Quantitative Patterns in Juvenile Delinquency: Age-Group Concentration, Guilt Rate Variation, and the Limits of Social Determinism

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Abstract:
The National Crime Records Bureau (NCRB), under India's Ministry of Home Affairs, each year publishes data sets on 'Crime in India', amongst other records. These records are very important for policy and governance as they provide evidence-based data lawmakers. Such data sets are equally important for academic and research purposes to increase public awareness and accountability. Researchers from various back grounds in criminology, sociology, and economics use this data for public policy studies and international comparisons. Such data also enables longitudinal studies on crime patterns over decades. The ability to separately track and identify the vulnerable groups, women, children, elderly, and marginalized communities, serves as a commitment to the socialist and secular directives of our constitution. Statistical analysis of aggregate data like crimes provides starting point to drill down with more granular analysis. However, NCRB cautions the readers that "Crime is a manifestation of myriad complex factors"; thus, overly simplistic inferences from the study of aggregate-level data should be used only for hypothesis building and should be further substantiated with detailed research and thinking. The researchers need to be aware of fundamental fallacies of statistical analysis when applying such frameworks on a subject as intricate as crime - If two variables move together, it doesn't mean one drives the other; a trend visible in aggregated data can disappear or even reverse when you break it into subgroups; conclusions drawn from group-level data cannot be automatically applied to individuals within that group. *Thus, high level statistical analysis should be viewed as directional evidence and not proof!* In present paper, the researchers used various statistical methods such as ANOVA, chi-square analysis, regression modelling and cluster analysis on the 5A and 5 B tables of the NCRB report which covers data on total crimes committed by juveniles for 2022–2024 period (Juveniles in conflict with Law separately monitored for States and Union territories and metropolitans respectively). In this paper, parallels are also drawn with results of similar prior studies to identify recurring trends and highlight contrasting conclusions.

Key Words: NCRB 2024; Juvenile Crime Statistics; Juvenile Crime rates; Guilt rates; Crime in India 2024

Introduction:

In May 2026; the National Crime Records Bureau (NCRB) released the 72nd edition of its annual report on 'Crime in India' covering 1st January to 31st December 2024 period. This report aims to provide a

comprehensive review of crime statistics in India. NCRB prepares this report by compiling and collating data from the police departments of all 36 states and union territories (UTs) in India and from state police agencies like State Crime Records Bureau (SCRB)/Crime Investigation Departments (CID) of 19 metropolitan cities (having a population of more than 20 lakhs). The data is reported separately for the states (including UTs) and the metropolitan areas, as it is widely accepted at policy making level that the nature, scale, and policing challenges of metropolitan cities is significantly different from those of the states (including UTs). The cohort analysis studies have indicated that sophisticated crimes like organized crime/cybercrime/economic offenses and crimes against women find prevalence in metropolitan cities; thus, separate reporting allows for more accurate analysis, comparison, and policy formulation. The data is collected with internationally accepted standard of 'Principal Offence Rule' which states that if many offences are registered in a single FIR case, only the most heinous crime i.e. the one that attracts maximum punishment, is considered as the counting unit.

The 5A and 5B sections of the NCRB report focus on juveniles in conflict with the law. The 5A section outlines that in the states (including UTs); a total of 34,878 cases were registered against juveniles during 2024; this shows an increase of 11.2% over 2023 (31,365 cases). A total of 42,633 juveniles were apprehended in these 34,878 cases, out of which 34,648 juveniles were apprehended under cases of IPC & BNS, and 7,985 juveniles were apprehended under cases of SLL during 2024. The crime rate also increased from 7.1 in 2023 to 7.9 in 2024.

Similarly, the 5B section outlines that in the metropolitan cities; a total of 5,050 cases were registered against Juveniles during 2024, showing a decrease of 7.8% over 2023 (5,480 cases). A total of 7,095 juveniles were apprehended in 5,050 cases, out of which 6,342 juveniles were apprehended under IPC and BNS cases and 753 juveniles were apprehended under SLL cases. Majority (77.2%) of juveniles in conflict with law apprehended under IPC & BNS and SLL crimes were in the age group of 16 to 18 years (5,478 out of 7,095) during 2024.

The readers before interpreting these numbers need to understand that 'rise in crime' and 'increase in registration of crime by police' are two different things, and any assertion necessitates a professional investigation of underlying factors. NCRB in its note rightly points out that "the causes of criminal behaviour lie in the social processes and structures". Particularly, focusing on juvenile in conflict with law; crimes occur due to the process of socialization that does not develop a strong sense of right or wrong, and ever-increasing desires act as a strong stimulus for taking to crime to fulfil these desires. Thus, to understand the juvenile in conflict with the law, we need to understand the desire behind the crime.

