Crime Prevention Through Environmental Design for Low-Income Residents (B40) in Sabah, Malaysia

Zuraini Alias[1], Noor Malinda Mohamed Mohan[2], Mohd Reza Abdol Ghani[2], Mazni Saad[3,*], Mokhtar Abdullah[4]

[1] Faculty of Management, Education & Humanities, University College Maiwp International, Malaysia
[2] Faculty of Business and Accountancy, Universiti Selangor, Malaysia
[3] Kulliyyah of Languages and Management, Universiti Islam Antarabangsa Malaysia, Malaysia
[4] Meritus University, Malaysia

*Corresponding e-mail: maznisaad@iium.edu.my

ABSTRACT

Safety, facilities, and environment are known to be among the core factors that influence the Quality of Life (QoL) of neighbourhood communities. This study evaluates the low-income residents' (B40) QoL and seeks to clarify whether People's Housing Program Environment (PPRE) and Crime Prevention through Environmental Design (CPTED) can be used collaboratively to improve the QoL of the People's Housing Project (PPR) communities. This study hypothesizes that implementing CPTED is one of the strategies that may enhance the feeling of safety in residential environments. This study utilised a quantitative cross-sectional design to collect data from 150 PPR residents. The PLS-SEM method reveals that a good PPRE has a significant impact on the residents' QoL. While the study's focus is primarily on the expected impact of CPTED on residents' QoL, the main finding suggests that CPTED can have a large impact on QoL on its own, but not as a mediator between PPRE and QoL. Community relationship, maintenance, natural surveillance, legitimate activity support, and target hardening were the five most important CPTED constructs. However, results did not support territorial reinforcement and natural access control as CPTED facilitators. This information is necessary for developing effective CPTED in housing policies that may improve PPR residential well-being.

Keywords: quality of life, crime prevention, environmental design, people housing project

INTRODUCTION

Quality of Life (QoL) is an important issue faced by the Malaysian government, which is tasked with improving the standard of living of local communities, especially low-income residents' (B40) communities. The QoL of Sabah residents living in the Malaysian government's low-income housing scheme, the People's Housing Project, known in Malay as *Projek Perumahan Rakyat* (PPR), is the focus of this study.

To understand the antecedents of QoL for Sabahan people, one needs to have familiarity with Sabah's geography and socio-economic status. Sabah is located at Borneo Island, which geographically has a 1,290 to 1,450 km long, heavily indented coastline that is washed by the South China Sea, Sulu Sea, and Celebes Sea. It was known as North Borneo during the British colonial period, and its land area is dominated by the highest mountain in Malaysia, Mount Kinabalu (4,101 meters). In addition, Sabah is popular among international tourists, particularly its ecotourism attractions such as Sipadan Island, Kapalai Island, and Mabul Island, and it is well known for seafood gastronomy and cultural diversity. Sabah has a diverse population of about 3.39 million, of which the *Orang Asal (*Original People*)* of Sabah constitute 55.5%, with Kadazan∕Dusun and Bajau being the two biggest ethnic groups*.* Despite being the second largest state and having the second highest population in Malaysia, Sabah is one of the poorest states in Malaysia (Fang et al., 2022).

Unfortunately, Sabah is home to a very large number of illegal immigrants (PATI) (Miwil, 2022). In fact, one in four people living in Sabah are non-citizens, which is very high compared to Peninsular Malaysia (Peng et al., 2021). Sabah has experienced migration on a particularly large scale, and is home to at least 44% of Malaysia's foreign workers, especially those from Indonesia (Somiah, 2022). These large numbers of illegal workers have contributed to the crisis of crime, which increased by 50% in 2022 (Berita Nasional Malaysia-Bernama, 2022). Among the crimes involving foreigners, cases include are snatch theft, rape, drug trafficking, murder, smuggling activities, and so on (Othman et al., 2020). The Kuala Lumpur Structure Plan 2020 is intended to address several issues, involving crime at low-cost housing sites in Sabah, brought on because of the low space standards, lack of community facilities, high maintenance costs, and poor quality of construction and materials used in building the houses (Othman et al., 2020).

The density factor of the residential area is also one of the contributors to criminal activity in these residential PPR communities (Nik Mahmood et al., 2017; Oliveira, 2021). Oliveira (2021), who studied low-income housing in Denmark, stated that crimes like theft increase in urban areas due to the larger population size. Indonesia is similar, with crime rates increasing due to population density that creates a big gap between poor and rich (Sugiharti et al., 2023). Crime has become a key issue for Sabahan locals that greatly impacts their QoL.

In addition to considering safety and security factors, this study intends to highlight other indicators in determine QoL of Sabahan people who live in PPR. Zumaya and Motlak (2021) mentioned that QoL is not only based on the physical features, and a sense of safety and security, but is also a function of the availability of social utilities such as public health, transportation services, local identity, and environmental pollution. As one example, transportation services are part of the many QoL elements that may influence residents' satisfaction and their QoL because accessibility makes their lives easier (Arabi et al., 2020). In the Malaysian context, the Malaysian National Housing Policy has reaffirmed the importance of quality as one of the features in any new housing developments (Ezeanya, 2020). Unfortunately, previous studies have dealt with housing provision and affordable housing (Hafidzi et al., 2019; Liu & Ong, 2021), but there has not been as much research done on housing quality (Ali, 2018).

In alignment with government directions and Sustainability Development Goal 9 (Sustainable Development Goals, 2020), this study proposes a Crime Prevention Through Environmental Design (CPTED) framework to assist the enhancement of overall QoL of PPR residents. In order to extend the knowledge and understanding regarding QoL among Sabahan staying in PPR, this study aims to enhance current QoL indicators by assessing them from the perspective of CPTED strategies. Specifically, the primary objective of this study is to investigate the role of CPTED as a mediator

between the PPR residential environment and the QoL of PPR residents.

