Journal of Design and Built Environment
E-ISSN: 2232-1500 | Print ISSN: 1823-4208
https://ejournal.um.edu.my/index.php/jdbe
Vol. 24 Issue 01, 2024, 33-52

A User-Centric CPTED-Based Approach to Investigate Physical Environmental Variables Influencing Perceived Security of Urban Park Users in Tiruchirappalli, India

Dherya Mehta[1*] and Padmanaban Gopalakrishnan[1]

[1]Department of Architecture, National Institute of Technology, Tiruchirappalli, India

*Corresponding author: dheryamehta@gmail.com

Article Info:
Submission date: 23rd January 2024
Acceptance date: 13th June 2024

Keywords:
CPTED; fear of crime; perceived security; urban green space; urban parks

ABSTRACT

The link between Fear of Crime (FC) and physical environment and crime levels is referred to as Crime Prevention Through Environmental Design (CPTED). However, FC, irrespective of the level of crime through physical environmental features, can hinder people's access to urban parks. This study is a novel attempt to evaluate the Perceived Security (PS) related to fear of (theft, robbery) crime under the CPTED classification by assessing actual users' perceptions of multiple physical environmental variables within and around fifteen Tiruchirappalli urban parks. The objectively measured CPTED variables were documented through observations and measurements by the authors, whereas subjectively measured ones were assessed using actual users' (n=524) perceptions. The results majorly highlight the significance of park design and landscape-based surveillance and park facilities and landscape-based maintenance variables towards predicting PS. The findings from this study can aid policymakers, park designers, and managers in adopting strategies that can enhance the PS of users, prioritise interventions, and engage residents in addressing specific design considerations.

1.0 INTRODUCTION

Urban Green Space (UGS) is an urban land, partially or fully covered with vegetation such as grass, shrubs, trees, etc. (De Haas et al., 2021). Parks, as a type of UGS, have become an important focus of new environmental strategies for cities (Madge, 1997). UGSs, particularly urban parks offer ecological, economic, health and social benefits (Abdul Malek et al., 2018; Konijnendijk et al., 2013). However, the physical environmental features of urban parks can also induce Fear of Crime (FC) among its users (Pérez-Tejera et al., 2022). UGS can articulate the many dimensions necessary to conceptualise fear and space, fear in space and fear through space (Tulumello, 2020). The presence of nature contributes to reducing violence in urban settings (Shepley et al., 2019). However, the level of crime is related to FC, but it does not reflect the actual levels of FC (Lorenc et al., 2012). One key concern regarding FC is that it can restrict the social life of people (Rahm et al., 2021), eventually affecting their mental health (Lorenc et al., 2012). Furthermore, awareness regarding UGS (Tokazhanov et al., 2020) and concern for mental health (Xiong et al., 2020) have increased since the COVID-19 pandemic.

Lorenc et al., (2012) presented a holistic framework tracing the theoretical links between crime and anti-social behaviour, FC, health, and well-being, built environment, social environment and national policies and economy. The relationship between FC and physical environmental features and crime levels is theorised as Crime Prevention Through Environmental Design (CPTED).

1.1. CPTED

CPTED promotes that 'the proper design and effective use of the built environment can lead to a reduction in the fear and incidence of crime, and an improvement in the quality of life' (Crowe, 2000). The term was first conceptualised by Ray Jeffery, (1971). However, Jane Jacobs, (1961), in her book 'The Death and Life of Great American Cities', highlighted the importance of 'eyes on the street'. She explained the role of informal natural surveillance in creating a secure environment by decreasing criminal activities, thus reducing FC. Similarly, Elizabeth Wood, (1961) and Scholomo Angel, (1968) established that modifications to the physical design features of urban environments could reduce criminal opportunities. Eventually, Oscar Newman, (1972), elaborated on the concept of CPTED by including four key physical environment standards such as territoriality, surveillance, maintenance, and access control to reduce both crime and FC. However, among various theories, CPTED is the prime focus in environmental research on producing safe public places (Askari & Soltani, 2023).

In a review discussing the current status of CPTED, Cozens and Love, (2015) mentioned that the current first-generation CPTED is based on seven key strategies: territoriality, surveillance, maintenance, access control, target hardening, activity support, and the surrounding environment. Territoriality intends to reduce criminal opportunities by promoting ownership of a space by rightful users. Surveillance aims to enhance guardianship by promoting natural surveillance through physical design. Maintenance of a space assures its proper functioning and conveys positive messages to its users. Access control over a space aims to increase risk perception and eventually reduce crime. Target hardening uses physical obstacles (such as fences, etc.) to restrict access to a criminal target. Legitimate activity support encourages use of public space through appropriate design interventions to promote 'eyes on the street' and deter crimes.

1.2. Fear of Crime

The definition of FC has evolved throughout history. FC was referred to as 'an emotional reaction characterised by a sense of danger and anxiety produced by the threat of physical harm elicited by perceived cues in the environment that relate to some aspect of crime for the person' (Garofalo, 1981). Ward et al., (1986) defined FC as a sense of security and feelings of vulnerability. Sacco, (1993) defined FC as a form of psychological disorder reducing quality of life, restricting access to social and cultural activities, and impairing social interaction within the community. Lately, FC has been defined as one that describes the ‘wide range of emotional and practical responses to crime and disorder individuals and communities may make' (Pain, 2000). In a nutshell, the studies have witnessed a shift from defining FC as a “fear” of “crime” to an 'umbrella' concept that includes both crime-related fear and diffuse 'feelings of insecurity' (Donder, 2009).

1.3. Fear of Crime in Urban Green Spaces

FC in UGS has been a global research concern over the past four decades (Jansson et al., 2013; Mak & Jim, 2018; Maruthaveeran & Bosch, 2014), with most of the studies done in North America (Sonti et al., 2020) and Europe (Pérez-Tejera et al., 2022) and a few in Africa (Mahrous et al., 2018) and Australia (James & Embrey, 2001). The Asian studies are done in China (Jing et al., 2021), Hongkong (Mak & Jim, 2022), Iran (Sezavar et al., 2023), Japan (Yokohari et al., 2006), Malaysia (Maruthaveeran & Bosh, 2015), Singapore (Yeoh & Yeow, 1997), South Korea (Min et al., 2022), and Turkey (Türkseven Doğrusoy & Zengel, 2017). Since the perception of safety (Hannah et al., 2016), application of research findings (Maruthaveeran & Bosh, 2015), and respective design recommendations (Subbaiyan & Gopalakrishnan, 2012) vary concerning the geographical context, it is essential to conduct more FC studies in different parts of the world (Maruthaveeran & Bosch, 2014) and compare them to comprehensively understand the cumulative effect on FC in UGSs (Mak & Jim, 2018). Moreover, past studies highlight the importance of examining FC in a greater range of racial/ethnic compositions and economic conditions (Swatt et al., 2013), and India offers astounding variety in virtually every aspect of social life ("Indian Society and Ways of Living", n.d.). Moreover, with ongoing urbanisation in the most populous developing country ("World Urbanization Prospects", 2018), around 82 crore people are predicted to live in urban settlements by 2051 ("Urban Greening Guidelines", 2014). However, the fewer Indian studies relating to the urban environment and FC are limited to the city level (Rai & Rai, 2019), urban neighbourhoods (Nalla et al., 2011; Patel, 2019), ATM (Hannah et al., 2016), streets (Lloyd-Sherlock et al., 2015), and bus stops (Subbaiyan & Tadepalli, 2012).

Studies on FC in urban parks have used virtual (Zhao & Huang, 2021) or real (Polko & Kimic, 2022) environments as stimuli to collect the perceptions of potential or actual users, respectively. However, a simulated stimulus of a natural environment is a passive experience which does not provide holistic spatial information, limits respondents' experience to visual sensation, and controls behavioural freedom and decision-making (Andrews & Gatersleben, 2010). However, FC results from multiple physical environmental attributes (Maruthaveeran & Bosch, 2014). A review done by Maruthaveeran and Bosch, (2014) analysing studies till 2012 on FC in UGSs categorised the fear-evoking attributes under five heads: personal, social, physical, image of the park and neighbourhood and time of the day and season. A study done by Mak and Jim, (2018) (examining fear-evoking factors in urban parks in Hong Kong) extends the literature by adding more factors (n = 90) under the five different categories, namely, inherent park characteristics, park design and management issues, visitor-related concerns, sociodemographic variables, and visit-related preferences. However, they did not specify the crime type they are evaluating under FC. Moreover, a dichotomous single-item FC question does not measure fear of a specific crime but fear of general crime. Further, the perception of crime type (murder, rape, etc.) in a single question evaluating general crime will differ among respondents (Lim, 2015). Furthermore, the previous studies (Mak & Jim, 2018, 2022; Maruthaveeran & Bosh, 2015) did not adopt the CPTED classification. However, work done in the parks of Sweden (Iqbal & Ceccato, 2016), Poland (Emilia, 2020), and Malaysia (Thani et al., 2016) adapted CPTED classification as an inventory tool to inspect safety, but they did not consider the multiple environmental variables that can evoke FC. Nevertheless, there is a possibility that the surrounding influences from outside a project boundary can compromise the overall evaluation strength if not accounted for in the CPTED project (Cozens & Love, 2015). Moreover, there is a need to consider users' perceptions of CPTED strategies (Sakip et al., 2012).

