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Kidnappers' spatial mobility and kidnapping activities: A case of Delhi urban system, India

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Abstract

The paper attempts to present kidnappers' spatial mobility pattern that becomes widely recognized especially for urban areas. Kidnappers' mobility and identification of their channels are challenging tasks to the crime combating agencies world-wide. In order to develop the spatial model for intensity and extent of kidnappers' mobility and kidnapping activities, the Tobler's law of spatial interaction is used in this research to compute kidnappers' mobility gradient between pairs of locations. Mobility matrix containing spatial gradient of kidnapper's flow confirms to their core locations that have push force to spray them outward for safe shelters. It is evident from this study that (a) porous inter-state border, especially in areas which are congested and with inter-state nodes of road and railways, enhance the intensity and extent of kidnapping crime, (b) kidnappers North- South corridor along with National Highways passing through peripheral areas of Delhi state are important kidnappers channels, and (c) victims accessibility to nearest police station, and female dominated phenomena of densely populated areas are major factors that attract kidnappers. This model can be useful for crime combating agencies and local police administration to trace the cores and corridors of kidnappers' movement in urban areas.

Keywords: *Kidnappers spatial mobility, kidnapper's concentration, population density, spatial variation, kidnappers flow velocity, functional analysis, multi-linear regression, urban system.*

Introduction

The intensity and extent of crime is influenced by socio-economic factors as much as it is a spatially determined issue. Increasing crime rates in India poses serious challenges not only to police administration but also to policy makers and criminologists involved in analyzing crime situations and social environment. Urbanisation that promotes industrial growth and invites migration of workers is one of the major factors (Clinard 1942, Tappan 1960, Gerben 2007) in increase in crime rates as it weakens social bonding and traditional ties (Kennedy and Krahn 1984). They also influence the socio-economic fabric of surrounding areas of crime occurrence spots (Tobler 1979, Clark, *et al.* 2014). Locational influence on crimes is no less important as one of the factors equally important to examine crime occurrences in the context of 'totality of area' (Tita and Radii 2010). Geographers often use locational factors such as crime hotspots and movement of criminals (Gupta 2020) bringing in location as a factor in crime occurrence. Spatial

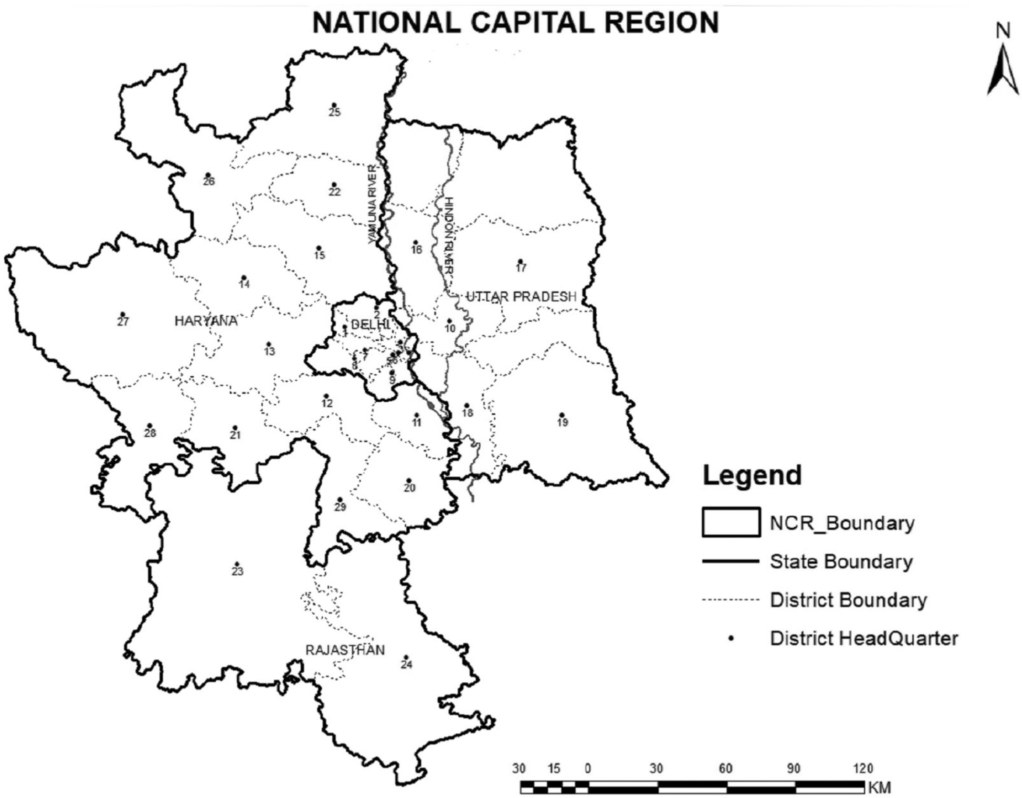

Fig. 1: NCR with district administrative units and their headquarters (for district names, see Table 1)

tools like GIS and mathematical models are increasingly used for the purpose. The present study focuses on spatial dimension associated with kidnapping in National capital region (NCR) as an urban system encompassing the surrounding districts of Uttar Pradesh, Rajasthan and Haryana.

