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DEMOGRAPHIC DYNAMICS AND URBAN PROPERTY CRIME: A LINEAR REGRESSION ANALYSIS IN KUALA LUMPUR AND PUTRAJAYA (2015-2020)

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Abstract

In an era where urbanization is rapidly transforming the landscape of cities, this study provides a crucial overview of how demographic shifts influence property crime in metropolitan areas. The paper delves into the complex interplay between property crime rates and demographic characteristics in the urban settings of Kuala Lumpur and Putrajaya, Malaysia, over six years from 2015 to 2020. Employing linear regression analysis, the study meticulously examines the relationship between property crime and various demographic factors, including total population, male and female populations, and residential and household densities. The findings indicate a consistent positive correlation between total population and property crime, emphasizing urban density's role in crime propensity. Notably, the male population shows a stronger correlation with property crime than females. The study also highlights how residential and household densities influence property crime in these urban settings. These insights are invaluable for policymakers and urban planners, guiding targeted strategies to reduce property crime in growing cities.

Keywords: Demography, Kuala Lumpur, Population, Property Crime, Putrajaya

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INTRODUCTION

Exploring the relationship between demographic factors and property crime rates reveals important insights. Research shows that population density has an inverse relationship with both property and violent crime rates (Hovel, 2014). In the United States, men are arrested for property crimes far more often than women (Statista, 2023). Additionally, there is an inverse relationship between regional crime rates and housing costs, indicating a complex link between crime and residential characteristics (Yang et al., 2022). However, current research does not clearly explain how specific demographic factors, such as total population, gender distribution, and residential and household characteristics, affect property crime rates. Further study on these demographic factors is necessary to better understand their impact on property crime rates.

Demographic factors undeniably influence property crime rates. Important factors include total population, gender distribution, residential density, and household density. Studies have shown connections between these demographics and property crime rates (Zhang et al., 2020). For example, areas with larger populations tend to have higher property crime rates due to more opportunities for crime and greater anonymity for criminals. The correlation between the male population and property crime rates is also notable, possibly due to socioeconomic disparities and peer influences (Yu et al., 2020). In Malaysia, property and violent crime rates dropped significantly in 2021, with a 19.3% decrease to 52,974 cases from 65,623 in 2020. This includes reductions in both crime types, with property crime decreasing by 13.4% and violent crime by 20.8% (Jabatan Perangkaan Malaysia, 2022). Despite this overall decrease, the Federal Territory of Kuala Lumpur has experienced a rise in property crime and violence in recent years. Authorities have implemented various measures to address this issue, but the effectiveness of these interventions still needs thorough evaluation (Jubit et al., 2022).

LITERATURE REVIEW

Several studies have explored the link between property crime and population. The complex relationship between population density and property crime is influenced by land use and traffic patterns in various U.S. cities (He & Li, 2022). Another study in Addis Ababa showed a negative correlation between property crime rates and strict law enforcement in areas with specific population sizes (Yigzaw et al., 2023). Other studies found that neighborhoods with higher percentages with certain ethnic groups and lower education levels have higher property crime rates (He & Li, 2022).

Walter et al., (2024) found a significant negative link between physical property investments and changes in crime rates on commercial and residential streets, highlighting the importance of urban planning. Household characteristics

and their relation to property crime have also been examined. The built environment and social disadvantages were found to be linked to property crime rates, with factors like commercial development, transit facilities, and alcohol establishments being positively correlated (He & Li, 2022). The physical environment's time-varying impacts on crime were studied, showing a connection between walkability and higher crime rates (Kim & Wo, 2023). Higher per capita income in certain neighborhoods was associated with higher property crime rates, while blighted property remediation was linked to domestic crime density (Kajeepeta et al., 2020). The research by Jubit et al., (2020b), (2020a), (2021), (2023a); Masron et al., (2021); Nordin et al., (2020) provides insights into property crime in urban areas like Kuching and George Town. They used the Hot Spot Getis Gi* method to analyze burglary patterns but did not examine the correlation between demographics and crime rates. This underscores the importance and novelty of the present study in filling this research gap. Just as floods have socio-economic impacts, property crime also significantly affects individuals, businesses, and communities (Said et al., 2024).