This paper examines Perceived Security (PS) under FC because fear comes to the forefront when safety needs are compromised (Tandogan, 2016). PS symbolises an emotion created through the perception of the possible risks to safety or security (Ruiter et al., 2001). Since PS depends on individuals' perception, it is not directly related to objective measures of real crime (Bedimo-Rung et al., 2005).

Hence, to fill the current research gap, this study evaluates PS under FC in real urban park settings in India by eliciting actual users' perceptions of CPTED variables. Furthermore, a holistic approach is adopted to consider multiple physical environmental attributes within and surrounding the parks, which may influence PS of park users. Although the concept of FC varies with respect to the application, in this study, PS refers to the emotional experience rather than actual crime or risk.

Hence, with the aim of investigating the effect of urban parks on perceiving FC by evaluating PS, the following objectives are targeted. First, to find out how personal characteristics affect users' PS. Second, to find out how the type and number of park users affect the overall PS. Third, to find out how CPTED variables affect PS among park users. And fourth, to find out the relative contribution of each CPTED variable towards predicting PS.

2.0 STUDY AREA AND METHODOLOGY

Tiruchirappalli (Trichy), located near the river Cauvery, is the fourth major city in Tamil Nadu, India (refer to Figure 1). The city is spread across 167.23 km^2 and accommodates a population of approximately 1.2 million. Females constitute 50.03% of the population, and males 49.97%. Trichy has an average literacy rate of 91.45%. Female literacy is 88.73%, and male literacy is 94.17%. The multi-cultural city houses people of various religions and languages. The most widely spoken language is Tamil (local vernacular language). English is also used as a medium of communication in educational institutions. The Tiruchirappalli City Corporation (TCC) manages the parks spread across the four administrative zones ("Tiruchirappalli City Municipal Corporation", n.d.). Parks are also developed under the central government's smart city initiative ("Smart Cities", n.d.).

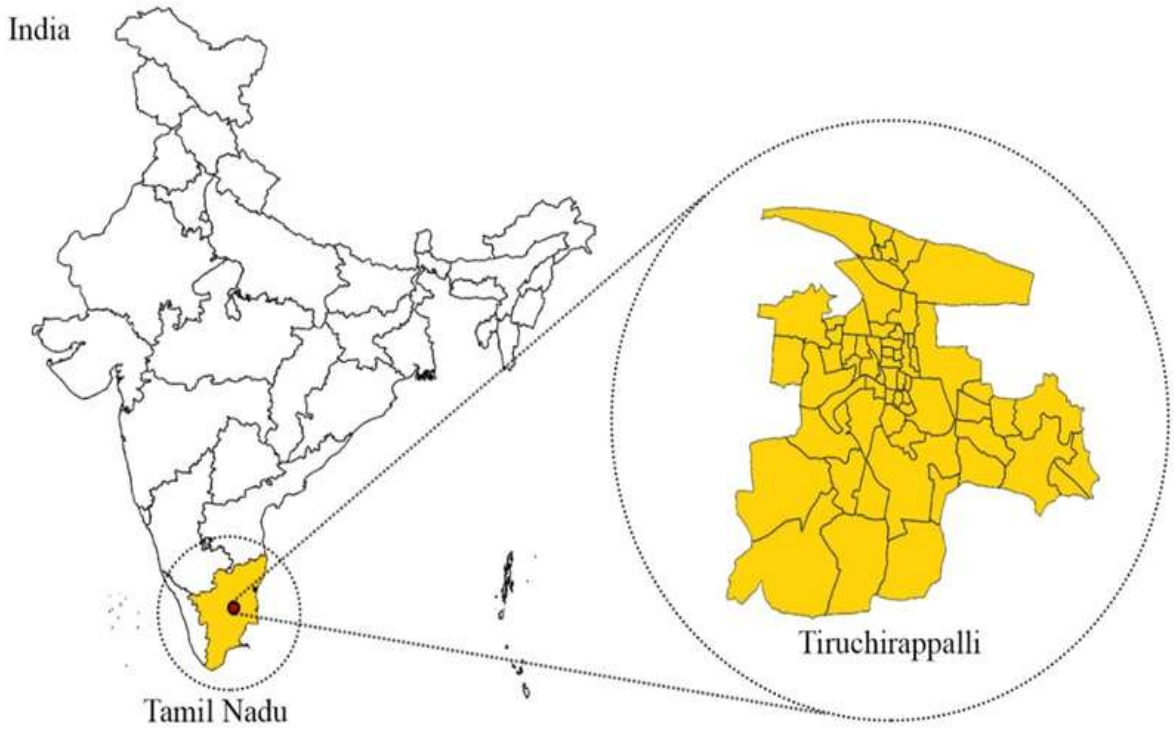


Figure 1. Location of the study area

The 57 parks across the city were traced through the TCC website, satellite imagery and city tour. The initial visit to the parks revealed that the parks have a constrained opening time. Since PS is largely influenced by lighting (Mak & Jim, 2022), the parks that are functional both in the morning/noon and evening hours were shortlisted. Hence, 15 TCC parks which were freely open to the public both in daylight and non-daylight hours, were selected for the study. Figure 2 provides the park details.

Using the physical environmental variables (that can influence the PS of urban park users) mentioned by Mak and Jim, (2018); Maruthaveeran and Bosch, (2014) a CPTED classification is prepared, presented in Figure 3. However, based on the initial park visit, new variables were identified and added to the classification.

All the CPTED variables were categorised into two types. First, the variables that can be objectively measured. Second, the variables should be subjectively documented. Hence, the required information was gathered through two data collection instruments, Forms A and B.

2.1. Objective Measurements - Form A

Form A was a park checklist and was filled out by the surveyor only. Form A included only the objectively measured CPTED variables, the number of park users every half an hour interval and the response rate. Form A was filled out through observations and field measurements. All the variations in boundary wall design with respect to height and opacity observed within a park were documented through measurements. The level difference in the pathway and surrounding green cover and the distance of the peripheral footpath and boundary wall were also measured. However, in all three variables, the average value was considered for the analysis. Since all the parks had mobile networks available within them and none had any dead ends in the pathway, the variables SM-03 and AD-03 were not considered for the analysis. Appendix A provides the details of Form A.

2.2. Subjective Measurements - Form B

Form B collected the date and time of the survey, subjectively measured CPTED variables, PS, and demographic information. Form B was compiled in English and Tamil. The subjective perceptions of CPTED variables among the park users were documented. The FC question evaluated PS by asking how safe (from possible crimes such as theft, robbery etc.) they felt while using the park on a five-point Likert scale ranging from 'strongly unsafe' (1) to 'strongly safe' (5). Appendix B provides the details of Form B.

A trained team of a total of 45 surveyors from the architecture department of NIT Tiruchirappalli completed the data collection on six dates ranging from mid-October to mid-November 2022. On the first three days, three parks (one park per day) were surveyed. Post reliability confirmation and minor formatting changes in Form B, all 15 parks were surveyed on the next three dates. Cronbach's alpha of 0.83 determined the high level of internal consistency and reliability of the questionnaire scale.

The 18 year and older actual park users were randomly approached for the survey. They were briefed about the study objectives and ensured no personal information, such as name and contact details would be collected. People in the nearby residences and walking on the surrounding streets who agreed that they either used or used the park sometimes were also approached for the survey. Respondents took approximately 15 minutes to complete the survey, while the older participants who were assisted throughout took around 25 minutes.

726 park users were approached for the survey, 202 denied, while 524 users responded. The total response rate of the survey was approximately 72%. 303 males and 221 females responded to the survey. 337 users opted for the English form, whereas 187 opted for the Tamil. We collected 18 – 70 surveys from each park.

