Gender-based violence in New Delhi, India: forecast based on secondary data analysis

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Abstract

Background: Violence against women is a global phenomenon.

Aims: To estimate and forecast cognizable crime against women in New Delhi, India, from 2016 to 2020.

Methods: Reported cognizable crime against women in New Delhi for 2009–2015 was extracted for statistical analysis, synthesis and modelling. The cognizable crimes reported are rape, attempt to commit rape, kidnapping and abduction, dowry deaths, assault on women with intent to outrage her modesty, insult to modesty of women, cruelty by husband or his relative, importation of girls from foreign countries, abetment of suicide of women and indecent representation of women.

Results: The actual number of registered cases of crime against women ranged from 4251 (2009) to 17 104 (2015). The projected number of cases ranged between 18 991 [95% confidence interval (CI): 13 092–24 889) in 2016 to 28 663 (95% CI: 22 314–35 013)] in 2020. A rising trend in crime against women was noticed in New Delhi, ranging from 204.6 (2016) to 308.8 (2020) per 100 000 women. After witnessing a substantive increase (116.2%) in reported crime against women in New Delhi in 2013, the subsequent actual and projected rise appears to be incremental in nature, with an annual percentage point change ranging between 9% and 18%.

Conclusion: Within limitations, it is concluded that the safety of women will continue to be a concern in the near future.

Keywords: crime, women's empowerment, gender training, police, time-series

Introduction

Gender-based violence is defined as any act that results in, or is likely to result in, physical, sexual, economic or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life (1). Women across the world [North American region (7–32%); Latin America and the Caribbean (14–38%); Europe (13–46%); Africa (6–64%); Asia (6–67%); and Oceania (17–68%)], regardless of socioeconomic strata, are subjected to some form of violence (2).

One in 3 women has experienced physical/sexual violence at some point in their life. In a World Health Organization multicountry study, 23–56% of women reported experiencing physical or sexual violence from their partner (3). In most countries less than 40% of women who experienced violence sought help of any sort. In addition, studies have revealed that mental health and psychosomatic conditions reported among survivors of violence (especially among refugees) could also be a risk factor for poor reproductive health outcomes (4–8). The prevalence of female genital mutilation/cutting ranged between 1% (Uganda) and 98% (Somalia), including 74% in Ethiopia, 66% in Liberia, 44% in Chad, 26% in Senegal and 15% in Tanzania (9). However, recent evidence suggests a decreasing trend across those countries with high rates and a target for the elimination of this practice by 2030 (10).

Women can face extreme discrimination due to a historical, orthodox, discriminatory mindset in society. The lower status of women increases and perpetuates gender-based violence, including female feticide, infanticide, gender discrimination (health care, nutrition, schooling, higher education, dress code, mobile phones and restriction of movement), early marriage, trafficking, rape, assault, insult to modesty, indecent representation of women, honour killing, etc. (11–13). These types of gender-based violence that are directed specifically against women are characterized as "crimes against women".

The constitution of India provides equal rights to its citizens irrespective of cast, colour, creed, religion, socioeconomic status and gender. Various policies, legislation, interventions, schemes and welfare measures have been formulated specifically for the protection and safety of vulnerable populations, including women. Empowering women to live with dignity and contribute as equal partners in an environment free of violence and discrimination is of paramount importance for quality of life as well as the economic development of society.

Evaluation of past data can help to predict future rates, patterns, types, locations and/or times of crime. Therefore, a time-series analysis was undertaken to determine and forecast cognizable crime against women in New Delhi, India, for the period 2016–2020 using National Crime Record Bureau statistical data for the period 2009–2015. This information may specifically help policy-makers and administrative and law enforcement agencies towards better preparedness for prevention of crime against women.