The current research attempts to draw statistically meaningful comparisons on the juvenile in conflict with law data sets; to better understand the offence patterns; institutional outcomes, and social background indicators. The analysis combines various statistical analysis such as descriptive statistics, ANOVA, chi-square tests, regression modelling, and cluster analysis to identify patterns that are relevant for juvenile justice policy and doctoral research in the Indian context.

Methods used in the study:

The following methods were used to study the crime data:

1. **ANOVA analysis -** Analysis of Variance (ANOVA) test is used by the researchers to assess if the average value of a variable differs across two or more groups. In this research, ANOVA was used to test a) if the crime rates are materially different between states and UTs; b) if crime rates have materially

changed over 2022-2024 period; c) if guilt rates are materially different between states and UTs, and d) lastly the states were divided into different bands to identify if the crime rates are materially different across guilt-rate bands.

2. **Chi-square Analysis –** Multiple studies in the past have tried to identify patterns within various offence categories. From a demographic study perspective, it is important to understand the age and gender patterns within various offence categories. Chi-square analysis was utilized to assess demographic decomposition of the various offence categories.

3. **Regression Modelling** - Ordinary Least Squares (OLS) regression is used to assess causation effect between two variables. Researchers have long tried to understand if social variables of juvenile can be used to explain the crime rates. A similar attempt is made in the current analysis on the 2024 state-wise crime data.

4. **Cluster Analysis** - K-Means clustering was used to group states and UTs into internally similar juvenile crime profiles using standardised indicators: crime rate, guilt rate, low-education share, homelessness share, property crime volume, and violent crime volume.

Results:

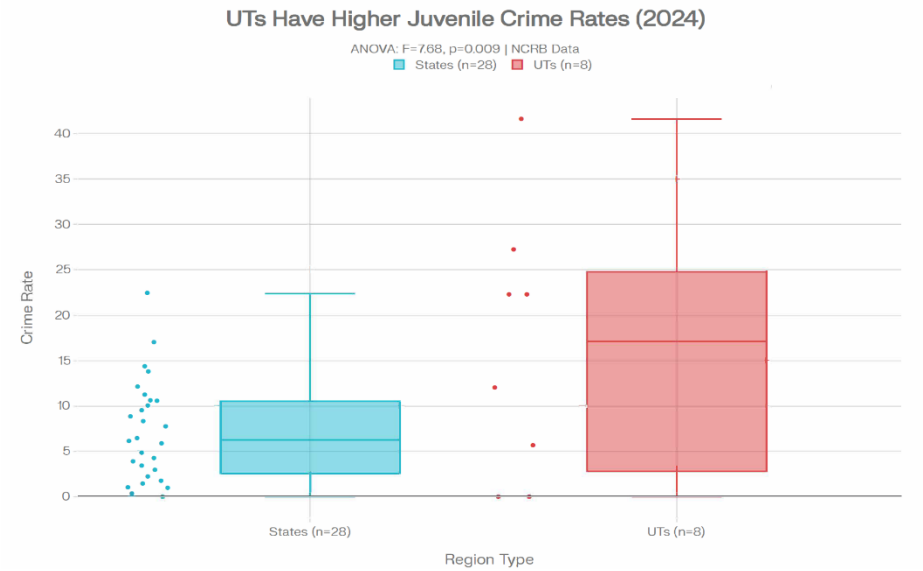
1. ANOVA analysis

1. A one-way ANOVA on crime rates per lakh children showed a statistically significant difference between states and the UTs [**Figure 1.1**]