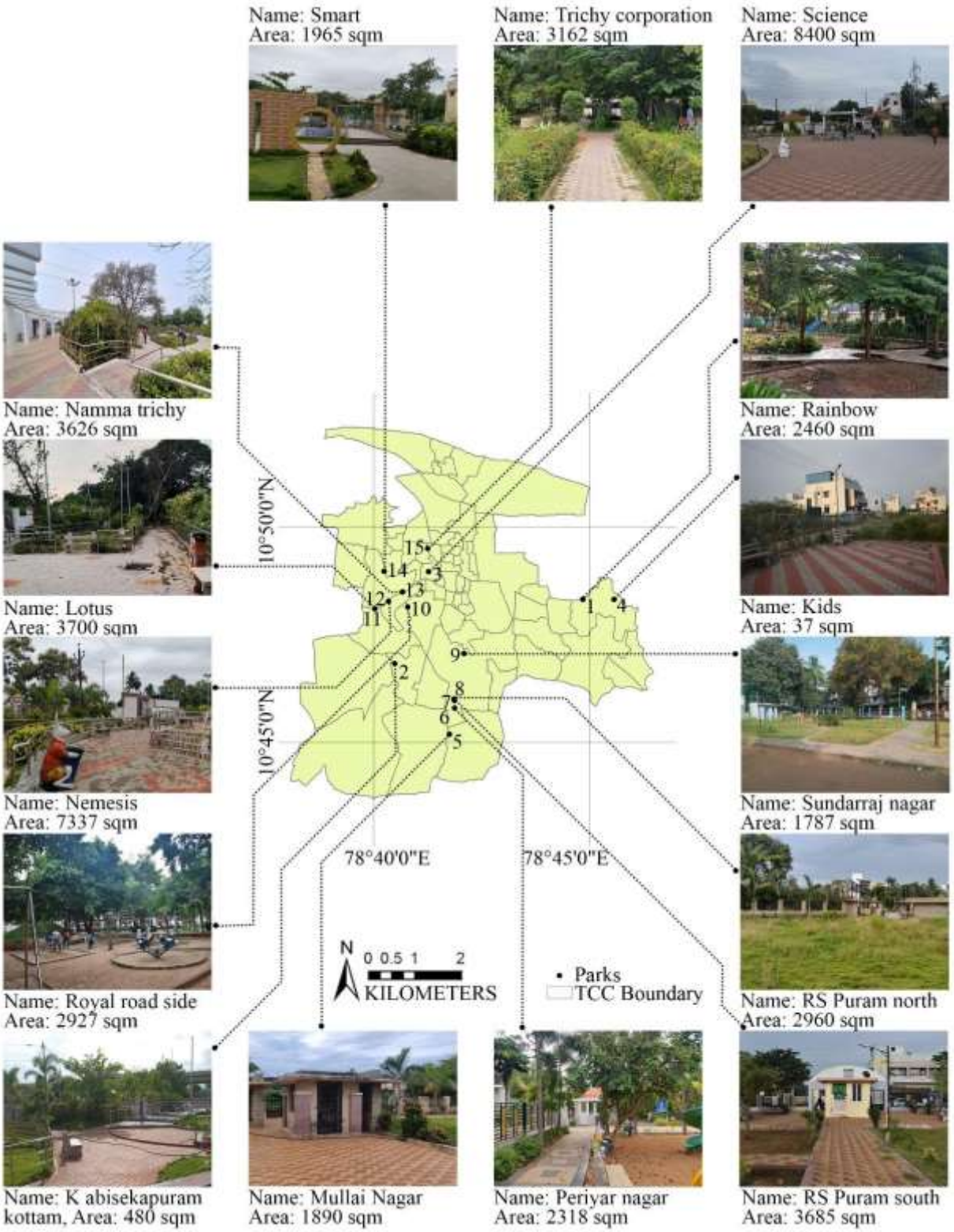


Figure 2. Details of the study sites

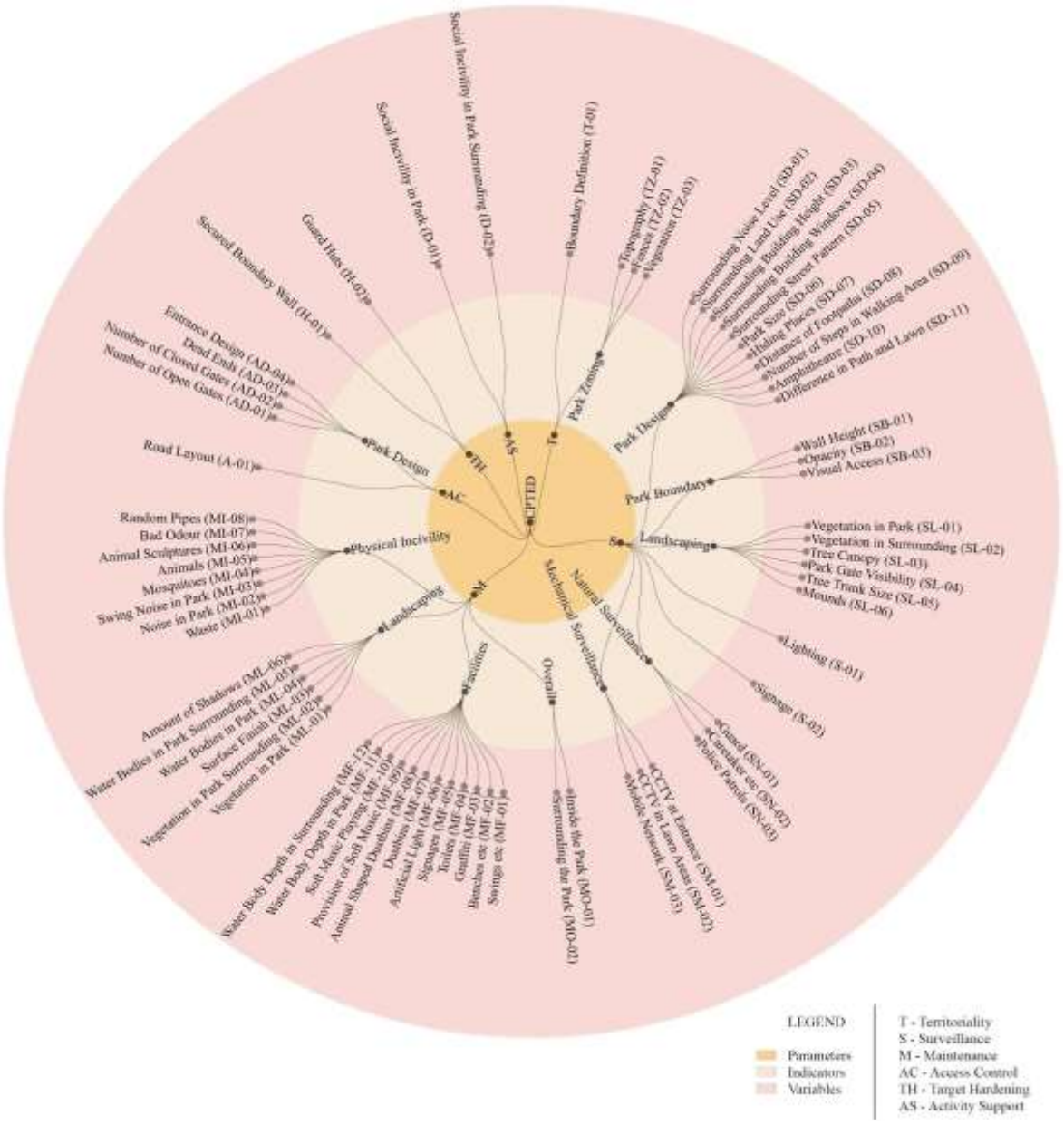


Figure 3. Parameters, indicators, and variables influencing PS under CPTED classification.

2.3. Data Analysis

Data analysis using Microsoft Excel and other statistical analysis packages is performed. In SPSS ("IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 29.0. Armonk, NY: IBM Corp", n.d.), a One-way Analysis of Variance (ANOVA) test whether the PS varies across various personal characteristics of the respondents. Through Jamovi ("The jamovi project (2022). jamovi (Version 2.3)", n.d.), multiple linear regression finds out the relation of PS with the number of male, female, and kids park users. Further, in JASP (JASP Team, 2023), the Pearson correlation test evaluate the correlation between PS and CPTED variables. A feature importance test using the Scikit-learn library's (Pedregosa et al., 2011) random forest classification algorithm determines each variable's relative contribution.

3.0 RESULTS AND DISCUSSION

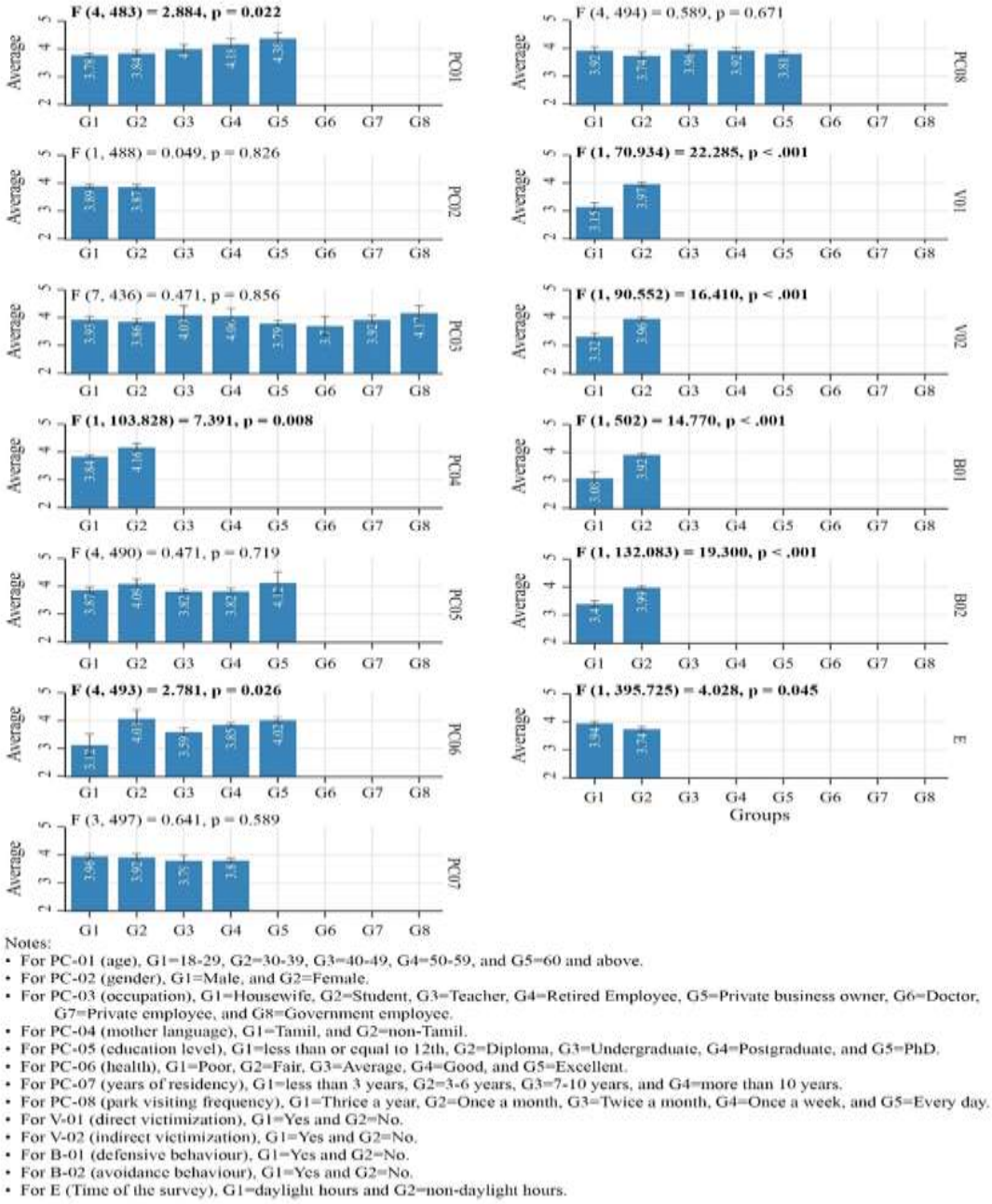
3.1. Relationship Between Personal Characteristics and Perceived Security

