

WEATHER CHANGES INFLUENCE THE CRIME ACTIVITY TOWARDS THE QUALITY OF LIFE

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ABSTRACT

The controversy over weather changes will lead to more stress, less social control, reduced social support, criminal tendencies, more possibilities for crime, and societal conflict. The factors driving criminal activity have received much attention, and voluminous literature has related the incidence of changing weather changes to criminal activity. However, weather variables can affect the environment and human behaviour differently. For example, past scholars found that homicidal crime has a connection with the weather change. However, although studies look at the relationship between crime and weather change, the source of the data is debatable. In addition, empirical studies showing the relationship between property crime and weather change are challenging to obtain because none can be found. Therefore, this paper aims to identify the pattern of criminal activity based on weather changes to address this situation. In this paper, the research methodology uses quantitative data. The crime data were gathered from the Royal Malaysia Police (RMP), and the weather data was gathered from Meteorological Department for Selangor, Kuala Lumpur, and Johor from 2011 to 2020. The data were analysed using SPSS statistical and illustrated in the bar graph method to identify the pattern and relationship between



crime and weather. This study found that non-aggressive and property crime is less influenced by the high temperature but influenced by the ambient temperature and humidity. Future research on the relationship between crime and weather towards the quality of life of people must be theoretically grounded and use measures of crime and weather that are justified by the quality-of-life index theory.

Keywords: *Temperature, Humidity, Property Crime, Criminal Behaviour, Quality of Life*

INTRODUCTION

The Sustainable Development Goals (SDGs) are frequently associated with a better quality of life that incorporates economic, social, safety and security, environmental systems that assure satisfaction, health and a productive environment. Several factors, including crime, now impact urban communities' quality of life. Crime has escalated into a significant societal concern that threatens public safety and quality of life in every community (Ghani, 2017). In addition, Ghani (2017) also stated that no singular factor could cause crime or criminal behaviour because of the differences and complexity of human behaviours. Numerous studies have been conducted on the factors influencing criminal behaviour, and a wealth of research has linked the incidence of weather changes with criminal activity (Habibullah, Muzafar, & Habibullah, 2017). Weather variables can be different circumstances affecting the environment and human behaviour. Therefore, the weather variables may determine different types of crimes and affect the quality of life of those affected (Ali Haider & Iamtrakul, 2018).

The potential role of weather in influencing criminal activity has caught the interest of researchers across the social sciences (Trujillo & Howley, 2021). The idea that weather can be a factor in criminal activity has received a lot of empirical support during the past forty years; however, the mechanisms are still debatable (Agnew, 2012; Anderson, 2001; Butke & Sheridan, 2010; Cohen & Felson, 1979; Cohn & Rotton, 2000; Corcoran & Zahnow, 2021; Habibullah et al., 2017; Horrocks & Menclova, 2011; Ranson, 2014; Trujillo & Howley, 2021). Most research into the relationship between crime and weather supports the theory that weather impacts criminal

activity (Muratya,2013). Nevertheless, most weather-crime-related studies have focused on how temperature affects crime, particularly violent crime (Habibullah et al., 2017). But the role of temperature affecting crime, particularly property crime, is lesser. Thus, this paper aims to identify the crime activity pattern – focusing on property crime and based on weather changes to answer the research question of how criminal activity changes or is influenced due to weather changes. This analysis draws on recorded data to estimate crime activity patterns based on weather changes.

Addressing weather into criminal activity or behaviour patterns can help provide significant empirical evidence for the criminal behaviour model. The weather could also be used as an instrumental variable in studies of the effect of crime on various variables such as property prices, quality of life indices and economic growth. Furthermore, Horrocks & Menclova (2011) found that weather could predict criminal activity. Therefore, crime prediction would be a valuable tool for police to allocate resources.