RESEARCH METHODOLOGY

The study uses linear regression analysis to predict the value of one variable based on another. In this case, the variable being predicted is the dependent variable, while the variable being predicted is the independent variable (IBM, 2024). Linear regression is defined mathematically in Equation 1. The main goal is to understand the relationship between property crime (dependent variable) and various independent variables (IVs). This method helps uncover the complex connections within the data, focusing on the relationship between total property crime and selected independent variables. The research uses secondary data obtained from the Royal Malaysian Police Headquarters in Bukit Aman and the Criminal Investigation Department (Intelligence/Operations/Records-D4 Division JSJ) at the Contingent Police Headquarters in Kuala Lumpur, covering the period from 2015 to 2020. The study employs a linear regression model with property crime as the dependent variable (DV) and demographic factors as independent variables (IVs), such as total population, male and female population, and residential and household density. The analysis aims to examine and interpret the relationships and patterns in the dataset to understand how these demographic factors influence property crime rates. This comprehensive approach ensures an evidence-based exploration of the dynamics of property crime in the specified region and period.

$$\boldsymbol{Y_i = f(X_i, \beta) + e_i}$$ **...Equation 1**

Y_i= dependent variable
f = function
X_i = independent variable
β = unknown parameters
e_i = error terms

Study Area

The geographical scope of this study encompasses the Kuala Lumpur Contingent Police Headquarters (KLCPH), segmented into six distinct District Police Headquarters (DPH): Brickfields, Cheras, Dang Wangi, Putrajaya, Sentul, and Wangsa Maju. Within these boundaries lie a total of 24 police stations, each contributing to the rich tapestry of data used in this study. These stations, which include Brickfields, Pantai, Petaling, Sri Hartamas, Sri Petaling, Taman Tun Dr. Ismail, Travers, Bukit Jalil, and others, are strategically distributed across the KLCPH area. The spatial distribution of these stations is vividly illustrated in Figure 1. The mapping and spatial analysis of this study area have been conducted using the sophisticated ArcGIS software, developed by the Environmental Systems Research Institute (ESRI) (Ahmad, 2015; Ahmad et al., 2011, 2013, 2015; Ahmad & Masron, 2013; Basiron et al., 2014; Jubit et al., 2023b; Marzuki et al., 2023; Mohd Ayob et al., 2013, 2014; Zakaria et al., 2023). The utilization of ArcGIS is supported by various scholarly works, which collectively underscore the relevance and efficacy of this software in conducting geographical analyses of this nature (Ahmad et al., 2024a, 2024b, 2024c, 2024d, 2024e, 2024f, 2024g, 2024h; Ariffin et al., 2024; Jubit et al., 2024).