Methods

Time-series analysis

A time-series analysis correlates a series of observations collected at regular time intervals (14,15). Typically, a time series comprises 4 components (variations) and traditionally 3 approaches (models) for forecasting future values (16). These variations are: trend variation (long-term change in the mean); seasonal variation (patterns that occur in a fixed and known period, e.g. quarter year, month, etc.); cyclic changes (pattern that exists when the data exhibit rises and falls that are not of a fixed or known period); and irregular component (any fluctuations that are observed excluding the above-mentioned variations from a time series). The statistical models used for predicting future events include regression-based methods, exponential smoothing methods and autoregressive integrated moving average (ARIMA) models (17).

Data source

Each year the government of India publishes statistical data on crime. The data for the current study were drawn from the National Crime Report Bureau (18). The cognizable crime as defined under the Indian penal court or local laws and registered by police stations is reflected in the annual report. The cognizable crimes against women are primarily: rape, attempted rape, kidnapping and abduction, dowry, assault with intent to defile her modesty, insult to modesty, cruelty by husband or relative, importation of girls from foreign countries, abetment of suicide, indecent representation of women, commission of *sati* (practice of immolation by a widow on the funeral pyre of her husband; now illegal), domestic violence and immoral traffic.

Cognizable crime data registered against women in New Delhi for the period 2009–2015 were extracted for statistical analysis, modelling and prediction using *SPSS*, version 16 (Table 1). Additional information was derived from the annual report 2015 to determine the pattern of cognizable crime committed against women in New Delhi in comparison to India as a whole in order to provide a comprehensive scenario.

Statistical analysis and modelling

The following steps were undertaken during modelling and forecast analysis (15,19).

Table 1. Total cognizable crime reported against women in New Delhi, India

Year	2009	2010	2011	2012	2013	2014	2015
No. registered cases	4251	4518	5234	5959	12 888	15 265	17 104

Source: National Crime Record Bureau, India.

- Time-series analysis was applied to determine presence of basic features such as trends, seasonal behaviour or both.

- Presences of any trend or seasonal components were eliminated either by differencing or by fitting appropriate models to the data. In our data set, only trend was present and was eliminated by using software command (Holt and auto ARIMA).

- Assessment of stationarity of data series was also checked. The autocorrelation function (ACF) and partial autocorrelation function (PACF) plots were used to determine the stationarity of the data and order of the model.

- In order to develop a forecasting model for the residuals, several models were chosen that could be representative for the available data. The optimal estimates for the coefficient of the chosen models were obtained at the identification stage. We used 20% of the dataset for "training" to find the parameters of the models, i.e. Holt Linear Model (HL) and ARIMA (20).

- In order to validate the performance of the models from the previous step, we used the remaining 80% of the data set for "testing".

- A statistical tool, the Ljung–Box Q statistic, was used to determine independence of data series. The test statistic Q is represented as:

$$Q_m = n\,(n+2) \sum_{n=1}^{m} \left(\frac{r2(e)}{n-k} \right) \sim \chi^2_{m-r}$$

where: $r2(e)$ = the residual correlation at lag k; m = the number of time lags included in the test; n = the number of residuals

- Forecast accuracy of the models was measured using mean absolute error (MAE), root mean square error (RMSE), mean absolute percentage error (MAPE) and Bayesian information criterion (BIC).

- The best model was selected on the basis of forecast accuracy measures obtained in the previous step and was used to predict future values of cognizable crime against women.

Holt's linear and the ARIMA models were found to be appropriate for the study dataset, and the best model was chosen based on the accuracy measures (21–23). Table 2 shows different model accuracy parameters. It was deduced that Holt's linear model was the best model for forecasting as it had the highest value of R^2, suggesting that it explained 85% variability along with lower values

Table 2. Accuracy parameters of the model

Parameter	Model fit statistics					Ljung-Box Q-test	
Model	R2	RMSE	MAPE	MAE	BIC	Statistic	P-value
Holt linear	0.858	2294.58	25.60	1688.88	16.03	4.04	0.257
ARIMA (1)	0.831	2960.03	25.99	1797.67	16.88	2.06	0.564
ARIMA (1,2)	0.848	3439.45	25.78	1775.02	17.48	2.09	0.554

RMSE = root mean square error.

