Research Article

Examining the Comparative Effect of the Built Environment on Crime Prevention in Plotted Development, Especially for Women's Safety at Both Hot and Cold Spots

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This study aims to establish that hot spot and cold spot-built environments are different, and this difference is triggering criminal activity. The present study was conducted in Gomti Nagar, Lucknow. A total of 390 spots were assessed based on parameters of the built environment. Then, a perception survey was conducted to understand women's perception of the effect of the built environment on crime occurrence. The present study concludes that a significant difference is identified in a cold spot-built environment and a hot spot-built environment, and women believe that the parameters used in analyzing the built environment affect crime prevention. The study thereby concludes that, in the Indian context (mainly tier-2 cities of the northern region of India), the identified parameters can contribute to improving crime against women in public spaces of tier-2 cities in northern India. Thus, when developing policies and recommendations for Indian cities, these identified parameters need to be considered.

Introduction

The data from the NCRB (National Crime Record Bureau) report shows that violence against women occurs every three minutes in India, and this figure is calculated from reported crimes. The unreported crime is much higher than the reported crime. Every hour, a woman is sexually assaulted, and every six hours, a girl is beaten to death, driven to suicide, or burned alive in India. Many studies have been conducted related to crime against women in metro cities like Delhi, but no study has ever been conducted in tier 2 cities (ISIWCD, 2017). Crime against women is a major challenge that our society is facing in the contemporary world. Researchers are trying various ways to reduce this from our society by creating apps, exploring electrical gloves, and changing the built environment (Chitkara et al., 2017). To reduce these crimes against women, researchers have proved that the built environment plays a role in facilitating crime. Due to the poor quality of urban

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space and the occurrence of crime in public space, terminology for these spaces has been developed, such as black and red urban space (Al-Ghiyadh & Neamah Al-Khafaji, 2021). Studies have already explored the role of urban design in planning safer cities for women (Bell, 1998) (Silva & Li, 2020).

Many theories have been established by theorists in the past (Piroozfar et al., 2019), but alterations are needed for a holistic approach to reducing crime in any area (Armitage, 2016). These changes are necessary due to contemporary lifestyle, context, and advancements in technology. The impact of surveillance, community participation, accessibility, lighting, and social inclusion have been explored in creating safer communities (White, 1998) (Badiora & Odufuwa, 2019) (Wia et al., 2010) (Tiftik & Turan, 2015) (Polyantseva, 2020). Worldwide, many initiatives have been taken to improve the built environment, and the difference between the before and after situation of the city implementing CPTED is observed (Kim et al., 2019). The fear of crime itself restricts women from going out and developing (Soraganvi, 2017). Cities have observed a reduction in the rate of crime in the area after the implementation of CPTED. Still, the implication of CPTED or the effect of the built environment on crime prevention in the Indian context is yet to be explored.

The objective of this study is to analyze the impact of the built environment on women's safety. This research also aims to identify the relationship between built environment parameters and women's safety in public spaces. Addresses of hot spots were collected to analyze the surroundings around those spots where crimes against women occurred. Secondary data of criminal records and data related to demography were collected from NCRB (National Crime Record Bureau) reports, Census 2011, and F.I.R. data accessed from the police department of Uttar Pradesh. The data of incidents registered under each police station area for the years 2018, 2019, and 2020 were collected from the police department. Crime data related to the specific I.P.C. code of Gomti Nagar was gathered. The third important data collected from the secondary sources were the specific locations of the actual incidents. They were marked on the map of Gomti Nagar, and from this, a hot spot and cold spot map was prepared.