People's Housing Projects and B40 Residents

The National Housing Department is the organisation with primary responsibility for implementing PPR projects in Malaysia. This Department is under the Ministry of Local Government Development (National Housing Department, 2022), which *is responsible for providing quality, conducive, and affordable housing for target groups. PPR,* known in Malay as "Program Perumahan Rakyat," is an initiative by the Malaysian government to help income earners under the B40 category to find a home and eradicate "squatter" areas throughout the nation. The B40–or the "bottom 40%"–is the socio-economic category that comprises those people with a monthly household income of RM4,850 or less (Romeli, 2022).

PPR can be divided into two categories, namely PPR Rented and PPR Owned. The National Housing Standard for Low-Cost Flat Housing specifies that the low-cost housing planning and design requirements must be used in all homes constructed under the PPR Owned and PPR Rented programs (CIS2). Through this program, the government uses PPR as an initiative that attempts to give low-income groups a chance to purchase a home. PPR Owned homes are offered for sale in Peninsular Malaysia for RM35,000 per unit, while those in Sabah and Sarawak are offered for RM42,000 per unit (National Housing Department, 2022). Figure 1 displays examples of PPR in Sabah.

A survey report conducted by the Department of Statistics Malaysia (2020) revealed that 16.3% of the Sabah population was in the B40 cluster. As these households suffer from low incomes, individuals in this group may end up on the streets if they are unable to pay for rent or monthly mortgage instalments. Some of them might not even have enough money for food. That is why the government must look after the basic need for shelter among these lower-income earners. Recognising this fact, the Malaysian government is attempting to tackle this issue through several projects, one of which is "Projek

Perumahan PPR," which aligns with the Fourth Malaysia Plan. There are certain qualifications imposed on individuals or households in order to qualify for this housing scheme. To date, there have been 118 PPR projects in Malaysia. In Sabah, there are 33 completed projects comprising 23,009 units of housing (Ministry of Housing and Local Government Statistics, 2022).

Violence crime is one of the issues faced by PPR residents in Malaysia. It has been found that underutilised spaces such as open rooftops, staircases and empty parking spaces are "go-to" spaces for drug users and addicts. In Kuala Lumpur, the Police Chief revealed that 69 crime cases in 2019 were recorded in PPR, with 1,001 people arrested for drug-related offences (Bernama Berita Nasional Malaysia-Bernama, 2019). Further, the Department of Statistics Malaysia (2020) reported that, among 52,344 crime index cases, break-ins and theft, with 14,040 cases, comprised the second highest category of crime in 2020 after vehicle theft. This indicates how security and safety are low, and, as a result, the QoL for these residents continues to deteriorate. The alarming crime rate in residential areas requires further special attention, and priority should be given to promoting public security and safety for the purpose of designing a stable and peaceful environment for the community, allowing residents to feel safe not only indoors but also outdoors (Sidek et al., 2021). Even residents of the PPR welcomed the move to place police personnel at the residential units in hopes that their presence would increase the security and help eradicate criminal activities in the area (Berita Nasional Malaysia-Bernama, 2019). Given the nature of PPR, the intervention via CPTED is seen as a solution which can help the B40 residents reduce or prevent crime through environmental design.

According to Mahdzir et al. (2022), the quality of life for individuals with lower incomes is influenced by residential units' attributes and the accessibility of nearby amenities. Housing residents commonly emphasize certain fundamental aspects, including the demarcation between living spaces and facilities, the level of privacy within the housing area, the management practices within the housing vicinity, and the overall arrangement and dimensions of the housing units. Mahdzir et al. (2022) primarily

highlight the distance between residential areas and essential facilities as a crucial factor. Among the key concerns of the residents in this locality are the proximity to health centers such as pharmacies, clinics, or hospitals as well as to grocery stores, and marketplaces for obtaining basic necessities. Other factors include access to support services, the nearest urban centers, educational institutions including kindergartens, nurseries, schools, and places of worship. The presence and convenience of these facilities significantly contribute to the overall quality of life for the inhabitants of a PPR area. Furthermore, Mahdzir et al. (2022) assert that the housing units' design and size also impact the tenants' quality of life. The presented literature led to the first hypothesis that PPR environment significantly influences quality of life.

Figure 1

Examples of PPR in Sabah

Note. Photo a from *Lapan PPR di Sandakan tidak perlu Bayar sewa sehingga,* by Sabah Gazette, 2021, Sabah Gazette (https://www.sabahgazette.com/lapan-ppr-di-sandakan-tidak-perlu-bayar-sewa-sehingga-mac/). Copyright 2021 by Sabah Gazette. Photo b from *4,400 units of PPR under construction in Sabah, Dewan Rakyat told*, by Berita Nasional Malayisa–Bernama, 2019, Edge Prop (https://www.edgeprop.my/content/1727702/4400-Wa]units-ppr-under-construction-sabah-dewan-rakyat-told). Copyright 2019 by Berita Nasional Malayisa – Bernama. Photo c from *A total of 1,308 PPR House Units in Sabah will be handed over to applicants*, by Sabah Post, 2019, Sabah Post (https://www.sabahpost.net/2019/07/17/sebanyak-1308-unit-rumah-ppr-di-sabah-bakal-diserah-kepada-pemohon/). Copyright 2019 by Sabah Post. And Photo d from *14 PPR Built Nationwide In 2020*, by Borneotoday, 2019, Borneotoday (https://borneotoday.net/14-ppr-dibina-di-seluruh-negara-pada-2020/). Copyright 2019 by Borneotoday.

LITERATURE REVIEW

Broken Windows Theory

Broken Windows Theory as described by Kelling and Bratton (1998) sees serious crime as the final result of a lengthier chain of events, theorizing that crime emanates from disorder, and that if disorder is eliminated, then serious crimes would not occur. Their theory further posits that the prevalence of disorder creates fear in the minds of citizens who are convinced that the area is unsafe. This withdrawal from the community weakens social controls that previously kept criminals in check. Once this process begins, it feeds itself. Disorder causes crime, and crime causes further disorder and crime. Reflecting on this, they put forward the theory, which uses broken windows as a metaphor for a disorder that can be referred to as decreased safety and security, especially in residential areas. The theory links disorder and incivility within a community to subsequent occurrences of serious crime (Kelling & Wilson, 1982).