Delhi urban system and kidnapping intensity

The NCR, delineated as an administrative unit by the National Planning Authorities, New Delhi, is a complete urban system in which central districts work as business and administrative core and satellite towns of the adjoining states as peripheries. It includes whole of Delhi state and the adjacent districts of Uttar Pradesh, Rajasthan and Haryana states (Fig. 1). Needless to say, Delhi is a hub of various crimes due to its location and population concentration. NCR covers an area of about 51,100 km^2 which includes about 50 million (estimated) residents in the year 2015. It constitutes a suitable base of spatial domain to investigate crime incidences because of two reasons: (i) significant spatial variation in area-size of the districts (smallest, 21 km^2, the Central district of Delhi state to the largest, 5,066 km^2, the Bharatpur district of Rajasthan) and relatively high concentration (Table 1) of kidnapping cases (972 cases in NE Delhi to 57 in Bhiwani district in 2015)

Table 1: Cross-sectional profile and concentration of kidnapping Crime in the NCR (2015)

		Total		Kidnappers concentration	
Location Code	District	persons involved in kidnapping per 10 victims**	Kidnapping cases	Kidnapping Rate (cases per lakh population*)	Kidnapping density (cases per 100 Km^2)
1	North West Delhi	3	749	20.32	169.07
2	North Delhi	5	317	35.54	519.67
3	North East Delhi	6	972	42.00	1567.74
4	East Delhi	5	780	45.24	1238.09
5	New Delhi	1	56	41.48	160.00
6	Central Delhi	5	330	56.48	1571.43
7	West Delhi	3	868	33.96	667.69
8	South West Delhi	3	767	33.14	182.18
9	South Delhi	4	801	29.02	324.29
10	Ghaziabad	4	549	11.61	46.56
11	Faridabad	4	447	24.46	60.32
12	Gurugram	4	421	27.53	33.46
13	Jhajjar	1	38	03.93	2.07
14	Rohtak	2	491	45.82	28.13
15	Sonipat	2	73	04.99	3.44
16	Baghpat	2	111	08.44	8.40
17	Meerut	2	317	09.12	12.39
18	G. Buddhnagar	4	209	12.56	16.30
19	Bulandshahr	1	303	08.58	6.71
20	Palwal	3	106	10.07	7.80
21	Rewari	1	60	06.60	3.76
22	Panipat	2	98	08.06	7.73
23	Alwar	1	355	09.57	4.24
24	Bharatpur	1	279	10.84	5.51
25	Karnal	2	424	27.90	16.82
26	Jind	1	60	04.45	2.22
27	Bhiwani	1	57	03.45	1.19
28	Mahendranagar	1	65	06.98	3.42
29	Mewat	2	73	06.63	4.84
	Total		10176		

N.B.: *Population for the year 2015 has been estimated by using compound growth formula $P1= P_0(1+r)^n$ where P_0 is population of 2011 and r = average growth rate (i.e., 1.93%) and n = number of years and also with the help of the Office of Chief Registrar, Births and Deaths, Government of NCT Delhi (compiled from: Economic Survey of Delhi: 2008-2009 and 2017-18).

** The Statistics of kidnappers are generated by surveying and interviewing in various Police administration offices.

and (ii) the locational advantage of NCR situated in the margins of Aravali mountains and Western part of the great plains of India; its core area is most urbanized while the surroundings mostly agricultural but growing fast as satellite towns with heightened migration and emergence of mixed culture of both rural and urban. Increased demographic and social heterogeneity and disparity has led to increasing crimes in this area. For the present cross-sectional study, the entire NCR area is taken into consideration comprising 29 districts. The district headquarters are considered as district locations where crimes are registered.

Only four of the 53 mega cities in India (Delhi, Kanpur, Mumbai and Benguluru) account for about 30 percent crimes in the year 2015 (NCRB, 2015). The crime statistics collected from NCRB reports 2015 and 2020 reveal that about 15 percent of all urban crimes are kidnapping which is only increasing over the years. In a span of a decade (2008-2018) such incidences increased by 443 percent, identified as the most dominating crime among heinous crimes like robbery, rape and murders. As many as 10,176 kidnapping cases (about 30% of total heinous crimes) were reported from NCR.

The crime distribution profile of NCR shows the concentration of kidnapping cases in the surrounding districts too apart from the Delhi state with more than 40 cases per million. Kidnapping density and rate are however the highest in Central Delhi district that includes old Central Business District of Delhi state (Table 1).