LITERATURE REVIEW

Crime Theory and Criminal Behaviour

Criminal activity patterns and the factor driving it has received much attention. For example, one factor that is believed to affect criminal activity is the weather. Theories of crime and criminal behaviour have focused on individual personality traits which ‘predispose’ people to commit the crime while ignoring the situational contexts and the differences between types of crimes (Cohn, 1990). However, the Routine Activity Theory (RAT) by Cohen & Felson (1979) examines the relationship between these variables and criminal behaviour. Routine activity suggests that individuals’ activities and daily habits are rhythmic and consist of repeated patterns over time.

Research RAT commonly explains the link between weather conditions and crime (Cohen & Felson, 1979). As opposed to other crime theories that explain offender motivations, RAT considers the situational components necessary to create opportunities for crime at a given time and place (Corcoran & Zahnow, 2021). RAT attributes the crime to three interacting factors; (1) a motivated offender; (2) an attractive target for the offender;



and (3) the absence of capable guardianship. All three must come together for criminal activity to be realised (Kitteringham & Fennelly, 2020). The weather can modify an individual's routine legitimate activities and alter crime opportunities' spatial and temporal distribution (Corcoran & Zahnnow, 2021). In the framework of RAT, the higher but not extreme temperature is likely to increase mobility and social interaction, increasing the likelihood of suitable targets occurring and hence more possibilities of crimes (Shen, Hu, & Wu, 2020).

Weather conditions such as temperature, rain and wind impact participation in outdoor activities that occur in public spaces. Weather changes can influence individuals' propensity to contact others and increase or decrease the potential for opportunistic, interpersonal crimes such as assault (Chen & Ng, 2012, as cited by Corcoran & Zahnnow, 2021). However, changes in the surrounding environment may result in changes in behaviour and activities. RAT's use to explicate the relationship between property crime and weather has yielded only limited (Cruz, D'Alessio, & Stolzenberg, 2020). Furthermore, for example, people tend to spend time outdoors during pleasant weather, resulting in more significant opportunities for personal interaction and increased availability of victims. Thus, it is reasonable to anticipate that "pleasant" weather will be associated with increased property crime and may expect pleasant weather to be associated with more property crime.

On the other hand, inclement weather, such as cold ambient temperatures, reduces the number of people available as victims, as people tend to stay off the street during bad weather. Those few individuals outdoors during unpleasant weather are more vulnerable as there are fewer potential witnesses to deter the criminal (Cohn, 1990; Horrocks & Menclova, 2011). The Routine Activity Theory supports the notion that weather affects criminal behaviour to crime.

Temperature and Crime

Several field studies have been conducted over the past twenty years examining the correlation between heat and crimes. The majority of weather-crime-related studies have focused on the role of temperature affecting crime, particularly violent crime (Habibullah et al., 2017). For

example, earlier studies by Anderson (1989) and Cotton (1986), show that temperature positively affects violent crime and other types of aggressive behaviour. Furthermore, Trujillo & Howley (2021) found a significant correlation between crime and weather since their research matched with other studies. In addition, they stated a correlation between temperature and various categories of criminal activity.

On the other hand, Corcoran & Zahnow (2021) found that higher daily temperatures are associated with an increased tendency for assault at the neighbourhood level. Finally, Cohn & Rotton (2000) analyse burglary and theft in Minneapolis over two years using calls for service to measure criminal activity. They find that theft is negatively correlated with temperature, but burglary and robbery are positively correlated with temperature.

The debate about the shape of the temperature-crime relationship has remained a crucial topic among researchers. However, this relationship's nature is contested (Trujillo & Howley, 2021). Property crime rates increase when people intend to stay outside more, such as vehicle theft and burglary. Additionally, Horrocks & Menclova (2011) studied the relationship between property crime and weather. They discovered that when the weather is 'good', people are likely to be absent from their homes, enabling robbery and burglary to occur without a guardian. According to Horrock and Menclova (2011) study analysis, criminal activity can also reduce the crime rate in terms of a property crime when the weather is in 'bad' condition because criminals are less motivated to perpetrate the crime.

The comprehensive study between temperature and crime showed a positive and significant relationship in criminal activity patterns. However, a few studies do not support the relationship between crime and weather. Ranson (2014) even proposed that the relationship between property crimes (such as burglary and theft) and temperature is highly nonlinear.