Methodology

To analyze the effect of crime and the activeness of the public, it can be explored through multiple criteria methods like PROMETHEE (Nazmfar et al., 2020). However, to analyze the effect of the built environment on crime prevention, a mixed method needs to be explored (Wrigley-Asante et al., 2019) (Risdiana & Susanto, 2019). In 2017, an important study was conducted to assess the role of crime prevention through environmental design (CPTED) on campus safety by Shariati (2017). This study examined the on-ground campus safety of different institutes in the USA. Interviews were conducted with students, security staff of the campus, and campus planners. After the interviews and identifying user perception, the built environment was assessed to analyze the quality of the built environment based on parameters defined by

CPTED. A study was conducted to analyze the historical evolution of the urban area and the mixed-use of the whole area (Bennetts et al., 2017). The research design adopted in the study was based on the built environment assessment of the historical precinct of Adelaide, Australia. Built environment assessment was conducted based on various parameters of built form like pedestrian activity, eye on the street, built form, character, and image. A series of interviews were conducted among the users of the space. Another study done by Paul Cozen in 2015 analyzed railway station precincts. The researcher identified two railway stations to do a comparative analysis for the research. While one railway station incorporated the CPTED strategy, the other did not incorporate any changes to prevent crime in their precinct with the help of the built environment. To analyze the precinct, interviews with security experts were conducted, and a land-use audit was done on the railway precinct. In 2021, Hillary Shiverenje Songole studied the Central Business District of Kabalangs, Uganda. This district also had a mix of activities mostly related to entertainment. A different group of users of the space was identified. The interview was conducted to assess the perception of safety and the effect of the built environment on the safety of the space. The relationship between different land uses like residential, commercial, and recreational concerning the distance of the crime spot was examined (Yusof & Fauzi, 2019).

From analyzing different methods used by these researchers, it can be concluded that the perception survey of the user and assessment of the built environment are the main variables to achieve this study's objective. The correlation between these two variables becomes important for this study, which will help establish the relationship between the built environment and women's safety. This whole process will be based on the parameters and indicators of the built environment which include land use, built form, surveillance, territoriality, physical deterioration, access control, entrapment, lighting, signage, maintenance and management, community deterioration, permeability, and placemaking.

Data Collection

Survey respondents were identified through a convenience sampling technique. Participants were approached for the survey while walking in different areas of the chosen neighborhood, and their consent was obtained for participation in this research. This survey was conducted between November 23, 2021, and November 26, 2021.

This survey covered three different areas of the neighborhood: the public area of Gomtinagar, the urban village of the neighborhood, and the residential area. Based on their distinct characteristics, these three areas were identified for analysis. A total of 404 surveys were conducted for this research: 39 in the Urban village, 58 in the Public zone area, and 307 in the residential area of Gomtinagar. Only female respondents between the ages of 15 and 65 years participated in this survey. While there were a few females who refused to participate in the survey due to lack of time, lack of interest in the subject, or the presence of small children

causing poor concentration on the survey subject. The response rate of the survey was 87%. The respondents were provided with a detailed explanation of the survey's objective, and verbal consent was obtained from them before starting the conversation. Consent was also obtained for audio recording and the use of their answers for the research. The purpose, aim, and benefits of participation were also explained to the survey participants.