The ANOVA test determines whether the PS varies across respondents' personal characteristics and time of the survey. Figure 4 summarises the results. The results showed a significant ($p = 0.022$) difference in PS among various age groups. With an increase in age, PS increases gradually. Post hoc follow-up procedure (Tukey) tests the difference between all pair-wise comparisons.

The results revealed a significant ($p = 0.042$) difference in PS among park users aged 18-29 and 60 and above. The results are similar to the studies done in the UK (Madge, 1997) evaluating fear of sexual attack and in Turkey (Türkseven Doğrusoy & Zengel, 2017) analysing fear of sexual harassment, robbery and theft. The possible explanation for the high PS among the older people could be that they did not feel the attack was more likely, just that they would be more vulnerable if attacked (Jorgensen & Anthopoulou, 2007). Moreover, unlike youngsters, they may not carry costly belongings such as mobile phones, jewellery, etc.

The difference in PS among the park users with their mother language as Tamil and non-Tamil is significant (Welch's ANOVA: $F_{1,103.828} = 7.391$, $p = 0.008$). Tamil-speaking Park users reported low PS compared to the non-Tamil speaking ones. The results are similar to a Spain-based study (Pérez-Tejera et al., 2022), where whites expressed more FC than non-whites. However, another study done in the UK (Madge, 1997) showed the Asian community perceived higher levels of FC compared to their counterparts. With both groups reporting PS on the safer side, a significant difference can be because local people are more aware of the possible crimes.

The results showed a significant ($p = 0.026$) difference in PS among park users regarding their self-reported health. The results reveal that the better the self-reported health, the higher the PS. The result is similar to the Hong Kong based study (Mak & Jim, 2018). The difference in PS among the park users who have been recently directly victimised and those who have not been recently directly victimised is significant (Welch's ANOVA: $F_{1,70.934} = 22.285$, $p < 0.001$). Users with recent direct victimisation experience reported less PS than those without recent direct victimisation experience. The results are similar to the studies done in Hong Kong (Mak & Jim, 2018) and Malaysia (Maruthaveeran & Bosh, 2015), where park users with victimisation experience had lower levels of PS. The difference in PS among the park users who have been recently indirectly victimised and those who have not been recently indirectly victimised is significant (Welch's ANOVA: $F_{1,90.552} = 16.410$, $p < 0.001$). Users with recent experience of indirect victimisation reported less PS than the ones who do not have recent experience of indirect victimisation. The difference in perception of safety among park users who carry any object in a defensive manner as a weapon while in the park and who do not is significant ($p < 0.001$). Users who exhibit defensive behaviour reported less PS than the ones who do not. A similar pattern can be observed in a Malaysian study (Maruthaveeran & Bosh, 2015), where most park users reported defensive behaviour by carrying car keys, penknife, pepper spray, and walking with dogs. The difference in PS among the park users who avoid specific areas in the park and who do not is significant (Welch's ANOVA: $F_{1,132.083} = 19.300$, $p < 0.001$). Users who exhibit avoidance behaviour reported less PS than those who do not. The result is contrary to one of the study's findings in the USA (Westover, 1985), mentioning park users showing avoidance behaviour and reporting high PS. Previous works have shown park users (Maruthaveeran & Bosh, 2015), especially women (Madge, 1997), to avoid areas with dense vegetation. The difference in PS among the park users using the park during the daylight hours and the non-daylight hours is significant (Welch's ANOVA: $F_{1,395.725} = 4.028$, $p = 0.045$). Users using the park in daylight hours reported higher PS than those using the park in non-daylight hours. The results support findings from previous studies (Emilia, 2020; Mak & Jim, 2022; Pérez-Tejera et al., 2022; Zhao & Huang, 2021). The difference in PS across gender, occupation, education level, years of residency in the park district and park visiting frequency is non-significant.



Notes:
- For PC-01 (age), G1=18-29, G2=30-39, G3=40-49, G4=50-59, and G5=60 and above.
- For PC-02 (gender), G1=Male, and G2=Female.
- For PC-03 (occupation), G1=Housewife, G2=Student, G3=Teacher, G4=Retired Employee, G5=Private business owner, G6=Doctor, G7=Private employee, and G8=Government employee.
- For PC-04 (mother language), G1=Tamil, and G2=non-Tamil.
- For PC-05 (education level), G1=less than or equal to 12th, G2=Diploma, G3=Undergraduate, G4=Postgraduate, and G5=PhD.
- For PC-06 (health), G1=Poor, G2=Fair, G3=Average, G4=Good, and G5=Excellent.
- For PC-07 (years of residency), G1=less than 3 years, G2=3-6 years, G3=7-10 years, and G4=more than 10 years.
- For PC-08 (park visiting frequency), G1=Thrice a year, G2=Once a month, G3=Twice a month, G4=Once a week, and G5=Every day.
- For V-01 (direct victimization), G1=Yes and G2=No.
- For V-02 (indirect victimization), G1=Yes and G2=No.
- For B-01 (defensive behaviour), G1=Yes and G2=No.
- For B-02 (avoidance behaviour), G1=Yes and G2=No.
- For E (Time of the survey), G1=daylight hours and G2=non-daylight hours.

Figure 4. ANOVA test result summary for respondents' personal characteristics and time of the survey with PS

3.2. Relationship Between the Number of Park Users and Perceived Security

Multiple linear regression finds out the relation of PS with the number of male users (M), number of female users (F) and number of kids (K) for daylight and non-daylight hours separately. The overall model for daylight hours was non-significant. However, the overall model for the non-daylight hour was significant with $p < .001$, $R2 = 0.128$, adj. $R2 = 0.096$. Table 1 presents the results for non-daylight hours. The effect of the number of male users on PS is significant ($p < .001$). The result showed that PS decreases as the number of male users increases. The effect of the number of female users on PS is closely significant ($p = .054$). The result showed that PS also increases as the number of female users increases. However, the effect of the number of kids on PS is non-significant.

Table 1. Multiple linear regression of user type and number with PS in the non-daylight hours.

	Unstandardised	Standard Error	Standardised	t	p
(Intercept)	3.822	0.129		29.601	< .001
M	-0.089	0.027	-1.001	-3.286	0.001
F	0.128	0.066	1.125	1.937	0.054
K	-0.032	0.044	-0.255	-0.718	0.474
M x F	0.001	0.004	0.555	0.332	0.74
M x K	0.008	0.004	2.983	1.943	0.054
F x K	-0.010	0.003	-2.831	-3.429	< .001
M x F x K	0.000	0.000	-0.443	-0.162	0.871
Notes: M = number of male users F = number of female users K = number of kids users					

Further, the effect of the number of male users x the number of female users' interaction is non-significant. However, the interaction effect of the number of male users x the number of kids is closely significant ($p = .054$). With the increase in the number of male users and a reduced number of kids, PS decreases, whereas, with the increase in the number of male users and more kids, PS increases. Moreover, the interaction of the number of female users x the number of kids is also significant ($p < .001$). With the increase in the number of female users and fewer kids, PS increased, whereas with the increase in female users and more kids, PS decreased. The effect of the number of male users x the number of female users x the number of kids is non-significant.

3.3. Relationship Between CPTED Variables and Perceived Security

Pearson correlation test evaluates the correlation between PS and subjective responses to the CPTED variables. Figure 5 summarises the strength of the correlation between PS and the studied variables. Figure 5 to be read side by side with Figure 3 for the full forms of the abbreviations used for the studied CPTED variables. Thirty-two out of seventy-four variables have a significant relationship with the PS.

A positive correlation between boundary wall definition, distinction between various zones in the park through topography and vegetation, and PS implies the importance of spatial definition in landscape design. The users who perceive the boundary wall to be highly defined have reported feeling safe in the park. The boundary wall should be clear and well defined because it interacts with the surrounding environment and road layout, supports entrance design, and creates a sense of ownership (Chen et al., 2021). But the significance of boundaries is also applicable within the park limits. Park users who agree that the topography and vegetation create distinction between various spaces in the park, feel safe. A clear distinction of various zones within the park promotes wayfinding and a sense of belonging, eventually increasing their PS (Chen et al., 2021). For example, the separation of kid play areas from adult playgrounds using physical barriers in the form of fences and hedges can ensure parental safety concerns (Mani et al., 2012; Mohamed et al., 2023). However, the correlation between the distinction of various zones in the park through fences and PS is non-significant. Nevertheless, a negative relationship implies that when the fences are not present in the park to create distinction among various zones, users may feel unsafe. Overall, the results agree with the findings of the Egyptian study, where the potential park users rating the park images agreed that the higher the level of spatial definition, the higher their PS (Mahrous et al., 2018).