Humidity and Crime

Humidity is one of the weather terms of conditions of the atmosphere besides precipitation, wind, temperature and atmospheric pressure over a short period (Lynch, Stretesky, & Long, 2020). The impact of relative



humidity on crime rates can be reasonably captured by traditional heat stress indices (Hu, Wu, Chen, Sun, & Li, 2017). Trujillo & Howley (2021) elaborate on the study by Lab and Hirschel in 1988 regarding the analysing of data crime and found that higher levels of relative humidity during months correlate with reduced personal violence. The relationship between humidity and the property crimes that occur during the day shows the number of property crimes decreases as the humidity increases. However, the property crime that occurs during the night indicates that property crime is more prevalent in low humidity (Lebeau, 1988). Lab and Hirschel (1988) conclude that humidity appears to exert an overriding influence on crime in general.

On the other hand, according to Cohn's study, only Rotton & Frey (1985) appear to have examined the influence of humidity on crime. Although they found no significant relationship between humidity and domestic violence, they found a slight negative correlation between daily humidity and the assault rate (Trujillo & Howley, 2021).

The Relationship Between Weather and Property Crime

The relationship between temperature and crime has a rich history within social science and more extensive study of weather and crime examining variations in temperature and humidity (Lynch et al., 2020). Criminal activity can also reduce the crime rate in terms of property crime. After all, it is challenging to do so in inclement weather. Additionally, properties are more likely to be occupied by the homeowner during the 'bad' weather. In addition, Hu et al. (2017) stated the effect of temperature on property crime might be interpreted by the RAT. Higher but not extreme temperatures are more likely to increase mobility and social interaction, increasing the likelihood of a suitable target occurring and presenting more opportunities for property crime. However, according to Rotton & Cohn (2000), generally inconsistent and sometimes contradictory results characterise the weather and property crime literature.

In contrast, another previous study by Lab and Hirschel (1988), as cited by Rotton & Cohn (2000), found a small positive relationship between temperature and property crime (burglary and theft) in Charlotte during daylight, not night-time hours. Lab and Hirschel also found a positive relationship between property crime and humidity. Theoretically, the link

between crime and weather conditions can be explained from a routine activity's perspective of the role that weather plays in creating opportunities for crime to occur (Corcoran & Zahnow, 2021).

To summarise, the literature is ambiguous about the effect of temperature and humidity on property crime. The crime and weather literature has consistently shown that weather exerts an important influence on crime. This relationship varies in direction and strength, dependent on crime types and the specific weather variable under examination. This study emphasises wanting to see patterns of crime and weather criminal behaviour.

METHODOLOGY

Data

This study uses a quantitative approach to achieve the research objectives. Therefore, the site selection needs to be examined first to get a clear view of the data collection in this study. First, the crime index from 2011 to 2020 was obtained to identify the crime situation for ten years in Malaysia from the Royal Malaysian Police (PDRM). Based on 14 states in Malaysia, Selangor, Kuala Lumpur, and Johor have been identified as the areas (states) with the highest crime indexes. The index crime statistics from 2011 to 2020 can be seen in Table 1.

Table 1. The crime index in Malaysia

State	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Johor	20970	19068	17105	15082	13480	12941	11307	10338	9870	7350
Kedah	10667	10100	8636	8028	7817	7440	6759	6221	5615	4131
Kelantan	6199	6053	5737	5603	5031	4548	4520	3987	3545	2531
Kuala Lumpur	25002	23022	22319	18293	15946	16989	13482	12127	11172	8301
Melaka	4830	4764	4186	3675	2948	3664	3097	2800	2561	1794
Negeri Sembilan	6050	6563	5993	5495	4787	4474	3973	3673	3327	2431
Pahang	5994	5619	5257	5085	4257	3777	3607	3584	3271	2331
Perak	9869	8545	7429	6860	6228	5841	5326	5128	4912	3388
Perlis	1113	974	831	814	741	655	603	563	527	493

