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ORIGINAL RESEARCH ARTICLE

Public perception of flood risks in Klang Valley, Malaysia: A case study

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ABSTRACT

Floods are becoming a major global concern as these disasters become more severe and frequent. This is no exception to Malaysia, as the trend of flood occurrences is increasing year by year. This study aimed to understand the public perception of the flood risks in Klang Valley, focusing on Kuala Lumpur and Selangor metropolitan areas. A total of 100 respondents participated in this survey via online questionnaire distribution. There are four variables tested in this survey, where factors on environmental concern and anticipating risk have moderate influence on the perception and awareness of flood risk. Both environmental concern ($\beta = 0.378$, $p < 0.000$) and anticipating risk ($\beta = 0.349$, $p < 0.000$) were the only correlations that were statistically significant. It was found that emotional impact ($\beta = 0.058$, $p < 0.511$) and effort to contribute ($\beta = 0.148$, $p < 0.077$) did not significantly predict awareness of flood risks. Further studies are needed to truly grasp the public's perception of flood risk in Kuala Lumpur and Selangor.

Keywords: perceived risk; flood risk; risk awareness; preparedness

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1. Introduction

Floods are often caused by heavy rainfall, rapid snowmelt, or a storm surge from a tropical cyclone or tsunami in coastal areas. This natural disaster has affected more than 2 billion people worldwide between 1998–2017[1] and with climate change and socioeconomic developments, researchers expect the frequency and severity of floods to increase[2,3]. The impact of floods depends on their severity. It can cause widespread devastation, which results in loss of life and damage to personal property and critical infrastructure[1]. In Malaysia, cases of floods have been more frequent and severe, especially in Kuala Lumpur and Selangor.

In Kuala Lumpur, flash floods are a common phenomenon and occur due to several factors. Two of the main factors highlighted are human-induced factors. For instance, rapid urbanization with an extreme increase in migration causes rapid changes in spatial land use and land cover (LULC) in Kuala Lumpur[4]. Rapid development also reduces green and forested areas, replacing natural surfaces with roofing and concrete. These materials have a very limited rate of water absorption, which might be sturdy and long-lasting but not useful during flash floods. Poorly maintained buildings with clogged drains, unsuitable design and construction of drainage and waterways, and indiscriminate dumping of garbage have also contributed to flash flooding[5,6].

Secondly are the natural factors such as lithology, terrain ecosystem, torrential rainfall, and the river system's natural drainage. The municipality of the city covers an area of 243 km^2, and the southern edge of KL has been developed into institutional and educational areas, therefore these amenities are moving closer to Kuala Lumpur[4].

In addition, floods are also not uncommon in Selangor. Floods have been occurring in Selangor, particularly in the urban area, which has resulted in property destruction and economic losses for those impacted. People and development are being drawn into floodplains as a result of the growing population of the state[7]. Besides that, Selangor experienced its heaviest rainfall on 17 December 2021, which resulted in extensive floods throughout the state[8]. The Department of Irrigation and Drainage reports that the rainfall topped 380 mm, more than double Selangor's highest recorded rainfall of 180 mm and more than twice the average rainfall of only 60 mm[9].

Moreover, a variety of factors can cause flood events that have been happening in Selangor. For instance, land use changes, a lack of water catchment areas, a narrow and blocked drainage channel, a lack of environmental awareness of the general community, and lower topography are all contributing factors to floods at Sentosa Klang Park in Selangor. Consequently, the post-flood population frequently suffers from skin problems, dengue fever, faulty smells, and material losses[10]. The research that investigates this type of natural disaster's susceptibility is very helpful for forecasting and establishing warning protocols, as well as for developing flood risk management plans[11]. Hence, the present study aimed to understand the public perception of the flood risks in Klang Valley, focusing on Kuala Lumpur and Selangor metropolitan areas.

2. Methodology

Research methodology is one of the key aspects that are vital to achieving reliable and valid research results. There are various methods used in research to achieve the set objectives of a study. This section explains the research design, sampling procedures, research instrument, development of the questionnaire, data collection, pilot testing, and data analysis.

The study is descriptive and cross-sectional quantitative in nature. This design fits to identify the factors that influence the awareness of floods and measure the relationship of environmental concerns, emotional impact, the effort to contribute, and risk anticipation to awareness of floods. The focused population of this study was residents that currently live in Selangor and the Federal Territories, both Kuala Lumpur and

Putrajaya. Selangor has the highest number of populations in Malaysia, with 6.56 million people, whereas Kuala Lumpur has 1.75 million[12,13].