- UTs mean: 16.38 per lakh children;
- States mean: 7.19 per lakh children

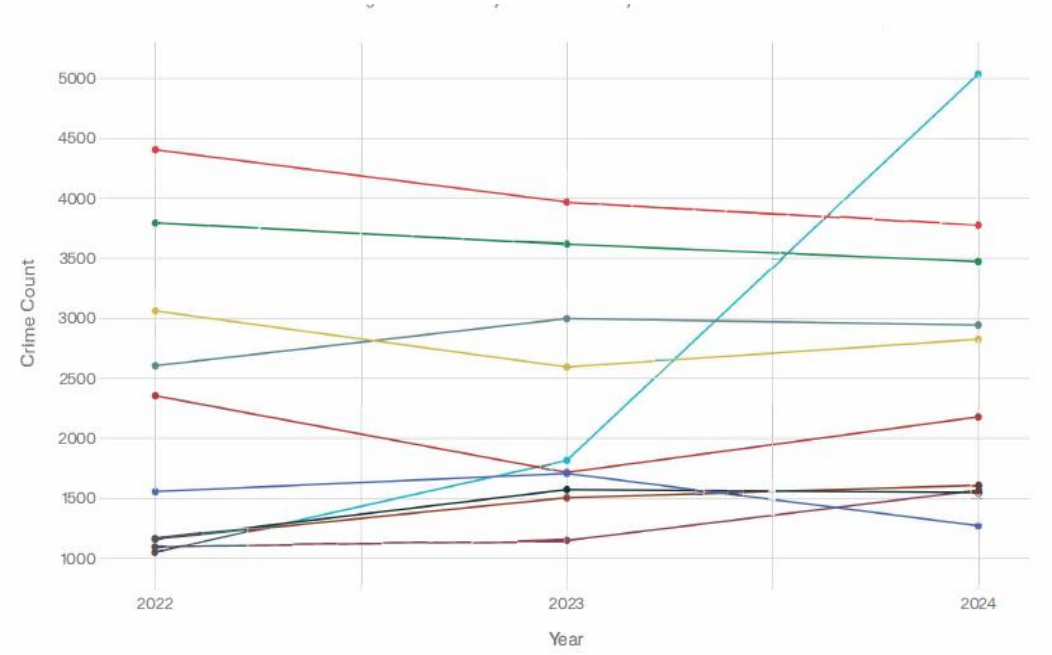
However, the **Mann-Whitney U test** (non-parametric equivalent) assessment was not significant. This additional test indicates that the significant ANOVA result might be driven by variance inequality and a small UT sample size (n=8).

Figure – 1.1 States v/s UT Crime Rates| ANNOVA Analysis



2. A one-way ANOVA across the 3-years for the states (2022, 2023, 2024) showed no statistically significant year-on-year change (F=0.1; p=0.9). This implies that juvenile crime rates have remained stable at the national level, masking state level fluctuations.

Figure – 1.2 Juvenile Crime Trends – Top 10 states



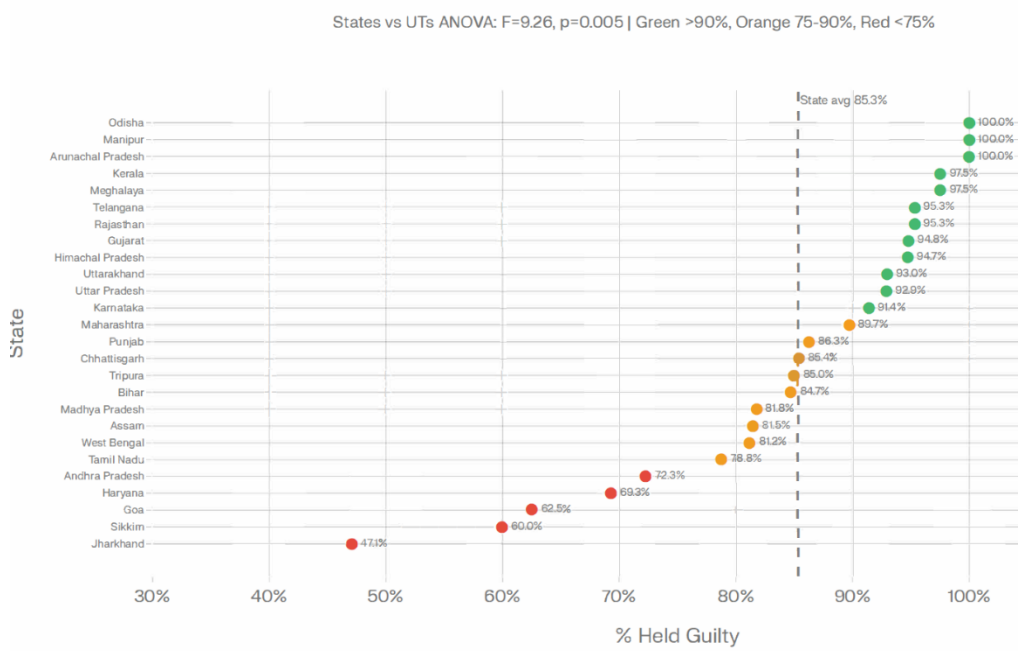
3. The researchers used one-way ANOVA to identify if there is a statistically significant difference between the juvenile guilt rates observed between states and UTs. The results showed that the states had a significantly higher guilt rate as compared to the UTs (85.3 percent v/s 57.1 percent) [**Figure 1.4**]. This is an important finding; as from a policy implementation perspective, the law makers would strive for consistent policies across India. However, this initial finding highlights the complexities of implementing a single framework across multiple states and UTs. There is a possibility of institutional variation in the functioning of Juvenile Justice Boards (JJBs). Prior studies had already highlighted weaker JJB infrastructure in the UTs which is also witnessed by especially low guilt rates in Chandigarh (0%), Puducherry (20%), and J&K (70%). Sundar (2022)[i] asserted that weaker JJB bench strength could explain the higher acquittal rates in the UTs. However, there are few deeper studies like Sharma & Gupta (2019)[ii] which highlighted that the guilt-rate gap between States and UTs became insignificant when pendency backlog was controlled. Still, this is an important finding that needs further deliberation. Next, researchers organized the states into 3 guilt rate bands (High >90%; Medium 75-90%; Low <75%) [**Figure 1.3**] to perform a one-way ANOVA analysis on crime rates across these three bands to identify a statistically significant difference exists within these three bands, however, the results were inconclusive ($F=1.12$; $p=0.34$); indicating that states having higher conviction rates do not necessarily have lower juvenile crime rates.