Pulau Pinang	9758	8399	7936	7491	6697	6116	5551	5017	5218	3853
Sabah	-	3489	5772	5210	5176	5367	6236	6151	5745	3799
Sarawak	-	6202	9191	7556	7230	6826	6381	5830	6023	5850
Selangor	44302	40629	43060	36165	32547	31222	26069	21420	19800	17272
Terengganu	3841	3505	3610	3213	2659	2494	2257	1823	1870	2099

Source: Royal Malaysia Police (2021)

Table 1 shows the three states of Selangor, Kuala Lumpur and Johor have a bigger number of crimes compared to other states. These three states are urban areas where criminal behaviour positively correlates with urban areas. Most previous scholars identified that urban and crime have a relationship. Crime is divided into six types: vehicle, motorcycle, lorry/van/truck, snatch, and burglary. Details of the index crime categories are shown in Table 2.

Table 2. Property crime data in Johor, Kuala Lumpur, and Selangor

State	Year	Theft	Vehicle Theft	Motorcycle Theft	Lorry/Van/ Truck Theft	Snatch	Burglary
Johor	2011	3811	2006	7571	479	76	2598
	2012	2910	1738	7731	590	38	2219
	2013	2322	2188	6754	776	28	1798
	2014	2216	1686	6052	552	40	1603
	2015	1934	1592	5595	473	33	1440
	2016	2073	1443	4686	400	44	1475
	2017	2032	1097	4104	274	11	1211
	2018	2021	1035	3881	278	4	1239
	2019	1908	981	3471	219	4	1364
	2020	1403	802	2347	141	0	1273
Kuala Lumpur	2011	4497	3326	5692	664	951	3480
	2012	3910	3359	5693	549	384	2838
	2013	3391	3281	5459	688	214	2506
	2014	3133	2481	4469	548	593	2118
	2015	2995	2229	4015	524	604	1907
	2016	3595	2104	3864	495	1288	1867
	2017	3121	1548	3328	291	7	1188
	2018	3118	1482	3030	253	3	1104
	2019	2729	1423	2763	254	2	1087
	2020	2057	1000	2200	147	0	949

Selangor	2011	5941	6389	12957	1653	799	8422
	2012	4437	5792	13285	1757	725	6337
	2013	5147	5832	12653	2049	984	7742
	2014	4675	4723	10688	1648	845	6184
	2015	4157	3932	9794	1326	950	5805
	2016	4793	3309	8890	1140	983	5497
	2017	3951	2586	7945	844	140	4133
	2018	3638	2358	6510	654	87	3515
	2019	3514	2204	5503	595	3	3679
	2020	3753	1544	4337	374	0	3025

Source: Royal Malaysia Police (2022)

Table 2 shows that the state of Selangor has the highest property crime statistics compared to Johor and Kuala Lumpur for all crime categories. However, in this study, data from the three states were taken and analysed to achieve the paper's objective of identifying the pattern of criminal activity based on weather changes. Therefore, crime statistics data in these three states will be analysed together with weather data by the station for these three states.

Therefore, the weather variables are essential to measure and organise the different types of crimes committed. Overall, the weather variables used to conduct this research are temperature and humidity. Daily, monthly, and yearly weather data were obtained from the Meteorological Department from 2011 to 2020. Weather variables were collected daily temperature in (oC) and total mean humidity in (%). In addition, crime observation in each district related to this research and a corresponding weather observation had to be found. This was done by matching and merging the police location district to the nearest weather station (s). While there are many police stations and weather stations in Johor, Kuala Lumpur, and Selangor, finding the appropriate and suitable data was complicated because not all the weather stations matched the location of police data records.

Analysis

The descriptive analyses were employed to identify the crime activity pattern between weather conditions and crime. The data on criminal activity are drawn from Royal Malaysian Police (RMP) data. These data, which are based on the yearly and monthly reports from RMP, tabulate offences in six



(6) major property crime categories; (1) theft; (2) snatches; (3) vehicle theft; (4) motorcycle theft; (5) van, lorry, and truck theft; and (6) burglary. Next, researchers merge these data with temperature and humidity yearly and monthly dataset records from the Meteorological Department Malaysia of Malaysia. After combining these two data sources, the researcher generates a dataset with year-by-month observations.