Based on the sample calculation and table by Krejcie and Morgan[14], a minimum of 384 samples were determined to represent the study. To ensure data sufficiency, 5% of 384 was added, which leads to the final number of required respondents of 403 people. The number of samples within 400 people is representable and good enough, as this enables the determination of consistencies in the focused population[15].

The sampling procedure used for this research was the snowball sampling method, which is one of the non-probability sampling methods. This method is simply defined as the respondents who will recommend other respondents with similar or suitable characteristics that suit the study's requirements[16]. Initially, the researcher distributed the questionnaires to targeted respondents, who are between the ages of 18 and above and living in either Selangor or the Federal Territories, through various social media and online mediums. Then, the respondents were asked to forward the questionnaire link to their peers, families, and even online acquaintances that match the required criteria.

The instrument was modified and adapted from relevant previous studies[17–19]. It is divided into four sections and composed of both open-ended and closed-ended questions. Section A basically consists of questions on the respondent's demographic background. Section B is gauging the respondent's experiences with a flood. In Section C, there are four dimensions: environmental concerns, emotional impact, effort to contribute, and anticipating risks. The factors of environmental concerns, emotional impact, and effort to contribute, respectively, have four items, whereas there are only three items in the anticipating risk factor. In the last section, the awareness of flood risk consisted of 12 items in total. Both items in Section C and Section D use a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, and 5 = strongly agree). To increase the questionnaire's reachability and content comprehension, a dual language of English and Malay is used to construct the items to facilitate those who are not well-versed in English.

Pilot testing was conducted before proceeding with actual data collection. The purpose of a pilot test is to determine the reliability and validity of the instrument. Furthermore, it helps to refine the construction of items in terms of word structure and language. For the pilot testing, we distributed 30 questionnaires to the respondents via an online link through instant messaging applications (Telegram and WhatsApp) and social media such as Facebook. The questionnaire link was immediately closed once the number of responses was reached.

From the results in **Table 1**, it was found that both items for "environmental concern" and "anticipating risk" have lower Cronbach Alpha readings. Thus, improvements to the questionnaire were immediately made by rechecking the construction of items (item redundancies) and revising the contents of the affected factors. It is noted that the respondents from the pilot testing were excluded from the actual data collection, and this was done through the identification and skimming of the provided email addresses collected by the online form. The improved and finalized questionnaire then proceeded to be distributed to the respondents.

For data analysis, the obtained data is analyzed with the aid of SPSS (Statistical Package for Social Science) software. For Sections A, B, C, and D, descriptive analysis was used to obtain the values of frequencies and percentages of responses. In addition, it obtains the mean, standard deviation, and mode of responses for each item in the factors of Sections C and D. This value is used to identify which factor is prominently influencing the perception of flood risk among the residents of Selangor and Kuala Lumpur. To measure the relationship between factors and awareness of flood risk, multiple linear regression is used to assess the strength of the relationship between the dependent and independent variables.

Table 1. Results for Cronbach Alpha testing on questionnaire items.

Factors	Cronbach value	Summary
Environmental concern	0.518	Weak
Emotional impact	0.790	Acceptable
Effort to contribute	0.734	Acceptable
Anticipating risk	0.632	Questionable
Awareness of flood risk	0.866	Good

3. Results

From the initial aimed number of responses which is 403, the study only managed to obtain a response rate of 25% ($N = 100$) from the determined size. It is expected that a response rate of 25% to 30% for email or web-based surveys without any follow-up emails and reinforcements such as incentives to participate[20,21].

3.1. Demographic and residential background of the respondents

As indicated in **Table 2**, 100 respondents, consisting of 46% males and 54% females participated in the survey of the public's perception of flood risk in Kuala Lumpur and Selangor. In addition, among the other age groups, the respondents who were between the ages of 21 and 39 were the most common (71%). In contrast, only 2% of respondents between the ages of 60 and 79 took part in the survey. In terms of ethnicity, Malay respondents represent the highest percentage (81%), while Indian respondents make up the lowest percentage (3%). Regarding education levels, the majority (63%) of respondents had tertiary education, while only 1% had primary education. In addition to that, when it comes to the employment status of the respondents, 71% of them are full-time students, making up most of the respondents, while only 1% of respondents are self-employed. According to the survey results, respondents in the M40 income group (M1–M2) had the highest percentage at 28%, while respondents in the T20 income group (T1) had the lowest percentage at 1%.