MAPE = mean absolute percentage error.

MAE = mean absolute error.

BIC = Bayesian information criterion.

ARIMA = autoregressive integrated moving average.

of accuracy measures (RMSE, MAPE, MAE, BIC). The Ljung–Box test indicated that the model was statistically correct ($P = 0.257$ for Holt's linear model). There were no statistically significant differences between actual and predicted values by model.

Results

The available data indicated that the actual number of registered cases of crime against women ranged from 4251 (2009) to 17 104 (2015). The number of projected cases ranged between 18 991 (95% CI: 13 092–24 889) in 2016 and 28 663 (95% CI: 22 314–35 013) in 2020. A rising trend was noticed for crime against women with the rate ranging from 204.6 (2016) to 308.8 (2020) per 100 000 women in New Delhi. Table 3 and Figure 1 depict observed, fitted and forecast values along with the 95% confidence intervals.

The data showed that that the population of women in New Delhi was 1.5% of that of India as a whole, while crime against women was slightly higher at 5.2% (Table 4). In regard to the pattern of crime against women, it was noticed that the number of cases registered under

Table 3. Projected cognizable crime against women in New Delhi, 2016–2020

Item	2016	2017	2018	2019	2020
No. of cases	18 991	21 409	23 827	26 245	28 663
UCL	24 889	27 423	29 955	32 485	35 013
LCL	13 092	15 395	17 699	20 005	22 314
Rate of total cognizable crime[a,b]	204.69	230.70	256.76	282.81	308.87

UCL = upper confidence level; LCL= lower confidence level.

[a]Rate = (reported cognizable crimes against women/female population) × 100 000.

[b]Projected female population (2015) in New Delhi used as base population (92.8 × 100 000).

"outrage and insult to modesty" was much higher in New Delhi (40.4%) in comparison to the country as a whole (27.8%). However, cruelty by husband and in-laws (members of husband's family) was less common in New Delhi (20.5%) in comparison to the whole country (34.6%) (Table 5). Similarly, kidnapping and abduction cases registered were also higher in New Delhi (25.0%) in comparison to the country (18.1%).
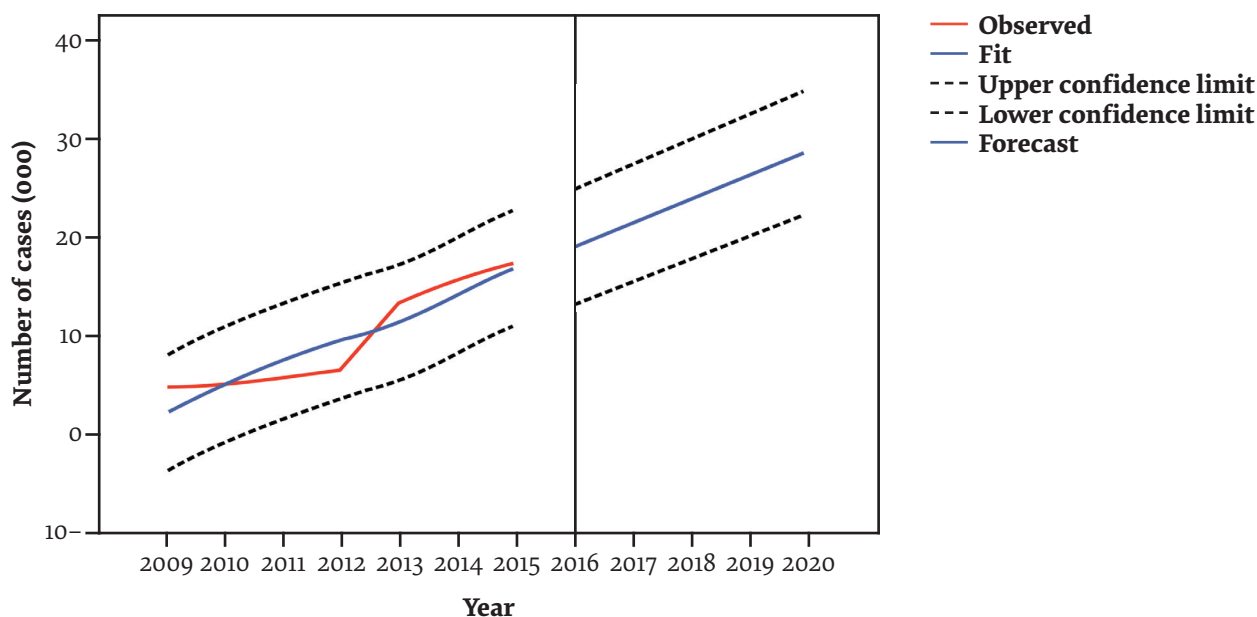
Figure 1. Historical (2009–2015; source: National Crime Record Bureau, India) and forecast (2016–2020) cognizable crime against women in New Delhi