Kidnapping and population

Kidnapping cases versus population concentration illustrate two obvious but relevant evidences of their spatial association. First is a significant increase in kidnapping cases in most concentrated population districts (0.72 times increase in kidnapping cases per unit increase in population share). Relationship between these variables is positive though weak (r= 0.50957) to allow robust conclusions. However, there is an emerging group of districts which account for more than half of the kidnapping cases but with only 30 percent share of the total population (Fig. 2A). These districts have the highest concentration of kidnapping cases as well as rate (about 4 victims per lakh) and high density (about 10 to 12 cases per km^2 annually). Second is noticeable inequality in spatial distribution of kidnapping cases (Gini Index= 30.12%) in relation to population concentration in Delhi urban system (Fig. 2B). Despite weak association between kidnapping incidences and population concentration, certain generalised observations are inescapable:

(1) Cases where kidnapping cases are not spatially uniform (as referred above);

(2) Where kidnappers' have spatial links with intensity and extent of spatial mobility, and

(3) When kidnappers create strong spatial links, it characterizes their mobility patterns (the issue of kidnappers' space relations and their locational importance).

The concerned issues are addressed in this paper by presenting 'mobility-gradient' approach for describing spatial interaction of kidnappers. For the purpose, kidnapper statistics are collected from Police Administrative Offices and police stations.

Data collection and the model

Since the statistics relating to persons involved in kidnapping are not available in

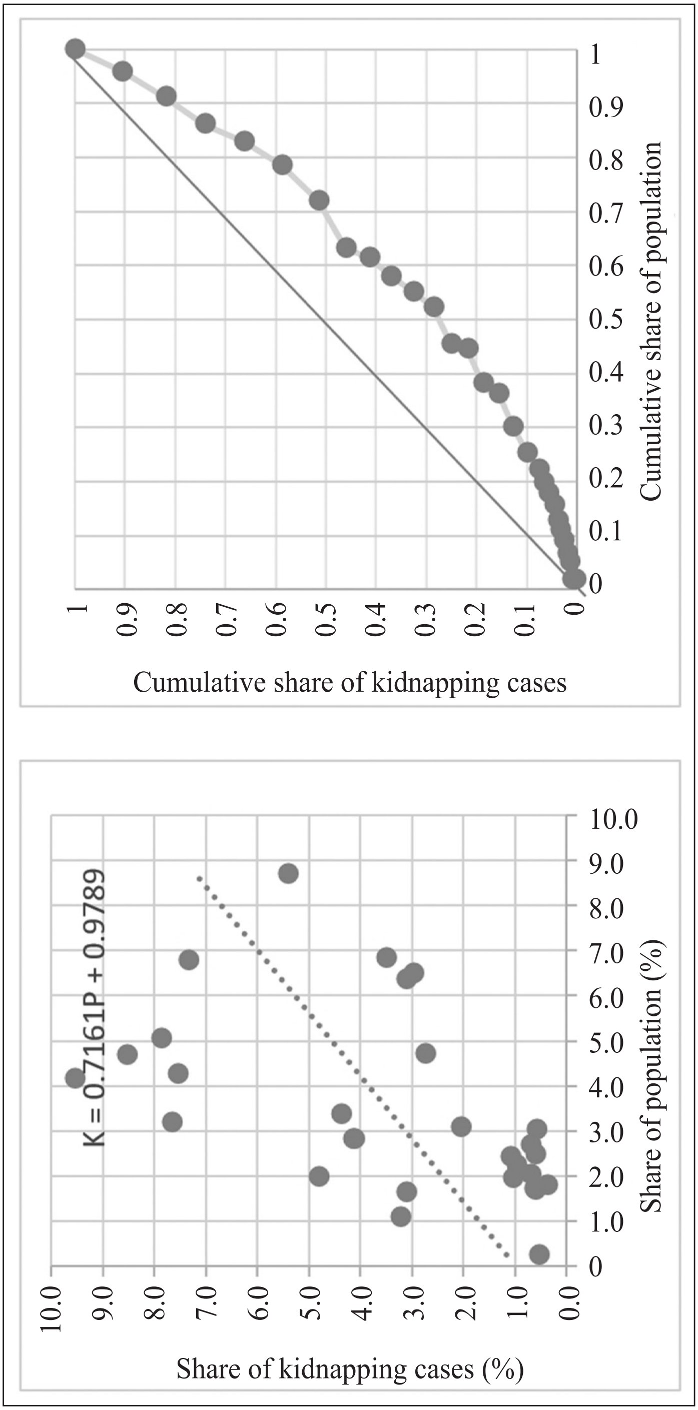

Fig. 2: Distribution of kidnapping versus population concentration: (A) Kidnapping crime regression and correlation with population, (B) Inequality in kidnapping cases