Table 2. Respondents' demographic data.

Demography category		F (n)	%
Gender	Male	46	46
	Female	54	54
	Total	100	100
Age	18–20 years old	10	10
	21–39 years old	71	71
	40–59 years old	17	17
	60–79 years old	2	2
	Total	100	100
Ethnicity	Malay	81	81
	Chinese	11	11
	Indian	3	3
	Others	5	5
	Total	100	100
Educational level	Primary	1	1
	Secondary	9	9
	Tertiary	63	63
	Postgraduate	27	27
	Total	100	100

Table 2. (*Continued*).

Demography category		F (n)	%
Employment status	Full time	71	71
	Part-time	2	2
	Self-employed	1	1
	Retired	3	3
	Unemployed	20	20
	Others	3	3
	Total	100	100
Income group	B40 (B1–B2)	19	19
	B40 (B3–B4)	23	23
	M40 (M1–M2)	28	28
	M40 (M3–M4)	16	16
	T20 (T1)	1	1
	T20 (T2)	3	3
	Total	100	100

In **Table 3**, 36% of respondents stayed in a grounded building. 8% of the respondents do not stay in the mid-rise building type (n = 8). According to the data, the large number of residence levels on the third floor is over (n = 45, 45%), followed by residents who stay on the ground floor (n = 29, 29%). The residence seldom stays on the 2nd floor. Most of them stay in the vicinity of river or water reservoirs (n = 49, 49%) and stay far from flood areas or water reservoirs (n = 46, 46%), and the remaining 5% of the respondents are uncertain (n = 5).

Table 3. Respondents' residential background.

Category		F (n)	%
Building type	Grounded building	36	36
	Low-rise	22	22
	Mid-rise	8	8
	High-rise	34	34
	Total	100	100
Residence level	Basement	6	6
	Ground floor	29	29
	1st floor	16	16
	2nd floor	4	4
	3rd floor and over	45	45
	Total	100	100
Vicinity to river/water reservoir	Yes	49	49
	No	46	46
	Uncertain	5	5
	Total	100	100

3.2. Respondents' flood experience

From the results obtained in **Figure 1**, most of the respondents (87) reside in the Selangor area. While the respondents who reside in Kuala Lumpur are only 13 people, A total of 100 respondents gave feedback regarding the flooding in their homes or in areas close to them. 61% of respondents do not have any experience with floods. Besides that, 39% are those who have experienced floods (**Figure 2**). Most of them are those who live far away from the flood area. Whereas the frequency of experiencing floods is high, most people have never experienced flooding (59%) (**Figure 3**). This may be because they live outside the flood area. The study also showed the lowest percentage (15%) where they only experienced flooding in their home area once. As for respondents that have experienced floods (**Figure 4**), the time when the flood happened showed as many as 60 people who have never experienced floods in their residential areas. The middle rate shows a total of 28

people who only experienced 0–3 years of flooding in their homes or nearby flooded areas, while only two people experienced floods in the past 8–19 years.

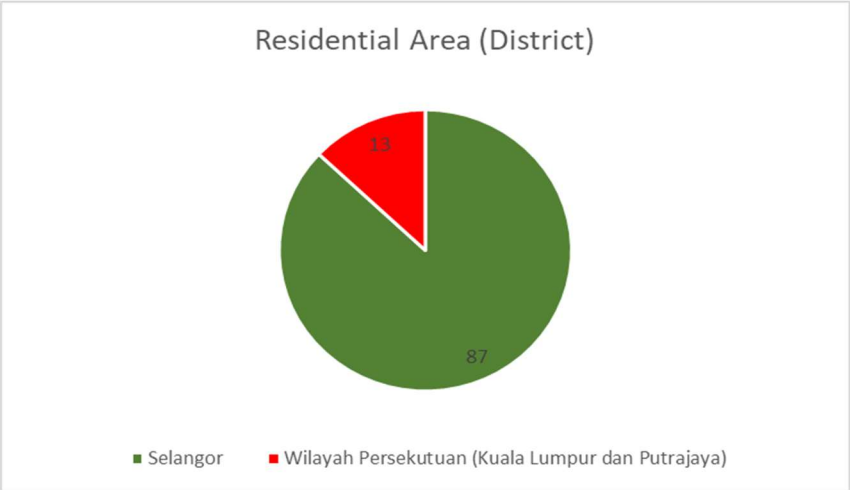

Figure 1. Locality of the respondents residing area.