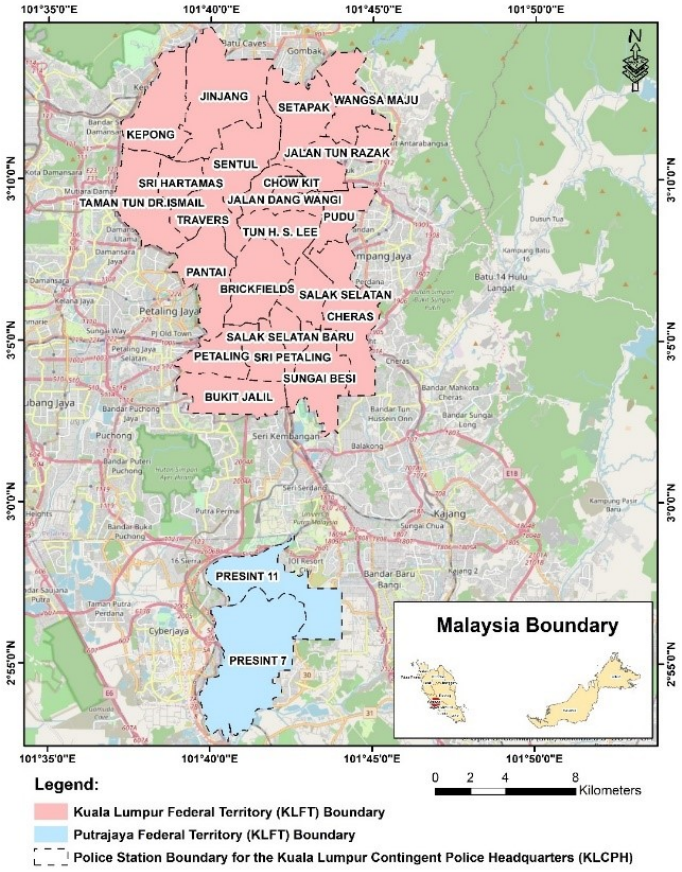

Figure 1: Police Station Boundaries for the Kuala Lumpur Contingent Police Headquarters (KLCPH)

RESULTS AND ANALYSIS

Linear Regression

The analysis, presented in Table 1 to Table 6, details the offenses of property crime under related sections and enforcement actions taken in the year 2015-2020. A notable observation is that the highest numbers of enforcements are predominantly associated with financial aspects, such as collected sums and accounting matters. In the linear regression analysis for 2015 (Table 1 & Figure 2), a moderately positive relationship between total population and property crime is evident, with an R-squared value of 0.422. This indicates that the total population accounts for a significant portion of the variation in property crime. The male population displays a weaker positive correlation with property crime, evidenced by an R-squared value of 0.262, suggesting it is a less robust predictor

compared to the total population. The female population shows the weakest link among the population categories, with an R-squared of 0.160, implying a minor role in property crime fluctuations. Residential factors exhibit a moderate positive relationship with property crime (R-squared of 0.378), signifying their significance but not as predominant predictors. Similarly, household demographics demonstrate a moderate positive correlation with property crime, as indicated by an R-squared of 0.352.

In 2016 (Table 2 & Figure 3), the total population maintains its positive correlation with property crime, albeit with a reduced R-squared value of 0.294, suggesting a slight decline in explanatory power. The trend continues with the male population, which exhibits a consistent yet weaker correlation (R-squared of 0.179). The female population's impact on property crime diminishes further (R-squared of 0.101), pointing to its minimal influence. Residential factors maintain a moderate relationship (R-squared of 0.270), indicating their continued influence on property crime. Household factors also show a moderate correlation, with an R-squared of 0.247, slightly lower than the previous year. In 2017, the relationship between total population and property crime remains positively significant (R-squared of 0.357), suggesting a steady influence (Table 3 & Figure 4). The correlation with the male population decreases (R-squared of 0.212), aligning with the trend of diminishing impact. The female population maintains a weak but positive relationship (R-squared of 0.109). Residential factors continue to exhibit a moderately positive correlation (R-squared of 0.333). The household factor also presents a moderate positive relationship (R-squared of 0.294).

The 2018 data indicates that the positive correlation between total population and property crime persists, though with a reduced R-squared value of 0.266 (Table 4 & Figure 5). The male population continues its trend of declining relationship strength (R-squared of 0.150). The female population retains a weak positive correlation (R-squared of 0.067). Residential factors show a moderate positive correlation (R-squared of 0.254), and the household factor exhibits a moderate correlation (R-squared of 0.214). In 2019, the total population demonstrated a relatively strong positive relationship with property crime (R-squared of 0.425), indicating an increase in explanatory power. The male population displays a moderate positive correlation (R-squared of 0.262) while the female population continues with a weak correlation (R-squared of 0.126). Residential factors exhibit a relatively strong relationship (R-squared of 0.416). The household factor shows a moderate to strong correlation (R-squared of 0.353) (Table 5 & Figure 6).

