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Impacts of Urban Planning on Crime Occurrence in Riyadh: A Statistical Analysis

By

Turki Almutairi,
Research Scholar, Regional and Urban Planning Department, King AbdulAziz University (KAU), Jeddah, Saudi Arabia.
Almutairiturki70@gmail.com

Abstract

Urban planning plays a key role in crime prevention. This planning helps in identifying the root causes and inaugurates the presence of the states and aids in building the trust among the groups and institutions which is a key tactic in crime prevention. Understanding the correlation amongst urban planning and crimes are significant for the criminologists as well as the urban planners to make suitable decisions for designing urban areas. The central aim involved in preventing crimes are to minimize the existing opportunities for committing crime. Such type of prevention is termed as SCP (Situational Crime Prevention). Though conventional methods attempted to study the urban planning impacts on crime occurrence, these researches disregarded significant factors involved in determining the crime occurrence. Moreover, SCP model is underutilized by neglecting its positive impacts. Hence, this study explores crime occurrences especially in the 15 municipal districts of Riyadh by employing the principles of SCP. The study also aims to examine the link between urban planning and potentiality for crime. To accomplish this, statistical analysis is performed using the data attained from field work and GIS that are obtained from secondary data and the police records in the districts of Riyadh. Additionally, it finds that, correlations exists between socio-economic factors as well as crime occurrences in Riyadh city. Collected data are tested. The descriptive statistical analysis, correlation, ANOVA and regression analysis proved relationship amongst the variables considered for the research. Lastly, the research also afforded recommendations to consider in future.

Keywords: Urban Planning, Crime Occurrence, Situational Crime Prevention, Geographic Information System

Introduction

Crime occurs pre-dominantly as a result of several adverse economic, family, cultural and social situations. To enhance safety among communities as well as to subsidies to the sustainable development, it is significant to understand the root reasons for crime so that it could be prevented. Further, Urban design is vital for preventing crimes as poorly designed areas could allow opportunities for occurrences of crime that could make individuals feel unsafe. Nevertheless, it is essential to realize that, poor management of urban designs are not only the risk factors leading to crime. Thus, a holistic strategy is needed to focus on enhancing the lives and subsidization in community for preventing crimes so that people could live a better and safe life. Moreover, crime happens as a result of complicated interaction of environmental and social factors which could not just be designed. Altering the built-in environment could be expensive and complex. On the other hand, employing good urban framework at the beginning could assist in averting the issues and huge expense in future.

Hence, in areas having crime issues, applying effective design principles to the specific location is an efficient way to address crimes. This is because offenders commit crimes in accordance with their viewpoint on the available opportunities. As a result, situational factors could provoke crime and addressing such factors could minimize crime rate. Evolving evidence regarding the contribution of opportunities involved to trigger crime has led to the introduction of few new theories of "opportunity" like rational-choice perspective and routine-activity theory. This later has given a theoretical foundation for SCP (Situational Crime Prevention) theory that has recently gathered a solid record for crime reduction accomplished in varied contexts. It is a methodology of handling conventional crime issues that shares techniques for achieving this with issue oriented policing [1].

Unlike supplementary criminological strategies for crime control, SCP concentrates on the specific settings where crime happens, instead of the offender. It initiates with the evaluation of such setting and pursues to develop discrete environmental and managerial alterations to minimize the incentives or opportunities for crime [2]. The impact of physical surroundings on crime incidences are studied. Existing study has considered housing type and age at varying scales based on filtering theory to measure the influence of the considered factors on crime rate. It has been found that, old housing age has resulted in maximum crime levels [3]. As urban area has impact on crime rate, the study [4] has utilized satellite images for exposing the link amongst the expansion of urban area over a period of 10 years and crime opportunities in Saudi Arabia. Correlations have been tested amongst such expansions and criminal happenings within the specific area. Outcomes have explored that, there exists computable relationship amongst criminal activities in accordance with the urban expansion.

Findings also support the fact of theory for crime opportunity as a possibility that recommends the existence of conceptual relationship between crime and population density. Correlations have been found to be strong where there exists high urban development. Further, crime possess risk to sustainability in long-term. Thus, conventional work has attempted to undertake a case study about the perceptions of people on sustainable residences in Riyadh, Saudi Arabia. Analytical results have explored that, there exists three main features for sustainable residences in developing as well as the developed countries. This includes environmental sustainability, economic sustainability and social sustainability.

Findings have revealed that, deficiency in the perceptions of individuals on sustainable residences have evolved as a critical problem which must be considered. Responses have also explored that, participants have been unaware about sustainable residences. Due to such deficiency in the knowledge about sustainable residences, there exists high chances for crime occurrence [5]. Although conventional works attempted to study the urban planning impact on crime rates, they have not considered significant factors like economic considerations and city planning. Few researches have also disregarded different kinds of crimes with specific focus on one country.

Thus, to reduce crimes, the present study intends to perform a statistical analysis for studying the impacts of urban planning on the crime occurrences especially in 15 municipal districts of Riyadh, Saudi Arabia based on SCP model. This study considers data from the field study and GIS that permits SCP modelling in urban planning and involves determination of planning actions and impact evaluations. The present work considers Riyadh as it is the cultural-capital of the country, Saudi Arabia. Though crime incidences occur at least rate in Saudi Arabia, there still exists certain crimes to some degree that has to be studied so that it can be completely eliminated for which the present work is considered.

Research Questions

The research focuses to answer two major questions through the proposed framework,

1. To what degree the crime occurrence and urban planning are associated with each other?
2. How do the socio-economic factors support in finding the crime incidences precisely in the urban environment?