Mckee (2022) emphasized that instead of depending on social policy, the Broken Windows Theory enables actions within the field of criminal justice policy to bring about change. This argument is supported by Weele et al. (2017), who stated that the Broken Windows Theory highlights indifference and lax enforcement by authorities, which heightens fear of crime and weakens social controls, opening the door for more serious offences. The authors also theorized that it is critical for the police to take part in the prevention and policing of unrest and small crimes like panhandling to stop the escalation of such activities to more serious crimes. To conclude, this theory, while recognizing that crime will still occur, places the stress on maintaining safety and preventing crime through strict enforcement of all laws and regulations, even those that seem quite inonsequential. Therefore, the full engagement of the safety authority (i.e., the police) is required to help in recognizing the importance of maintaining, intact, communities without "broken windows" because if minor crimes and poor behavior are not addressed, then more serious crime will flourish (Yates et al., 2022).

Crime Prevention Through an Environmental Design Framework

As reported by Mudim (2020), certain apartments within in the PPR program have deteriorated to an alarming state, transforming them into hubs for criminal activities. Residents have expressed enduring discomfort due to pervasive odors of garbage and a constant sense of vulnerability to break-ins. Instances of robbery and theft are also commonplace, and are often attributed to the presence of drug addicts residing within the PPR apartment complexes. As reported by Malaysia Kini in 2018, a noteworthy 58% of PPR units in Kuala Lumpur have received red flags, indicating heightened susceptibility to drug addiction issues.

The CPTED for Queensland Government (2021) defines CPTED as comprising the planning, designing, and urban management of towns and cities in order to improve community safety by implementing all the principles and practices of CPTED. The seven CPTED principles are defined by the Queensland government as activation, surveillance, ownership, stakeholder management, legibility, territoriality, and vulnerability (Queensland Government, 2021), while, according to the International CPTED Association (ICA), CPTED comprises five principles, which are physical security, surveillance, movement control, management and maintenance, and defensible space. Regardless of the specific definition of principles one adopts, the main objective of CPTED is to reduce crime-fear, restrict crime opportunities, and promote social interaction among users by designing and manipulating the built environment (Silva et al., 2022). The concept is that crimes against people and property are less likely to occur if other people are around. The CPTED concept further stresses the importance of people in adjoining buildings and spaces being able to see what is happening, and being encouraged to respond as well as help victims. Moreover, the aim of CPTED is to give people safe choices about where to be and how to anticipate and respond to problems (Queensland Government, 2021).

Numerous studies provide evidence that CPTED principles have been successfully applied in

urban spaces to prevent crime. For instance, Piza and Welsh (2019) evaluated the efficacy of crime prevention, and found CPTED has been effective in reducing crimes and fewer crimes-related fears. In the UK, Piroozfar et al. (2019) investigated the adoption of CPTED to enable effective use of the built environment to reduce crime, and they found that since interventionary measures had begun in BTC in 2011, the city had experienced a decline in crime rates. In local research, Rozhan and Mohd Yunos (2019) stated that safe city program improvement through the principles of CPTED are possible because their application prevents crime from happening. Entezari (2020) examined the extent of the sense of security in relation to Crime Prevention Through Environmental Design (CPTED) along a transect line stretching from the downtown area to rural regions of Des Moines, Iowa. The findings of this research established a link between the differences in urban and rural environments and CPTED factors, encompassing natural surveillance, access control, territoriality, and maintenance. CPTED is widely regarded as a highly effective approach for bolstering the sense of security and promoting crime prevention within an urban setting.

Unfortunately, Rajadurai et al. (2021) found that most projects in Selangor are designed by people who do not understand CPTED entirely, that CPTED application and strategies are less effective due to the yearly budget limitations, and the police have not been included in the CPTED design process.

Based on this evidence, it is argued that CPTED implementation for residences such as PPR housing areas is important, and that it perhaps results in the reduction of crime rates or prevention of crime in those areas, leading to improved QoL for the residents. The above literature supports our second hypothesis that PPR environment has a significant influence on CPTED.