Table 4. Selected parameters relating to women, New Delhi, 2015

Parameter	New Delhi (a)	India (b)	Proportion (a/b) (%)
Total projected mid-year population (100 000)	208.8	12 591.1	1.6
Female population (100 000)	92.8	6 070.8	1.5
Total registered cognizable crime (including crime against women) (No.)	191 377	2 949 400	6.5
Crime against women (registered cases) (No.)	17 104	327 394	5.2
Proportion of crime against women to total crime (%)	8.9	11.1	–

Source: National Crime Record Bureau, India.

Table 5. Pattern of cognizable crime committed against women, India and New Delhi, 2015

Crime	India (%)	New Delhi (%)
Outrage and insult to modesty	27.8	40.4
Kidnapping and abduction	18.1	25.0
Cruelty by husband and relatives	34.6	25.5
Rape and attempted rape	11.9	13.0
Dowry	5.4	0.3
Miscellaneous	2.2	0.8
Total	100	100

Source: National Crime Record Bureau, India.

Discussion

A time-series analysis was undertaken to determine and forecast crime against women in New Delhi, as defined under Indian legislation, for the period 2016–2020. There was a 40% increase in reported cases in New Delhi from 2009 to 2012 while the rise was 33% from 2013 to 2015. It was projected that if the current situation remains unchanged, there will be a 25% increase in crime against women.

Our findings need to be considered in view of a number of limitations: firstly, the rate of increment of crime against women should be the same with some fluctuation in the future comparing with current levels; secondly, the social makeup should be considered as the current scenario, and finally distribution of crime has a variation in respect to age but our study includes total crime against women irrespective of age.

India, the second most populated country and the largest democracy in the world, is undergoing an epidemiological, demographic, cultural, social, nutritional and economic transition and witnessing the double burden of disease (communicable and noncommunicable) with widespread ramifications for mortality. In recent years, societal awareness, the system of accountability and enforcement of existing legislation have improved in the country following the brutal gang rape and death of a victim in Delhi in 2012 (24) . This was considered to be a watershed year, which attracted global media attention, discussion, debate and protest and candle-lit marches in the streets of the capital, resulting in an enhanced political commitment and the announcement of additional safety measures for women. Following this event, a sudden rise in the reporting of crime against women was noticed (116.2%) in New Delhi during 2013 as reflected in Table 1. The subsequent actual and projected rise appears to be incremental in nature, with an annual percentage point change varying between 9% and 18%. The prevailing high crime rate in Delhi is suggestive either that such cases were not registered by

the police in the past or that women have become more assertive and/or the scope of cognizable crime against women has broadened under various legislative sections and local laws and/or sensitivity has increased since a large number of female personnel have been inducted into the police force.