Objectives of the study

The main contributions of this study are listed below,

- To evaluate the impact of urban planning on the crime occurrences in the 15 municipal districts in Riyadh.
- To statistically analyse the processes involved in urban planning and design to minimise the crime incidences through the analysis of socio-economic factors which impact crime rate in the urban environment.
- To determine the highest crime occurrence among the considered crimes as well as to find the municipal district that has encountered maximum level of crimes through statistical analysis.
- To explore specific targets of crime incidences using the principles of SCP in Riyadh city.

Paper Organisation

Section I explores the fundamental ideas related to crime occurrence, need for crime prevention, urban planning impact on crime incidences, application of effective design principles to address crimes like SCP, conventional approaches considered in this area, limitations of conventional works and proposed methods to solve the major existing issues. Following this, section II discusses the review about existing work along with research gap. This is followed by section III with area of the study, variables chosen, conceptual framework, data, research model, hypothesis and method of data analysis. Subsequently, section IV explores the results of proposed work with frequency table, ANOVA, correlation, regression and descriptive statistics. Finally, the overall study is summarized in section V with future work.

Review of Existing Work

Various conventional studies have used many approaches to analyses the impact of urban planning on crime occurrences. Necessary and significant problems determined during the analysis of existing works have been elongated in this section.

The prior study, [6] aimed to offer an analysis of both propositions-of-routine activity theory. Weighted regression modelling has been employed in the existing study. The outcomes recommended that there is an optimistic relationship among the population and crime in several areas. Further, there are other studies that has focused on specific crimes on a selective regions. Similarly, the traditional research [7] attempted to discover the practices of steal to order burglars. The conventional research organized interviews and the accumulated data was evaluated using the qualitative analysis. The existing research has disclosed a continuum behavior among who engage in the offence, steal to offer, and others who steal to order and remaining who steal more expensive goods to order. In parallel to the prior study, the

conventional research [8] formulated the study with the aim to segregate the target and determine the weaknesses of the neighborhood in crime forecasting. Risk Terrain Modelling (RTM) was the methodology used in the detecting the spatial risk factor and the protective risk factors in the residential burglary in the city of Milan, Italy.

The results of the study disclosed that a target oriented research is beneficial to increase and interpret the reasons of why certain location will undergo in crimes in future too. Identical to the prior study, the traditional research [9] attempted to test the impacts of neighborhoods and the features of house on the burglar's target selection. The study utilized quantitative analysis on the victimization surveys. The study disclosed that the burglars select the target when the resident is detached, has low residential density, residents that are in single units, and renter occupied residents. Similarly, the conventional research [10] attempted to trace the significance effect of housing design on the burglary risk from the perception of the burglars. Thematic analysis was employed to identify the pattern themes of the responses and content analysis was used to count the regularity along with the themes. The study considered certain principles of CPTED like surveillance, physical security, movement control etc. The results affirmed that the design of the residential housing stands as the significant factor in the decision making criteria of the burglars, it was also highlighted that the existing CPTED should be reconsidered and reorganized for further implementation.

In relation with the previous research [11] tried to evaluate the effect of neighborhood penetrability on the risk of residential-burglary. Statistical evaluation is employed in the research. The outcomes of the research revealed that certain kinds of commercial facilities, well integrated road networks, global and local had pessimistic impact on the density of the crime in the residential burglary. Likewise, the existing research [12] investigated the impact of the extent and the quality of roads on the crime activities in the Jizan province of Saudi Arabia. The study conducted Ordinary Least square regression analysis by considering road quality and length as independent variables and crime rate as its dependent variable. The result revealed that districts with better quality road recorded lower rates of crime. In relevance to the prior research, [13] examined the existence of the spatio-temporal association between the crime activities after the regulation of the environmental influences using Risk Terrain Modelling (RTM). The study emphasized that land features are one of the prominent reasons for the robbery activities. The results revealed that by considering the past risks and vulnerabilities, the modelling theory would help in preventing the crime activities by providing accurate locations of the crime-events.

In addition, the existing research [14] tried to examine the data signatures in residential burglars that yields results from drop of the crime. Spatial evaluation has been implemented. The existing research reported that there was a crucial change in the pattern of spatial of residential burglary. The existing research has attempted to analyses the general spatial patterns, the traditional research [15] tried to investigate how the patterns of spatial crimes are described by general crime patterns. The research used spatial analysis to evaluate the spatial crime. The research estimated the two shared constraints to capture the general crime patterns brief the largest proportions of inconsistency for all general crime types. Crimes like robbery, burglary and vehicle crime reveal the specific patterns that are dissimilar from each other.

There are certain researches that concentrated on the crime which has its relationship with the environment. For instance, the traditional research [16] presented the growth of an automated machine learning procedures to interpret the relationship between the environment and the crime. Case study was performed for a small area in England. The research revealed that there is a high possibility to improve the machine learning techniques to differentiate the

various features of the environments which in turn determines the crime. In parallelism, the conventional research [17] attempted to study about the socio-economic, mobility conditions and built environment that are related to the crime in various cities. The study employed Bayesian model. It was revealed that mutual use of the mobility information, physical features and socio-economic conditions of the neighborhood will provide an efficient explanation about the rise of the crime and enhance the work of the existing methods.

Likewise, the existing research [18] attempted to offer a quick calculation technique to analyses the sustainability of urban environment. Weight approach was employed by the research. The study resulted that the four cities of Chinese have revealed drop in sustainable growth. Likewise, the conventional research [19] tried to recommend a framework would help in sustainability of social building by arranging social sustainability criteria based on the context of Iran. The research adopted quantitative research methodology. The outcomes disclosed that the recommended local experts and criteria considered safety problem when compared to the site considerations for the buildings of Iran. The existing research [20] tried to assess the impacts police crime intervention and prevention at the crime hotspots. Campbell collaboration and meta-analysis were followed in the existing study.