Quality of Life

Quality of life (QoL) is defined as how individuals' perception of their position in society aligns with their interests, expectations, goals and living standards within the system of culture and values in which they live (Morkoc & Erdonmez, 2018). There are many factors that can positively or negatively affect an individual's QoL (Tvaronaviciene et al., 2022). According to Ali (2018), the factors can be represented by non-financial components that influence life satisfaction, such as people's mental and physical health, the social relationships with the environment, motivation, workload, and many other factors. According to Haque et al. (2022) and Wimalasena et al. (2022), housing safety conditions comprise one of the important aspects
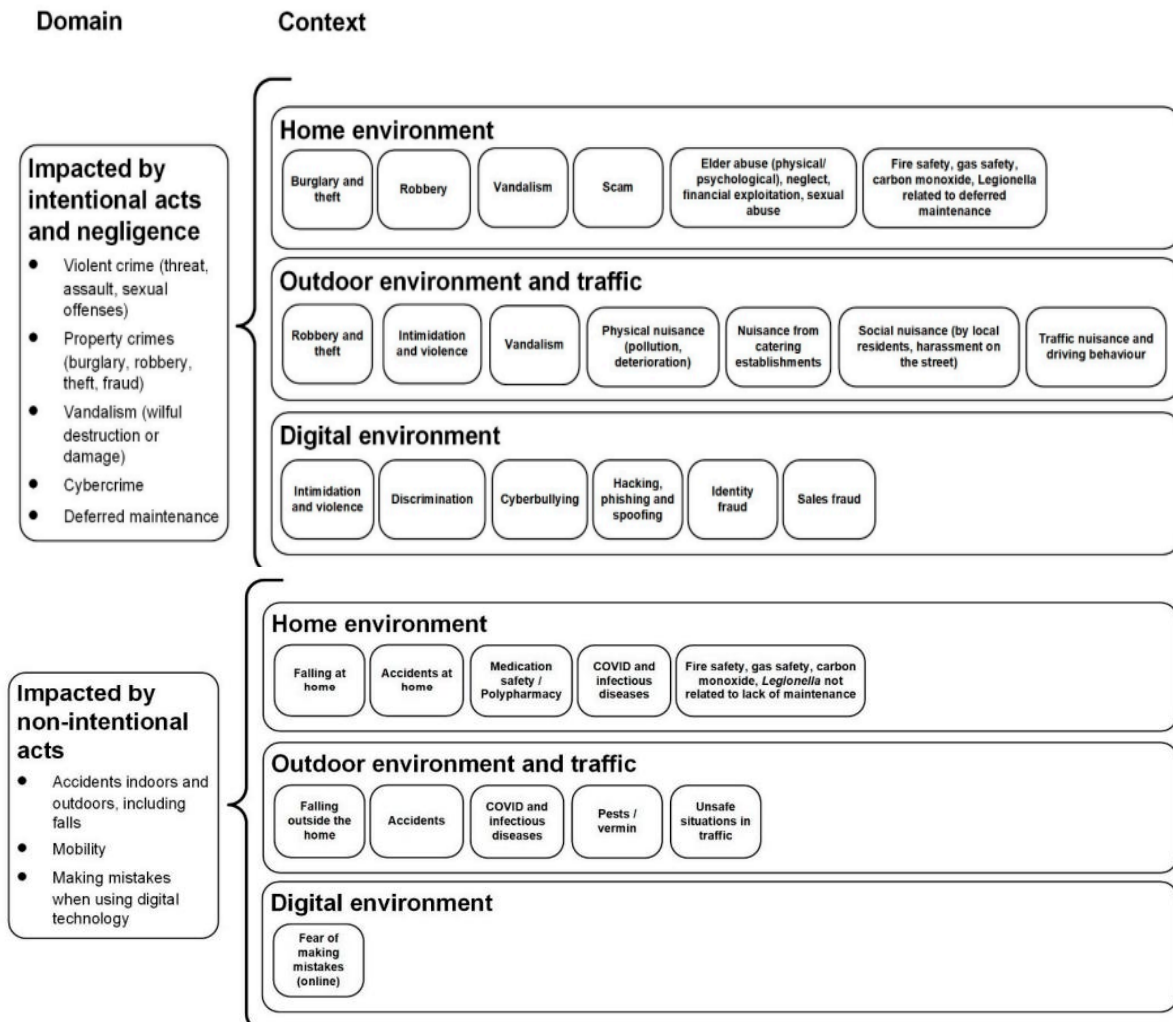
Table 1

Housing Quality Indicators

Quality	Indicators
Social Attributes	Emphasising the social aspects of being able to interact with communities in the neighborhood.
Design Quality	Housing layout designshould not only be beautiful, but must also be cost-efficient.
Lifestyle	Lifestyle and family values which can be improved through the quality of the living environment.
Safety & Security	Whether the design includes the aspect of safety and security in their layout design related to the ambience, safety, security, and all aspects.

Note. Adapted from "Interpreting the meaning of housing quality towards creating better residential environment," by M. Ali, 2018, *Environment-Behaviour Proceedings Journal, 3*(8), pp. 141–154 (https://doi.org/10.21834/e-bpj.v3i8.1414). Copyright 2018 by Maimon Ali.

Figure 2

A Classification of Experienced Safety and Security in Housing Areas

Perceived sense of safety and security

Domain   **Context**

Impacted by intentional acts and negligence
- Violent crime (threat, assault, sexual offenses)
- Property crimes (burglary, robbery, theft, fraud)
- Vandalism (wilful destruction or damage)
- Cybercrime
- Deferred maintenance

Home environment
| Burglary and theft | Robbery | Vandalism | Scam | Elder abuse (physical/psychological), neglect, financial exploitation, sexual abuse | Fire safety, gas safety, carbon monoxide, Legionella related to deferred maintenance |

Outdoor environment and traffic
| Robbery and theft | Intimidation and violence | Vandalism | Physical nuisance (pollution, deterioration) | Nuisance from catering establishments | Social nuisance (by local residents, harassment on the street) | Traffic nuisance and driving behaviour |

Digital environment
| Intimidation and violence | Discrimination | Cyberbullying | Hacking, phishing and spoofing | Identity fraud | Sales fraud |

Impacted by non-intentional acts
- Accidents indoors and outdoors, including falls
- Mobility
- Making mistakes when using digital technology

Home environment
| Falling at home | Accidents at home | Medication safety / Polypharmacy | COVID and infectious diseases | Fire safety, gas safety, carbon monoxide, Legionella not related to lack of maintenance |

Outdoor environment and traffic
| Falling outside the home | Accidents | COVID and infectious diseases | Pests / vermin | Unsafe situations in traffic |

Digital environment
| Fear of making mistakes (online) |

Note. Adapted from "Towards a better understanding of the sense of safety and security of community-dwelling older adults," by J. van Hoof, J. van Dikken, W. H. van Staalduinen, Z. van der Pas, R. F. M. van den Hoven & L. M. Hulsebosch-Janssen, 2022, *International Journal of Environmental Research and Public Health, 19(7)*, pp. 1–20 (https*://*doi.org*/*10.3390*/*ijerph19073960). Copyright 2022 by Joost van Hoof, Jeroen van Dikken, Willeke H. van Staalduinen, Zuzan van der Pas, Rudt F. M. van den Hoven and Loes M. Hulsebosch-Janssen.

of QoL, and play a central role in in bringing satisfaction, health and well-being to individuals in a community. These conditions are determined by the safety of the architectural design, user comfort, location, and neighbourhood (Wimasalena et al, 2022). Housing quality is defined as the extent to which housing provides a healthy, safe, secure, and resilient environment for individuals and families in which to live and participate in community activities (Ali, 2018).

Table 1 summarises the indicators for housing quality components.