In 2020, total population maintains a significant positive relationship with property crime (R-squared of 0.405). The male population exhibits a moderate positive correlation (R-squared of 0.257), while the female population

continues with a weak positive relationship (R-squared of 0.123) (Table 6 & Figure 7). Residential factors display a strong correlation (R-squared of 0.409), and the household factor presents a moderate to strong positive relationship (R-squared of 0.341). Overall, the total population consistently demonstrates a significant positive relationship with property crime across the years, often emerging as the strongest predictor. The male population tends to exert a more substantial impact on property crime than the female population, though both exhibit positive correlations. Residential and household factors consistently show moderate to strong positive correlations with property crime, underscoring their importance in explaining property crime variations. These trends indicate that while all these factors are relevant, total population and residential factors are consistently more significant predictors of property crime in this dataset. The strength of these relationships is potentially shaped by a range of socioeconomic and environmental factors, warranting further exploration.

Table 1: Linear Regression 2015

No.	Independent Variable (IV)	Coefficient	Intercept	R^2
1.	Total Population	0.0049	130.71	0.422
2.	Male Population	0.0022	217.23	0.262
3.	Female Population	0.0013	304.61	0.160
4.	Residential	0.0041	148.47	0.378
5.	Household	0.0033	160.05	0.352

Table 2: Linear Regression 2016

No.	Independent Variable (IV)	Coefficient	Intercept	R^2
1.	Total Population	0.0047	175.79	0.294
2.	Male Population	0.0020	268.95	0.179
3.	Female Population	0.0012	357.26	0.101
4.	Residential	0.0039	189.25	0.270
5.	Household	0.0031	205.00	0.247

Table 3: Linear Regression 2017

No.	Independent Variable (IV)	Coefficient	Intercept	R^2
1.	Total Population	0.0036	105.39	0.357
2.	Male Population	0.0015	185.25	0.212
3.	Female Population	0.0008	257.20	0.109
4.	Residential	0.0030	114.04	0.333
5.	Household	0.0023	131.67	0.294

Table 4: Linear Regression 2018

No.	Independent Variable (IV)	Coefficient	Intercept	R^2
1.	Total Population	0.0027	148.00	0.266
2.	Male Population	0.0011	217.98	0.150
3.	Female Population	0.0005	277.34	0.067
4.	Residential	0.0023	152.71	0.254
5.	Household	0.0017	171.79	0.214

Table 5: Linear Regression 2019

No.	Independent Variable (IV)	Coefficient	Intercept	R^2
1.	Total Population	0.0031	85.44	0.425
2.	Male Population	0.0012	161.48	0.262
3.	Female Population	0.0007	226.88	0.126
4.	Residential	0.0025	87.30	0.416
5.	Household	0.0019	109.67	0.353

Table 6: Linear Regression 2020

No.	Independent Variable (IV)	Coefficient	Intercept	R^2
1.	Total Population	0.0023	67.91	0.405
2.	Male Population	0.0009	126.50	0.257
3.	Female Population	0.0005	175.90	0.123
4.	Residential	0.0019	66.23	0.409
5.	Household	0.0014	86.10	0.341

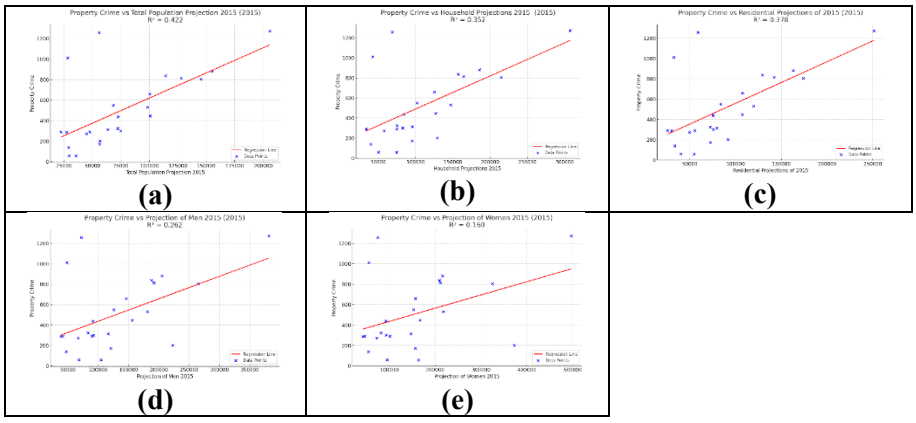

Figure 2: (**2015**) Property Crime VS (a) Total Population Projection, (b) Household Projection, (c) Residential Projection, (d) Men Projection and (e) Women Projection