Figure – 1.3 Classification of States into various guilt rate bands

Band	No. of States in Band	Ag. Guilt rate	Key States
High >90%	12	96%	Kerala (97.5%), Meghalaya (97.5%), Gujarat (94.8%), Himachal Pradesh (94.7%)

Medium 75–90%	9	83.8%	Bihar (84.7%), Chhattisgarh (85.4%), Odisha (100%), Punjab (86.3%)
Low <75%	5	62.2%	Jharkhand (47.1%), Sikkim (60%), Goa (62.5%), Andhra Pradesh (72.3%)

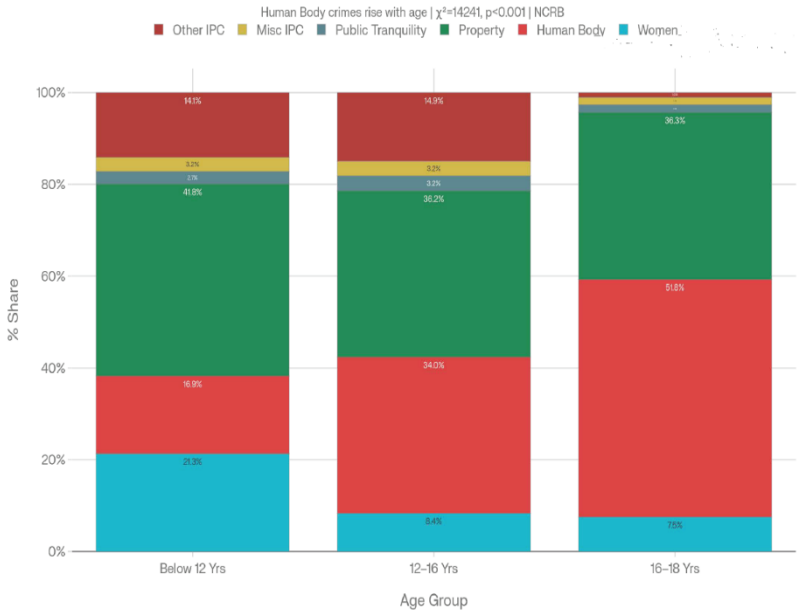
Figure 1.4 State wise variation of Juvenile Guilt Rates



2. Chi-square analysis

Both the 5A and 5 B data sets were sorted by arranging the crimes in 3 age groups (Below 12 years; 12-16 years; and 16-18 years); similarly the data was sorted by various categories of crime – Offences against women and child; Offences affecting human body; Offences against Public Tranquillity; Offences against Property; Miscellaneous IPC/BNS Crimes; Offences related to Documents & Property Mark; and Other IP/NBS crimes [**Figure 2.1**]. Chi square test was first performed on the crime category and age group for both the a) states & UTs; and b) metropolitans and then it was performed on gender and age group for both a) the states & UTs and b) metropolitans.

Figure 2.1 Crime-mix shift across age groups

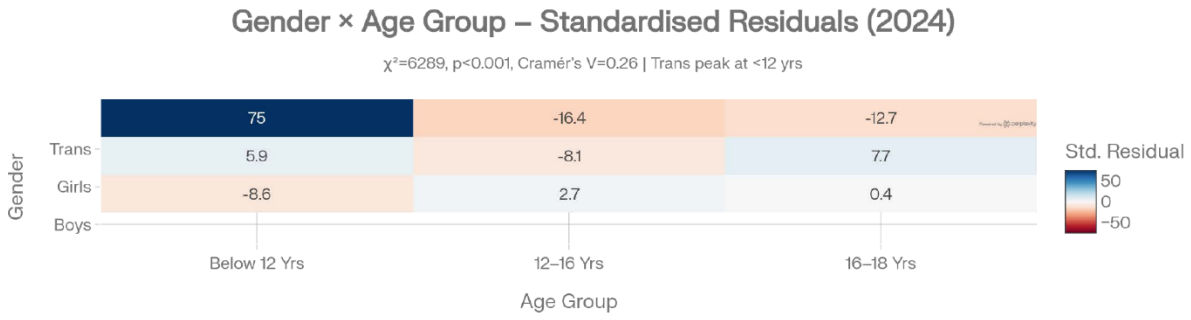


All 4 tests resulted highly significant results ($p<0.0001$) indicating that the distribution of crime types is not independent of age group or the gender; however, the low Cramer values indicate that the associations are moderate and not overwhelming [**Figure 2.2**].