Three new variables are added under surveillance through park design. The number of steps in the walking area and level differences between the pathway and surrounding lawn area may affect users' perception of accuracy in escaping any harmful situation. The presence or absence of residential (SD-02.1), commercial (SD-02.2), educational (SD-02.3), hospital (SD-02.4), recreational (SD-02.5), temple (SD-02.6), railway track (SD-02.7) and vacant land (SD-02.8) in the park surrounding under the land use (SD-02) were documented. A negative correlation between surrounding noise level, the presence of vacant land, the number of windows

facing the park from the surrounding buildings and a positive correlation for the presence of educational land use with PS is found for the variables under surveillance through park design. The higher the surrounding noise levels, the lower the PS. Similarly, users of the parks with vacant land near them reported feeling safe. Moreover, the more windows overlooking the park from the surrounding buildings, the lower the PS reported. These results contradict the findings from the study done by Mak and Jim, (2018), which reported that parks situated in quiet areas, low-density residential areas, and industrial zones can invoke lower PS compared to their counterparts. However, users of the parks with educational land use next to them reported feeling unsafe. This finding can result from park users exhibiting indirect parental concerns for their kids.

The study found non-significant correlations for boundary wall height and opacity under surveillance through the park boundary and PS. However, the level of visual connectivity through the boundary wall to the surroundings is significant. Since the relationship between a boundary wall and fear stands complicated (Saisanath & Gnanasambandam, 2019), these contradictory findings can be explained by the fact that boundary wall height and opacity, along with the peripheral vegetation, facilitate surveillance. In other words, only boundary walls' architectural characteristics cannot determine the clear field of vision until there is no vegetation on the park's boundary. However, to ensure certain permeability through the park boundary (Sezavar et al., 2023), the results indicate that the higher the level of visual connectivity through the boundary wall to the surroundings, the higher the PS.

Higher levels of visual connectivity through the boundary wall to the surroundings related to increased PS along with higher noise levels, the absence of vacant land and a greater number of windows overlooking the park in the surroundings associated with lower levels of PS support the 'prospect–refuge' theory that argues that the ability to see (prospect) without being seen (refuge) is an intermediate step in the satisfaction of biological needs. In other words, both, first the increased possibility of seeing around from the park to its surroundings enhancing natural surveillance and second decreased possibility of being seen from the surroundings to the park providing anticipated protection from possible offenders, enhances PS of park users.

One new variable is added under surveillance through landscape elements. The total height of the mound can hide a possible offender behind it or even hinder users' sightlines. Among the variables under surveillance through landscape elements, the correlation between the density of vegetation in the park and the density of overhead tree canopy cover with PS is significant. The positive correlation implies that the higher the density of vegetation, the higher the PS. Apart from the study by Mahrous et al., (2018), the result is contrary to the other studies (Zhao & Huang, 2021), where high-density vegetation is related to lower levels of PS. This is because, a higher density of vegetation generates higher concealment and reduces surveillance. However, a mean value of 3.324 of density of vegetation in park and 3.864 of PS can symbolise users' preference for medium density vegetation regarding increased PS. Overall, the results are in line with a recent study done by Sezavar et al. (2023) who mentioned park users preferring medium-enclosed environments over very enclosed and very open ones regarding PS because they allow people to see their surroundings without being seen. Similar stands for the positive correlation between the density of overhead tree canopy cover (mean value of 2.775) and PS. A positive correlation between the amount of light in the park and PS confirms the findings from previous studies (Lis et al., 2023; Zhao & Huang, 2021) which establish that more light leads to higher visibility and enhanced surveillance, ultimately increasing PS.

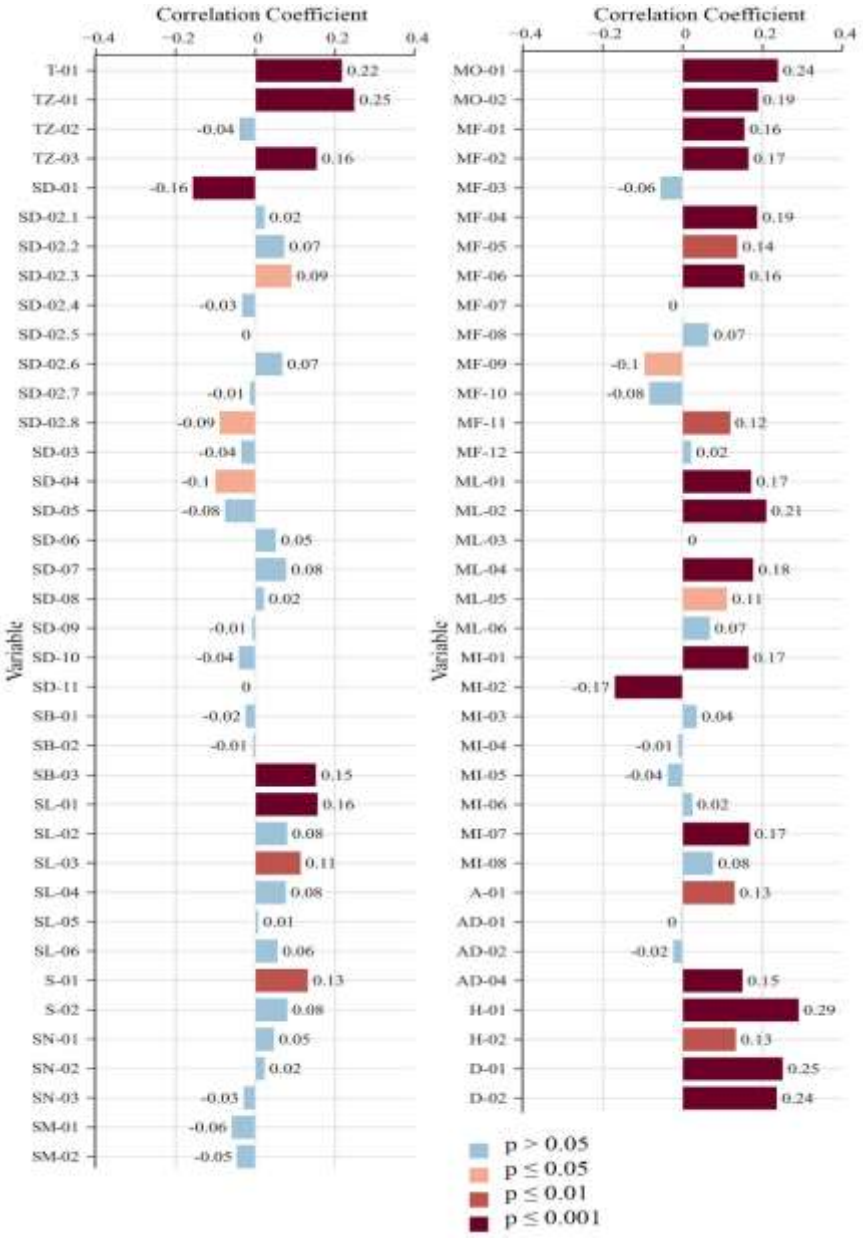


Figure 5. Pearson correlation between CPTED variables and PS

A positive correlation of the overall level of maintenance in the park with PS confirms the findings from previous studies (Mak & Jim, 2022), which concluded that the higher the level of maintenance, the higher the PS. The study also found a positive correlation of the overall level of maintenance in the park surrounding and PS. The results imply that users reported higher PS if the overall maintenance within the park and surroundings was good. However, the study also tests the maintenance of park facilities, vegetation, and other physical incivilities.

Six new variables are added under maintenance through park facilities. The damaged swing facilities can also affect the perception of maintenance, influencing PS. The use of animal-shaped dustbins in the park is also tested under maintenance. Providing soft music along the park pathway and its functioning may help users navigate even without adequate lighting. As evaluated by Polko and Kimic, (2022), perceptions of the depth of water bodies are also tested. A positive correlation between maintenance of swings and gym machines, benches, toilets, signage, artificial light, water body depth in the park is found for the variables under maintenance through park facilities. However, no significant correlation exists between the presence of graffiti

and the number of dustbins with PS. The results indicate that the higher the maintenance of swings, gym machines, benches, toilets, signage, and artificial light, the higher the PS. However, according to the results, as the park users perceive the water body to be deeper in the park, they feel safer. Apparently, the result contradicts the finding from the study by Zhao and Huang, (2021), which states that shallow and still water instead of deep and running one indicates a safer landscape. However, most parks have only fountains with a reported mean value of 1.793, which justifies higher PS for shallow fountains within the park. Moreover, a negative significant value for the soft music provision and playing in the park states that users felt safe in the parks where the soft music is provided and played.

Three new variables are added under maintenance through landscape elements. As evaluated by Polko and Kimic, (2022), the condition or maintenance of water bodies are tested. The amount of shadows due to vegetation cover and lighting creating light and dark patches can reflect the maintenance level of vegetation. Among the variables under maintenance through landscape elements, the correlation between the maintenance of vegetation in the park and surrounding areas and the water body in the park and surrounding with PS is significant. Studies have already shown that a higher level of vegetation maintenance in the park is related to higher PS (Zhao & Huang, 2021). This study also found that the higher the level of the maintenance of vegetation in the park surrounding, the higher the PS. Similarly, higher levels of maintenance of water bodies in the park and surrounding areas are related to higher levels of PS. However, no significant correlations exist between the quality of the surface finish and the amount of shadows in the park and users' PS.