Figure 1. (a) Land Use Plan of Gomti Nagar Area

Source: Author

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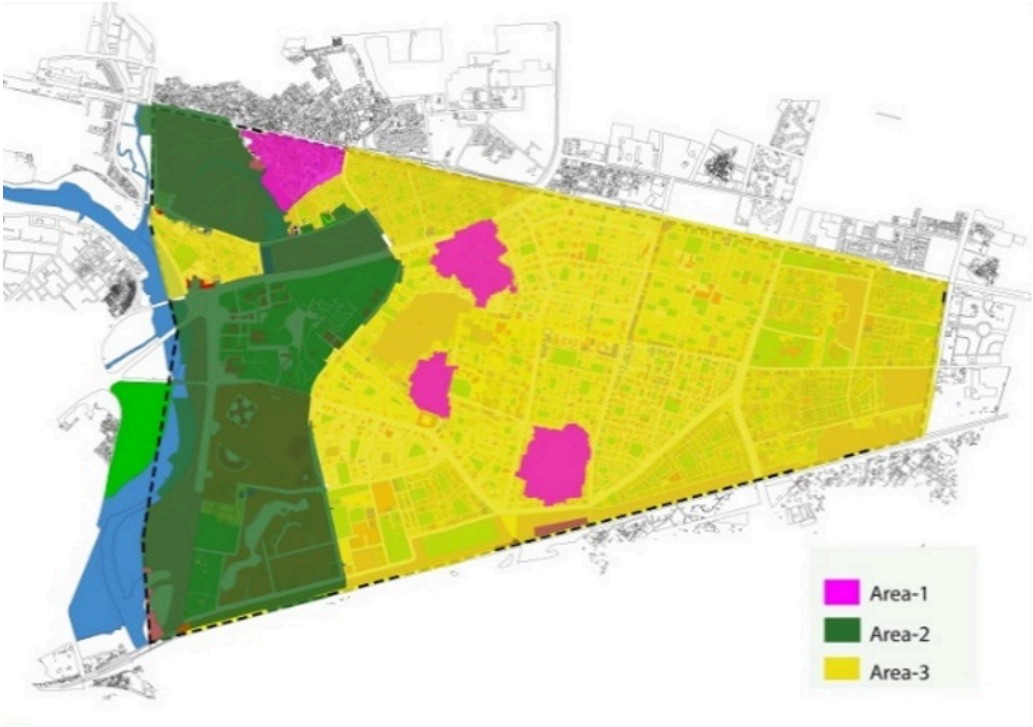

Figure 1. (b) Three Different Identified Areas/Zones of Gomti Nagar

Source: Author

The second important component of data was collected from the site through systematic observation of the built environment in all three areas selected for the research. This observation was conducted in both the hot spots and the areas outside of hot spots. An area where a crime has occurred is known as a hot spot, while the area where no crime has been registered or the area left after the hot spot is known as a cold spot. A total of 318 cold spots and 76 hot spots were identified and analyzed for comparative analysis.

Data Collection Tools

Perception Survey Data Collection

The perception survey of women for analyzing the effect of the built environment on women's safety has been collected through a Likert scale of 1-5 to measure women's agreement on the effect of specific built environment parameters on women's safety in their respective areas (Bajwa et al., 2018). A total of 14 questions were framed to assess the dependency of the crime that occurs in the area because of the condition of the built environment. These 14 questions were based solely on the identified parameters of the built environment. Subsequently, the 14 questions were formulated to yield 44 questions for the independent variable of the built environment.

There are 2 sections in the questionnaire. The first one collects demographic information such as the respondent's name, age group, marital status, education, and income. Three different areas in Gomti Nagar were categorized based on the characteristics of the built environment. The questionnaire was prepared in both English and Hindi languages to ensure better understanding by the respondents. The second section of the questionnaire addresses women's opinions on the effect of the built environment on women's safety. A rating scale was used to gauge women's perceptions of the effect of the built environment on women's safety, indicating their agreement with the various parameters of the built environment. The parameters upon which the questionnaire is based include land use, built form, surveillance, territoriality, physical deterioration, access control, entrapment, lighting, signage, maintenance and management, community deterioration, permeability, and placemaking. On the scale (as discussed in Table 1), a rating of 1 signifies strong disagreement with the statement, while a rating of 2 indicates disagreement. If an individual is neutral or unsure about a statement, they can assign a rating of 3 to that parameter.

S No.	Level of Agreement	Likert Scale Rating
Level 1	Strongly Agree	1
Level 2	Disagree	2
Level 3	Neutral	3
Level 4	Agree	4
Level 5	Strongly Agree	5

Table 1. Likert Scale for Women's Perception on the Effect of Built Environment on Women's Safety

It is evident that the lower rating score on the Likert scale means that women do not agree that the specific parameter contributes to women's safety. Conversely, a high ranking for the parameters indicates that women strongly believe that the specific parameters affect women's safety in the area.