government records, personal interview and discussion with Delhi Police Headquarters and District police authorities/officers were the only viable means to record the characteristics and movement pattern of the kidnappers. Outcome of the discussions were quantified to estimate average number of persons engaged in kidnapping activities per victim. The police authorities confirmed that kidnapping is a highly organized and hierarchical group activity, especially in case of children kidnapping, from local level to the international. It was reported that a group of 9-12 persons is involved in 30-40 kidnapping/abduction cases annually, especially of minors at local level of the chain. The average figure of kidnappers per 10 kidnapping cases is recorded 3 in the study area. However, there are significant variations to this rate across different areas within the NCR. Most crime prone localities such as Central and North Eastern districts of Delhi state have 4 to 5 kidnappers per 10 kidnapping cases while ratio falls to 2 kidnappers in the peripheral districts situated in Rajasthan state (Table 1). These average figures of kidnappers can be considered as conversion weight, W, to assess kidnappers' strength. When district wise statistics of three parameters of spatial mobility, namely, the reported kidnapping cases, K, spatial weight, W, and distance between pair of location of incident (district headquarters), d_{ij}, are available, it is possible to use this statistic to model the extant and intensity of kidnapper movement.

Two criteria of modeling spatial mobility of the persons involved in kidnapping are important. First is the Toble's law of spatial interaction; 'the intensive mobility of persons at neighboring places and less at distant places' (Tobler 1970, 1979) that involves distance factor. It provides extant of spatial mobility pattern. Second is the 'spatial gradient of mobility' that examines the intensity of kidnapper's flow between places. The kidnappers' strength at a particular place creates the force of flow. It follows the law of liquid's flow; flow intensity and direction of kidnappers between locations that are controlled by the size of their strength. Larger the kidnappers' strength available at a particular place, the greater is its intensity of push of their flow towards lower strength places. The total amount of flow between pair of locations is thus derived by computing difference of associated kidnappers' strength at a crime location, W_iK_i to another location, W_jK_j, where kidnappers contact other persons for his/her hiding safety. This difference (W_iK_i - W_jK_j) computes the total amount of flow, while its intensity, S_{ij}, is distance dependent, dij. Distance parameter of model is considered as 'crow-fly' distance for Delhi urban areas because of its gentle topography, dense road network, high road connectivity, and very low ratio of actual inter-location distance with linear distance (detour index = 1.08745).

The extant and intensity of kidnapper's mobility is derived to equate these terms, expressed as:

$$S_{ij}.d_{ij} = (W_i K_i - W_jK_j) \text{ and } \quad \ldots\ldots\ldots(1)$$

We then simplify it for S_{ij} as:

$$S_{ij} = (W_i K_i - W_jK_j)/d_{ij} \quad \ldots\ldots(2)$$

This equation explains two parametric relationships: kidnappers 'mobility strength' at district location, W_iK_i, while distance is assumed minimum as 1.0 km (numerator term), and the inverse distance relationship of 'kidnappers' intensity' (denominator in equation) when they move outward from their location. It is based on 'power function'.

Table 2: Kidnappers movement matrix (into and out of District locations)

	Location 1		Location 2			Location j	
	in to 1	1 out of	in to 2	2 out of	…	into	out of
Loaction1	1 to1 ↑	1 out of 1	1 to2	2 out of 1	…	1 to j	j out of 1
Location2	2 to 1	1 out of 2	2 to 2	2 out of 2	…	2 to j	j out of 2
…	…	…	…	…	…	…	…
Location, i	i to 1	1 out of i	i to 2	2 out of i	…	i to j	j out of i
…	…	…	…	…	…	…	…
Location j	j to 1	1 out of j ↓	j to 2	2 out of j	…	j to j	j out of j
Total	$\sum_j aji$	$\sum_i aij$	$\sum_j a2j$	$\sum_i ai2$	…	$\sum_j a1j$	$\sum_i ai1$
				Net flow N= $(\sum_j aji - \sum_i aij)$			

N.B.: 1. Upper direction arrow shows the sum of flow into location 1 (inflow –ve); 2. Lower direction arrow shows the sum of flow out of location 1 (outflow +ve); 3. The Net flow is defined as (outflow – inflow); N= $(\sum_j aji - \sum_i aij)$. 4. The diagonal elements of matrix are zero as we assume that there is no kidnappers' mobility remains within the location.

Equation (2) can be generalized to make it more workable in the form:

$$S_{ij} = W_i K_i (d_{ij})^{-q} \quad \text{……….(3)}$$

Where $W_i K_i$ is kidnapper's mobility strength that follows first parametric relationship (maximum strength at location, i) and q is coefficient to determine kidnappers flow velocity.

