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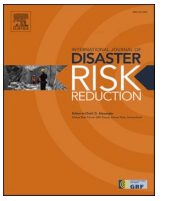

Flood risk perceptions and future migration intentions of Lagos residents

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ABSTRACT

Coastal communities across the world face intense and frequent flooding due to the rise in extreme rainfall and storm surges associated with climate change. Adaptation is therefore crucial to manage the growing threat to coastal communities and cities. This case study focuses on Lagos, Nigeria, one of the world's largest urban centers where rapid urbanization, poor urban planning, degrading infrastructure, and inadequate preparedness compounds flood vulnerability. We situate flood risk perceptions within the context of climate-induced mobilities in Lagos, which no study has done, filling a necessary knowledge gap. Furthermore, we apply a unique approach to flood risk perception and its linkage to migration, by using three measures of risk – affect, probability, and consequence, as opposed to a singular measure. Results show that the *affect* measure of flood risk perception is significantly higher than *probability* and *consequence* measures. Furthermore, flood risk perception is shaped by prior experiences with flooding and proximity to hazard. The effect of proximity on risk perception differs across the three measures. We also found that flood risk perceptions and future migration intentions are positively correlated. These results demonstrate the usefulness of using multiple measures to assess flood risk perceptions, offering multiple pathways for targeted interventions and flood risk communication.

1. Introduction

How society perceives current and projected climate change risks and impacts can provide an entry point into assessing people's response and adaptation strategies. In this study, we address the knowledge gap between flood risk perception among residents of Lagos and its association with mobility responses, when considering future climate change threats. The links between migration decisions and risk perceptions have been highlighted in the literature [1–3]. It is important to note that this is not a linear relationship, but involves a range of socio-economic and political factors [2]; [4]Black et al., 2011). Hence, the overarching question for this study is: *How are flood risk perceptions associated with future mobility intentions among Lagos residents in the Anthropocene?*

Lagos is an important location for this study for many reasons. First, the city is vulnerable to sea level rise and coastal flooding linked to climate change [5,6]; [7]; [8]. Flooding events have been occurring more frequently, leading to the loss of property, and impacting people's everyday lives [9–12]. Slaughter and Odume (2017) report the loss of 360 lives and displacement of an estimated

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two million people following flooding in March 2012 that affected most of Nigeria. An increase in the frequency and intensity of flooding events might have even more drastic impacts on individuals who live in this city. Also critical is the largely unknown risk of concomitant environmental hazards (e.g., from nearby legacy pollution sites or adjacent industrial facilities) which present the potential for mobilization of toxics as a consequence of extreme weather and flood events [13]. Being an economic hub not only for the country but also the West African region, climatic impacts on the city can have damaging consequences. A Verisk Maplecroft report using a climate change vulnerability index, finds Lagos to be one of the top five cities with high economic exposure to climate change, at a financial risk estimated at $128.5 billion by 2023 [14]. For meaningful outreach, effective policy making and public responsiveness, it is important to assess and understand how residents of the city perceive flood risk and what factors influence those risk perceptions which could potentially guide adaptation choices such as migration, relocation, or *in-situ* adaptation.

2. Methods

This study explores flood risk perceptions among Lagos residents and examines where it shapes human mobility responses as a form of adaptation. We draw on a mixed-methods approach using results from quantitative surveys and qualitative analysis to address the following research questions:

RQ1. How do residents of coastal Lagos perceive flood risk?

RQ2. What factors shape their perceptions?

RQ3. Does flood risk perception influence future migration intentions?

2.1. Data collection and analysis

From April–August 2020, online survey recruitment messages were published through ads on social media platforms (Facebook and Instagram) to residents of Lagos, Nigeria. A total number of 120,896 people were reached during this time, with 4315 clicks. Using social media for distribution allowed for a large reach, while using limited resources; although not everyone who clicked the survey completed the survey. We acknowledge that administering surveys online likely excluded segments of the population with limited internet access and literacy, introducing potential bias in selection among the general population [15]. However, administering the surveys online was necessary due to restrictions and safety concerns that the COVID-19 global pandemic posed during the period of this study.

Processes were taken to protect research subjects. Background information on the research project was communicated through the informed consent form, and respondents only proceeded if they agreed to participate. Total survey responses prior to data cleaning were 434. There were 29 survey questions for the project, taking respondents 44 min on average to complete. Respondents' privacy was protected by password protecting data storage and clearing out personal information from the final dataset used for the analysis. While a total of 434 surveys were received, 364 responses were left after data cleaning excluding responses that were at least 90% incomplete. Of the remaining responses after data cleaning, 191 respondents indicated that they had experienced flooding in the past 10 years. Further data analysis on flood risk perceptions and predictors of flood risk in this study were assessed with the 191 respondents and analysis was conducted using SPSS. One limitation inherent in the small sample size is that findings are not generalizable to the wider Lagos population. Although, this approach was taken because perspectives on those who have been affected by flooding were the most vital to this study.