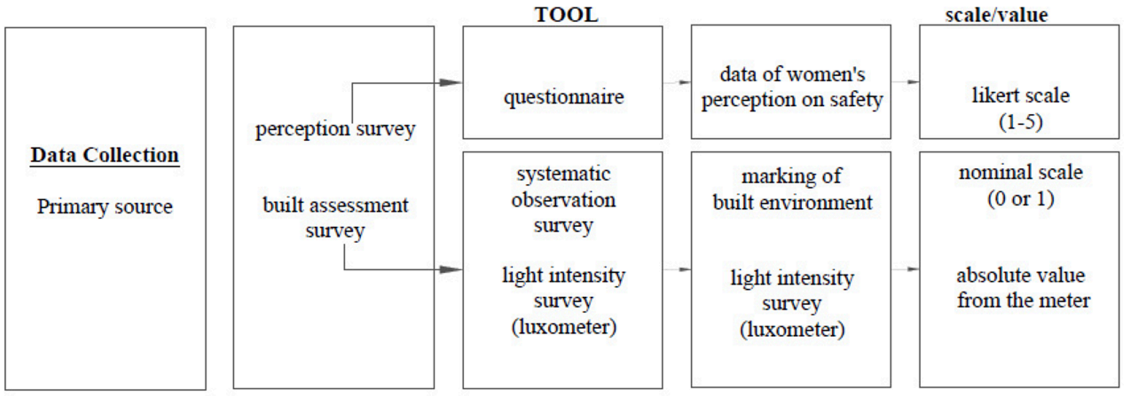

Figure 2. Flowchart Diagram for Primary Data Collection from Study Area

Source: Author

Built Environment Assessment Data Collection

To analyze the built environment of the selected areas, the entire area was mapped. Crime mapping can be done through different methods, such as creating a dot map, line map, ellipse map, choropleth map, and isoline map (Gonzales et al., 2005). A dot map is created when the address or location of the crime is identified. This type of map is useful for creating a hot spot map when the exact locations are known. The second type is a line map, which is created to identify hot spots at the street level. For broader area or macro-level analysis of crime, identifying hot spots and cold spots can be achieved through ellipse, choropleth, or isoline maps. Since the types of crime identified for this research occur in public spaces, there is a risk of crime beyond the known locations. The choropleth map is the most suitable for analyzing cold spots of the area, which are beyond the hot spot areas and are marked using the dot map. By using a choropleth map, different regions were identified through a grid referencing system. The grid's dimensions were within walkable distances for humans in public spaces. In urban studies, the grid referencing system helps in analyzing the study area (Krambeck & Shah, 2006).

All the parameters were judged based on the variables defined earlier in the assessment. These variables were then converted into physical indicators. These physical indicators were examined in the identified areas of the hot spots and cold spots.

The built environment was assessed in both hot spots and cold spots, which were identified from the retrieved data of the Uttar Pradesh police department. The cold spots were finalized through a grid of 200x200 meters. Each point was assessed on a nominal scale.

Marks were allocated to each parameter for each point. Then, from the collected data, two types of analyses were conducted. The first aspect of the study involved the total marks of each point based on the built environment. This assessment was conducted to analyze the condition of each spot in the built environment. The difference in conditions of the built environment between cold and hot spots was assessed. The second aspect of the study involved analyzing the condition of each parameter in the hot spots and cold spots. A comparative analysis was performed by summing the total marks of each parameter in both hot and cold spots. Then, data normalization was carried out due to the difference in survey numbers: 72 hot spots were surveyed compared to 318 surveys of cold spots. Thus, after determining the data average, a comparative study was conducted, and the most problematic parameters in the hot spots were identified.

Sample Size: As explained by Kothari (2004) in his book, to calculate the sample size, the formula needed is:

$$\text{Sample size} = \frac{\frac{z^2 \times p\,(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p\,(1-p)}{e^2 N}\right)}$$

Where N is the total population, e is the margin of error, z is the z-score, and p is the sample proportion. For the calculation of the sample size, a confidence level of 95% was used, a margin of error of 5%, and a sample proportion of 0.5. The female population of the three wards lying in Gomti Nagar was added to calculate the population. Therefore, the total female population of the area is 40,416.