The analysis disclosed that a small crucial mean effect which assist in decreasing the crime results. Some relevant studies have analyzed about the environmental violence/assault. In relation, the conventional research [21] attempted to discover the geospatial technologies to upkeep the efforts of the community organization to reduce the gun related crimes. The schematic design is used in this research. The study revealed that the hotspot trends have been intensified in most of the communal areas like safe-passage routes and school zones. Similarly, the conventional research [22] discovered that environmental and population factors related with the violent crime. Statistical analysis was performed. It was revealed that single member households and the nearest distance of the subway are regularly related with the density of the assault. Similarly, The traditional research [23] attempted to evaluate the effect of environment on school safety and crime prevention. Qualitative methodology was adopted in the existing method. The research revealed that even after the implementing all safety measures, schools should distinctly and visibly provide the appearance as a place of learning. Similar to the prior research, the conventional study [24] attempted to analyses the fear of college students regarding the crime and their safety perceptions and the relationship with the safety efforts taken by the university and their preventive behaviours. By considering the student's perception towards safety measures offered by the university and alterations in their routine activities as independent variable, quantitative analysis was attempted. The outcomes of the research revealed that around 71% of students didn't change their routine activities. Lighting on campus was analyzed to be one of the significant factors related to students' fear of victimization.

Additionally, the research [25] examined the effect of mixed-land usage on property crime and violence in neighborhood block groups. Spatial analysis was employed in the research. The study revealed that a differential effects of land use features should be considered during the urban planning. The absence or presence of few urban facilities could figure out the occurrences of crime. Another study [26]conducted in Punjab, India showed that there had been a significant impact on the crime rate when the offenders were deflected and social infrastructure too played a major role in the minimization of crime. This study [27] has taken into consideration the role of urban planning with proper city planning, contributing to the lower occurrences of crime rate. Well-planned design strategies of city, policies and actions were found to enhance the well –being of the society as the crime rates were drastically reduced

[28]. The study also identified that robust city planning had a correlation between the functional and morphological topographies of urban setting.

An existing research [29] recommended and implemented a geo-statistical method to research and examine the crime activities in terms of the proximity of city centers. The research considered certain criteria like arresting intruders, forgers, vipers etc. The outcomes of the study revealed that security in parks decreased when the population density is low and when they are located far away from the city center. The conventional study [30] tried to evaluate the satisfying features of the urban parks in Dammam city in Saudi Arabia. Statistical evaluation was performed. The results the environmental issues will be systematic as there was no significant differences in the level of satisfaction was found. Certain researchers attempted to evaluate the physical assault against children. One such conventional research [31] attempted to perform a retrospective research to report about the child maltreatment in Riyadh, Saudi Arabia. Case study based evaluation was performed. The results disclosed that the child protective authorities should develop methodologies to reduce the rate of child maltreatment.

A conventional research [32] attempted to interpret the crime issues of SA using Routine Activity Theory (RAT) and Crime Pattern Theory (CPT). The research was performed by correlating the Motor Vehicle Theft (MVT) activities with the household of foreign workers. The outcomes of the research disclosed that the existing theory of environmental crime should be altered and not by just changing the location of the parking slot and the time of the crime events.

The review research [33] has discussed significance of health behavior theory to gain better interpretation of behavior of drivers. Statistical analysis was performed. The results revealed that there is a significant relations among number of collisions, population, number of vehicles, count on injuries and fatalities. In connection with the prior study, the existing research [34] has discussed about the role of environment in physical activity of individuals with or without the physical debilities in Saudi Arabia. Statistical analysis was performed. The findings of the research revealed that among the individuals with physical disabilities, older people especially females were often subject Physical Activities compared to young age group.

Research Gap

The traditional research [19] has discussed about the indicators of sustainability framework which did not focus much in practice and theory. No methodology was applied to enable the planners and decision makers realise the significance of the urban-planning factors. Thus it can be considered that both practical and theoretical; sustainability would be a factor for the further enhancement of human designed architecture that can lead a sustainable society.

Similarly, [15] has illustrated the crime types which includes various subtypes, but the difference among the recorded and intended crime were not recognised. Also data was not accessible for other detailed types at small scale area, there are possibility that crime general or crime specific patterns are not perceived with the data like homicides for theft, assault or residential burglaries.

Methodology

This section elaborates in detail about the research approach, research design, sample data and the type of data analysis employed in the current research.

3.1. Area of Study

The current study is conducted in the 15 Municipal districts of Riyadh city which is presented in table 1. The reason for selecting Riyadh as the study area is because it is one of the rapidly developing cities in the region of Middle East with a nebulous sub-divisions and neighborhood that aid in the commercial development as well. The population rate also has dramatically grown in Riyadh with a rapid growth in economy simultaneously. Over the last few decades, the urban area population has enormously increased. Though there is a rapid development in the economy, there is also an increase in the occurrence of crime in the city of Riyadh [35]. This is due to the inadequate urban planning. Therefore the study has attempted to find the impact of urban planning on the occurrence of crime in Riyadh. The spatial image of Riyadh city can be seen in figure 1.

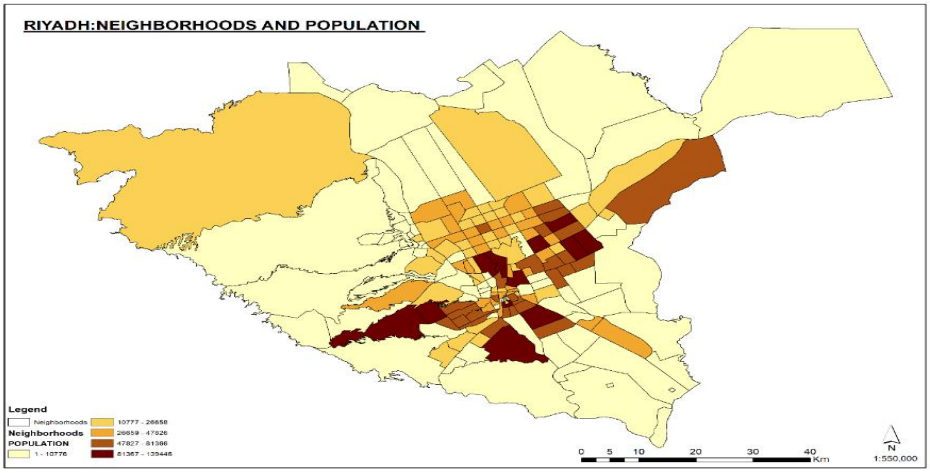

Figure 1: Map of Riyadh City [36]