It further explains three conditions of mobility gradient (S_{ij}) to determine the spatial flow pattern: (i) if $S_{ij}>0$, there is kidnappers movement flow 'out of' district location i, (ii) when $S_{ij}=0$ it shows no outflow and inflow between pair of locations but occurrences of crime and hiding criminals can happen within the district itself and (iii) if $S_{ij}< 0$ the kidnapper's movement 'into' a particular district location i.

Kidnappers wish to hide either in the neighborhood or distant places to ensure their safety. So each and every location is more or less prone to act of kidnapping and hiding of the criminals. The computed data of kidnappers' movement are arranged in a matrix of n-by-n size to arrange data systematically for deriving characteristic features of spatial mobility patterns. It contains a dataset of mobility 'out of 'and 'into' districts. Non-mobility category of kidnappers, $S_{ij}=0$, is not included in the matrix. This type of matrix has been used in other disciplines also such as Regional Economics, Economic Geography, Business management to analyze the commuting areas, local labour market areas, commuting zones, functional regions, and journey to work pattern (Masser and Brown 1975, Masser and Scheurwater 1980, Mitchell and Watts 2010). However, in present context, location wise spatial data are arranged in the following way as in the matrix (Table 2).

Spatial mobility

Mobility pattern

After computing mobility gradients with the arrangement of their 29-by-29 matrix, the flow pattern of kidnappers' movement has been examined in two ways:

(a) The difference between totals of kidnapper's flow 'out of' and 'into' a particular location determines their locational strength (net flow). If difference is positive, it measures 'push' force of mobility of a location to spray kidnappers outside to occur crimes. The stronger the mobility push, larger is its intensity and extent of kidnappers' movement.

(b) When aggregated difference is negative at a particular location, it measures the mobility 'pull' force indicating that such locations are safe receptive places of kidnappers.

On the basis of these defined parameters of flow intensity, the district locations have been classified to obtain the spatial pattern of kidnappers' movement with (a) the identification of locations which form 'core area' where mobility is faster and greater and (b) the search of 'kidnappers Corridor' that determines path of fast and frequent kidnappers' mobility.

The following facts emerge from the processed spatial dataset. First, the areas of Eastern and Southern side of interstate borders between Delhi–Uttar Pradesh and Delhi-Haryana are more porous and well connected. Locations like Sahadara- Loni-Sahibabad- Ghaziabad forms 'kidnappers' core'. Saharada town located in North Eastern district of Delhi is considered found to be criminals' 'hub' in this core area. Conducting field survey-based micro-area study in this zone, Gupta (2020) analysed the crime flow characteristics and concluded that Ghaziabad, Loni, NOIDA, Faridabad and Gurugram are main feeder towns of the criminals to the kidnappers' hub due to porous inter-state borders. As a result, the Mahipalpur- Palam- Gurugram area where Indira Gandhi International Airport is located is the extended core of kidnapping. These areas are frequently used by the kidnappers within and outside locations taking advantage of two different state police administration, Delhi and Uttar Pradesh-Haryana. In this way, an important kidnappers' link is also recognized by Delhi Police between core area of N-E district and Gurugram satellite town located in the Southern part in NCR. Major locations of kidnappers' strength with their outward mobility are five in number falling under the core area revealing an important and interesting pattern. Greater intensity of kidnappers is observed from Shahadara trans-Yamuna town towards (i) the congested areas of Delhi state, especially to Vazirabad (North side) and Redfort-Chandni Chawk (Central Delhi) and (ii) towards NOIDA and Ghaziabad as satellite towns located in Uttar Pradesh (Fig. 3).

Secondly, the frequent flow channels of kidnappers show their main paths and corridors. Locations within core areas, no doubt, are noticed for high velocity of flow with greater interaction. Two kidnappers' corridors are identified from total flow matrix: (a) North-South corridor that passes through core area situated in the South and (b) the Ghaziabad-Loni-Baghpat corridor situated along the eastern side of Yamuna River. Both corridors pass through Sahadara, the most dominating outward kidnappers' movement identified as kidnappers' hub. In addition, the Chandni Chawk-Sahadara is a connecting 'feeder' for kidnappers that provide them a free path to move (Fig. 3).