The crime and weather data need to be coded, keyed in, and edited. Then, outliers, inconsistencies, blank responses, and data transformation. Data are typically changed to avoid problems in the next stage of the data analysis process (Sekaran,2016). The study initially constructed a figure depicting the analysis illustrated in a bar graph chart to show the criminal activity pattern. The first researcher illustrates a bar graph between temperature and property crime. Second, the researcher demonstrates the humidity of weather conditions with property crime. Property crime is divided into six categories (theft, vehicle theft, motorcycle theft, lorry/van/truck theft, snatch, and burglary) according to Royal Malaysia Police record data from 2011 to 2020. For all analyses, researchers used descriptive analysis in SPSS.

RESULT

The Temperature-property Criminal Activity Pattern

The researcher initially constructed a figure depicting the relationship between crime and weather over the past years of record data. The distribution of property crime and the mean monthly and yearly temperatures and humidity are shown in the completed graph below. The criminal activity pattern between temperature and property crime rates are illustrated in Figure 1. A bar graph was used to indicate a line of best fit in each case. The first graph in Figure (a) shows the relationship between temperature and theft crime. Observations between January 2011 to December 2020 for theft crimes showed a total of 25,928 theft crimes reported during this period. The vehicle theft, there were a total of 18,363 crimes reported 43, 961 crimes reported for motorcycle theft, 4, 734 crimes reported for lorry/van/truck theft, 2,608 crimes reported for snatch crime and 22, 617

crimes reported for burglary. Researchers observed a relationship between temperature and theft crime (Figure 1 (a)). The researcher observed from the graph analysis that the theft rate is high between 25.0 (oC) and 28.0 (oC) with the ambient temperature.

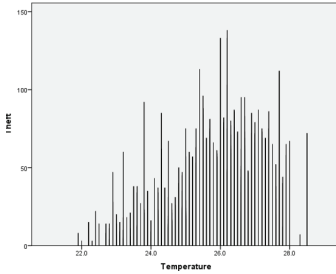


Figure 1 (a): Temperature and theft crime

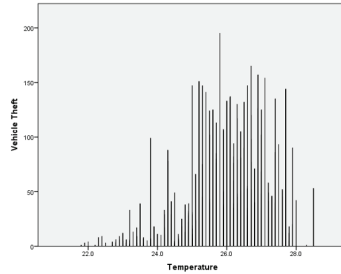


Figure 1 (b): Temperature and vehicle theft

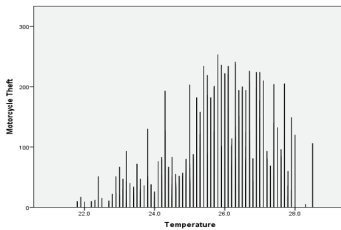


Figure 1 (c): Temperature and motorcycle theft

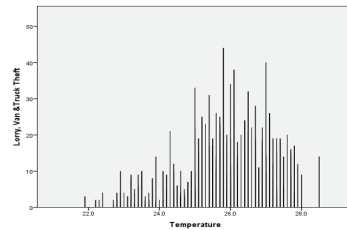


Figure 1 (d): Temperature and lorry/van/truck theft

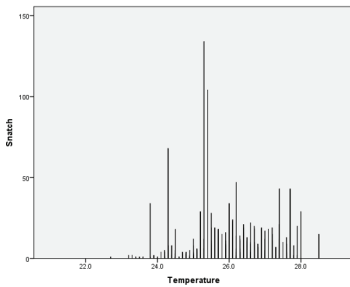


Figure 1 (e): Temperature and snatch theft

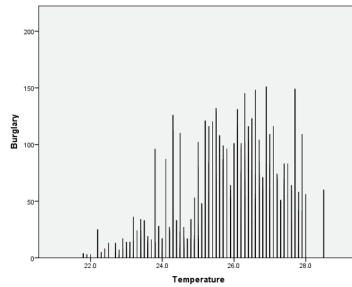


Figure 1 (f): Temperature and burglary

(Source: Author)