The national capital region constitutes a mix of urban, slum and urbanized rural population of 20 million residing in 11 revenue districts, with an 86% literacy rate along with one of the highest per capita income rates in India, but with a skewed sex ratio (number of females per 1000 males) 868 compared with 940 for the whole country in 2011 (25). The cosmopolitan environment constitutes diverse economic, cultural, dietary, language and religious practices. The porous boundaries of planned and unplanned urban development in the region is expanding and encroaching on neighbouring states. Such increasing urbanization, material aspirations and migration are leading to challenging pressures on space and basic utility services, increased pollution and mushrooming of slum clusters. Meanwhile, there is also increasing access to the Internet, social media, mobile phones and other tools of technology with concomitant misuse leading to an increase in impersonation, defamation and public insult of women. Additionally, the proportion of cases registered as "cruelty by husband and relatives" was 20.5%, which appears to correlate with a slightly higher population-based prevalence of spousal violence (26.8%) experienced by women in New Delhi (26).

In neighbouring Pakistan spousal abuse is also considered to be widespread (27). The World Economic Forum's Global Gender Gap report revealed that Pakistan is the second lowest performing country globally in terms of gender equality (28). Tazeen et al. found that almost all forms of spousal abuse (81.8%, psychological; 56.3%, physical and 53.4% sexual) were prevalent in urban areas of Karachi (29). In Saudi Arabia, spousal physical violence was reported by 45.5% of women (30). It is pertinent to mention that the WHO South-East Asia Region has one of the highest (37.7%) prevalence rates for partner violence globally; this compares with the Eastern Mediterranean Region (37.0%), African Region (36.6%), the Americas Region (29.8%), European Region (25.4%) and Western Pacific Region (24.6%) (5).

Conclusion

From the findings of the current study it is clear that safety of women will remain a concern and will require a multipronged preventive strategy. A comprehensive approach (individual, family, community and societal) including efforts to improve women's access to resources (e.g. credit, training, inheritance and land rights), hostels for working women and access to them (e.g. through anti-discrimination and gender-based violence legislation, gender-aware justice systems, and government mechanisms to improve gender equality) may improve the situation (*31*). Other measures such as sustained political commitment, increasing system accountability, social consciousness, digital awareness, removing online child pornography, restricting migration, socioeconomic improvement, safe transport, gender sensitization training, counselling, surveillance and increased crime control policing may lead to lower crime rates against women in society. On a positive note, some of the recent legislative, policy and development measures initiated by the present government of India will transform society and strengthen transparency, including financial transactions, and as a secondary outcome may possibly bring down crime rates.

Violence sexiste à l'encontre des femmes à New Delhi (Inde) : projections basées sur une analyse des données secondaires

Résumé

Contexte : La violence à l'encontre des femmes est un phénomène mondial qui nécessite une attention constante.

Objectifs : Évaluer les délits caractérisés à l'encontre des femmes à New Delhi (Inde) entre 2016 et 2020 et établir des projections à cet égard.

Méthodes : Les délits caractérisés à l'encontre les femmes, rapportés à la police, à New Delhi pour la période allant de 2009 à 2015 ont servi de base à un travail d'analyse statistique, de synthèse et de modélisation. Les délits caractérisés à l'encontre des femmes ayant fait l'objet d'un dépôt de plainte sont : le viol, la tentative de viol, l'enlèvement et le détournement de femmes, les meurtres liés à la question de la dot, les agressions sur les femmes avec intention d'attenter à leur pudeur, l'outrage à la pudeur, les actes de cruauté de la part du mari ou d'un parent, la traite de jeunes filles originaires de pays étrangers, l'incitation au suicide des femmes, la représentation obscène de la femme.