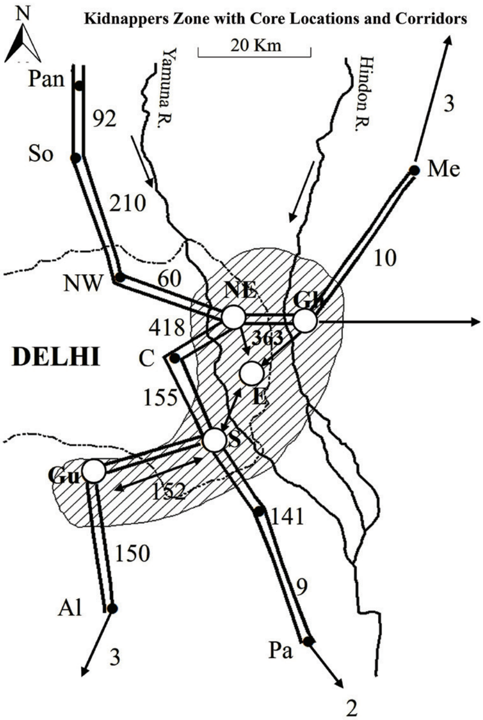

Fig. 3: Kidnappers zone (shaded) with core locations (open circles) and corridors (double lines with bold points): figures on line shows kidnappers total flow;

Abbreviations: NE - North East Delhi district location, E - East Delhi, NW - North West Delhi, S - South Delhi, Gh - Ghziabad, Me - Meerut, Gu - Gurugram, F - Faridabad, Pa - Palwal, Al - Alwer, So - Sonipath, Pan - Panipath

Spatial mobility and functional analysis

The prevailing factors of each district have implicit impact on kidnappers' movement pattern. It is important to keep in mind the varying factors that determine spatial mobility pattern. A simple approach of examining mobility pattern and factors relationship is to map and find areas of their unique features. Statistical approach is, however, adopted to create a set of factorial input data to analyze functional characteristics.

Kidnappers' velocity

Spatial interaction model explains the distance decay core periphery relations (Watts 2004, 2009, Mitchell and Watts 2010, Wilson 1974, 2010). Similarly, the application of present kidnappers' mobility gradient model specifies the spatial extent of kidnappers' velocity. Model explains two parameters: the strength of movable kidnappers at core location, WK and spatial decay of their movement velocity, q, as described in earlier section (Eqn-3). Higher the value of coefficient q, larger is the extent of kidnappers' velocity rate and *vice versa*. North East Delhi and East Delhi districts identified as kidnappers 'hub, have higher strength of 551 and 252 kidnappers respectively. But the mobility intensity in these two districts diminishes with greater velocity of about 8 kidnappers per 10 km with velocity coefficients of q= -0.807 and -0.796 respectively. They cover large peripheries for kidnappers' movement influencing greatly in the close surrounding areas (Fig. 4A and B). The relationship between strength and rate appears positive. As kidnapper's strength becomes lower at core locations, the force of their velocity rate and spatial extent happen to be reduced towards distant locations (Fig. 5 and Table 3).

Functional analysis

Movement of kidnappers in Delhi urban system is, of course, uneven. The nature and characteristics of kidnappers in core areas and corridors are influenced by factors such as migration, population concentration, socio-economic conditions and accessibility to district locations (Ahamad 2012, Singh Rambali 2018, Sardar and Nayak 2020). We unpack the umbrella of related factors in this section to understand and examine their effect on kidnappers' mobility.

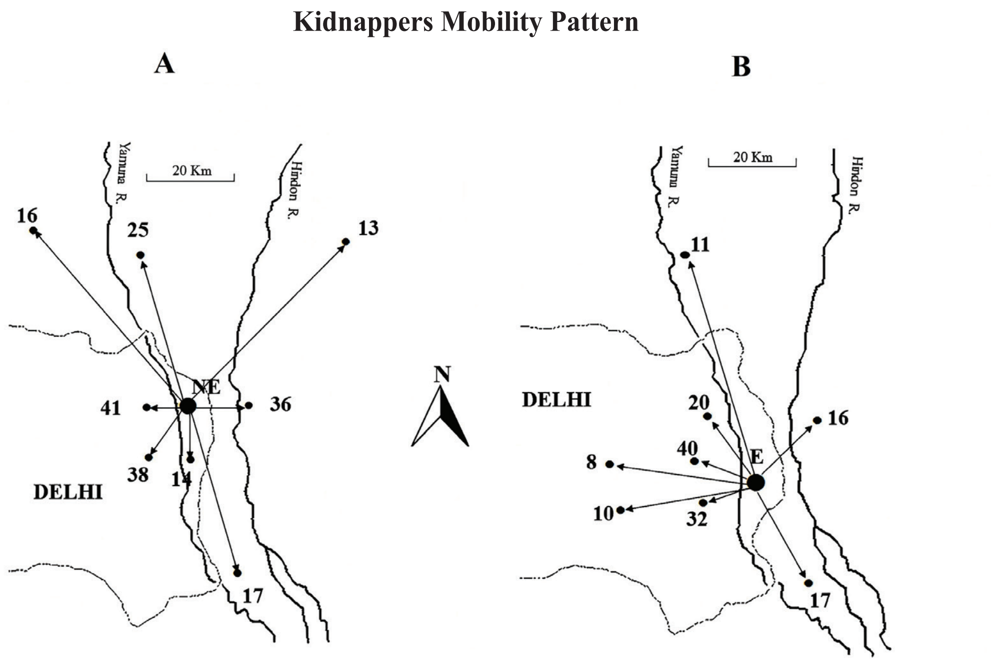

Fig. 4: Kidnappers mobility pattern of core district locations: (A) North East Delhi, (B) East Delhi Location (Figures show intensity of mobility flow outward core locations)