Table 1: Municipal Districts of Riyadh City

Al-Bat'ha	Al-'Olayya & Sulaymaniyyah
Nemar	Al-Naseem
Al-Shemaysi	Al-Ma'athar
Al-Ha'ir	Al-'Aziziyyah
Al-Malaz	Al-Shifa
Al-Urayja	Irqah
Al-Rawdhah	Al-Selayy
	Al-Shemal

Variables Chosen

The variables that are chosen aid in determining the impacts of urban planning on the occurrence of crime and are briefed below.

Independent Variable – Urban Planning

Urban planning is the prime factor that plays a vital role in the crime rate. Generally it refers to the set of regulations and design practices that concentrate on the social impacts, economic functions and physical form of the urban environs. This lies in the fact that as urban planning relies on the political, social, architectural and engineering concerns. In addition to this, urban planning is the responsible factor for the renaissance of the city, open land development with which the data is collected and analyzed. With the analyzed data, forecasting, strategic planning, design and public consultation are accomplished for a better

urban design. All these processes are aided by the data collected through GIS and during field study. Hence the design of non-vulnerable and safe buildings, street design, etc. are responsible in minimizing the crime occurrences. Various researches also described this strategy that if the cities are well-designed with the administration of crime prevention techniques then the rate of crime occurrence also get drastically reduced. The SCP model also concentrates on such parameters instead of simply focusing on the particular criminal act.

Therefore poor urban planning can make a city a hub of criminal ground. Among the various factors of urban planning, certain factors are considered as much significant in making the urban planning more effectual and they are, robust city planning (in this research, this factor concentrates on the way in which local populace interact with facilities or infrastructure within neighborhood), uncompromising rules (indicated by creating rules and placing signage in suitable locations like parks, community centers, buildings, sidewalks etc.), higher chances of being caught (concentrates on enhancing the likelihood wherein offender gets caught for averting crime occurrence and this could be managed through attributes like use of good CCTV or alarm system, particularly on public places and commercial sites with consideration of better street pattern), diverting offenders (instances include the use of timer switches for making homes appear to be occupied even if its vacant after several time of darkness and undertaking youth diversionary organizations with the partner agencies, minimized anonymity (alleviating the deficiency lack due to space tradition and their municipal context), economic considerations (indicates framing of programs and policies for promoting economic development. Suitable economic consideration will impede the offenders from undertaking crimes) and enhanced street surveillance (improvising surveillance throughout businesses, public places or surveillance daunts criminals. For measuring such factors, these are partitioned into particular built-in environment attributes that are discussed later in the model.

Moderating Variables –

Crime occurrences are closely related to the socio-economic factors. Some of the prime socioeconomic factors are family status, employment rate, education level and income level. Poor family status has been one of the main factors that is associated with the criminal conduct. The upsurge in the gap between income levels causes a proliferation in disparity among people. The greater variances between the income level of communal group, the greater likelihood of social agitation and dissatisfaction. Disparity is not the reason for the growth in crime but has a greater influence on criminal conduct of those who belong to the lower social status. Unemployment is another factor that causes people to think and act criminally. Such a scenario makes the unemployed people consider crime as the authorized identity for themselves and the accepted means of income. By examining the impacts of socioeconomic factors of crime in the districts of Riyadh, a deeper insight on the system of transformations occurring globally can also be identified.

Dependent Variable - Crime Occurrence

The occurrences of crime are logically associated with collective methods of social transformation that suits societies. Urban planning is responsible in altering the crime intensification.

The conceptual framework of the proposed study is presented below in figure 2.

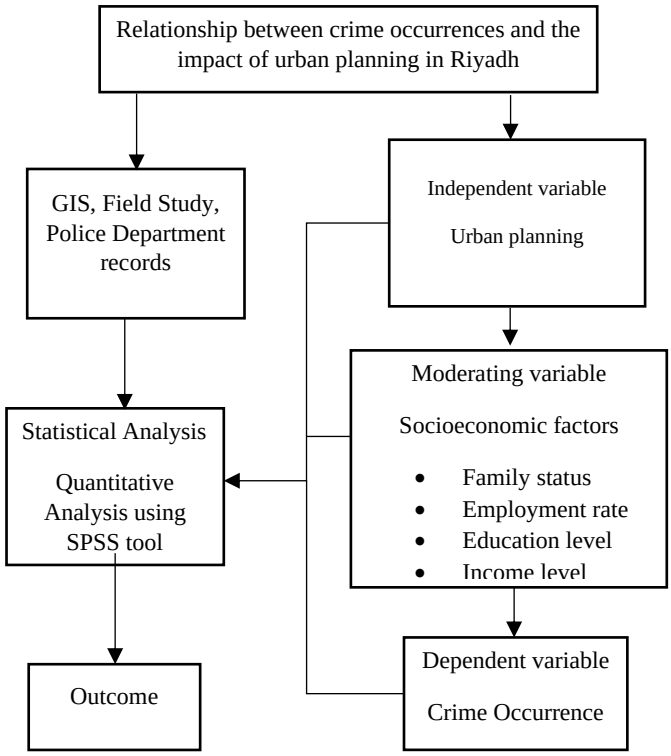

Figure 2 Conceptual Framework

Data

The current research has aimed in conducting a statistical analysis for which the source of data can be categorized as follows,

Crime Data

The research is focused collect wide range of crime data that include certain crimes like assaults, petty theft, intentional homicides, burglary, murder and robbery. The prime source of data for the current study were collected from the crime reports from the police department of Riyadh city for time stamp ranging between January 2015 to December 2018. The data included residential crime, public crime and business crime records in the 15 municipal districts of Riyadh.