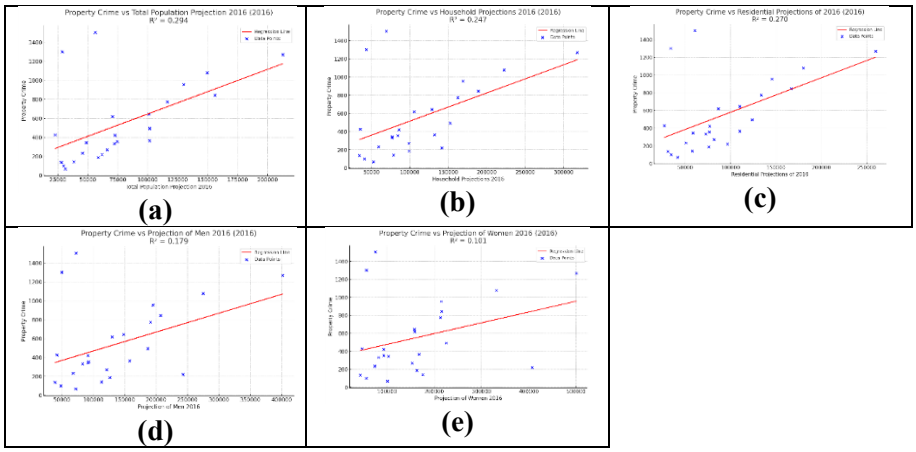

Figure 3: (**2016**) Property Crime VS (a) Total Population Projection, (b) Household Projection, (c) Residential Projection, (d) Men Projection and (e) Women Projection

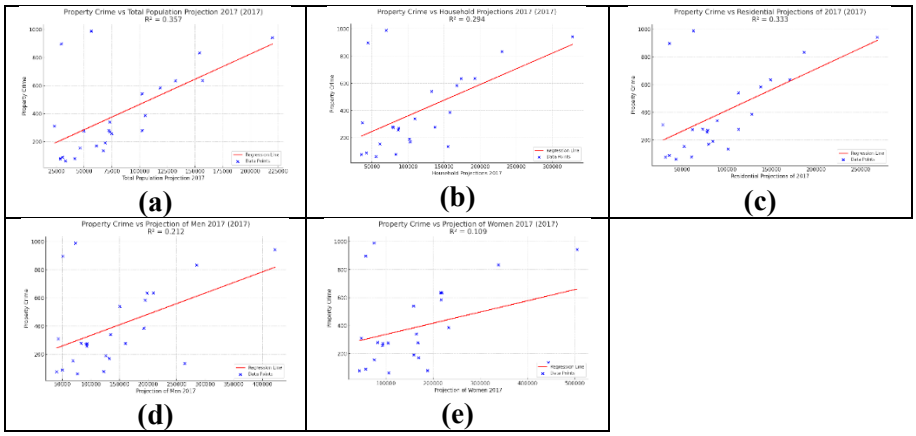

Figure 4: (**2017**) Property Crime VS (a) Total Population Projection, (b) Household Projection, (c) Residential Projection, (d) Men Projection and (e) Women Projection