Figure 2.2 Summary of Chi-square analysis statistics

Test	X^2	df	p-value	Cramer V	Effect
Crime Category X Age Group (States & UTs)	14,241	10	<0.0001	0.242	Moderate
Crime Category X Age Group (Metro Cities)	426.8	10	<0.0001	0.129	Moderate
Gender X Age Group (States & UTs)	6,289	4	<0.0001	0.259	Moderate
Gender X Age Group (Metro Cities)	94.5	4	<0.0001	0.1359	Small-Moderate

Figure 2.3 Chi-square analysis result of Crime type X Age for States & UTs



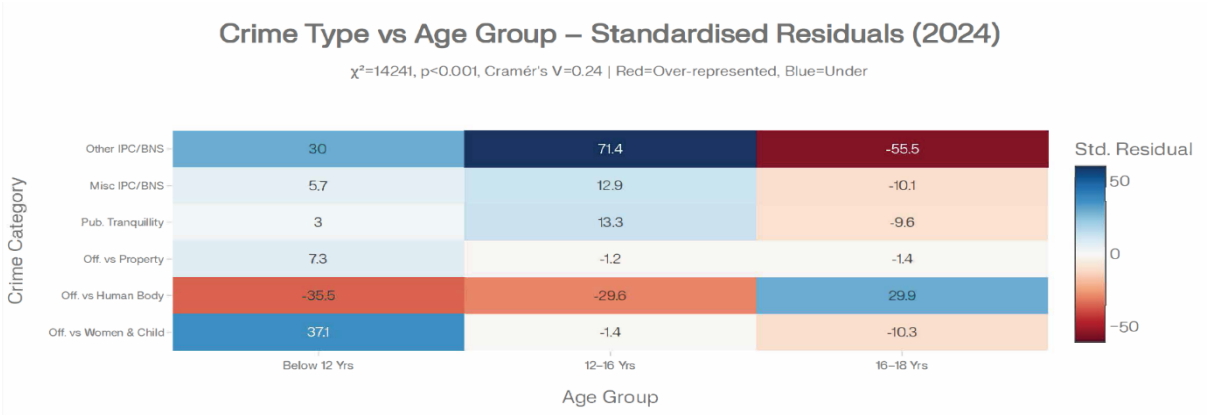


Figure 2.4 Chi-square analysis result of Gender X Age for States & UTs

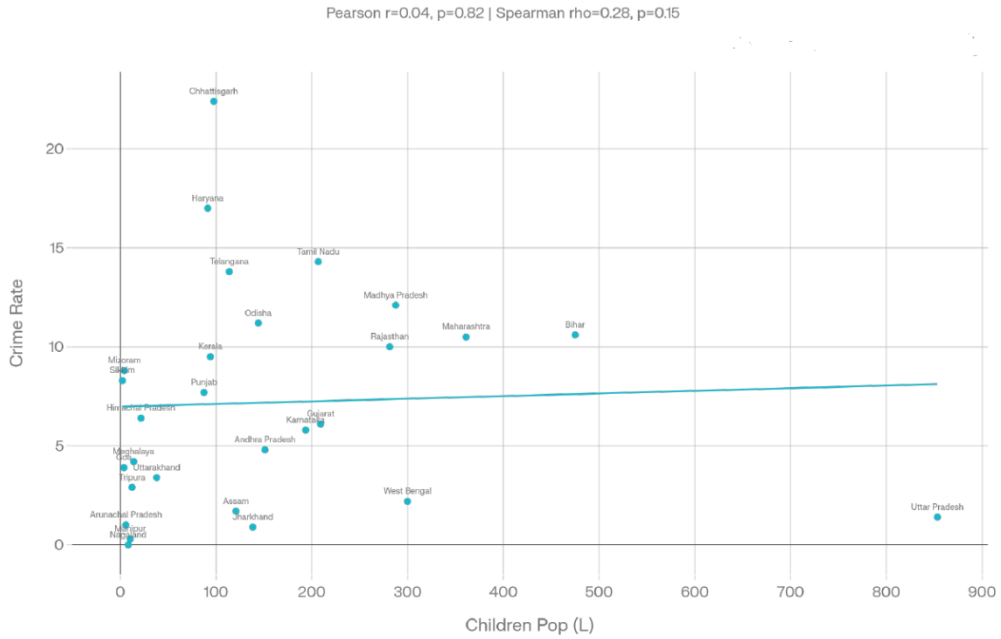
Thus, the above test for the states and UTs indicates the following:

- **Below 12 years** children are heavily over-represented in the Offences vs Women & Child category (**Figure: 2.3;** Residual = +37.1). This concentration raises questions about the JJ 2015 Act's handling of very young offenders and warrants further studies to understand if POCSO victim-accused conflation inflates this category. Chandrashekar, B. et al. (2023)[iii] also noted anomalous patterns in sub-12 recording; indicating a possibility of classification artifacts in youngest offender category. Contrasting trend is visible in the metro cities where below 12 years children have concentration in Offences against Property category.
- **16-18 years** children are over-represented in Offences vs Human body category. This category includes violent crimes such as murder, grievous hurt, attempt to murder, kidnapping (**Figure: 2.3;** Residual = +29.9). Similar trend of 16-18 years children concentration is visible in the metro cities as well. Kaur et al. (2024)[iv] using NCRB 2016–2021 data concluded that the 15–18 age band accounts for approximately 80% of apprehended juveniles nationally.
- **12-18 years** children are significantly over-represented in the Other IPC/BNS category. This category includes crimes related to property-adjacent, petty crimes, and miscellaneous offences (**Figure: 2.3;** Residual = +29.9). Contrasting trend is visible in the metro cities where 12-18 years children have a concentration in Offences vs Women & Child category.
- The gender-age analysis indicates that transgender juveniles are significantly over-represented in the Below 12 age group (**Figure 2.4**; Residual = +74.9) and under-represented in older bands. In metropolitan cities; the gender wise concentration is not very significant within the three age groups.

3. Regression analysis

1. First; a single variate OLS regression model was built to explain juvenile crime rate as a function of the population. No significant correlation could be established between children's population in a state and juvenile crime rate (**Figure 3.1**; R=0.04; p=0.82). This implies that a simplistic population-density explanation of crime rate is not true, i.e. it cannot be established that larger population states would have higher juvenile crime rates.

Figure 3.1 Population v/s juvenile crime rate



2. Secondly; a multi-variate OLS regression model was built by selecting four explanatory variables: a) percent illiterate, b) percent low education, c) percent homeless, and d) percent guilty as predictors of juvenile crime rate (cases per lakh children). None of the individual coefficients were significant at conventional levels [**Figure 3.2 & 3.3**]. Dreze & Khera (2000)[v] found that conviction severity could not meaningfully explain crime rates across Indian states, with education as a stronger moderating factor. Butts & Mears (2001)[vi] in the international context argued that punitive juvenile disposals have weak deterrence effects versus rehabilitation. Deshpande & Weisberg (2018)[vii] found a non-linear relationship between per capita income in any state and the prevailing crime rates. Many studies have tried to identify if the socio-economic factors can explain the juvenile crime rates, however, the studies have been inconclusive in different time frames. For instance, Mukherjee & Sinha (2015)[viii] assessed poverty, literacy, and urbanisation as predictors in a fixed-effects panel model and found none individually significant. Tripathi et al. (2020)[ix] studied the dependency of juvenile crime rates on illiteracy in a much deeper district level analysis (all the analysis done in current paper is limited to states and UTs) and concluded no significant predictive relationship. Das & Mohanty (2023)[x] also opinionated similar point, according to their study the NCRB social background variables can predict only 12% of the explain less than 12% juvenile crime rates once institutional variables are controlled.

$$\text{Crime Rate}_i = \beta_0 + \beta_1(\text{Illiteracy\%}) + \beta_2(\text{Low Edu\%}) + \beta_3(\text{Homeless\%}) + \beta_4\,(\text{Guilt Rate\%}) + \varepsilon_i$$

Figure 3.2 Regression analysis Graphical plot

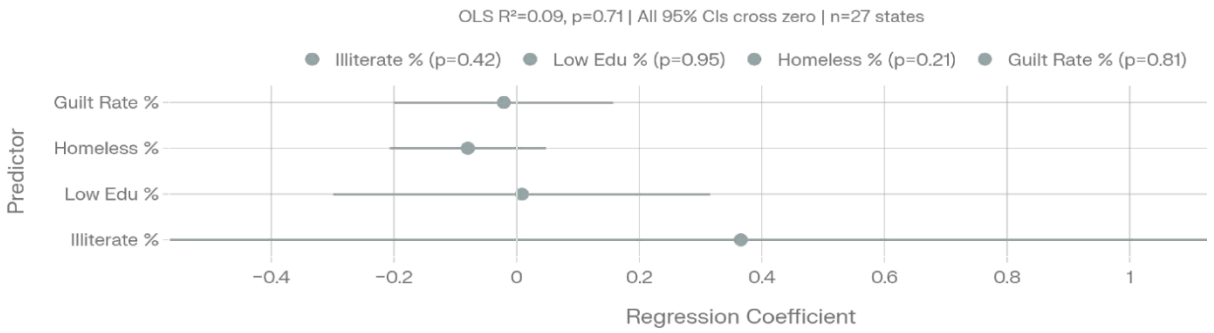


Figure 3.3 Regression analysis results

Predictor	Coefficient	P -value	Interpretation
% Illiterate	+0.366	0.424	Not significant
% Low Education	+0.009	0.954	Not significant
% Homeless	−0.080	0.21	Not significant
% Guilty	−0.021	0.811	Not significant
Overall Model	**$R^2 = 0.089$**	p = 0.708	Not significant