For qualitative data, follow-up interviews were conducted from August and September 2020 with 21 survey respondents who had indicated interest in participating in an interview. Interview invitations were sent through respondents' preferred contact information – emails or text messages. A total of 7 females and 14 males participated in the interviews. Although the intent was to have gender balance in representation, not everyone who indicated interest in the interviews responded to emails and text messages, while some messages were not delivered. Participants were interviewed using the WhatsApp smartphone app, and participants were compensated for data costs. Interviews lasted, on average, between 30 min to an hour. All phone interviews were recorded using a password protected recording device. Interviews were transcribed by the researcher and uploaded into NVivo 12 for coding and analysis. Coding was done through two intensive iterations to arrive at emerging themes. Codes that were mentioned by at least 10 out of 21 interviewees were considered as a theme. Codes that emerged from less than 10 interviewees were only included in discussions if they supported findings from the quantitative analysis. Overall, interviews are presented in the discussion section of this paper to support findings from the quantitative analysis.

Prior to data analysis, diagnostic tests of normality were conducted for applicable variables. Data generally showed non-normality through Shapiro-Wilk test, and tests for skewedness & kurtosis. Non-parametric tests and parametric tests were run, but the latter is presented in this study because parametric results did not deviate significantly from non-parametric tests.

3. Theoretical framework

3.1. Risk perception variables

We apply [16] rationale that a multidimensional measure of risk perception including variables that capture – affect (worry), probability (likelihood) and consequence (impact) components are essential for studies trying to explain future adaptive behaviors through risk perception. These variables are used as predictors to explain risk perception in this study and to answer RQ1. Statistical tests of mean, standard errors, and a one-sample *t*-test are used to evaluate flood risk perceptions in this study, similar to [17].

3.2. Factors that influence flood risk perception

To answer RQ 2, the dependent variables used in this study are the affect, probability, and consequence variables (see: [16]). The independent variables were selected based on findings from other studies. For instance, several studies have found that prior experience with flooding events influences people's perception of flood risks [18,[19], [20]21,22]; and is one of the strongest predictors of flood risk [23]. Therefore, only respondents who had prior experience with flooding in the past 10 years were included in the analysis for this study. Consequently, prior experience in this paper is defined by respondent's rating of past flood experience, measured by flood severity[2] (see: [24]).

Others have identified demographic variables (particularly gender) as a predictor of flood risk perception [25], along with age [26] – which respondents entered as an open response, these were further coded into age groups in SPSS – and education [27]. Proximity is another key predictor of risk perception identified in the literature and included in this study [21,28]. In this study, proximity is defined as neighborhoods within 5 km to the coastline, as characterized by Koerth et al. [24]. Social trust in government was included as a predictor variable [23,29]. Using spatial techniques with Geographic Information System (GIS) software, 113 neighborhoods were identified as meeting this parameter. In the online survey, respondents were asked to identify their neighborhoods from a drop-down list, with an "other" option to capture those living outside of identified flood zones. These were further coded as "1" for those who specified living in any of the identified neighborhoods and "0" for those outside of the identified areas [see Fig. 1]. Summary statistics on all these variables are represented in Table 2.

3.3. Risk perception and future migration intentions

To answer RQ3 on the linkages between flood risk perception and the likelihood that individuals will respond through migration, a correlation analysis was conducted. Three measures of flood risk perception – affect, probability and consequence were used interchangeably. Other potential predictor variables were included in the analysis which included socio-economic and demographic variables.

4. Results

In this section we present and discuss the summary statistics of the survey participants. We follow up with a subsection presenting data and results on analysis addressing RQ1 on what flood risk perceptions are among the survey population. Subsequently, we present a subsection on results for RQ2 which looks at the factors that affect flood risk perceptions among the survey population. Finally, a subsection with results on correlation analysis for RQ3 is presented, exploring the linkages between flood risk perception and future migration intentions. Only results for the quantitative analysis are presented in this section. Interviews are used to discuss the quantitative findings in the discussion section.

4.1. Characteristics of survey respondents

Table 1 captures the demographic details of the survey. About 56% of the survey participants had experienced flooding within the past 10 years. People who identify as male made up 55% of respondents, while those who identify as female were about 45%. Compared to the wider population [30], estimates the total female population in 2020 as 49.3%. Most respondents (91%) were between ages 18–44 years old. Over half of the surveyed population had at least a bachelor's degree, with less than 0.6% having only primary education or no formal education. The age of participants in this study were centered towards a younger population, where the majority of participants were between 18 and 45 years old. This means that the perspectives of older groups were not captured. However, it is necessary to note that Nigeria overall has a young population with reports showing that over half of the country's population is under the age of 30 [31].(see Fig. 2).