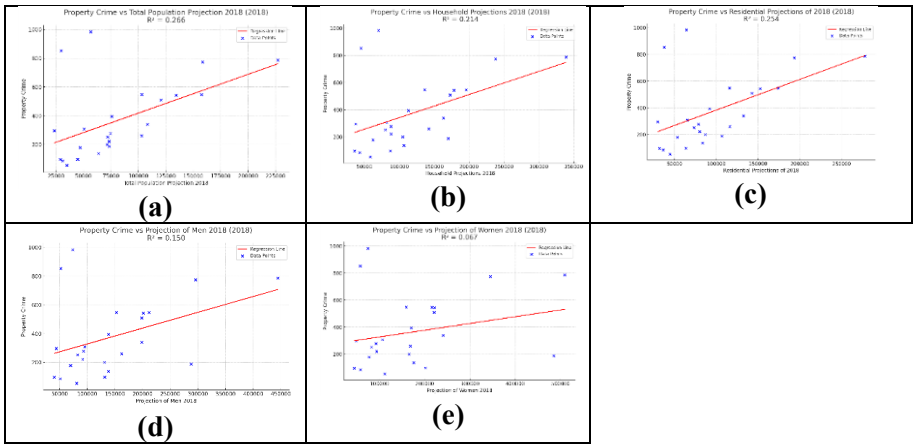

Figure 5: (**2018**) Property Crime VS (a) Total Population Projection, (b) Household Projection, (c) Residential Projection, (d) Men Projection and (e) Women Projection

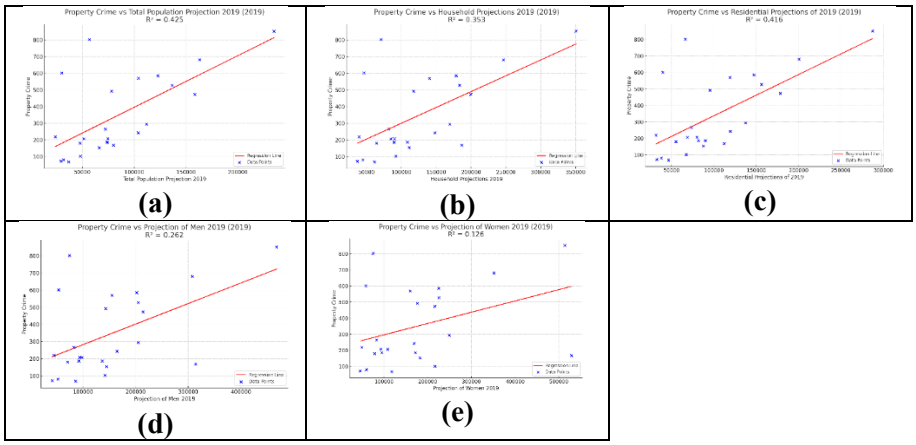

Figure 6: (**2019**) Property Crime VS (a) Total Population Projection, (b) Household Projection, (c) Residential Projection, (d) Men Projection and (e) Women Projection

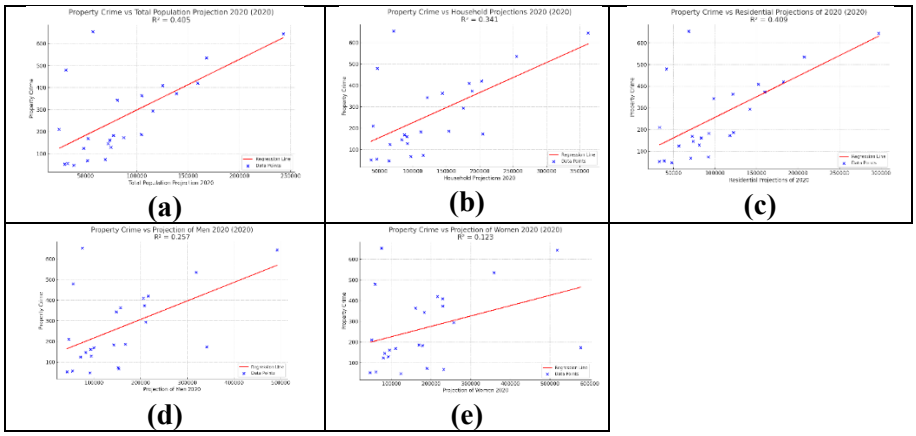

Figure 7: (**2020**) Property Crime VS (a) Total Population Projection, (b) Household Projection, (c) Residential Projection, (d) Men Projection and (e) Women Projection