In relation to QoL and safety through sustainable infrastructure, SDG 9 aims to realise the development of quality, reliable, sustainable, and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all by 2030 (Sustainable Development Goals, 2020).

As shown in Figure 2, there are two domain acts of safety: intentional acts and negligence. The former include crimes in physical and digital environments, while the latter comprise non-intentional acts, which include outdoor accidents, failures, or any hazards from the environment that are uncontrollable by humans (Hoof et al., 2022). This classification offers a way for people to emphasise the main aspects that need to be highlighted to improve the sense of safety in residential areas.

Previous studies indicate that elements of the neighbourhood such as safety from crimes are positively linked with residential satisfaction (Hafidzi et al., 2019). On the other hand, a study of the community of Nanhuan and Daoqian emphasised that the satisfaction of residents towards the facilities such as property management, unrestricted space mobility, and demand for various facilities and recreation spaces were the most prominent elements to improve residents' satisfaction for seeking their QoL (Chen et al., 2020). This is supported by another study in which it was stated that the level of crime, lack of amenities, or industrial development or location of workplace are probably contributors to neighbourhood dissatisfaction that weakens QoL (Mohit & Raja, 2014). Therefore, all the indicators being discussed demonstrate the importance of the focus on strengthening the "social" environment–not merely the material environment–in order to enhance the QoL among the people, especially in housing areas.

CPTED, Residential Environment and QOL

The concept of liveability suggests that higher-level human motivational needs comprise a critical component for sustaining a safe neighbourhood. Since liveability is used in urban planning as a key indicator of QoL, this study proposes that the next generation of CPTED should aim to increase the overall QoL by making neighbourhoods healthy, socially and personally fulfilling, and, ultimately, safe. Arabi et al. (2020) studied the QoL of the people from Cleveland and Saville using CPTED strategies. One of the strategies was to ensure the connection between the transportation facilities and services that could be accessed. Their results revealed that social cohesion, which is enhanced by participation in local and social events with the community, can significantly influence the QoL (Arabi et al., 2020). As Azman and Harith (2020) indicated, the strategic positioning of residential zones holds significant importance for the B40 demographic. Both home builders and government entities should carefully consider this aspect to avoid redundant construction and unfavorable reactions from potential applicants. CPTED primarily emphasises the enhancement of safety within residential environments, aiming to guarantee overall security and residents' quality of life. This is further reinforced by the findings of a study indicating that CPTED correlates with the residents' quality of life in residential environments. This correlation encompasses various factors, including the standard of living spaces, the presence of amenities, the convenience of access, safety, and zones of comfort (Mazur et al., 2022).

Previous studies have argued that CPTED practices affect human behaviour and improve the sense of safety (Mihinjac & Saville, 2019; Thani et al., 2016). In Indonesia, Jadiyantara and Sukabdi (2022) found that vulnerability to terrorist attacks at MRT Lebak Bulus Jakarta could be identified based on Physical Security Theory, and that implementation of CPTED in the design of the security system contributed to continuous safety protection of the passengers. Thani et al. (2016) revealed that integration of CPTED principles in physical planning and design of the surroundings in urban parks in Malaysia helped in providing a safer outdoor environment for recreational activities. Lee et al. (2020) added that the principles of CPTED are related to access control and natural surveillance that requires support activities like increasing the number of attractions and rearranging the facilities to increase human activities and motivational reinforcement, focusing on encouraging personalised environments and involving the citizens or community to help increase residents' QoL and satisfaction.

Jagamogan et al. (2022) explained that CPTED's basic principles rely on natural surveillance, which refers to lights, windows, fences, and landscaping that limit criminal opportunities in relatively cost-effective ways. Rose (2021)

investigated students' perceptions towards the implementation of the CPTED model in Leicester, and found that 97% of students agreed that the CPTED strategy regarding lighting enhanced their sense of safety and left them satisfied with the results. Most recently, Lee et al. (2023) found that several physical features associated with the CPTED principles, such as installing and displaying signs featuring images of watching eyes, were linked with reduction in violent crime around low-income minority schools. Moreover, they found that the adoption of CPTED principles made it safer for students to commute to school and enhanced overall safety in school neighbourhoods. Community involvement, exemplified by initiatives like neighbourhood renewal programs, has revolutionized approaches to reducing crime in numerous developed nations. Consequently, Alonso et al., (2019) proposed that the implementation of neighbourhood renewal programs represents a efficacious strategy for diminishing crime rates. Factors that trigger fear among individuals due to both human behaviour and environmental conditions discourage people from visiting parks, leading to a decline in the quality of recreational experiences and overall enjoyment. Unfortunately, planners and managers have frequently overlooked these significant concerns. In a study by Mak and Jim (2021), 872 park users across eight urban parks in Hong Kong were surveyed through a questionnaire. This survey aimed to assess their perception of personal safety in relation to various park characteristics. The study revealed that the factors identified as contributors to this issue could play a role in crime prevention through environmental design. This involves cataloguing secure and insecure elements within parks, and devising targeted alternatives and solutions to address them.

Based on those principles, it can be argued that the third-generation CPTED principles fulfil Maslow's hierarchy of human needs, especially because they directly influence QoL and, thus, address human needs across all six levels of Maslow's revised hierarchy of needs (Mihinjac & Saville, 2019). From the literature review and discussion above, the following hypotheses (H_3-H_{11}) are formulated.

H_3: CPTED has a significant influence on quality of life

H_4: CPTED significantly mediates the association between PPR environment and quality of life

H_5: Territorial reinforcement (TR) has a significant influence on CPTED

H_6: Natural surveillance (NS) has a significant influence on CPTED

H_7: Natural access control (NAC) has a significant influence on CPTED

H_8: Maintenance (M) has a significant influence on CPTED

H_9: Legitimate activity support (LAS) has a significant influence on CPTED

H_{10}: Target hardening (TH) has a significant influence on CPTED

H_{11}: Community relationship (CR) has a significant influence on CPTED

RESEARCH METHODOLOGY

This study adopted a cross-sectional research design and quantitative method through survey questionnaire with PPR residents in Sabah. A total of 150 respondents were selected using purposive sampling through contact with the PPR block leaders in July 2022. Before the survey was distributed, the researchers approached the Ministry of Local Government Development for approval to conduct a study in the PPR context. Once the permission was obtained, the approval letter was obtained and appointments were scheduled with PPR block leaders for the survey activities.