Although the sample has a high proportion of people with higher levels of formal education, low income levels were reported where about 55% earn less than N50,000 ($129)[3] monthly. Most of the surveyed respondents are renters, with just around 12% of people owning homes. In addition, Fig. 3 shows the distribution of information sources on flooding in the study area. Results show that most respondents' level of concern about flooding is influenced mostly by information from the media (31.5%), followed by personal opinion at 23.6%, government (17.5%), peers (14.4%), family (10.3%) and others (2.7%).

4.2. Flood risk perceptions

Here, we present results for RQ1 on what the perceptions of flood risk are, among the surveyed population. This was done using statistical tests such as t-tests, ANOVA, means and standard errors in SPSS.

The mean score for the affect variable measuring level of worry as a risk perception construct was 3.64, the mean score for probability as a risk perception measure was 3.09 while the mean score for the consequence measure was 3.39. Results from Table 3 show that for the 'affect' variable the sampled population has a moderate-high flood risk perception as it relates to being worried about future flooding events occurring in their neighborhoods. A mean value of 3.09 for the measure of probability indicates that people have moderate risk perceptions of the likelihood that a future flooding event will affect them in the future. While the consequence variable, has a mean score of 3.39. This means that people in the sample have moderate perceptions of flood risk about how serious they feel the negative consequences of future flooding events will be to them and their households. All risk perception variables (affect, probability,

[2] Flood severity is used here to represent the level of prior experience had by respondents.

[3] As of August 30, 2020, the US Dollar to Nigerian Naira exchange rate was $1 ~ N387.46.

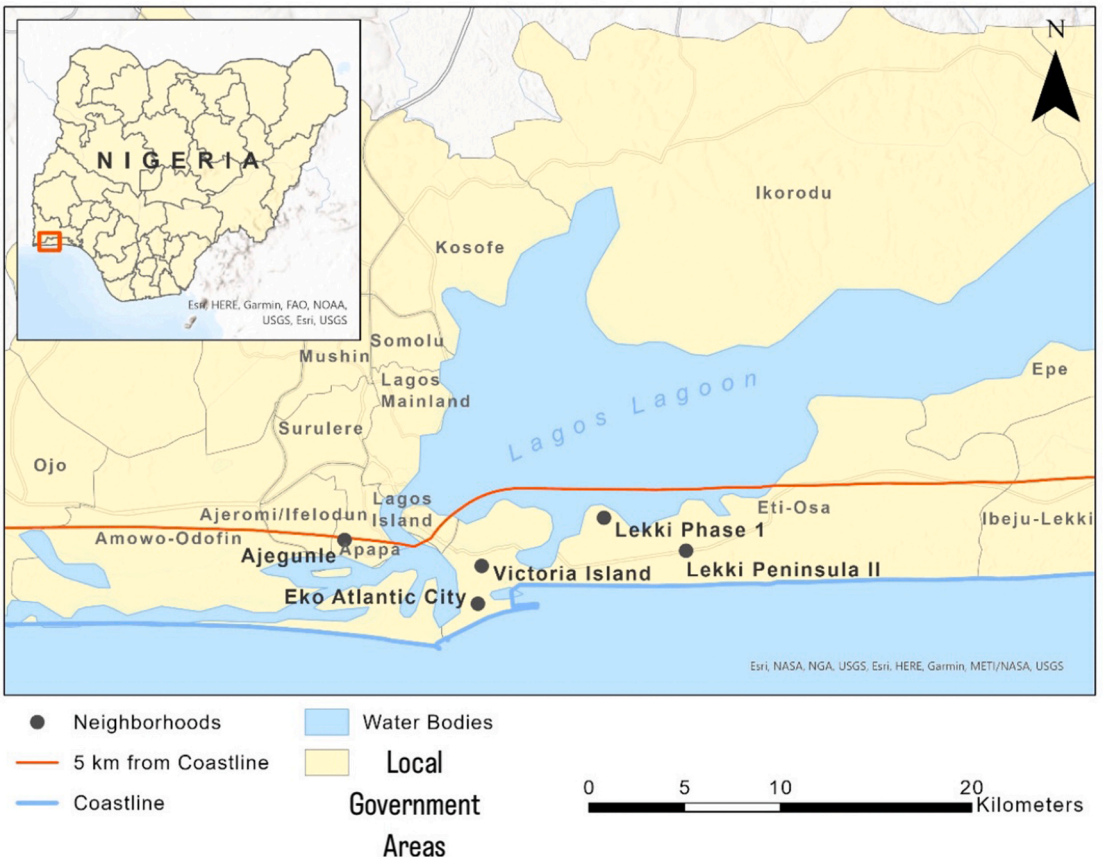

Fig. 1. Map of Lagos highlighting neighborhoods within 5 km of coastline. Map created by Kate Gregory (2022).

and consequence) are significant at the 95% level.