DISCUSSION

Interpretive Analysis of Results

This study's exploration into the nexus between property crime and demographic variables in Kuala Lumpur and Putrajaya presents a rich tapestry of socio-spatial dynamics that are at play in urban environments. The substantial and consistent correlation between the total population and property crime rates across the studied period reinforces the notion that urban centers, with their dense population matrices, serve not only as hubs of economic and social activity but also as fertile grounds for property-related criminal activities. Intriguingly, the male population exhibits a less potent but still significant relationship with property crime, hinting at the underlying socio-cultural and economic fabric that shapes male-oriented criminal behavior. This finding dovetails with gender-based criminological theories that argue for the influence of societal constructs and peer dynamics in shaping male predispositions towards property crimes. Conversely, the female population's weaker linkage with property crime underscores the gendered nuances of criminal engagement, possibly pointing towards differing societal roles, opportunities, and perhaps even deterrents that operate distinctly for women in urban spaces (Jones et al., 2021). The moderate to strong correlation of residential and household density with property crime rates is a compelling finding. It highlights the significance of urban design and residential configurations in facilitating or inhibiting criminal activities (Piroozfar et al., 2019).

Implications

This study adds a rich layer of empirical evidence to several criminological theories. It reaffirms routine activity theory by providing a robust empirical foundation for the concept that higher populations catalyze increased criminal opportunities. Simultaneously, it lends credence to social control theory, particularly regarding gender-specific criminal behavior, highlighting how societal norms and peer group dynamics potentially fuel male-associated property crimes (Stewart et al., 2021). Moreover, the study enriches our understanding of environmental criminology. The observed correlations between crime rates and residential as well as household densities resonate with the theory's assertion of the environment's pivotal role in shaping criminal behavior. Additionally, the findings validate crime pattern theory, affirming that crime clusters in specific urban locales where potential offenders are likely to converge.

Moreover, the findings provide practical, actionable insights for law enforcement agencies and urban planners. Law enforcement can leverage these insights for strategic resource allocation and focused crime prevention efforts in identified high-risk areas. Urban planners, on the other hand, are presented with a compelling case to integrate crime prevention through environmental design (CPTED) principles in urban layouts to mitigate property crime risks (Lee et al., 2023). Customized community policing initiatives, especially in areas with a higher male demographic, could prove more effective. Such initiatives could be tailored to address the unique socio-demographic and economic realities of these neighborhoods, thereby enhancing their efficacy in crime prevention.

Limitation of the Study

While the study offers valuable insights, it is not without its limitations. Firstly, the use of linear regression, while effective in discerning correlations, stops short of establishing causality. This limitation necessitates a cautious approach in interpreting the results, particularly in policy formulation contexts. Secondly, the study's reliance on reported crime data might not comprehensively capture the complete spectrum of property crime due to possible underreporting and recording disparities. This limitation underscores the need for more robust data collection and reporting mechanisms. Another notable limitation is the geographical focus on just two federal territories, which may not accurately reflect the diverse socio-economic and cultural landscapes of Malaysia. This geographical limitation might affect the study's generalizability and applicability to other Malaysian regions or similar urban settings elsewhere. Moreover, the study does not account for other potentially influential factors like economic conditions, law enforcement efficiency, or broader cultural dynamics, which could significantly impact property crime rates. These factors should be

considered in future research to provide a more comprehensive understanding of property crime dynamics.

CONCLUSION AND FUTURE WORK

The comprehensive analysis illuminates the complex interplay between demographic factors and property crime in Kuala Lumpur and Putrajaya, revealing a marked correlation between population density and crime rates. It underscores the influence of urban dynamics and gender on criminal activities, highlighting the significant role of residential patterns in shaping property crime. These insights provide a multi-dimensional perspective on urban crime, offering crucial guidance for effective urban planning and law enforcement strategies. For future work, this research sets a foundation for expansive studies in urban criminology, paving the way for deeper investigations into the socio-economic, cultural, and environmental factors that influence crime patterns in diverse urban settings. It encourages exploring beyond Kuala Lumpur and Putrajaya to include diverse urban environments, enhancing the generalizability and comparative depth of property crime dynamics. Future studies should integrate varied factors such as economic trends, law enforcement methods, and cultural impacts to enrich our understanding of their complex interplay with property crime. There's a need to shift towards causal investigations, delving into the underlying mechanisms beyond mere correlations. This progression in research will not only enrich the empirical landscape of urban criminology but also foster the development of tailored and effective strategies for crime prevention and urban safety.

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