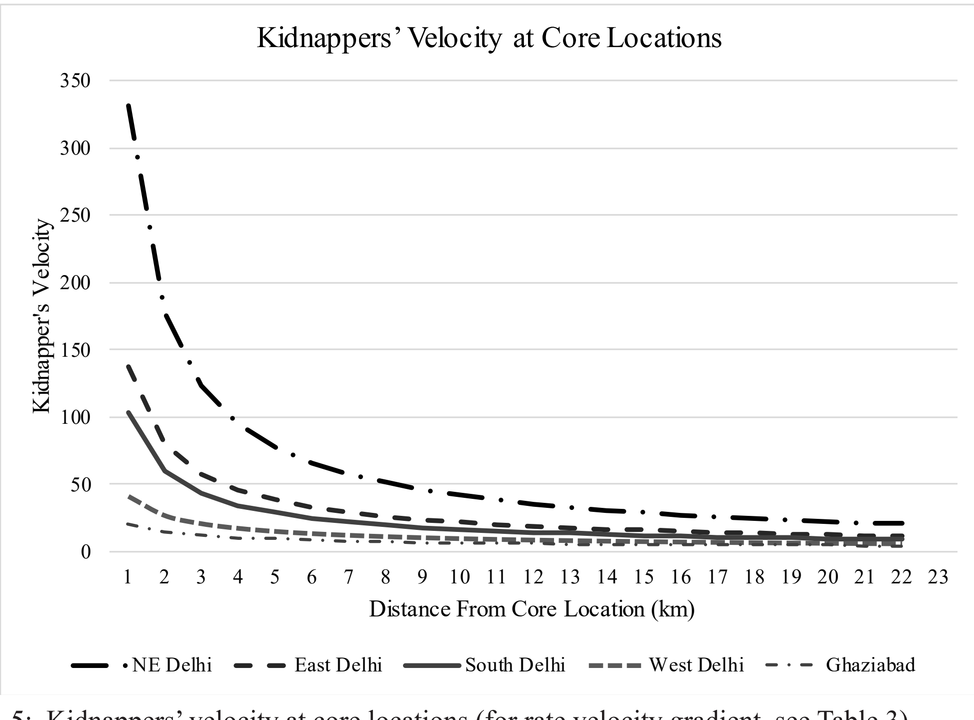

Fig. 5: Kidnappers' velocity at core locations (for rate velocity gradient, see Table 3)

Table 3: Kidnappers velocity gradient

District Location code	Kidnappers strength) at Core locations*	Distance decay coefficient $S_{ij}= W_iK_i(d_{ij})^{-q}$	Degree of Determinant (R^2)
3. North East Delhi	S_{3j} = 330.8	q3= - 0.897	0.9311
4. East Delhi	S_{4j} = 137.9	q4 = -0.796	0.8154
9. South Delhi	S_{9j} =103.7	q9= -0.791	0.7492
7. West Delhi	S_{7j} = 41.7	q7 = -0.618	0.5294
10. Ghaziabad	S_{10j} = 20.9	q10 = -0.491	0.5395

*W_iK_i denotes Kidnappers' strength at core location when second term of equation- 3 is assigned as unity.

Movement of kidnappers in Delhi urban system is, of course, uneven. The nature and characteristics of kidnappers in core areas and corridors are influenced by the determining factors such as migration, population concentration, socio-economic conditions and accessibility to district locations (Ahamad 2012, Saha and Roy 2020, Singh Rambali 2018, Sardar and Nayak 2020). We unpack the umbrella of related factors in this section to understand and examine their effect on kidnappers' mobility.

Physical accessibility, that is distance-dependent, is an indicator of opportunity available to population at district center (Tali *et al.* 2019). Most of the district Headquarters usually have police stations. The areas close to kidnapping site are more prone to kidnapping activities. However, different travel modes, frequent and comfortable journey options, dense road network and metro-rail services in NCR are also major concerns for boosting passengers and also kidnappers' frequency and movement. Migration- a crucial factor in creating heterogeneous societies in urban areas (Rogaly *et al.* 2002), under-development and poverty- the primary causes for female migration that implicitly affect sex ratio, social composition (Scheduled Caste population) and economic situation (share of unemployed in the work force) in an area (Roy and Singha 2020, Choubey and Rai 2019, Suryakant 2018) and the population density and concentration- the indicators of congestion to make kidnappers more comfortable in kidnapping activities, are major determining factors of mobility. All the locations are grouped into two classes for easy analysis: (a) Set-a of nine locations that is kidnapping incidents dominated by outward movement (the +ve value push force dominated locations) and (b) Set-b of 20 locations facilitate hiding the victims and kidnappers (-ve valued pull force locations). Kidnappers mobility is much more variable spatially in the Set-a (CV= 121.089%).