From the formula, the total sample size is calculated to be 381.

The second method for sample calculation involves calculating 1% of the total population. So, 1% of 40,416 is 404. Now, the final sample size would be the higher number among both, which is 404.

Results

Result of Built Assessment

In the built assessment form based on the built environment parameters, 72 hot spot and 318 cold spot built environments were assessed. Marking was done on a nominal scale: if the variable of the specific parameter was present, 1 mark was given, and if the variable of the parameter was not present, 0 marks were given. After comparing the physical indicators between hot spots and cold spots, another analysis was conducted based on the assessed built environment. All the physical indicators were assessed at the identified points, and a total of 119 points were examined. All the identified points were added to indicate the quality of the built

environment at those spots. Then, the total marks obtained by each point in hot spots and cold spots were studied. Total marks obtained by each spot ranged from 20 to 90 out of 119. All the total marks of the identified points were then mapped onto the base plan of Gomti Nagar. The maximum marks that any spot received in a hot spot were 74 out of 119, and the minimum was 24. The marking was divided into 5 ranges: the initial two ranges obtained the lowest marks, spots lying between 20 to 34 and 35 to 44, spots with average marks ranging between 45 to 54, and the last ranges being 55 to 64 and 65 to 74. From lowest to highest, the ranges were color-coded as blue, purple, pink, orange, and yellow (refer to Fig.). To analyze the cold spots, as discussed above, the whole area was divided into a 200m x 200m grid. The marking for the cold spots started from 14 marks, and the maximum marks obtained were 84 out of 119. The color code remained the same as for hot spots, with the addition of cyan and green colors to depict the range between 14 to 24 and 74 to 84 respectively.

This map helped us identify the areas with the most issues in the built environment, indicating an immediate need for improvement and rectification.

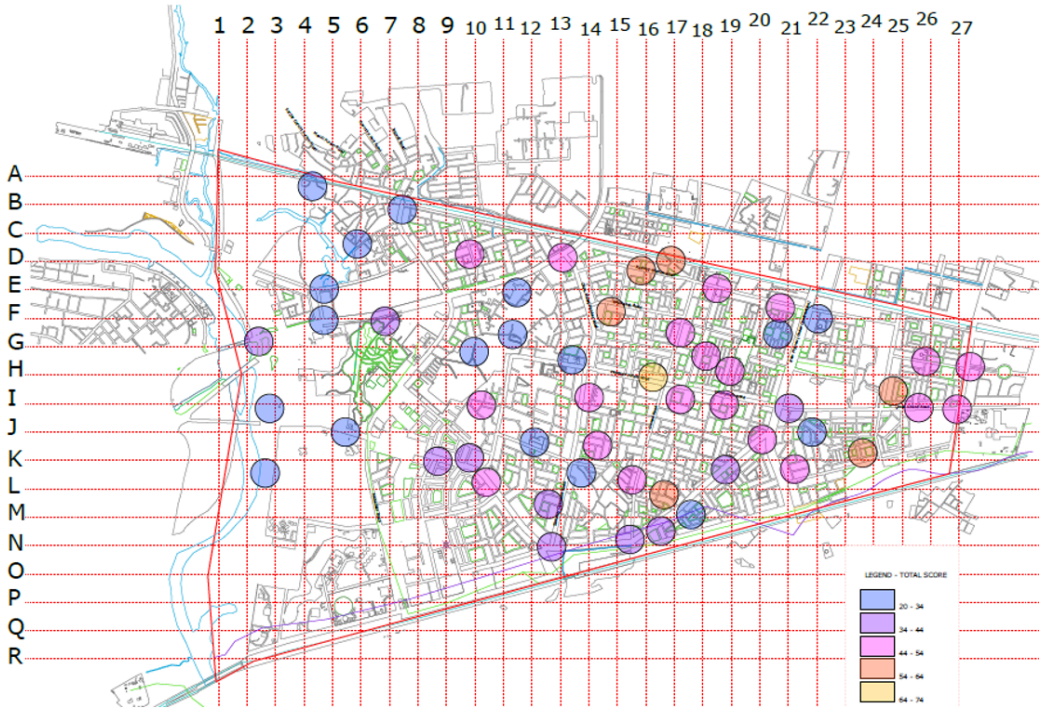

Figure 3. Map Showing Built Environment Assessment on Hot Spot.