Four new variables are tested under maintenance through physical incivility. The presence of bad odour, noise due to swings, and randomly lying water irrigation pipes can also affect the perception of maintenance, influencing PS. The presence of animal sculptures in the park is also tested. A significant positive correlation between the presence of unusual and undesirable wastes and the presence of bad odour in the park and a significant negative correlation between the level of noise in the park and PS are documented. Unlike the study by Ceccato and Nalla, (2020), where the presence of garbage did not bother the park users, this study confirms the results from the previous work by Maruthaveeran et al., (2018), where the presence of garbage is related to low PS. Further, the presence of bad odour in the park decreasing the user's PS is also supported by the previous work by Mak and Jim, (2022). Moreover, the relationship between higher levels of noise in the park and decreased PS also supports the results from previous work done by Mak and Jim, (2022).

A positive correlation between the design of surrounding roads and PS states that if the users agree that the surrounding roads are designed nicely, they report high on PS. Similarly, a positive correlation between clarity of entrance design and PS shows that when the users agree that the design of the entrance space/s is clear, they report high PS. However, unlike the study by Mak and Jim, (2018), which shows insufficient park gates induce fearful feelings among park users, this study found no significant correlation between the number of open and closed park gates and PS. The possible explanation for the difference in the results from this study and the one done by Mak and Jim, (2018) can be attributed to the varying park sizes. Mak and Jim, (2018) focused on medium and large sized parks, whereas this study analysed neighbourhood parks. It is possible that the number of open and closed park gates in small parks does not affect the PS of park users.

Both the variables under target hardening, namely the security of the boundary wall and the number of guard huts, had significant positive correlations with PS. The result shows that when the users agreed that the park boundary was highly secured, they reported experiencing high PS. Moreover, wherever the number of guard huts increased, users felt safer in the park. In other words, beyond physical means, target hardening also aims to increase the perceived effort and risk of committing a crime by possible offenders. Hence, even the presence of a guard hut in a park can give the perception of the presence of security personnel, thereby increasing PS of users.

The variables under activity support, namely social incivility in the park and surrounding areas, had a significant positive correlation with PS. If the users did not find any beggars, smokers, suspected thieves, etc., present in the park and surrounding areas the PS would be higher. The results confirm the findings from the previous studies (Mak & Jim, 2022), which related the presence of illegitimate users to unsafe feelings in parks.

3.4. Relative Importance of CPTED Variables

A feature importance test is conducted using the random forest classification algorithm. The test employed the Gini impurity index to measure the importance of each feature. The Gini impurity index calculates the total impurity reduction achieved by splitting the data based on a particular feature. Figure 6 presents the test results. Figure 6 should be read side by side with Figure 3 to refer to the full forms of the abbreviations used for the studied CPTED variables. The Feature Importance Score (FIS) in random forest models is typically normalised, with the total sum of all FISs equal to 1. A higher FIS indicates greater importance for that specific feature. Therefore, features with a higher FIS are considered more important compared to features with lower FISs. The test results indicated that maintenance had the highest FIS of 0.439, followed closely by surveillance with a score of 0.352. Territoriality (0.077), access control (0.065), target hardening (0.043), and activity support (0.024) had relatively lower FIS.

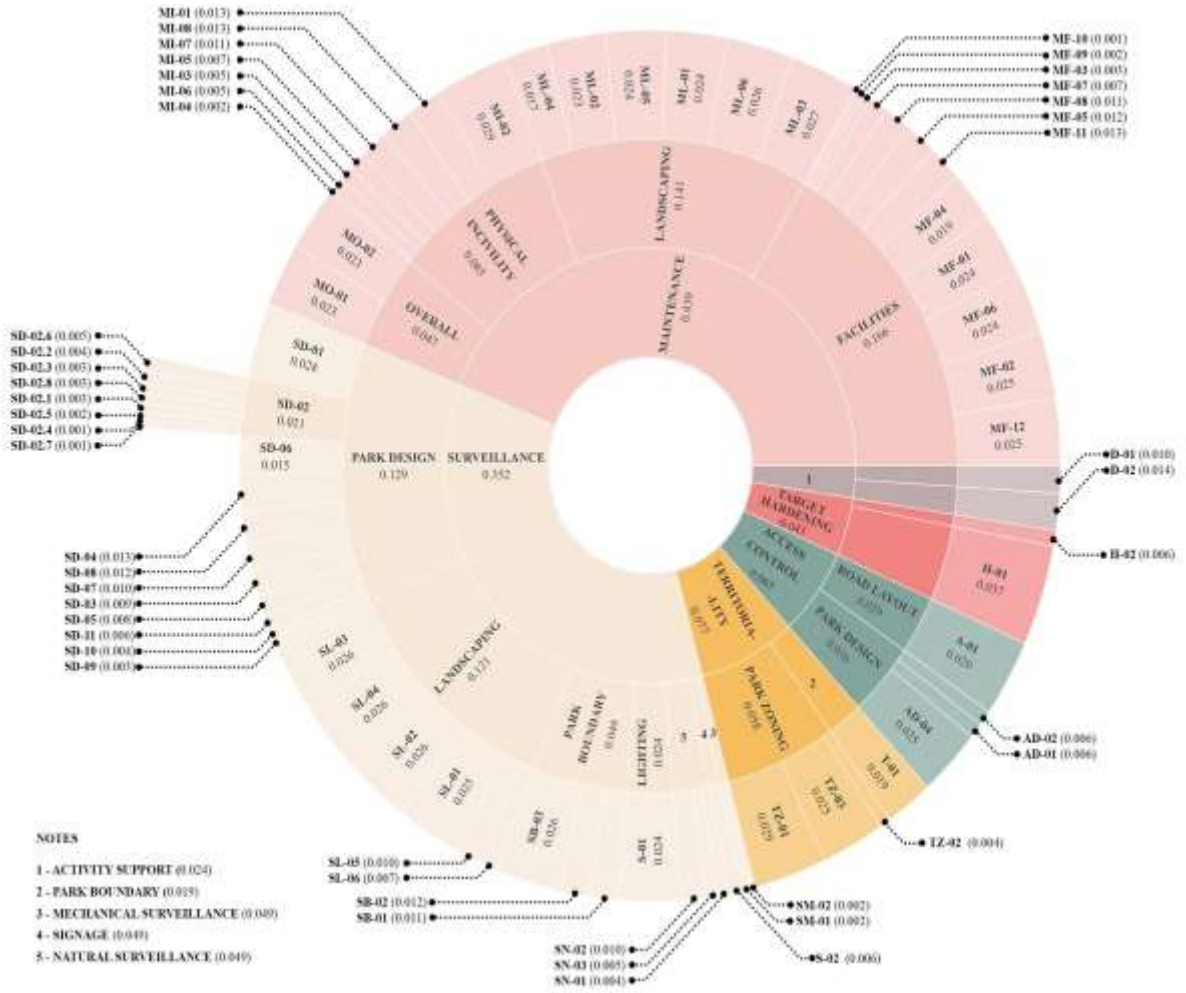


Figure 6. Feature importance of the studied CPTED variables towards predicting PS.

The results from the correlation between CPTED variables and PS (Figure 5) and the FIS of the studied CPTED variables towards predicting PS (Figure 6) are analysed together to get insights into the most effective park design and management strategies that can increase PS of users. Surveillance and maintenance are identified as the most effective CPTED parameters. Furthermore, surveillance through park design and landscaping elements and maintenance of park facilities and landscaping elements are more important CPTED indicators that can contribute to elevating PS among park users. Surveillance through park design indicators reveals users' preference for parks located in quiet and sparsely populated areas. Surveillance through landscape elements shows park users experienced higher levels of PS with medium vegetation density in the

park. The results clearly direct towards interventions that reduce the possibility of park users being seen from its surroundings, while increasing the possibility of users seeing around from the park to its surroundings. Maintenance of park facilities such as swings, benches, toilets, signage, artificial light, and the provision of soft music are important concerning park users' PS. Moreover, both, maintenance of vegetation and water bodies in the park and its surroundings are important to increase the PS of users.

4.0 CONCLUSIONS

Fear of crime can deter people from using parks, negatively impacting their social lives. Previous studies have established that FC and levels of crime are independent of each other. Furthermore, to compare the results from similar past works, studies demand evaluating specific crime types. Hence, this study investigates the physical environmental variables of urban parks influencing PS (for theft, robbery, etc. crimes) under FC using a CPTED classification.

The results from the study can inform park design and management professionals to adopt strategies that can reduce fear and increase perceptions of security. Specifically, the physical environmental variables related to PS and contributing the most to the CPTED classification should be addressed in Trichy parks. This study when compared with others, can also provide insights into how different communities perceive and experience fear of crime in parks, helping park managers and community leaders engage with residents to address concerns and build trust. Furthermore, research can guide decisions about resource allocation and policing strategies, ensuring that resources are deployed effectively to address areas of highest concern. Addressing fear of crime in parks is crucial for promoting social equity and access, as certain groups may be disproportionately affected, limiting their access to park amenities. Ultimately, findings from these studies contribute to long-term planning and policy decisions related to urban green space development, community safety initiatives, and public health strategies, helping to create safer, more inclusive, and more widely used parks.