To estimate random effect of associated determinants derived from concerned raw statistics (considered as explanatory variables, $X_{1, 2, 3\ldots,7}$) on kidnappers' mobility (dependent variable, Y), a multiple linear regression model is applied, expressed as

$$Y_e= a+b_1X_1 +b_2X_2 +b_3X_3 +\ldots+b_7X_7 \quad \ldots\ldots(\ )$$

Where X_1= Victims accessible to police station; average distance (km) between pair of locations, X_2=Population density (persons/sq km), X_3= Population concentration (share of population of particular district to total population of study area, in units), X_4= Sex ratio (female population per 1000 males), X_5= share of Scheduled Cast population to total district population (%), X_6= literacy rate and X_7= share of marginal workers to total

Table 4: Random effect multi-linear regression of kidnapper's flow

Explanatory Variables	Set-a (Core locations)		Set-b (pull force locations)	
	Coefficients	SE	Coefficients	SE
Average Distance to HQ (Km)	0.2565	0.4573	0.6141	0.5986
Population Density (persons/sq km)	138.8313	54.7416	0.2177	0.3722
Population Concentration (%)	-0.0406	0.4187	0.0016	0.2965
Sex Ratio (Female/Male)	-0.6295	0.4282	0.4348	0.3128
Scheduled Caste Population (%)	0.1382	0.3763	-0.1714	0.4271
Literacy rate (%)	-0.1384	0.4660	0.1643	0.4375
Marginal worker (% share)	0.2310	0.5871	0.0338	0.3816
Multiple correlation (r)	0.983182	-	0.7657	-
Degree of Determinant (R2)	0.966646	-	0.5864	-

population (%). In this equation, a denotes constant and b's are coefficients specifying factorial strength to estimated kidnapper's mobility, Y_e. Having input dataset normalized (mean=0, Standard Deviation =1), the model examines and explains various facts as given below:

Table 4 reveals interesting facts about kidnappers' mobility patterns. The population density, showing positive and gender disparity showing negative relationship are primary factors having high impact on mobility pattern in the district locations of high concentration of kidnappers and higher intensity of their movement (push force core locations, Set-a). In fact, districts that accounted for much higher population density such as North East district of Delhi report higher kidnapping incidents with intense outward kidnappers' flow as discussed in the earlier section. The flow is 1.38 times higher when population density increases (Table 4). It appears that the female kidnapping cases are concentrated less in these district locations as these areas have congested clusters of well-off households where act of kidnapping is more for ransom and other acts of money exchange. The inter-state border areas of North East and East districts of Delhi (core of push force) have inter-state bus stops and most congested industrial areas where such ransom-kidnapping is most prevalent (Gupta 2020).

Regression coefficients of Set-b of Table 4 confirm the facts that (i) the kidnappers mobility is noticed intensive and frequent with kidnappers receptive trend at distant locations from police stations/ district Headquarters in the peripheral areas of NCR, and (ii) Since gender disparity is a factor that promotes crime rate (Bhatt and Joshi 2013, Lee and McNally 2002), it seems that the kidnapping activities are to be an emerging trend in peripheral areas where kidnappers get two type of advantages, the safe shelters and the women kidnappings.

Observations and conclusions

As might be anticipated from the debate of the causes and consequences of kidnapping activities, our analysis extends previous work to unveil hierarchic processes of spatial mobility of kidnappers to test the validity of facts considering Delhi urban system as a case, which is most kidnapping-prone area across the emerging urban systems in Indian. A significant spatial variation in kidnappers' mobility can be seen in Delhi urban system where diverse social groups reside. Victims' accessibility to nearest police headquarters to report cases, dominance of females in demographic composition of population and dense populated areas of district locations greatly enhance kidnapping activities in this urban system. Core areas and mobility patterns of kidnappers are noticeably controlled by the National Highway and intense road network. Highways and their junctions such as inter-state bus stops and taxi stands are main centers to channelize kidnappers' frequent and fast movement. Of course, inter-state porous borders are also another factor to make free move of kidnappers for their safe hiding.

We can use this model as a 'tool' for identifying main centers of kidnappers' stay and their movement especially in urban areas where kidnapping is frequent. It would essentially be helpful for police administration and crime combating agencies. In order to make the model more workable, one can use distance parameter, d_{ij}, in the model in terms of time-distance or actual physical distance rather than imposed assumed linear inter-location distance.

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