Measurement of the Constructs

A survey questionnaire was developed based on the indicators linked with each of the proposed research model's constructs. This study adapted questions from Cozens and Tarca, 2016; Mohd, et al., 2015; Olajide and Lizam, 2017; Rosni et al., (2019). Section A comprises the demographic profile of the respondents. The other three sections contain items related to dependent and independent variables. The respondents were

asked to indicate their perception levels on a 6-point Likert Scale, ranging from Strongly Disagree (1) to Strongly Agree (6). Table 2 shows the measurements of the constructs and their sources.

A pre-test was carried out by two experts in research methodology, and, after further corrections, the final survey draft was piloted to 30 respondents. A preliminary analysis of the data was performed and a reliability assessment of the constructs was carried out by calculating the values of Cronbach's alpha for each construct separately. The results of Cronbach's alpha were: 0.926 for CPTED, 0.742 for PPR Environment, and 0.852 for QoL. Hence, the internal consistencies of all constructs were considered acceptable since each reliability test exceeded the threshold (0.70) suggested by Hair et al. (2019a).

Data Analysis

This study utilised PLS-SEM to examine if CPTED had the ability to mediate the association between the PPR environments (PPRE) and PPR residents' QoL. PLS-SEM, which had been utilised by Nitzl et al. (2016) to evaluate the mediation effects of CPTED within the framework, was determined to be the optimal technique. In certain cases, researchers were required to work with a research model containing higher order constructs (HOC). Typically, HOC models are identified by the number of levels in the model (typically restricted to second-order models) and the distinct relationships between the HOCs and the LOCs (reflective and formative relationships) (Becker et al., 2012). A higher- (or second) order construct is a general idea that is either represented (reflective) or formed (formative) via its dimensions (lower or first-order constructs) (Becker et al., 2012). Four types of HOC models were discussed in the literature (Wetzels et al., 2009) and used in applications (Johnson et al., 2012). These models are based on the relationships between the first-order latent

**Table 2**

Measurement of the Constructs and their Sources

Constructs	No. of Items	Source(s)
Territorial Reinforcement (TR)	4	Cozens and Tarca (2016), Olajide and Lizam (2017)
Natural Surveillance (NS)	5	Cozens and Tarca (2016), Thani et al. (2016)
Natural Access Control (NAS)	5	Hedayati-Marzbali et al. (2016) , Cozens and Tarca (2016), Olajide and Lizam (2017)
Maintenance (M)	5	Armitage and Monchuk (2017), Cozens and Tarca (2016), Konkel et al. (2019), Sugiharti et al. (2023)
Legitimate Activity Support (LAS)	5	Cozens et al. (2005), Olajide and Lizam (2017)
Target Hardening (TH)	5	Cozens and Tarca (2016)
Community Relationship (CR)	5	Permyakov and Krasnova (2020)
Quality of Life (QoL)	12	Streimikiene (2015)
PPR Residential Environment (PPRE)	5	Cozens and Sun (2019), Olanrewaju and Lee (2022), Arabi et al. (2020)

variables and their manifest variables, as well as the relationships between the second-order latent variables and the first-order latent variables (Becker et al., 2012).

The HOC model takes into account the association between PPRE and QoL, as well as the role of CPTED as a mediating variable in the HOC relation (Type II, Reflective-Formative) between PPRE and QoL. When higher-order constructs are included in the model, PLS-SEM is the preferable statistical method (Hair et al., 2019b; Hair et al., 2022; Sarstedt et al., 2019). CPTED is a higher-order construct, which further supports the use of PLS-SEM in the current study.

Figure 3

The Research Framework
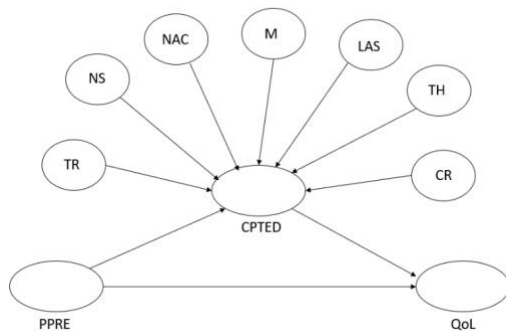
Based on the research framework illustrated in Figure 3, this study predicts that the independent latent construct PPRE will have a significant association with the dependent latent construct QoL. Seven sub-constructs contribute to the mediating latent construct CPTED , namely, territorial reinforcement (TR), natural surveillance (NS), natural access control (NAC), maintenance (M), legitimate activity support (LAS), target hardening (TH), and community relationship (CR). While PPRE and QoL are considered to be reflective constructs, CPTED is considered the higher order construct in relation to the corresponding lower order constructs (TR, NS, NAC, M, LAS, TH, and CR), which are assumed to be formative constructs. Meanwhile, CPTED, which is expected to be influenced by PPRE, is anticipated to have a significant influence on QoL. Therefore, the hypotheses statements in relation to the various relations in the research model are as follows.