The study has a few limitations. First, there is no standard definition of FC. Because there is no definition, questions to measure FC are different according to surveys, which is an inherent limitation to measuring FC. Second, the survey happened in one month; hence, the possible effect of weather conditions on FC is not explored. Third, the number of users during the survey was calculated only in a 30-minute time interval. And fourth, the overlapping CPTED principles make the interpretation of results critical. For example, the height of the boundary wall controlling surveillance is also territorial, access control, and a target hardening feature.

Since India provides a variety in cultural and social life, similar studies should be conducted in different parts of the country. The influence of surrounding physical environmental variables in parks on the PS of users within the park should also be explored in detail in future works. Furthermore, future studies of FC in park settings should also consider the variables under second and third generation CPTED.

ACKNOWLEDGEMENT

The authors acknowledge the students at the National Institute of Technology Tiruchirappalli for their support in the data collection.

5.0 REFFERENCES

Abdul Malek, N., Mohammad, S. Z., & Nashar, A. (2018). Determinant Factor for Quality Green Open Space Assessment in Malaysia. Journal of Design and Built Environment, 18(2), 26–36. https://doi.org/10.22452/jdbe.vol18no2.3

Andrews, M., & Gatersleben, B. (2010). Variations in perceptions of danger, fear and preference in a simulated natural environment. Journal of Environmental Psychology, 30, 473–481. https://doi.org/doi:10.1016/j.jenvp.2010.04.001

Angel, S. (1968). Discouraging crime through city planning. Berkeley: University of California, Institute of Urban and Regional development.

Askari, A. H., & Soltani, S. (2023). CPTED Principles and Preventing Crimes: The Cases from Shiraz City, Iran. Journal of Design and Built Environment, 23(2), 1–13. https://doi.org/10.22452/jdbe.vol23no2.1

Bedimo-Rung, A. L., Mowen, A. J., & Cohen, D. A. (2005). The significance of parks to physical activity and public health. American Journal of Preventive Medicine, 28(2), 159–168. https://doi.org/10.1016/j.amepre.2004.10.024

Chen, G., Zhang, S., Yan, B., & Miao, S. (2021). Environmental safety evaluation of geopark based on CPTED concept and fuzzy comprehensive analysis. PLOS ONE, 16(11), e0260316. https://doi.org/10.1371/journal.pone.0260316

Cozens, P., & Love, T. (2015). A Review and Current Status of Crime Prevention through Environmental Design (CPTED). Journal of Planning Literature, 30(4), 393–412. https://doi.org/10.1177/0885412215595440

Crowe, T. D. (2000). Crime prevention through environmental design: Applications of architectural design and space management concepts (2. ed). Butterworth-Heinemann.

De Haas, W., Hassink, J., & Stuiver, M. (2021). The Role of Urban Green Space in Promoting Inclusion: Experiences From the Netherlands. Frontiers in Environmental Science, 9, 618198. https://doi.org/10.3389/fenvs.2021.618198

Donder, L. D. (2009). Feelings of insecurity in context: Theoretical perspectives for studying fear of crime in late life. International Journal of Economics And Finance, 1(1).

Emilia, B. (2020). Safety of urban park users The case of Poznań, Poland. In Crime and Fear in Public Places: Towards Safe, Inclusive and Sustainable Cities. Routledge. http://dx.doi.org/10.21428/cb6ab371.4aca704d

Evensen, K. H., Nordh, H., Hassan, R., & Fyhri, A. (2021). Testing the Effect of Hedge Height on Perceived Safety—A Landscape Design Intervention. Sustainability, 13(9), 5063. https://doi.org/10.3390/su13095063

Garofalo, J. (1981). The Fear of Crime: Causes and Consequences. The Journal of Criminal Law and Criminology (1973-), 72(2), 839. https://doi.org/10.2307/1143018

Goharipour, H., Gibson, H., & Latifi, G. (2021). Regardless if it is comedy, action, thriller, or biography: A review of urban crime in the 1980s cinema of Chicago. Frontiers of Architectural Research, 10(3), 555–571. https://doi.org/10.1016/j.foar.2021.02.005

Hannah, C., Srinivas, T., & Subbaiyan, G. (2016). The Impact of Design and Placement of ATM Deployments on Perceived Safety in India. International Journal of Criminal Justice Sciences, 11(1), 16.

IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 29.0. Armonk, NY: IBM Corp. (n.d.).

Indian Society and Ways of Living. (n.d.). Center for Global Education. https://asiasociety.org/education/indian-society-and-ways-living

Iqbal, A., & Ceccato, V. (2016). Is CPTED Useful to Guide the Inventory of Safety in Parks? A Study Case in Stockholm, Sweden. International Criminal Justice Review, 26(2), 150–168. https://doi.org/10.1177/1057567716639353

Jacobs, J. (1961). The death and life of great American cities. Vintage books.

James, K., & Embrey, L. (2001). "Anyone could be lurking around!": Constraints on adolescent girls' recreational activities after dark. World Leisure Journal, 43(4), 44–52. https://doi.org/10.1080/04419057.2001.9674248

Jansson, M., Fors, H., Lindgren, T., & Wiström, B. (2013). Perceived personal safety in relation to urban woodland vegetation – A review. Urban Forestry & Urban Greening, 12(2), 127–133. https://doi.org/10.1016/j.ufug.2013.01.005

JASP Team. (2023). JASP (Version 0.17) [Computer software]. https://jasp-stats.org/

Jeffery, R. C. (1971). Crime prevention through environmental design (1. print). Sage Publ.

Jing, F., Liu, L., Zhou, S., Song, J., Wang, L., Zhou, H., Wang, Y., & Ma, R. (2021). Assessing the Impact of Street-View Greenery on Fear of Neighborhood Crime in Guangzhou, China. International Journal of Environmental Research and Public Health, 18(1), 311. https://doi.org/10.3390/ijerph18010311

Jorgensen, A., & Anthopoulou, A. (2007). Enjoyment and fear in urban woodlands – Does age make a difference? Urban Forestry & Urban Greening, 6(4), 267–278. https://doi.org/10.1016/j.ufug.2007.05.004

Konijnendijk, C. C., Annerstedt, M., Nielsen, A. B., & Maruthaveeran, S. (2013). Benefits of Urban Parks A systematic review.

Lim, H. (2015). The Limitations and Advancements in Measuring Fear of Crime. Journal of Public Administration and Governance, 5(2), 9.

Lis, A., Zienowicz, M., Kukowska, D., Zalewska, K., Iwankowski, P., & Shestak, V. (2023). How to light up the night? The impact of city park lighting on visitors' sense of safety and preferences. Urban Forestry & Urban Greening, 128124. https://doi.org/10.1016/j.ufug.2023.128124

Lloyd-Sherlock, P., Agrawal, S., & Minicuci, N. (2015). Fear of crime and older people in low- and middle-income countries. Ageing and Society, 36(5), 1083–1108. https://doi.org/10.1017/S0144686X15000513

Lorenc, T., Clayton, S., Neary, D., Whitehead, M., Petticrew, M., Thomson, H., Cummins, S., Sowden, A., & Renton, A. (2012). Crime, fear of crime, environment, and mental health and wellbeing Mapping review of theories and causal pathways. Health & Place, 18, 757–765. http://dx.doi.org/10.1016/j.healthplace.2012.04.001

Madge, C. (1997). Public parks and the geography of fear. Tijdschrift Voor Economische En Sociale Geografie, 88(3), 237–250. https://doi.org/10.1111/j.1467-9663.1997.tb01601.x

Mahrous, A. M., Moustafa, Y. M., & El-Ela, M. A. A. (2018). Physical characteristics and perceived security in urban parks: Investigation in the Egyptian context. Ain Shams Engineering Journal, 9, 12. https://doi.org/10.1016/j.asej.2018.07.003

Mak, B. K. L., & Jim, C. Y. (2018). Examining fear-evoking factors in urban parks in Hong Kong. Landscape and Urban Planning, 171, 15. https://doi.org/10.1016/j.landurbplan.2017.11.012

Mak, B. K. L., & Jim, C. Y. (2022). Contributions of human and environmental factors to concerns of personal safety and crime in urban parks. Security Journal, 35(1), 263–293. https://doi.org/10.1057/s41284-020-00277-9

Mani, M., Abdullah, A., Mustafa, R. A., Jayaraman, K., & Bagheri, A. (2012). The Importance of Well-Designed Children's Play-Environments in Reducing Parental Concerns.

Maruthaveeran, S. (2016). The Perception of Social Safety in a Green Environment: A preliminary study at the Kepong Metropolitan Park. Asian Journal of Environment-Behaviour Studies, 1(1), 99–111. https://doi.org/10.21834/aje-bs.v1i1.171

Maruthaveeran, S., Arnberger, A., & Bosch, C. K. van den. (2018). Fear of crime in urban parks based on different levels of concealment, incivilities and human presence. 3rd International Conference on Rebuilding Place, Malaysia.