Built Environment Data

Dataset includes the GIS layers which state the built-up regions of Riyadh. This includes road data, commercial hubs, neighborhoods, land-use data, parks and police stations. The key data attributes which will assist the analysis involves area, specific uses location, feature's shape and length of the road. Data is sourced from "Higher Commission for Development of Riyadh and Kind Abdullah for Science and Technology (2018)". Other type of built environment data have been collected as primary data at the time of field study.

3.3.3 Socioeconomic Data

The aforementioned socioeconomic factors that influence the occurrences of crime are family status, employment rate, educational level and income level. Data is attained from 2018 demographics data of Riyadh city organized by higher-commission for Riyadh development utilizing demographic data (from Saudi Arabia tract level-2018 census). Income score of median household varies from 1-5 (from highest-to-lowest income level of median household),

allocated in accordance with the lowest-income categorization of the median household-income.

Research Model

There are several researches that have initiated the in-depth analysis in the urban planning. Such studies have also identified that the theory of planning over a narrow scope failed in examining the key models that are responsible for proper urban planning. As urban planning permits to progress expert knowledge in regional and town planning, granting a variety of proficient skills like: knowledge of planning and design, the optimal deign planning will be attained through it. In spite of the substantial level of knowledge on the crucial role of protection in city, most of the urban designers, architects and planners choose decisions constructed on either restricted or insufficient knowledge on patterns, generators and attractors of crime that would lead to improve the likelihood of occurrences of crime.

To solve this, the present study attempts to perform statistical analysis for studying the impact of crime in urban environment based on SCP (Situational Crime Prevention principles) [37] with specific focus on Riyadh that will act as a guideline for the urban planners to perform suitable urban planning processes and design based on which crime rate can be reduced. The data collected with respect to urban planning attributes were segregated by calculating the mean values. Using the crime data records and urban planning of Riyadh city, the current study delves the relationship between the SCP measures of urban planning and the occurrence of crime.

This is accomplished with the five principles of SCP which involve in concentrating on the particular crime category, crime concentration, comprehending in what manner crime occurs, deployment of an action research-model and suggestion of solutions. This is because SCP is diligently associated with crime occurrence and implements the methodology of problem solving through prevention. Hence with this, the problem is analyzed, following which hypotheses are developed. Eventually with the factors, the solution is recognized and results are assessed.

The model includes crime data, built environment attributes and socio-economic data. Few of them have been attained by cartographic analysis through GIS (ArcGIS10.6.2). Others have also been attained from fieldwork. All the gathered data from field study, GIS or secondary data were associated with the SCP principles. To accomplish data collection, an evaluation checklist was created in accordance with the outcomes of literature review by which individual principles are classified distinctly to major classifications that comprise of factors namely robust city planning, uncompromising rules, heightened chances of being caught, diverting offenders, minimised anonymity, economic considerations and enhanced street surveillance (See table 2). Classifying checklist might simply integrate these factors to principles as it will assist in evaluating individual grouping through weighting of scores using Likert scale.

Finally, scores that are assigned to individual factors are added to obtain the overall evaluation result for distinct classification and overall evaluation for principle. Research adopts residential sites within chosen neighborhood for data collection for the field work. Moreover, sites chosen for this research possess identical spatial layout that includes parking, routes (sidewalks, street and paths) and buildings that explore that, it has been design based on the perception to be valuable for measuring the SCP principles. Besides, it is aimed for choosing the residential blocks which are associated with public regions (commercial activities and parks). This would improve the accessibility of the physical components for measurement and

might enhance the user prevalence likelihood. This might be useful in measuring the SCP principles. In addition, identifying the houses are regarded as similar kind of house. This represents that building design with similar characteristics in these neighborhoods have been regarded. Such similarities encompass of window placement, fencing, landscaping, parking lot etc. Lastly, accessibility, transition from the public to private areas and road structures are regarded while choosing the sites.

Table 2: Attributes of built-in environment with corresponding techniques

Factors	Attributes of built-in environment	Explanation	Technique
Robust city planning	Mixed land-use	Proportion of commercial region to residential region	GIS
		Ratio of the residential region to the total neighbourhood region	GIS
		Average storeys available in the neighbourhood building	GIS
Minimised anonymity	Transition-description	There exists a clear outline explanation of the controlled-space (through the explanation of conversions from public to semiprivate and later to private-space) afforded	Field work
		Amenities are stated in the public regions for several activities and varied ages (susceptible activities, parks and pathways)	Field work
		Entry-points are reduced in accordance with the accessibility and road design	Field work
		Landscape is maintained well for affording impression of care, security and ownership	Field work
Uncompromising rules	Signage	Standard symbols, simple graphics and strong colours are utilized for informational-signs (finding activities and public area usage)	Field work
		Signage also exists for organised access and movement thereby affords directions	
Enhanced street-surveillance	Kind of street activities	Through the use of coding-system as street having no activities will consider value of 0, street having active clustering will consider value of 3 and street with less activities will consider value of 1	Field work
	Lighting	For the areas aimed to be utilized at night, the lighting is positioned at low-height for assisting visibility for the pedestrians	Field work
		In the areas utilized by the pedestrians, lighting sparkles on the probable entrapment spaces and pedestrian pathways	Field work