H_1: PPR environment has a significant influence on quality of life

H_2: PPR environment has a significant influence on CPTED

H_3: CPTED has a significant influence on quality of life

H_4: CPTED significantly mediates the association between PPR environment and quality of life

H_5: Territorial reinforcement (TR) has a significant influence on CPTED

H_6: Natural surveillance (NS) has a significant influence on CPTED

H_7: Natural access control (NAC) has a significant influence on CPTED

H_8: Maintenance (M) has a significant influence on CPTED

H_9: Legitimate activity support (LAS) has a significant influence on CPTED

H_{10}: Target hardening (TH) has a significant influence on CPTED

H_{11}: Community relationship (CR) has a significant influence on CPTED

ANALYSIS AND DISCUSSION

In looking at the demographic characteristics, 60% of the study's participants were female as compared to 40% male. Further, the age ranges show that more than half (53.6%) of the respondents were between 18 and 30 years old. The majority of respondents were employed full-time, with an earned monthly income of less than RM1,200**.** This study also tapped some information on the household, and 27.**3%** of the respondents were family leaders**.**

PLS-SEM Result

SmartPLS 3.0, a PLS-SEM software, was used to examine the research model (Figure 3). In this study, the repeated indicators approach was used, and the reliability and validity of the reflective first order indicators were tested before analyzing the formative second order constructs.

Measurement Model Assessment

The reflective measurement model is used to assess the extent to which a variable is loaded on its underlying construct (Henseler et al., 2015). PLS evaluates the reflective measurement model in terms of consistency reliability, indicator reliability, convergent validity, and discriminant validity. Table 3 displays the results of the reflective measurement model.

For secure consistency and indicator reliabilities, the statistics should meet three permissible levels. First, factor loadings of 0.40 are considered acceptable in exploratory studies (Hair et al., 2017). Second, Cronbach's alpha values (α) must be larger than 0.7 (Hair et al. (2019a), and, finally, composite reliability (γ) should be significantly more than 0.7 (Gefen et

al., 2000). The results indicate that all construct items factor loadings exceeded 0.40. In addition, both Cronbach's alpha values and composite reliability were greater than 0.7. As a result, these two reflective constructs, PPRE, and QoL can be considered reliable, and validity has been established.

In assessing the convergent validity, each latent variable's average variance extracted (AVE) should be bigger than 0.5 (Hair et al., 2017). The results in Table 3 show that the AVE values for PPRE and QoL are 0.649 and 0.509, respectively. These results confirmed the construct's convergent validity after two QoL items (QoL3 and QoL12) were removed from the construct. Finally, the discriminant validity was assessed using the heterotrait-monotrait ratio (HTMT), which was introduced by Henseler et al. (2015). A cut-off points of 0.85 was recommended by Henseler et al. (2015), and

Table 3

The Reflective Measurement Model Statistics

Indicators & Items	Loading	α	γ	AVE
PPR Environment (PPRE)				
PPRE 1	0.702			
PPRE 2	0.756			
PPRE 3	0.823	0.865	0.902	0.649
PPRE 4	0.877			
PPRE 5	0.857			
Quality of Life (QoL)				
QoL 1	0.737			
QoL 2	0.741			
QoL 4	0.712			
QoL 5	0.787			
QoL 6	0.497			
QoL 7	0.670	0.830	0.866	0.502
QoL 8	-0.630			
QoL 9	0.837			
QoL 10	0.862			
QoL 11	0.783			
QoL 13	0.479			

Note. CPTED and its constructs are formative constructs and therefore, convergent validity is not relevant, α = Cronbach's Alpha; γ = Composite Reliability; AVE = Average Variance Explained; *p <.05.

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when HTMT values are higher than 0.85, it indicates that discriminant validity problems occur. The HTMT score for assessing discriminant validity of PPRE and QoL was 0.819, which is lower than the recommended guideline of 0.85. As a result, the discriminant validity criteria were met.

Structural Model Assessment

Figure 4 shows the findings for structural model assessment. The predictive power result shows that the two variables in the model were able to explain about 79.7% of the variance explained toward the QoL, indicating a "substantial" model. Hair et al. (2017) proposed an additional step of examining the change in the R^2 value via the effect size (f^2) value. The effect size results (f^2), which measure the impact of a particular predictor construct on an endogenous construct, are shown in Table 4. The f^2 values of 0.02, 0.15, and 0.35 represent small, medium, and large effects, respectively, on an endogenous construct (Gefen et al., 2000). It was observed that the PPRE variable had a small effect size on CPTED ($f^2 = 0.043$) and QoL ($f^2 = 0.113$). On the other hand, the CPTED variable had a large effect size on QoL ($f^2 = 1.275$).

An important metric for the formative HOC, i.e., CPTED, is collinearity (measured by VIF) between the indicators (LOCs) (Sarstedt et al., 2019). Most of the VIF values were below the recommended maximum level of 5.0, except for two items of M (M3 and M4), three items of NAC (NAC2, NAC3, and NAC5) and one item of TH (TH4) all of which exceeded the 5.0 threshold. Eliminating these six items from the constructs M, NAC, and TH produced some improvements in the levels of significance or strengths of the

relationships between CPTED and the five significant LOCs, which are CR, TH, LAS, M, and NS.

In the context of the causal relationships, the results in Table 5 confirm that PPRE ($\beta = 0.216$, t = 3.616[***]) and CPTED ($\beta = 0.721$, t = 3.400[***]) have simultaneously positive significant effects on QoL, and thus, H_1 and H_3 are supported. On the other hand, the results show that PPRE ($\beta = 0.031$, t = 0.802[NS]) has an insignificant effect on CPTED, leading to rejection of H_2.

With respect to the role of CPTED influeincing the PPR residents' QoL, the findings reveal that five out of seven factors, namely, natural surveillance (NS), maintenance (M), legitimate activity support (LAS), target hardening (TH), and community relationship (CR), were significant. Meanwhile, the other two enablers of CPTED, which are territorial reinforcement (TR) and natural access control (NAC), were not supported by the data. In conclusion, the result suggests that H_6, H_8, H_9, H_{10}, and H_{11} were supported, while H_5 and H_7 were not supported. Among the significant factors that influenced CPTED, CR was the most influential
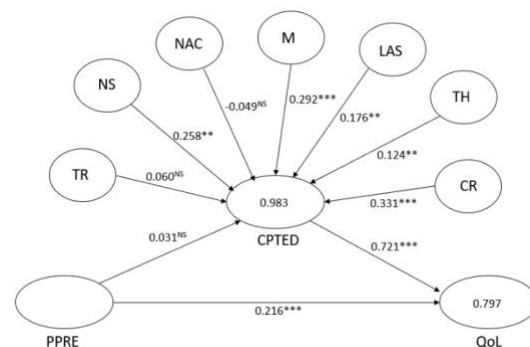
Figure 4

The Estimated Structural Model

Table 4

Effect Sizes (f^2) Result

	PPRE	CPTED	QoL
PPRE		0.043	0.113
CPTED			1.275

(β = 0.331, t-stat = 4.214***), and NS (β = 0.258, t-stat = 3.011***). The other factors, LAS (β = 0.176, t-stat = 2.450**) and TH (β = 0.124, t-stat = 2.048**), were the least influential even though they still had significant positive impacts on CPTED.