Résultats : Les données disponibles indiquent que le nombre véritable de délits enregistrés à l'encontre de femmes était compris entre 4251 (2009) et 17 104 (2015). Selon les projections, le nombre de cas varie entre 18 991 (IC à 95 % : 13 092–24 889) en 2016 et 28 663 (IC à 95% : 22 314−35 013) en 2020. On a observé une tendance à la hausse des délits perpétrés contre des femmes, le taux allant de 204,6 (2016) à 308,8 (2020) pour 100 000 femmes à New Delhi. En outre, on a constaté qu'après avoir enregistré une augmentation importante (116,2 %) des délits à l'encontre des femmes à New Delhi en 2013, ayant fait l'objet d'un dépôt de plainte, la hausse réelle et prospective semble être progressive par nature, l'évolution en points de pourcentage allant de 9 à 18 %.

Conclusion : Dans certaines limites, l'étude conclut que la sécurité des femmes restera une préoccupation sérieuse dans un avenir proche, exigeant une attention accrue à la fois au niveau politique et au sein de la communauté.

العنف القائم على الجنس في نيودلهي، الهند: التوقعات القائمة على تحليل البيانات الثانوية

نيدي دويفيدي، سانديب ساشديفا

الخلاصة

الخلفية: تُعَدُّ الجرائم المرتكبة ضد النساء ظاهرة عالمية تحتاج إلى معالجة مستمرة.

الأهداف: تم تقدير نسبة الجرائم التي يعترف بها القانون المرتكبة ضد النساء وتوقعها في نيودلهي، الهند، بداية من عام ٢٠١٦ حتى عام ٢٠٢٠.

طرق البحث: استُخرجت نسبة الجرائم التي يعترف بها القانون المرتكبة ضد النساء في نيودلهي للفترة بين عامي ٢٠٠٩ و٢٠١٥ من أجل تحليلها إحصائيًا وتجميعها ونمذجتها. وشملت الجرائم التي يعترف بها القانون والمُبلَغ عنها المرتكبة ضد النساء: الاغتصاب، ومحاولة الاغتصاب، والاختطاف والأسر، وحالات الوفاة بسبب المهر، والاعتداء على النساء بنية خدش حيائهن، وخدش حياء المرأة، والتعرض للقسوة على يد الزوج أو أحد أقاربه، وجلب الفتيات من البلدان الأجنبية، والتحريض على انتحار النساء، والتصوير غير اللائق للمرأة.

النتائج: أشارت البيانات المتاحة إلى أن العدد الفعلي للحالات المسجلة للجرائم المرتكبة ضد النساء تراوحت بين ٤٢٥١ (٢٠٠٩)، و١٧ ١٠٤ (٢٠١٥). وتتراوح عدد الحالات المتوقعة بين ١٨ ٩٩١ (٩٥٪ CI: ٠٩٢ ١٣ إلى ٢٤ ٨٨٩) في ٢٠١٦ إلى ٢٨ ٦٦٣ (٩٥٪ CI: ٢٢ ٣١٤–٣٥ ٠١٣) في عام ٢٠٢٠. ولوحظ تصاعد وتيرة الجرائم ضد النساء، حيث تراوح معدل الجرائم المرتكبة ضد النساء بين ٦، ٢٠٤ (٢٠١٦) و٨، ٣٠٨ (٢٠٢٠) لكل ١٠٠ ألف امرأة من سكان نيودلهي. بالإضافة إلى ذلك، لوحظ أنه بعد ملاحظة زيادة جوهرية (٢، ١١٦٪) في الجرائم المُبلَغ عنها ضد النساء في نيودلهي في عام ٢٠١٣، بدا أن الارتفاع اللاحق الفعلي والمتوقع ذو طبيعة تزايدية حيث يتراوح التغيُّر بالنقاط المئوية السنوية بين ٩٪ و١٨٪.

الاستنتاجات: تم استنتاج أن سلامة النساء ستظل مصدر قلق بالغ في المستقبل القريب، وأنه يجب إعطاء مزيد من الاهتمام لهذه القضية على المستوى السياسي وفي المجتمع.

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