	Building out and site	Exits or main entrances are positioned in front of the street/site view Clear designing of open-spaces and placed at spots that are observed easily Impediments exist that might avert visibility by windows	Field work
	Entry points	Entry-points are reduced in accordance with the accessibility and road design	Field work
Diverting offenders	Community centers	Attributes concentrate on neighbourhood spots and measured through coding system namely focal points, neighbourhood edge and fragmented	GIS
	Family status	Single, divorced, widowed or married	Secondary data
	Employment rate	Number of female and male who are legally working from the overall neighbourhood residents	Secondary data
Socio-economic factors	Income median-level	It is categorised in accordance with data census based on 5-scores: 5-lesser than 36000-Saudi Arabia riyals/year, 4-ranging from 36000-72000/year, 3-more than 72000 and lesser than 1,20,000-Saudi riyals/year 2-more than 1,20,000-1,50,000 1-more than 1,50,000-Saudi riyals	Secondary data
	Education level	Higher studies (Doctoral and Master), bachelor, diploma, secondary-school and illiterate	Secondary data
	Dwelling density	Overall dwelling densities on the residential region excluded from other land-uses like commercial activities, schools, roads and parks	GIS
Economic considerations	Economic policies	Activities are ranked into 5 main categories: 1) job centres or government sectors 2) Commercial actions like retail offices, small shops etc. 3) industrial uses 4) integration of all	GIS
		Active surveillance (police patrols, guard service, CCTV or alarm systems)	Field work
More chances of getting caught	Street around plots	Street patterns are coded into four kinds throughout a plot from 1-4 indicating (1) as dead end, (2) as L-kind streets, (3) as T-kind streets and (4) as traffic sheets	GIS

Hypotheses

The hypotheses for the current research is as follows,
$H_1$1: There is a momentous relationship between the impact of urban planning and crime occurrences.
$H_1$0: There is no momentous relationship between the impact of urban planning and crime occurrences.
$H_2$1: There is a momentous relationship between the socioeconomic factors and crime occurrences.
$H_2$0: There is no momentous relationship between the socioeconomic factors and crime occurrences.

Method of Data Analysis

The research adopts the statistical method of analysis to evaluate the results. This analysis technique obtained the overall evaluation and individual scale category of the factors evaluated in checklist were exported into MS-Excel with district wise and type of crime committed. The total number of crimes per 1000 people is calculated for the area under study. In that manner a total count of 100 data for each type of crime with respect to the district is segregated. With the frequency of type of crime that occurs most, the district that is most vulnerable to crimes and the impact of urban planning factors on the crime occurrence will be calculated in three levels. The statistical analysis is performed with the tool IBM SPSS version 20. The three levels of analysis of the current study is as follows,

Level – 1: Segregation of crime data in MS-Excel
Level – 2: The statistical analysis is performed with the SPSS software to find the frequency of the type of crime, the frequency of crime occurred in the 15 districts, and the mean & standard deviation value of the variables used in the study.
Level – 3: Testing of hypotheses using ANOVA, correlation and regression analysis.

Result

This section presents the results of the analyzed data and the respective interpretations.

Table 3: Frequency Distribution of the Type of Crime in Riyadh City

	Type of Crime				
		Frequency	Percent	Valid percent	Cumulative percent
Valid	Assaults	16	16.0	16.0	16.0
	Petty theft	32	32.0	32.0	48.0
	Intentional homicides	12	12.0	12.0	60.0
	Burglary	30	30.0	30.0	90.0
	Murder	4	4.0	4.0	94.0
	Robbery	6	6.0	6.0	100.0
	Total	100	100.0	100.0	

From the above table 3 it is evidential that the frequency of petty theft crime is higher comparatively with 32% than the other types of crime. Followed by the petty theft is the

burglary crime with almost 30%, while the intentional homicides account for 12% of the crime, murder accounts for 4% and robbery accounts for 6% of crime in the city of Riyadh.

Table 4: Frequency Distribution of Crime Occurrence in the Districts of Riyadh

Crime Occurrence in the Districts of Riyadh					
		Frequency	Percent	Valid percent	Cumulative percent
Valid	Al-Bat'ha	7	7.0	7.0	7.0
	Nemar	5	5.0	5.0	12.0
	Al-Shemaysi	4	4.0	4.0	16.0
	Al-Ha'ir	4	4.0	4.0	20.0
	Al-Malaz	4	4.0	4.0	24.0
	Al-Urayja	6	6.0	6.0	30.0
	Al-Rawdhah	8	8.0	8.0	38.0
	Al-Shemal	3	3.0	3.0	41.0
	Al-'Olayya & Sulaymaniyyah	7	7.0	7.0	48.0
	AL- Nassim	12	12.0	12.0	60.0
	Al-Ma'athar	9	9.0	9.0	69.0
	Irqah	5	5.0	5.0	74.0
	Al-Shifa	9	9.0	9.0	83.0
	Al-'Aziziyyah	8	8.0	8.0	91.0
	Al-Selayy	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

From the above table 4, it is evidential that among the 15 municipal districts of Riyadh, the district AL- Nassim tops in the occurrence of crime with 12%, followed by it are Al-Ma'athar, Al-Shifa, Al-Selayy with 9% each. Followed by this are the districts namely, Al-Rawdhah, Al-'Aziziyyah with 8% each, Al-Bat'ha and Al-'Olayya & Sulaymaniyyah with 7% each, Al-Urayja with 6%, Nemar, Al- Irqah with 5% each, while Al-Shemaysi, Al-Ha'ir, Al-Malaz with 4% each and Al-Shemal with least percentage of crime of 3%.

Table 5: Descriptive Statistics of Type of Crime

	N	**Mean**	**Std. Deviation**
	Statistic	Statistic	Statistic
Number of crimes per 1000 people	100	1.12	.422
Assaults	100	1.66	.216
Petty theft	100	1.97	.512
Intentional homicides	100	1.51	.369
Burglary	100	1.85	.350
Murder	100	1.14	.211
Robbery	100	1.27	.223
Valid N (list-wise)	100		

It can be ascertained from the above table 5 that the mean values of the variables have the positive values where the highest mean value is 1.97. Therefore, it can be stated that the

variable with the value 1.97 is most frequently occurring crime in the 15 municipal districts of Riyadh.