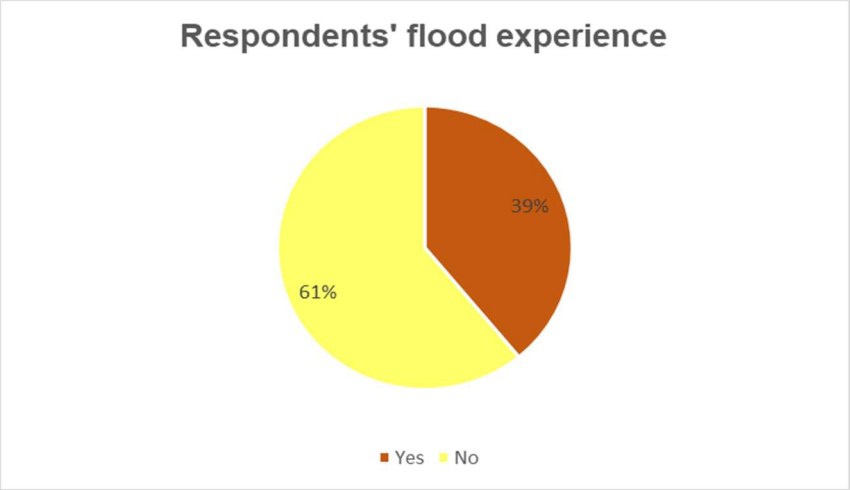

Figure 2. Respondents' flood experience.

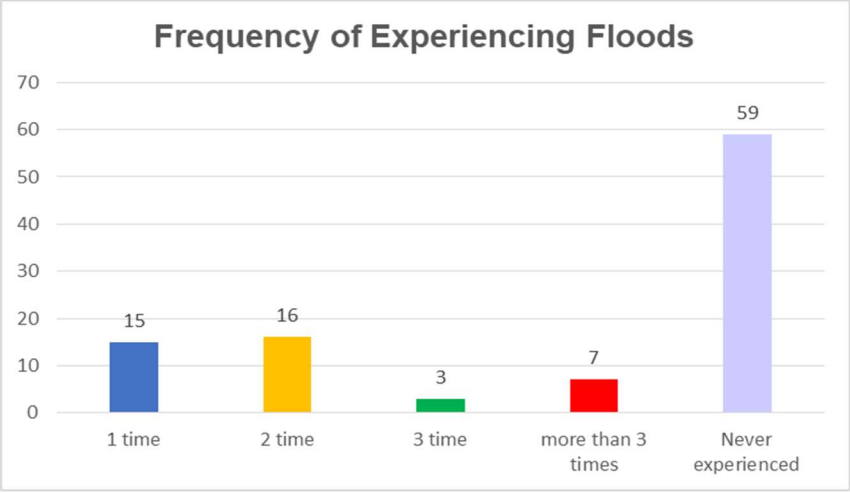

Figure 3. Frequency of experiencing floods.

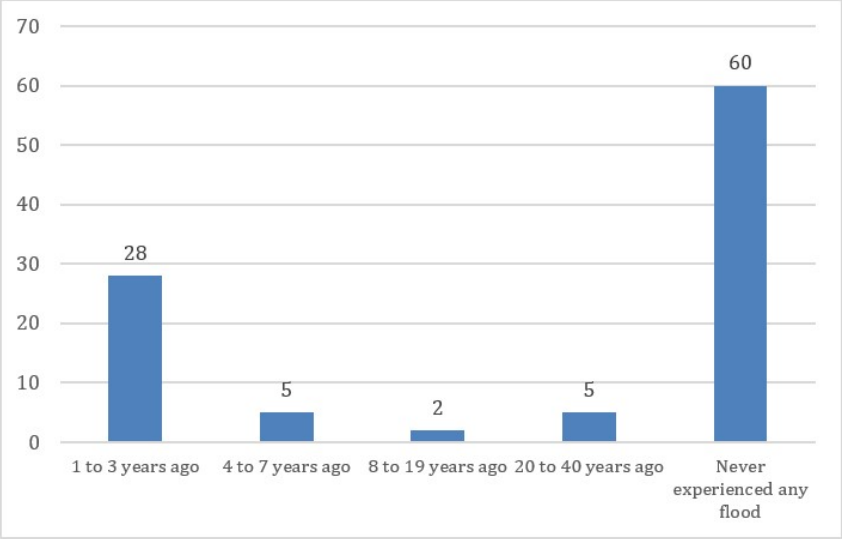

Figure 4. The time when flood happens according to respondents' experience.