We examined the role of temperature change on theft, vehicle theft, motorcycle theft and lorry/van/truck theft were significantly related to ambient temperature. It shows that temperature between 25.0 (oC) to 28.0 (oC) influences vehicle theft (Figure 1(b)), motorcycle theft (Figure 1(c)), and lorry/van/truck theft (Figure 1(d)). The graph illustrated the visual



of the pattern of crime alongside key weather variables for temperature. Meanwhile, there is a relationship between the criminal activity pattern for the temperature and burglary (Figure 1 (f)) illustrates the higher number of burglary cases between 26.0 oC and 28.0 (oC). Since there are six property crimes in the above bar graph, temperature changes can also influence property crime rates. Based on the bar graph above, all types of property crime appeared between temperatures reaching 25.0 oC.

Theft (Figure 1 (a)) and burglary (Figure 1(f)) were found to have a relationship with ambient temperature in this study. A study reflects the findings and results of the analysis (Horrocks & Menclova, 2011). In the meantime, only burglary incidents showed a positive correlation between temperature and burglary in the study that Rotton & Cohn (2000) carried out. Their research looked at the relationship between the two variables. This is because there was a negative correlation between temperature and theft crime in the study they carried out.

In addition, the correlation between temperature and snatch produced both nonlinear and inconsistent results. The result reveals that the crime pattern graphically illustrated in Figure 1 (e) has little impact on the snatch theft between the temperature 26.0 (oC) to 28.0 (oC) but getting higher on the 25.0 (oC).

The Humidity-property Criminal Activity Pattern

There has been a growing body of work to support the suggestion that humidity can be an essential factor in explaining variation in criminal activity patterns. However, previous findings relating to humidity and property crime link may not apply to contributions like Johor, Kuala Lumpur, and Selangor. This stands in contrast to the more criminal activity pattern and humidity. Refer Figure 2.

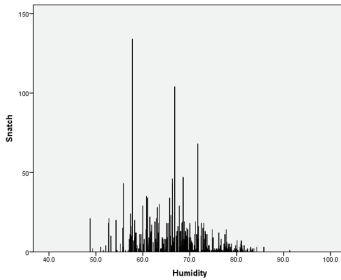


Figure 2 (a): Humidity and theft

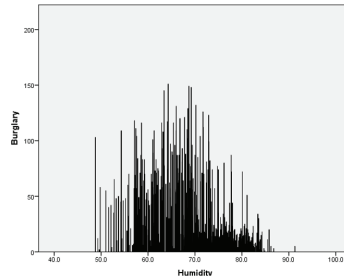


Figure 2 (b): Humidity and vehicle theft

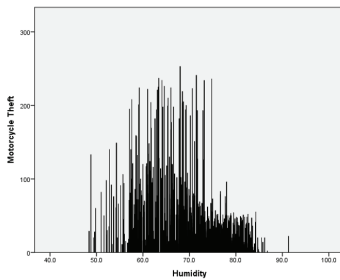


Figure 2 (c): Humidity and motorcycle theft

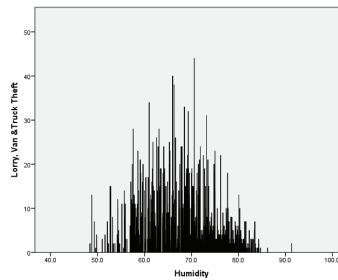


Figure 2 (d): Humidity and lorry/van/truck theft

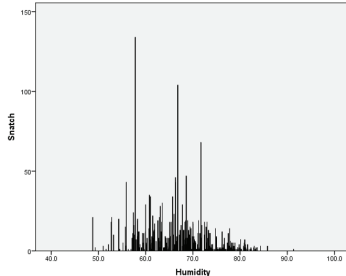


Figure 2 (e): Humidity and snatch theft

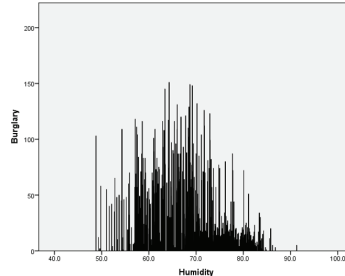


Figure 2 (f): Humidity and burglary

(Source: Author)