In this study, the role of CPTED in enhancing QoL was further examined. Table 6 shows the findings for the indirect effects of the CPTED construct on the association between PPRE and QoL. The results show that while CPTED significantly influenced QoL, it was found to be insignificant (β = 0.028, t-stat = 1.703NS) as a mediating factor in the association between PPRE and QoL. Therefore, this finding is "direct-only non-mediation" because the direct effect is significant, but not the indirect effect.

CONCLUSION

The purpose of this study was to identify how the PPR Environment (PPRE) and Crime Prevention Through Environmental Design (CPTED) may be combined to enhance the quality of life (QoL) of PPR communities in Sabah. This study addressed some of the gaps in the current literature. First, it evaluated seven principles of CPTED (i.e., territorial reinforcement, natural surveillance, natural access control, maintenance, legitimate activity support, target hardening, and community relationship at the PPR neighbourhood level), particularly around low-income earning residents. Little research had previously been carried out on the applications of CPTED principles around low-income

Table 5

Path Coefficients of Structural Model

H	Path Estimate	β	t-stat	p-value	Significance
H_1	PPRE → QOL	0.216	3.616	.000***	Yes
H_2	PPRE → CPTED	0.031	0.802	.423NS	No
H_3	CPTED → QOL	0.721	3.400	.001***	Yes
H_5	TR → CPTED	0.060	1.142	.254NS	No
H_6	NS → CPTED	0.258	3.011	.003**	Yes
H_7	NAC → CPTED	-0.049	0.945	.345NS	No
H_8	M → CPTED	0.292	3.572	.000***	Yes
H_9	LAS → CPTED	0.176	2.450	.012**	Yes
H_{10}	TH → CPTED	0.124	2.048	.041**	Yes
H_{11}	CR → CPTED	0.331	4.214	.000***	Yes

Note. ***denotes significance at .01 level; **denotes significance at .05 level; NS denotes not significant)

Table 6

Indirect Effect of CPTED

Indirect Relationships	Specific Indirect Effects	t-Statistic	p-value
H_4: PPRE -> CPTED -> QOL	0.028	1.703	0.284NS

Note. ***denotes significance at .001 level; **denotes significance at .05 level;

NS denotes not significant at 0.05 level.

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residences. Previously, the majority of studies adopted CPTED assessment at parks (Hafidzi et al., 2019; Rozhan & Mohd Yunos, 2019; Thani et al., 2016). Second, this study assessed the associations between various PPR environmental conditions and QoL. This filled a gap in the literature since existing studies had not adequately captured environment features such as surrounding block groups (Lee et al., 2023). As pointed out by Sullivan et al. (2017), although the amount of research evidence on the effectiveness of developmental crime prevention such as CPTED has grown considerably in recent decades, the translation of this scientific knowledge into policy and practice has lagged behind.

This study's empirical results suggest the importance of PPRE (low-income residences) and CPTED in enhancing the QoL of low-income earners residents. The results of this study show strongly indicate that PPRE has a significant effect on QoL. This result is supported by McLeod et al. (2003) who revealed that low household income is consistently associated with poor health, which is an indicator of QoL. The findings in this study also seem to be in agreement with Armitage et al., (2013), who argued that the design of homes can enhance the QoL of residents by reducing their vulnerability to crime. Furthermore, according to Armitage et al. (2013), award winning design must be supplemented by the incorporation of crime-reductive design for residents to enjoy the quality of life conferred by good design, uncompromised by high crime rates. In a study by Green et al. (2002), they found significant associations between "fear of crime" and "health status" and "feelings of safety" (which are elements of QoL).

Furthermore, the data analysis yielded interesting results–specifically, that CPTED alone can have a substantial effect on QoL, but not as a mediator between PPRE and QoL. This finding is supported by the results obtained by Cervantes et al. (2023), who argued that violence and homicides have become pressing public health and economic concerns for their effect on QoL - health, development, and economic growth. Furthermore, due to its low cost and high impact, prevention is the most efficient way to respond to crime and violence, while also being an essential component of sustainable strategies aimed at

improving citizen security (Cervantes et al., 2023).

This study also found that five features associated with the CPTED principles were linked with QoL around low-income residents, namely natural surveillance (NS), maintenance (M), legitimate activity support (LAS), target hardening (TH), and community relationship (CR). These findings tend to agree with the arguments made by Marzbali et al. (2012) that CPTED is best measured by four principles: natural surveillance (NS), access control, territoriality, and maintenance (M). In fact, two factors, i.e., NS and M, used in this study were among the four factors suggested by Marzbali et al. (2012).

It is hoped that stakeholders, including the government and private sectors, will step up and continue to implement CPTED in low-cost housing planning and design requirements, especially PPR with suitable attributes to enhance residents' QoL. While five CPTED features need to be maintained (natural surveillance, maintenance, legitimate activity support, target hardening, and community relationship), the lack of significant contributions of the other two features (territorial reinforcement and natural access control) towards strengthening CPTED should be reexamined. This might be accomplished by gathering a larger and more representative sample size of residences and improving the quality of the study instrument so that prospective responders can comprehend it more fully and more easily. Future research should be expanded to other parts of the country (i.e., other states) so that results on the effect of PPRE and CPTED on the QoL can be compared across multiple contexts.

ACKNOWLEDGEMENT

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