Figure 3.4 Family Background: Homeless v/s with parents

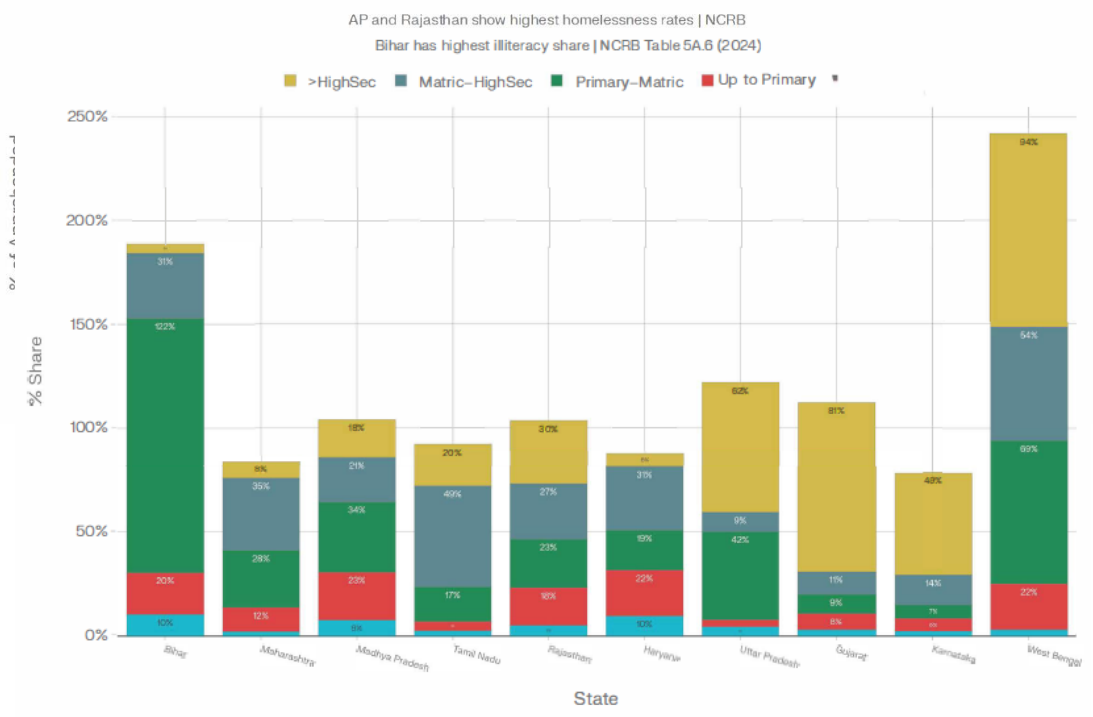


Figure 3.5 Education level of Apprehended Juvenile in Top 10 states

4. Cluster Analysis

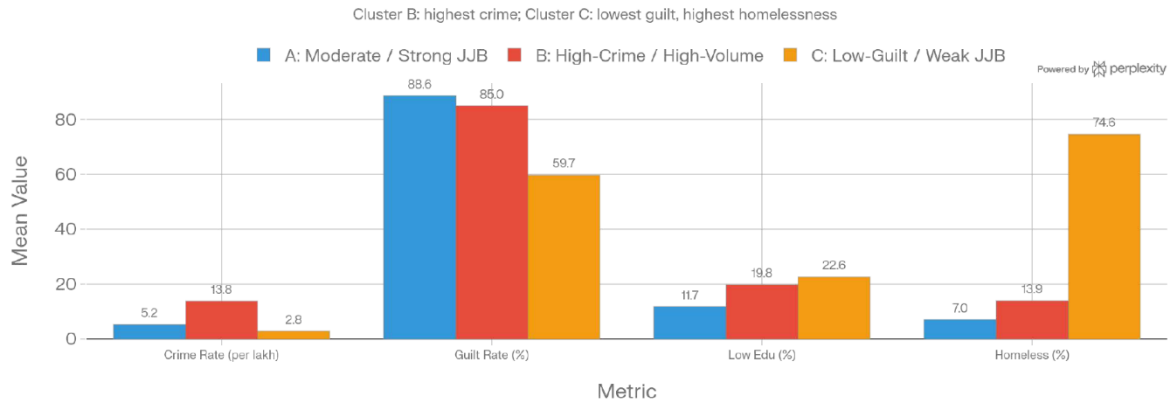
Considering the high number of variables associated with juvenile crime rates, an unsupervised cluster analysis was performed using Perplexity.ai. The Sonnet 4.6 model was used to study the Indian state-wise