Table 6: ANOVA Analysis of Robust city planning and Crime occurrences

ANOVA					
Robust city planning and Crime occurrences					
	Sum of squares	d-f	Mean Square	F	Sig.
Between Groups	58.146	1	34.146	14.262	.000
Within Groups	56.562	98	.570		
Total	56.709	99			

It can be ascertained from the table 6 that the value of significance for the urban planning factor robust city planning is 0.000 which is lower than the value 0.05. This indicates the acceptance of the hypotheses and the null ones rejected. It can be confirmed that there is a momentous relationship between the urban planning and the crime occurrences.

Table 7: ANOVA Analysis of Uncompromising rules and Crime occurrences

ANOVA					
Uncompromising rules and Crime occurrences					
	Sum of squares	d-f	Mean Square	F	Sig.
Between Groups	32.101	1	21.118	12.562	.001
Within Groups	35.112	98	.330		
Total	35.344	99			

It can be ascertained from the table 7 that the value of significance for the urban planning factor uncompromising rules is 0.001 which is lower than the value 0.05. This indicates the acceptance of the hypotheses and the null ones rejected. It can be confirmed that there is a momentous relationship between the urban planning and the crime occurrences.

Table 8: ANOVA Analysis of Higher chances of being caught and Crime occurrences

ANOVA					
Higher chances of being caught and Crime occurrences					
	Sum of squares	d-f	Mean Square	F	Sig.
Between Groups	41.226	1	41.216	11.001	.020
Within Groups	40.132	98	.451		
Total	42.069	99			

It can be ascertained from the table 8 that the value of significance for the urban planning factor higher chances of being caught is 0.020 which is lower than the value 0.05. This indicates the acceptance of the hypotheses and the null ones rejected. It can be confirmed that there is a momentous relationship between the urban planning and the crime occurrences.

Table 9: ANOVA Analysis of Diverting offenders and Crime occurrences

ANOVA					
Diverting offenders and Crime occurrences					
	Sum of squares	d-f	Mean Square	F	Sig.
Between Groups	42.006	1	40.453	13.139	.007
Within Groups	43.921	98	.412		
Total	40.512	99			

It can be ascertained from the table 9 that the value of significance for the urban planning factor diverting offenders is 0.007 which is lower than the value 0.05. This indicates the acceptance of the hypotheses and the null ones rejected. It can be confirmed that there is a momentous relationship between the urban planning and the crime occurrences.

Table 10: ANOVA Analysis of Minimized anonymity and Crime occurrences

ANOVA

Minimized anonymity and Crime occurrences

	Sum of squares	d-f	Mean Square	F	Sig.
Between Groups	51.322	1	50.226	12.877	.003
Within Groups	54.116	98	.362		
Total	51.788	99			

It can be ascertained from the table 10 that the value of significance for the urban planning factor Minimized anonymity is 0.003 which is lower than the value 0.05. This indicates the acceptance of the hypotheses and the null ones rejected. It can be confirmed that there is a momentous relationship between the urban planning and the crime occurrences.

Table 11 ANOVA Analysis of Economic considerations and Crime occurrences

ANOVA

Economic considerations and Crime occurrences

	Sum of squares	d-f	Mean Square	F	Sig.
Between Groups	37.016	1	.146	14.262	.000
Within Groups	35.211	98	.570		
Total	33.441	99			

It can be ascertained from the table 11 that the value of significance for the urban planning factor economic considerations is 0.000 which is lower than the value 0.05. This indicates the acceptance of the hypotheses and the null ones rejected. It can be confirmed that there is a momentous relationship between the urban planning and the crime occurrences.

Table 12: ANOVA Analysis of Enhanced Street surveillance and Crime occurrences

ANOVA

Enhanced street surveillance and Crime occurrences

	Sum of squares	d-f	Mean Square	F	Sig.
Between Groups	58.146	1	47.344	13.353	.006
Within Groups	56.562	98	.623		
Total	56.709	99			

It can be ascertained from the table 12 that the value of significance for the urban planning factor enhanced street surveillance is 0.006 which is lower than the value 0.05. This indicates the acceptance of the hypotheses and the null ones rejected. It can be confirmed that there is a momentous relationship between the urban planning and the crime occurrences.

Table 13: Correlation between Socioeconomic factor and Crime Occurrences

		Socio-economic factors	Crime Occurrences
Socioeconomic factors	Pearson Correlation	1	.002
	Sig. (2-tailed)		.025
	N	116	116
Crime Occurrences	Pearson Correlation	.002	1
	Sig. (2-tailed)	.025	
	N	116	116

The Pearson correlation between the socioeconomic factors and the crime occurrences in the above table 13 reveals that the value of correlation coefficient is 0.002. It can be observed that the value of both the variables tends to increase to 1 which indicates that there is a positive relation between the variables. Hence it can be determined that the socioeconomic factors make a momentous impact on the occurrences of crime in the municipal districts of Riyadh.

Table 14: Regression Analysis- Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.185[a]	.716	.043	.786	.079	2.313	4	110	.003

a. Predictors: (Constant), Family status, Employment rate, Education level, Income level

It can be observed from the above table 14 that the value of significance is 0.003 that is lower than the value 0.05 interpreting that there is a significant relation between the socioeconomic factors namely, family status, employment rate, and education level & income level and crime occurrences. The value of R^2 denotes this significance.

Table 15: Regression Analysis of Socioeconomic factors and Crime occurrences

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.651	.731		1.007	.036
	Family status	.125	.023	.251	1.623	.029
	Employment rate	.034	.012	.342	.581	.012
	Education level	.087	.087	.081	.883	.022
	Income level	.154	.105	.412	1.216	.035

a. Dependent Variable: Crime occurrences

From table 15, it is evidential that the value of standardized coefficient β is higher for the factor income level with 0.412 and this is the significant factor in determining the occurrence of crime followed by that are employment rate with 0.342, family status with 0.251 and education level with 0.081.