Maruthaveeran, S., & Bosch, C. C. K. (2014). A socio-ecological exploration of fear of crime in urban green spaces – A systematic review. Urban Forestry & Urban Greening, 13, 18. http://dx.doi.org/10.1016/j.ufug.2013.11.006

Maruthaveeran, S., & Bosh, C. K. van den. (2015). Fear of crime in urban parks – What the residents of Kuala Lumpur have to say? Urban Forestry & Urban Greening, 14, 12. http://dx.doi.org/10.1016/j.ufug.2015.05.012

Min, Y. H., Byun, G., & Ha, M. (2022). Young women's site-specific fear of crime within urban public spaces in Seoul. Journal of Asian Architecture and Building Engineering, 21(3), 1149–1160. https://doi.org/10.1080/13467581.2021.1941993

Mohamed, A. A., Kronenberg, J., Łaszkiewicz, E., Ali, F. A., Mahmoud, S., & Abdelhameed, R. (2023). Parental Perceived Safety Using PPGIS and Photo Survey across Urban Parks in Cairo, Egypt. Leisure Sciences, 1–24. https://doi.org/10.1080/01490400.2023.2243278

Naceur, F. (2013). Impact of urban upgrading on perceptions of safety in informal settlements: Case study of Bouakal, Batna. Frontiers of Architectural Research, 2(4), 400–408. https://doi.org/10.1016/j.foar.2013.06.004

Nalla, M. K., Johnson, J. D., & Hayes-Smith, R. (2011). Prior Victimisation, Region, and Neighborhood Effects on Fear of Crime in Mumbai, India. Asian Journal of Criminology, 6(2), 141–159. https://doi.org/10.1007/s11417-011-9114-y

Newman, O. (1972). Defensible Space; Crime Prevention through Urban Design. Anchor Press/Doubleday.

Pain, R. (2000). Place, social relations and the fear of crime: A review. Progress in Human Geography, 24(3), 365–387. https://doi.org/10.1191/030913200701540474

Patel, A. B. (2019). Factors affecting fear of crime: A study of elderly in a district of Uttar Pradesh. Working with Older People, 23(4), 217–227. https://doi.org/10.1108/WWOP-05-2019-0009

Pedregosa, F., Varoquaux, G., Gramfort, A., Michel, V., Thirion, B., Grisel, O., Blondel, M., Prettenhofer, P., Weiss, R., Dubourg, V., Vanderplas, J., Passos, A., Cournapeau, D., Brucher, M., Perrot, M., & Duchesnay, E. (2011). Scikit-learn: Machine Learning in Python. Journal of Machine Learning Research, 12, 2825–2830.

Pérez-Tejera, F., Anguera, M. T., Guàrdia-Olmos, J., Dalmau-Bueno, A., & Valera, S. (2022). Examining perceived safety and park use in public open spaces: The case of Barcelona. Journal of Environmental Psychology, 81, 101823. https://doi.org/10.1016/j.jenvp.2022.101823

Polko, P., & Kimic, K. (2022). Gender as a factor differentiating the perceptions of safety in urban parks. Ain Shams Engineering Journal, 13(3), 101608. https://doi.org/10.1016/j.asej.2021.09.032

Rahm, J., Sternudd, C., & Johansson, M. (2021). "In the evening, I don't walk in the park": The interplay between street lighting and greenery in perceived safety. URBAN DESIGN International, 26(1), 42–52. https://doi.org/10.1057/s41289-020-00134-6

Rai, R., & Rai, A. K. (2019). Fear of victimisation and women fearscapes: An exploratory study of Varanasi city, India. International Journal of Advance and Innovative Research, 6(1), 203–212.

Ruiter, R. A. C., Abraham, C., & Kok, G. (2001). Scary warnings and rational precautions: A review of the psychology of fear appeals. Psychology & Health, 16(6), 613–630. https://doi.org/10.1080/08870440108405863

Sacco, V. F. (1993). Social support and the fear of crime. Canadian Journal of Criminology, 35(2), 187–196.

Saisanath, G., & Gnanasambandam, S. (2019). Study of the perceived functions and the quality of physical boundaries of public spaces. Archnet-IJAR: International Journal of Architectural Research, 14(2), 233–250. https://doi.org/10.1108/ARCH-07-2019-0160

Sakip, S. R. M., Johari, N., & Salleh, M. N. M. (2012). The Relationship between Crime Prevention through Environmental Design and Fear of Crime. Future Communities: Socio-Cultural & Environmental Challenges, 68, 628–636. https://doi.org/10.1016/j.sbspro.2012.12.254

Sezavar, N., Pazhouhanfar, M., Van Dongen, R. P., & Grahn, P. (2023). The importance of designing the spatial distribution and density of vegetation in urban parks for increased experience of safety. Journal of Cleaner Production, 403, 136768. https://doi.org/10.1016/j.jclepro.2023.136768

Shepley, M., Sachs, N., Sadatsafavi, H., Fournier, C., & Peditto, K. (2019). The Impact of Green Space on Violent Crime in Urban Environments: An Evidence Synthesis. International Journal of Environmental Research and Public Health, 16(24), 5119. https://doi.org/10.3390/ijerph16245119

Smart Cities. (n.d.). https://smartcities.gov.in/node/181

Sonti, N. F., Campbell, L. K., Svendsen, E. S., Johnson, M. L., & Novem Auyeung, D. S. (2020). Fear and fascination: Use and perceptions of New York City's forests, wetlands, and landscaped park areas. Urban Forestry & Urban Greening, 49, 126601. https://doi.org/10.1016/j.ufug.2020.126601

Subbaiyan, G., & Gopalakrishnan, P. (2012). A Study of Association Between Fear of Crime of People at Bus Stops and Features of Street Segments. International Journal of Research in Social Sciences, 2(2), 14.

Subbaiyan, G., & Tadepalli, S. (2012). Natural Surveillance for Perceived Personal Security: The Role of Physical Environment. American Transactions on Engineering & Applied Sciences, 1(3), 13.

Swatt, M. L., Varano, S. P., Uchida, C. D., & Solomon, S. E. (2013). Fear of crime, incivilities, and collective efficacy in four Miami neighborhoods. Journal of Criminal Justice, 41(1), 1–11. https://doi.org/10.1016/j.jcrimjus.2012.09.004

Tandogan, O. (2016). Fear of Crime in Public Spaces: From the View of Women Living in Cities. Procedia Engineering, 161, 8. https://doi.org/10.1016/j.proeng.2016.08.795

Thani, S. K. S. O., Hashim, N. H. Mohd., & Ismail, W. H. W. (2016). Surveillance by Design: Assessment Using Principles of Crime Prevention through Environmental Design (CPTED) in Urban Parks. Procedia - Social and Behavioral Sciences, 234, 506–514. https://doi.org/10.1016/j.sbspro.2016.10.269

The jamovi project (2022). Jamovi (Version 2.3). (n.d.). https://www.jamovi.org

Tiruchirappalli City Municipal Corporation. (n.d.). Retrieved March 28, 2023, from https://www.trichycorporation.gov.in/cityinfo.php#menu

Tokazhanov, G., Tleuken, A., Guney, M., Turkyilmaz, A., & Karaca, F. (2020). How is COVID-19 Experience Transforming Sustainability Requirements of Residential Buildings? A Review. Sustainability, 12(20), 8732. https://doi.org/10.3390/su12208732

Tulumello, S. (2020). Landscapes of Fear. International Encyclopedia of Human Geography (Second Edition), 8, 127–130. https://doi.org/10.1016/B978-0-08-102295-5.10277-X

Türkseven Doğrusoy, İ., & Zengel, R. (2017). Analysis Of Perceived Safety In Urban Parks: A Field Study In Büyükpark And Hasanağa Park. METU JOURNAL OF THE FACULTY OF ARCHITECTURE. https://doi.org/10.4305/METU.JFA.2017.1.7

Urban Greening Guidelines. (2014). Town and Country Planning Organisation Government of India Ministry of Urban Development. https://mohua.gov.in/upload/uploadfiles/files/G%20G%202014(2).pdf

Ward, R. A., LaGory, M., & Sherman, S. R. (1986). Fear of Crime Among the Elderly as Person/Environment Interaction. The Sociological Quarterly, 27(3), 327–341. https://doi.org/10.1111/j.1533-8525.1986.tb00264.x

Westover, T. N. (1985). Perceptions of crime and safety in three midwestern parks. The Professional Geographer, 37(4), 410–420. https://doi.org/10.1111/j.0033-0124.1985.00410.x

Wood, E. (1961). Housing design: A social theory. Citizens' Housing and Planning Council of New York.

World Urbanization Prospects. (2018). United Nations Department of Economic and Social Affairs Population Dynamics.

Xiong, J., Lipsitz, O., Nasri, F., Lui, L. M. W., Gill, H., Phan, L., Chen-Li, D., Iacobucci, M., Ho, R., Majeed, A., & McIntyre, R. S. (2020). Impact of COVID-19 pandemic on mental health in the general population: A systematic review. Journal of Affective Disorders, 277, 55–64. https://doi.org/10.1016/j.jad.2020.08.001

Yeoh, B. S. A., & Yeow, P. L. (1997). Where women fear to tread: Images of danger and the effects of fear of crime in Singapore. GeoJournal, 43(3), 273–286. https://doi.org/10.1023/A:1006817400224

Yokohari, M., Amemiya, M., & Amati, M. (2006). The history and future directions of greenways in Japanese New Towns. Landscape and Urban Planning, 76(1–4), 210–222. https://doi.org/10.1016/j.landurbplan.2004.09.033

Zhao, J., & Huang, Y. (2021). Physical Characteristics of Urban Green Spaces in Relation to Perceived Safety. Journal of Urban Planning and Development, 147(4), 05021032. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000742