The humidity pattern trends of property crime rates are shown in Figure 2. In this Figure, property crime rates show uneven but downward trends. We conducted a statistical analysis and found the turning points, namely, 60% to 70% for relative humidity. The statistical analysis is utilised for analysing the criminal activity pattern trends within six property crime categories. In Figure 2, theft (Figure 2(a)), vehicle theft (Figure 2(b)), motorcycle theft (Figure 2(c)), lorry/van/truck theft (Figure 2(d)), and burglary (Figure 2(f)) show the highest crime rates in between 60% to 70% relative humidity



conditions of weather. The snatch shown in Figure 2 (e)) was a turning point for the snatch rate at 59% to 70% of relative humidity.

The concept of quality of life is highly relevant when considering sustainable development. It may argue that the quality of life reflects the social dimension of sustainable development. However, it does not imply that quality of life is affected by social conditions only. But also, quality of life may be affected by economic, social, and environmental conditions. Since sustainability implies a balance between environmental, social and economic equalities, policies that seriously decrease an individual's quality of life can hardly be called sustainable (Serag El Din, Shalaby, Farouh, & Elariane, 2013).

However, people cannot control the weather. Still, we could predict criminal activity, which would be a helpful tool for police in their resource allocation effort and could improve the quality of life based on the weather changes.

CONCLUSION

This paper identifies the criminal activity patterns on criminal behaviour in response to weather changes and has yielded few conclusions. Theft and burglary appear to be related to temperature. However, they grow at ambient rather than high temperatures, at least up to around 28 oC. On the other hand, snatch does not appear to be linked to high temperature. The research on humidity is related to motorcycle theft, vehicle theft, lorry/van/truck theft and burglary. Meanwhile, criminal behaviour of snatch and humidity shows an uncertain crime pattern. However, this study found that non-aggressive and property crime is less influenced by the high temperature but influenced by the ambient temperature and low relative humidity.

The empirical result also agrees with previous studies and theoretical literature. In sum, research on crime and weather has evidenced that the weather influences crime. This relationship varies in direction and strength, dependent on crime types and the specific weather variables under examination (Corcoran & Zahnow, 2021). In addition, theoretically, from the Corcoran & Zahnow (2021) perspective, the link between crime and

weather conditions can be explained from a routine activity's perspective of the role that weather plays in creating opportunities for crime to occur. Criminological explanations of crime have long indicated that weather and temperature may influence crime and that an increase in temperature may encourage criminal activity (Lynch et al., 2020).

This study set the path for future crime-weather research in various directions. The first would be to discover the relationship between crime patterns and weather for quality of life. The study focuses more on property crime and weather on people's quality of life. The second is to develop a framework for crime prediction of criminal acts based on weather towards the quality of life. Future research on the relationship between crime and weather towards peoples' quality of life should be theoretically grounded and use measures of crime and weather that are justified by the quality of life theory. The data analysis should employ the more advanced statistical technique, such as correlation analysis.

Currently accepted theories of criminal behaviour support the belief that weather may significantly affect some criminal behaviour and pattern. However, more research into the relationship between crime patterns and weather is required to include quality of life as a variable in new explanations of fluctuating crime rates, improving our ability to predict criminal activities based on weather changes towards the quality of life.

A recommendation to further enhance this study would be to update the data that has been obtained. Studies of this nature are an essential baseline; however, further research needs to be done for better results by studying current data and patterns of weather and crime to correlate the relationship between crime and weather changes.

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AUTHOR CONTRIBUTIONS

All authors contributed to the design of the research and the write-up. All authors have read and approved the final manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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