Discussion

The reasons for the occurrence of crime are varied, but there is a momentous relationship between the urban planning, design and management. From the data analysis it was found that the petty theft crime tops in the frequency of the crimes comparing to other types of crime. This is because, the legal system is scrutinized in Saudi Arabia for both civil and criminal matters. Though the crime occurrences in Riyadh is comparatively low, there are still incidences of crime in the region with relatively low percentage. Followed by the petty theft crime is the burglary crime, assaults, intentional homicides, robbery and murder. All though crime levels are usually low, there is an up surge in the recent times. From the results, it was also revealed that which municipal district tops in the crime occurrences where Al-Naseem district showed the highest percentage.

Moreover, the relationship between the socioeconomic factors showed a significant contribution to the occurrences of crime. Among the socioeconomic factors, income level was found to be more significant. This denoted that low income was a predictor that led to the occurrence of crime in a relatively higher extent. Followed by that was employment rate, which implied that people who were unemployed were mostly found be indulged in the crime activities. The third factor was family status which implied that a poor family status was a significant predictor in making people get involved in crime. The least significant factor was the education level, which implied that education level was a least predictor in indulging people into crime than the other factors. With all this assessments, the impacts of urban planning on the crime occurrences were analyzed and revealed that the rate of crime was related with the urban planning factors namely, robust city planning, uncompromising rules, higher chances of being caught, diverting offenders, minimized anonymity, economic considerations and enhanced street surveillance. It can be stated that when a robust planning is done within the city the possibility of crime occurrence also lowers, similarly it can be affirmed that when uncompromising rules are more emphasized the possibility of crime gets lower.

Likewise the other factors of urban planning higher chances of being caught can make the offenders restrain from committing crimes. Also diverting the offenders like closure of streets can prevent crime through a change in the environment. Minimized anonymity like clear outline explanation of the controlled-space (through the explanation of conversions from public to semiprivate and later to private-space) afforded can prevent crime occurrence. Similarly economic considerations can prevent crime and enhanced street surveillance like proper street lighting, defensible design of space can prevent crime occurrences.

Most of the existing studies have considered principles of CPTED for crime prevention [38-40]. However, these studies have averted to focus on the opportunities causing crime as most of the crimes can be avoided when the opportunities are diminished. Accordingly, situational opportunistic theory states that, physical environment and social environment of the areas impact the existence of criminal chances. Taking this into account, SCP based model is considered in this study that relies in the assumption that crime could be reduced by creating strategic alterations to the environment. This specifically focusses on the ways in which crimes occur rather than the reason for its incidence so as to prevent crime. Further, most of the studies have analyzed the impact of urban planning on crime occurrence without giving special focus to one region and only scanty amount of quantitative analysis has been performed. Hence, the present study has filled this gap by contribution to perform comprehensive quantitative analysis with significant variables by focusing on one specific area (Riyadh).

Implications

This research affords significant clue to the policy makers and urban planners for incorporating the SCP principles in conceptualizing their urban planning in practical and policy terms so as to minimize the incidence and fear of crime thereby enhance protection in the communities by planning and assembling the components of urban problems (for example: enhanced street surveillance, minimized anonymity, economic considerations, higher chances of being caught, robust city planning, uncompromising rules and diverting offenders. This result in healthy urban built-in environment that stimulate a good life quality and well-being. Particularly, including this pattern motivates walkability, physical as well as mental health and improvises the air circulation that has positive impact on the attitudes and behaviors of the people.

Further, efficient urban planning that offers physical setting for effective passive surveillance, maximum legibility, regulated routine management, urban space management, network design of the grid street, open spaces and discouraging underutilized streets in initial stage of the design or alterations of conventional urban setting might avert or reduce the implications of numerous social issues like lack of public health and crime. Public health has a firm link with the built-in environment. Hence, the urban spaces that have been planned to motivate walkability are favorable, particularly for individuals who are susceptible to have a sedentary-life (for instance: elderly, young parents, immobile, unemployed and children) affording them the chances to involve in daily cycling and walking, hence, minimize the disease risk and supportive social interaction.

Nevertheless, particularly in the developing nations like Saudi Arabia which are experiencing intense and rapid urbanization processes, attempts have to be considered so that network design of the road anticipates building construction in the initial phase of planning as it establishes good neighborhood design. This might be vital for numerous future interventions. Similarly, interventions and urban rehabilitation should encourage safe borders between the neighborhoods and recreational facilities for preventing crime opportunities.

Limitations

Main limitation of this research is that, it has considered only Riyadh. Further, in future, considering analysis of urban planning impact on crime occurrences among many other major cities within Saudi Arabia would assist in providing generalized results.

Conclusion

Crime prevention involves all the attempts undertaken to prevent and control crime from its occurrence. Further, crime rates within urban areas have been usually high due to maximum community size. Hence, preventing it will improvise the safety of people in the society. As urban planning has significant role in crime prevention, present study considered to examine the impact of urban planning on crime occurrence with specific focus on 15 municipal districts in Riyadh. Most of the crimes occur mainly due to several opportunities. Hence, to avert this, SCP model was considered in this study. Outcomes of the study explored that socio-economic factors such as family status, employment rate, education level and income level played a moderating role in enhancing crime occurrences. Similarly, there existed significant relationship between urban planning and crime occurrences in Riyadh. There are numerous methods considered by several institutions and governments to prevent crime. As

good urban planning has significant contribution on crime prevention, it is important for the urban planners to consider effective models during urban design. Hence, this study would assist in decision making during urban planning in a way opportunities for crime could be reduced.

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