3.3. Factors of perceived flood risk

Based on **Table 4**, each item with high mean values is highlighted to represent the level of impact of the said factors. Under environmental concern, "I care about taking care of the environment" and "I think that modern science and technology can decrease the risk of floods" obtained a mean of 4.5 (SD = 0.6) and 4.2 (SD = 0.9), respectively. Both of these items lean towards strongly agreeing and agreeing with modes 5 and 4.

For the emotional impact factor, there are three items with high mean readings. "I believe that the flood would have a strong impact on my life" has the highest mean of 4.0 (SD = 0.8, Mode = 4). Meanwhile, both items "I am afraid of the flood" (SD = 1.0, Mode = 4) and "I believe what I can do to prevent a flood is pointless if no one else does the same" (SD = 1.1, Mode = 5) received the same mean of 3.9. All of these items are leaned toward strongly agreeing and agreeing.

Table 4. Descriptive analysis of the factors of perceived flood risk.

Item	Mode	Mean	SD	% of response				
				1	2	3	4	5
Environmental concerns								
1. I care about taking care of the environment.	5	4.5	0.6	0	0	6	36	58
2. I feel that Malaysians worry too much about floods.	5	3.9	1.2	6	10	17	27	40
3. I feel that the damage done by floods is irreversible and uncontrollable.	4	3.4	1.2	7	16	23	35	19
4. I think that modern science and technology can decrease the risk of floods.	4	4.2	0.9	1	4	12	42	41
Emotional impact								
1. I believe I am powerless to prevent floods.	2	3.1	1.2	7	28	27	21	17
2. I am afraid of the flood.	4	3.9	1.0	4	5	20	43	28
3. I believe what I can do to prevent flood is pointless if no one else does the same.	5	3.9	1.1	2	11	20	33	34
4. I believe that the flood would have a strong impact on my life.	4	4.0	0.8	0	2	24	43	31

Table 4. (*Continued*).

Item	Mode	Mean	SD	% of response				
				1	2	3	4	5
Effort to contribute								
1. I think the government's effort to reduce the risk of flooding should be cost-free for the people.	5	4.1	1.0	2	5	17	30	46
2. I would contribute part of my income if I were certain that the money would be used to prevent floods.	4	3.3	1.2	10	12	30	32	16
3. I do not mind the increase in taxes if it is used to prevent or recover from floods.	3	3.1	1.2	13	18	30	24	15
4. I believe that educating the younger generation about the knowledge of flood is important.	5	4.4	0.8	0	0	17	28	55
Anticipating risk								
1. I believe that the COVID-19 pandemic has badly affected the prevention of floods, the restoration and relief efforts.	4	3.3	1.3	12	16	25	27	20
2. I expect floods to occur in my area in the next 10 years.	3	3.4	1.2	7	13	32	26	22
3. I always think about the possibility of flooding when I want to purchase a house in a particular area.	5	4.1	1.0	2	5	17	29	47

In the effort to contribute factor, the item "I believe that educating the younger generation about the knowledge of flood is important" obtained the highest mean value of 4.4 (SD =0.8). The item "I think the government's effort to reduce the risk of flooding should be cost-free for the people" has a mean value of 4.1 (SD = 1.0). Both items have a mode of 5, which indicates that the responses were more strongly agreeable.

The final factor, which is anticipating risk, the item "I always think about the possibility of flooding when I want to purchase a house in a particular area," has obtained a mean of 4.1 (SD = 1.0). Next, the item "I expect floods to occur in my area in the next 10 years" obtained a mean of 3.4 (SD = 1.2). As for mode values, the item "I always think about the possibility of flooding when I want to purchase a house in a particular area" was leaning more towards strongly in agreement with the mode of 5, whereas the item "I expect flooding to occur in my area in the next 10 years" has a mode value of 3, which indicates the responses are more uncertain.

3.4. The awareness of flood risk

Based on **Table 5**, there are a few items that have obtained high mean values. The highest mean was for the items "Floods will affect the mental and physical health of a person" (mean = 4.3, SD = 0.8) and "Floods will potentially cause economic losses" (mean = 4.3, SD = 0.8). Both items, "Flood will affect social stability" and "Flood is currently a major issue in Malaysia," obtained a mean value of 4.2 (SD = 0.8). All of these items are more towards modes 4 and 5, in which the majority of the responses are strongly agree to agree.