juvenile crime rate profiles. The model tested separation qualities across all K-values (2-7) and identified the optimal number of clusters as 3 using Silhouette Score (0.335) and the Davies-Bouldin Score (1.056). Two principal components were selected to explain the juvenile crime landscape in India.

- **Principal Component 1 (PC1) - Crime Intensity Axis:** It was used to separate high-crime/high-volume states from low-crime states
- **Principal Component 2 (PC2) - Social Vulnerability Axis:** It was used to separate high-homeless/high-guilt states from low vulnerability states
- The Principal Component Analysis (PCA) decomposition explained 64.6% of total variance in two components: PC1 (41%) loading heavily on crime volume, property crime, violent crime, and Narcotic Drugs and Psychotropic Substances (NDPS) cases; and PC2 (23%) loading on guilt rate (inverse) and homelessness/low education [**Figure 4.1**].
- The mean values of these four components a) crime intensity, b) guilt rate, c) education disadvantage, d) homelessness for the three clusters are provided in [**Figure 4.2**].

Figure 4.1 State crime profiles – K-means clustering

Figure 4.2 Mean profile of each cluster



The following table shows the grouping of the states and UTs in the 3-cluster model using a) crime intensity, b) guilt rate, c) education disadvantage, d) homelessness indicators.

Parameter	Cluster A	Cluster B	Cluster C
Quality	Moderate Crime, Strong JJB	High Crime, High Volume	Low Guilt/ Capacity issue or Weak JJB or Different philosophy
Total members	16 States + 4 UTs	8 States + 1 UTs	2 States + 1 UT
States	Assam, Goa, Gujarat, Himachal Pradesh, Karnataka, Kerala, Manipur, Meghalaya, Mizoram, Odisha, Punjab, Sikkim, Tripura, Uttar Pradesh, Uttarakhand, West Bengal	Bihar, Chhattisgarh, Haryana, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Telangana	Andhra Pradesh, Jharkhand
UTs	A&N Islands, D&N Haveli & DD, J&K, Puducherry	Delhi	Chandigarh
Avg. Crime Rate	7.3 per lakh	16.9 per lakh	11.0 per lakh
Avg. Guilt Rate	83.4%	85.9%	39.8%
Avg. Low-Edu %	10.3%	18.0%	16.1%
Avg. Homeless %	7.0%	13.9%	74.6%

Recommendations:

1. **Special attention is required for the UTs –** The significantly high crime rates and guilt rates in UTs as compared with the states (noted in ANOVA analysis) warrants for special attention. It might be possible that they need supply-side JJB strengthening - more JJB benches, trained magistrates, legal aid for juveniles, etc.
2. **Target 16–18 violence prevention separately –** The chi-square analysis has shown severe concentration of 16–18-year age group in violent offences. Rather than framing generic programs, it might benefit society to focus on this age group with focused peer-group interventions, substance-use prevention, and specialised psychosocial support. The recommendation to age-target violent crime prevention at the 16–18 cohort was also supported by Loeber & Farrington (2014)[xi], who stressed that late adolescence (15–18) is the peak period for violent offending.
3. **Requirement of an expanded juvenile justice data architecture –** The regression analysis indicates that the most accessible social-background indicators in NCRB tables are insufficient to explain state-level crime-rate differences and the addition of external variables such as urban density, slum

concentration, child labour prevalence, police capacity, school drop-out rates, and district-level deprivation indices might help to better understand the causation of juvenile crime.

4. **Possibility of uneven policy implementation by JJBs –** The guilt rate of just 39.8% for Cluster C (observed in the cluster analysis) calls for deeper inspection into the workings of JJBs of this cluster. It is possible that JJBs of this cluster are either acquitting heavily, having high pendency, or cases are being disposed differently (sent home on advice vs. formal guilt finding), which might not be consistent with the approach of other JJBs in India. There is also a possibility that the Cluster C is susceptible to recording errors, as the %homeless proportions of juvenile against law in states like Andra Pradesh (100%) and Jharkhand (49.2%) seem high.

5. **Policy learning models -** Kerala and Himachal Pradesh, belonging to Cluster A (observed in the cluster analysis), with high guilt rates but low crime rates, demonstrate effective JJB functioning without punitive excess. These JJBs can be studied for the standardization of the JJBs approach in India.

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