Source: Author

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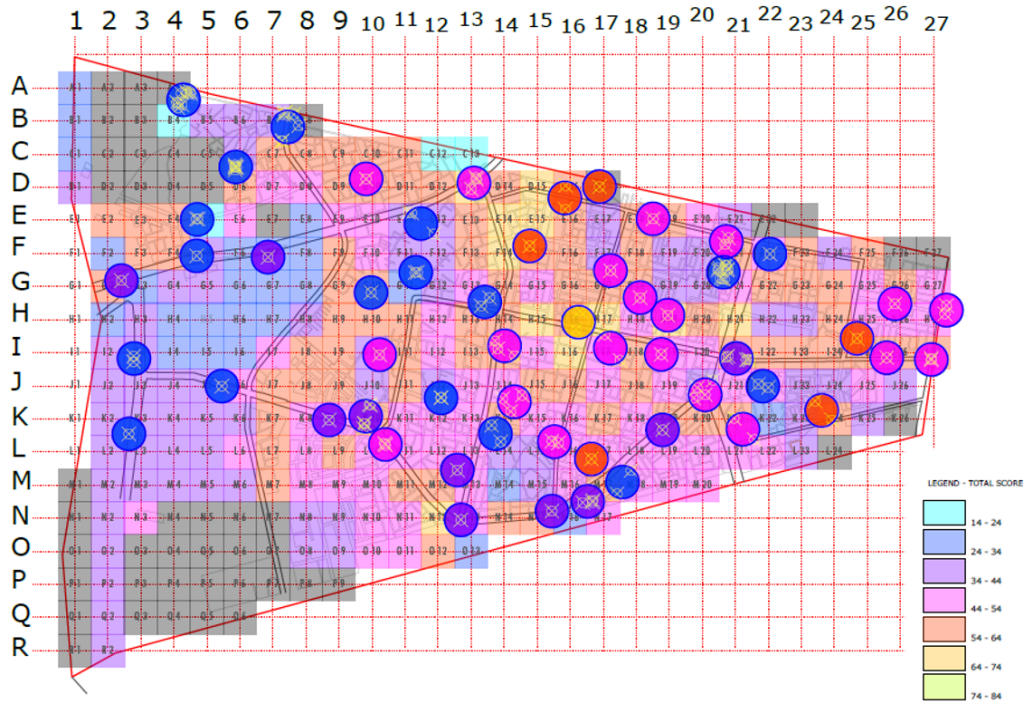

Figure 4. Map Showing Built Environment Assessment on Cold Spot and Hot Spot

Source: Author

Result of Perception Survey

The perception survey was conducted in three different areas: planned residential neighborhoods, urban village, and city-level public spaces. The sample size was fixed according to the percentage area distribution of the context. Thus, out of the 381 sample size, 49 perception surveys were conducted in the urban village, and 70 were conducted in public spaces. The remaining surveys were conducted in residential neighborhoods. From the survey, it was observed that 20% of respondents who participated in the survey belonged to the 13-20 years age group, 31% belonged to the 21-30 years age group, while 52% were in the age group of 31-45 years. In terms of education level, 59% of the respondents had an undergraduate degree, and 21% had a postgraduate degree. Regarding marital status, 38% of the women reported being single or unmarried, while 62% were married. In terms of annual income, 25% of the women earned less than 1 lakh per annum, 8% earned less than or equal to 3.5 lakhs per annum, 19% earned 5 lakhs or more yearly, while 34% of women did not respond to this question.