The lowest mean is on the items "The COVID-19 pandemic prevented flood preparation and repair" and "I know the location of emergency shelters nearby," with a mean value of 3.3 (SD = 1.2). These items also obtained a Mode of 4, in which the responses were more agreeable.

Table 5. Descriptive analysis of the awareness of flood risk.

Item	Mode	Mean	SD	% of responses				
				1	**2**	**3**	**4**	**5**
Awareness of flood risk								
1. There is sufficient awareness in social media about the threats of flood.	4	3.6	1.1	2	20	20	37	21
2. The COVID-19 pandemic prevented flood preparation and repair.	4	3.3	1.2	8	21	26	28	17
3. I always follow news about floods.	4	3.9	1.0	1	10	18	43	28
4. Flood is currently a major issue in Malaysia.	4	4.2	0.8	0	1	18	42	39
5. Flood occurs solely due to heavy rain.	2	3.0	1.3	15	25	20	24	16
6. Floods will potentially cause economic losses.	5	4.3	0.8	0	2	11	40	47
7. Floods will affect social stability.	4	4.2	0.8	0	3	13	46	38
8. Floods will affect the mental and physical health of a person.	5	4.3	0.8	0	1	14	37	48
9. I have the stockpiled essential materials and foods at my home in case of a flood.	4	3.4	1.2	7	14	28	32	19
10. I know the location of emergency shelters nearby.	4	3.3	1.2	11	17	24	31	17
11. I would like to participate in flood emergency drills if it is organized.	4	3.9	1.0	1	8	22	38	31
12. I am willing to purchase flood insurance if it is available.	4	3.9	1.0	0	11	21	36	32

*1 = "Strongly disagree" to 5 = "Strongly agree", 2 = Slightly disagree, 4 = Slightly agree, 3 = Uncertain. The mode value is shown in bold.

3.5. The relationship between factors and the awareness of flood risk

Referring to **Tables 6** and **7**, the prediction model was statistically significant, F (4, 95) = 25.338, $P <$ 0.000, $R^2 = 0.516$, R^2 adjusted = 0.496. Environmental concern, emotional impact, the effort to contribute, and anticipating of risk were used in a standard regression analysis to predict awareness of flood risk.

Table 6. Model summary from multiple regression analysis.

Model summary								
Model	**R**	**R square**	**Adjusted R square**	**Std error of the estimate**	**F change**	***df***	***df*²**	**Sig**
1.	0.718[a]	0.516	0.496	5.50763	25.338	4	95	0.000

Note: $P < 0.05$.

Table 7. ANOVA results from the regression.

Model	**Sum of squares**	***df***	**Mean square**	***F***	**Sig**
Regression	3074.38	4	768.595	25.338	0.000*
Residual	2881.73	95	30.334	-	-
Total	5956.11	99	-	-	-

The correlations between variables are shown in **Table 8**. The R^2 value of regression is 0.516 (refer to **Table 6**). Hence, it indicates that just 51.6% of the variance in the level of awareness of flood risk is explained by the levels of environmental concern, emotional impact, effort to contribute, and anticipating risk. This was also obtained by calculating the variance percentages for each of the items, as emotional impact has a 20% variance percentage, whereas effort to contribute has only scores of 2% (refer to **Table 9**). The increased levels

of environmental concern and anticipating risk primarily predicted the level of flood risk awareness. Environmental concern obtained a slightly stronger beta weight, followed by anticipating risk.

Table 8. Correlation of the variables in the analysis ($N = 100$).

Variables	2	3	4	5
1. Awareness of flood risk	0.593	0.445	0.422	0.588
2. Environmental concern	-	0.473	0.294	0.417
3. Emotional impact	-	-	0.446	0.409
4. Effort to contribute	-	-	-	0.396
5. Anticipating risk	-	-	-	-

Table 9. The percentage of variance is to be explained by each factor in the regression.

Independent variables	Sr^2
Environmental concern	0.1
Emotional impact	0.2
Effort to contribute	0.02
Anticipating risk	0.09

In **Table 10**, both environmental concern ($\beta = 0.378$, $p < 0.000$) and anticipating risk ($\beta = 0.349$, $p < 0.000$) were the only correlations that were statistically significant. It is found that emotional impact ($\beta = 0.058$, $p < 0.511$) and effort to contribute ($\beta = 0.148$, $p < 0.077$) did not significantly predict the awareness of flood risks.

Table 10. The standard multiple regression results.

Model	Unstandardized coefficient		SD coefficient	Pearson r	t	Sig	Structure coefficient
	B	SE	Beta				
Constant	8.031	3.962	-	-	2.027	0.045	-
Environmental concern	1.163	0.261	0.378	0.593	4.460	0.000	0.826
Emotional impact	0.139	0.212	0.058	0.445	0.659	0.511	0.620
Effort to contribute	0.361	0.202	0.148	0.442	1.787	0.077	0.588
Anticipating risk	1.023	0.246	0.349	0.588	4.154	0.000	0.819

Note: SE = Standard error; *$P < 0.000$.

Based on **Figure 5**, there is a bit of skewness on the right of the histogram as the distribution is a little stretched out. The range is with a minimum value of 30.36 and a maximum value of 56.65 (Mean = 45.17, SD = 5.57). Despite there being some deviations from normality, the values are small, and the residuals are roughly but normally distributed.

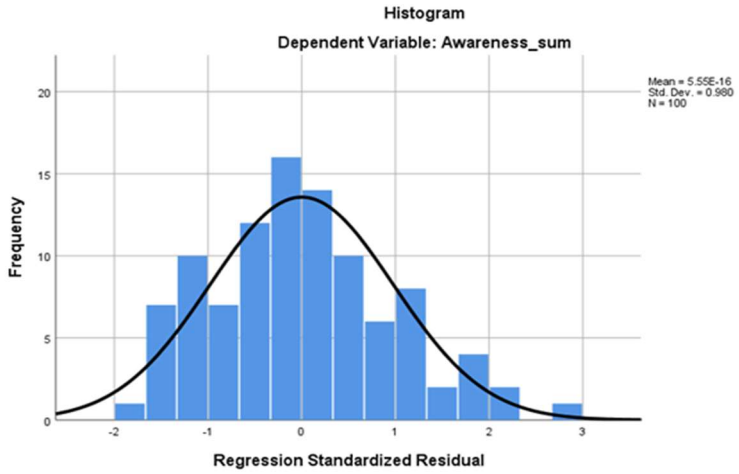

Figure 5. Histogram of variables used in multiple linear regression analysis.

As seen in **Figure 5**, the residuals are normally distributed as it shows the points are equally distributed across all values of the variables. Therefore, the homoscedasticity of the model is claimed. From the P-P plot (**Figure 6**), it is determined that there were no outliers which lead to a positive effect on the regression analysis and the model assumptions are fulfilled.

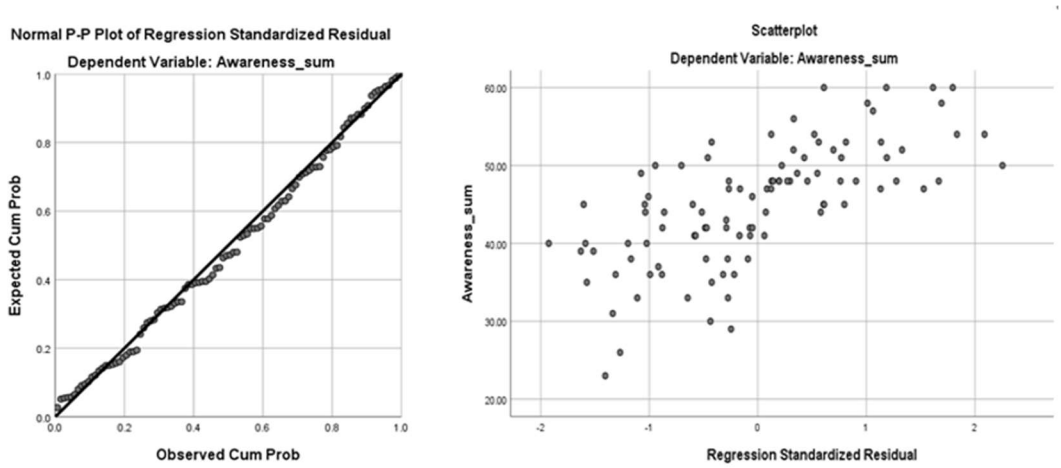

Figure 6. P-P plots show the normality and the relationship between factors of perceived food risk and the awareness of flood.