Discussion

In the perception survey, agreement to the effect of parameters ranged from strongly disagree, disagree, neutral, agree, and strongly agree. If collectively people strongly disagreed that a specific parameter was not contributing to women's safety, the marking range would be between 0% to 20%. If people disagreed with the statement that a specific parameter was not contributing to women's safety, the marking would range between 21% to 40%. If people were neutral about their opinion on any parameter's effect on women's safety, the minimum marks they obtained were 41%, and the maximum was not specified. From the perception survey, it was identified that people believed that each parameter had an effect on women's safety, with each parameter obtaining more than 55% marks. The most effective parameter was surveillance, which was impacting the safety and security of women in the neighborhood.

From the mapping of the built assessment on the Gomti Nagar base map, it is observed that in hot spots, the average mapping is marked in purple and blue colors, which are the lowest and second lowest ranges in marking. This means that in hot spots, the identified physical parameters that are helpful in crime prevention are absent, resulting in the lowest marks. In contrast, in the cold spot map, the major colors visible are pink, orange, and yellow. This implies that in cold spots, those physical indicators that are useful in creating a safe environment are present, and they obtain higher marks in the built assessment analysis.

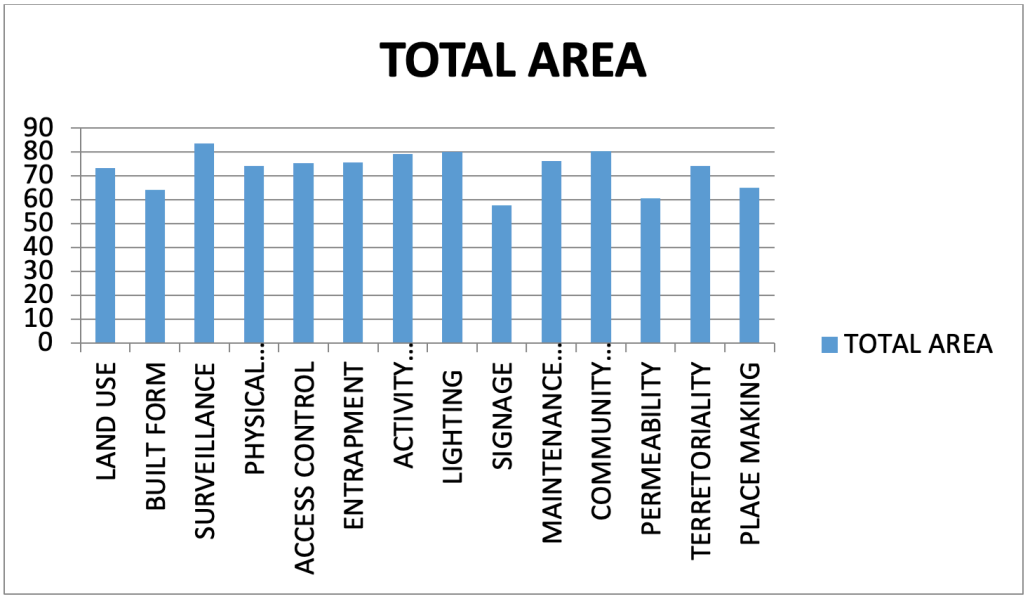

Figure 5. Bar Chart Showing Women's Perception on Effect of Parameter on Crime Prevention

Source: Author

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Conclusion

After examining the Indian context, it can be concluded that evident differences exist in the variables, along with their physical indicators, between cold spots and hot spots. The physical indicators of variables were largely absent in hot spots, influencing women's safety in the area. In cold spot areas, physical indicators of the built environment that are helpful in creating a safe environment were present. Thus, it can be stated that the built environment helps in creating safe spaces in the public domain. Another significant conclusion from the perception survey is that signage is the least important parameter of the built environment that influences women's safety in public areas. The final conclusion of the research is that surveillance and lighting are the most important parameters that affect women's safety in public areas.

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