4. Discussion

The high mean values on items under the environmental concern factor reflect the representation of substantial environmental awareness, especially among the educated and youth. Environmental-related programs and awareness in the mainstream media have facilitated the development of people's awareness and encouraged actions to minimize pollution[22,23]. In addition, updated information and issues on the environment, campaigns, and pro-environmental activities can be easily accessed through the Internet, as its infrastructure has greatly improved during the pandemic. According to Falco and Corbi[24], environmental awareness is more likely to be high if the negative after-effects are experienced firsthand, such as floods and landslides. The implementation of sustainable practices in universities and by the government has also educated the public on environmental issues as well as intervened against pollution, especially water and air pollution[25]. Furthermore, access to the advancement of technology and science for better geographic information, hydrologic modelling, weather predictions, and remote sensing can help mitigate the severity of floods[26].

Cognitive and affective functioning for preparing against floods can be affected by emotional distress, evidently for those who have experienced it[27]. These emotional distresses, such as dread, fear, and powerlessness, are commonly associated with dealing with the effects of the flood. Nevertheless, the devastation of floods has been portrayed through various mainstream media and has somehow impacted those who have not directly experienced it as well. Aisha et al.[28] have stated that information sharing on social media has allowed flood victims to gain support and aid from others, mainly those who are unaffected by the flood, authorities, and even prominent figures like celebrities and politicians.

The residents of Selangor and Kuala Lumpur strongly believe that the government must be fully responsible to reduce the risk of floods. As supported by Sandaran and Selvaraj[29], government agencies have the power, resources, and responsibility to majorly improve methods of mitigation (before, during, and after), such as developing effective countermeasures like reservoirs and better drainage systems, introducing educational programs to empower communities to prepare for and prevent floods, and improving relief efforts for those who are affected.

The awareness of climate change and poorly planned urban development has impacted the anticipation of the risk of floods. At present, people are aware of the effects of climate change on global weather, bringing in unpredictable storms and wetter and hotter climates, which rationally associates it with the possibility of floods in some areas in the near future. Mondino et al.[30] stated that experiencing and witnessing such events can add to the flood risk knowledge, which is related to climate change on floods, identifying areas prone to flooding, as well as adaptation and preparedness for floods.

From the regression analysis, the relationship between factors of environmental concern and anticipating risk has shown a moderate and significant influence on the awareness of flood risk among the residents of Selangor and Kuala Lumpur. In current times, environmental concerns are well associated with awareness of climate change and pollution. Ngo et al.[31] have stated that knowledge of climate change risks is one of the key predictors of taking any adaptive measures. The notion of the possibility of losing one's life, livelihood, and even possessions has reinforced naturally the need to prepare ahead before floods happen. As discussed by Fox-Rogers et al.[32], and Siegrist and Gutsher[33], past experiences and exposure to the recency of flood events have a positive influence on the community's awareness and preparedness, as to strengthen their belief in the ability to adapt or mitigate the problem or lessen the impact of the disaster. Those who have experienced and been affected by floods in the past are more likely to be engaged in adapting to reduce future vulnerabilities compared to the latter. In locations prone to floods and their vicinities, the community is likely to be aware of the risk and may take a degree of precautionary steps to anticipate such disasters[34]. Thus, this is also supporting the positive relationship between anticipating risk and one's awareness of flood risk.

5. Conclusion

Both environmental concern and anticipating risk have a moderate influence on the relationship between perceived flood risk factors and awareness of flood risk. However, for further study, it is recommended that the conservation resource stress model, which was developed by Hobfoll[35], will be used to explain the issue from a different set of perspectives, especially the differences in socio-demographic backgrounds in adapting and adjusting to crises. Since the response rate is low in this study, the method of a self-administered questionnaire is suggested to distribute the surveys to the intended respondents. Nevertheless, if an online distribution is used, periodical respondent follow-ups from the researcher and incentives are included in the suggestion to improve the rate of response. As for the sampling method, the probability sampling approach is also recommended to decrease data biases and best represent the general population.

Author contributions

Conceptualization, CKY, WMS, HO, YH and ADS; methodology and investigation, DKAS, JMC, DNS, MNAR, IZ, HO, YH, and MCO; formal analysis and validation, KK, TYAH, MSI, and SAW; data curation, DKAS, JMC, DNS, MNAR, IZ, HO, YH, and MCO; writing—original draft preparation DKAS, JMC, DNS, MNAR, IZ, ADS, KK and WHC; writing—review and editing, CKY, WMS and DKAS; visualization, DKAS, JMC, IZ and MSI; supervision, CKY, WMS, and WHC. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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