Comparing all measures of risk perception reveals that the people in the sample rated the affect measure of risk perception highest among the other measures of probability and consequence. A One-Way Repeated Measures ANOVA test was conducted to show if there is a significant difference between all measures of risk perception. The Greenhouse-Geisser correction, results indicate an overall significance $F(1.993, 246.440) = 28.894$, $p < 0.0005$). Furthermore, post-hoc tests using the Bonferroni correction reveals the differences across each combination of risk perception measures. Results show that affect > probability (0.553), affect > consequence (0.245) and consequence > probability (0.309). Probability measures the least out of all risk perception variables while affect measures the greatest among all risk perception variables. All differences in values are significant at $p < 0.05$.

4.3. Factors that influence flood risk perception

This section presents results from quantitative analysis of the factors that predict flood risk perception, informed by prior studies in the literature. Data was analyzed using SPSS and results are presented in Table 4.

Like [23,32,33] an ordinal logistic regression analysis was used to assess factors that influence flood risk perception in this study. This method was chosen because the dependent variables (affect, probability, and consequence) are ordered on a scale of 1–5 respectively. Independent variables included in the model are age, gender, education level, proximity, flood severity and government trust.

Table 1
Description of risk perception variables.

Variable	Survey Question	Scale
Affect	How worried are you about future flooding events occurring in your neighborhood?	1 = Not Worried to 5 = Extremely Worried
Probability	How likely is it that a flooding event will affect you in the near future where you live?	1 = Not Likely to 5 = Extremely Likely
Consequence	How concerned do you feel the negative consequences of future flooding events are, to you or your household?	1 = Not Severe to 5 = Extremely Severe

Several tests were run to show the goodness-of-fit of the model for the study. The Omnibus test of fitting model was significant $X^2(6) = 47.886$ showing that the model was an improvement in fit over the null - a model without predicting variables [34]. Likewise, Cox and Snell (0.264) and Nagelkerke (0.278) Pseudo R^2 show the strength of association between the dependent and independent variables. While the pseudo R^2 numbers for this model reveal relatively low strengths of association at 26.4% (Cox) and 27.8% (Nagelkerke), there is still debate in literature about the relevance of this measure. Similarly, the Pearson and Deviance estimates are another way of testing the goodness of fit for ordered logistic models. In the case of this model, the Pearson test of goodness of fit $X^2(546) = 607.134$; $p = 0.036$ does not show significance of the model. However, Deviance estimates at $X^2(546) = 377.435$; $p = 1.000$ shows that the model is significant [34].

Table 4 shows results of the ordinal logistic model. For the affect dependent variable which measures risk perception in terms of worry about being impacted by future flooding events, the only significant predicting independent variable was *flood severity* ($p = 0.000$). The co-efficient (B) on flood severity means that for every unit increase in flood severity, there is a resulting increase of 0.893 in the log-odds of being on a higher level of the dependent variable when all other predictor variables are controlled. While the Exp (B) coefficient >1, suggests that the odds of being on a higher level of flood worry increases by a factor of 2.442. In other words, estimates show that the higher the individual's experience of flooding in terms of severity, the higher the odds of them being in a higher category of the dependent variable – flood risk perception in terms of worry which is measured on a scale of 1–5. None of the socio-demographic variables in this model were statistically significant. This could be due to the low sample size of the study. However, some studies have shown that socio-demographic variables explain little of risk perceptions but rather, act as amplifiers or attenuators of risk perceptions [29].

With probability as a dependent variable, tests on the goodness of fit for the model were conducted. Results of the Omnibus test $X^2(6) = 26.903$; $p = 0.000$ show that the model is a good fit over an intercept only model. Pseudo R^2 values for Cox and Snell (0.158) and Nagelkerke (0.165) indicate that the strength of association between the dependent and independent variables are 15.8% and 16.5% respectively. Pearson estimates to test the goodness-of-fit of the model was $X^2(546) = 567.609$; $p = 0.253$, indicating non-significance while the Deviance test $X^2(546) = 436.593$; $p = 1.000$ indicates the goodness-of-fit of the model. Ordinal logistic regression results show the statistical significance of the *flood severity* ($p = 0.000$) as a predictor of flood risk perception, measured in terms of the probability of people being affected by flooding events in the future.

Specifically, results in Table 4 suggest that a unit increase in flood severity results in a predicted increase of 0.587 in the log-odds of being on a higher level of the dependent variable (flood probability) based on the B coefficient. As far as the odds ratio, there is an increase in probability of being on a higher level of flood probability as the flood severity reported by individuals increases. That is, the higher people rank the severity of their flood experience, the higher the odds that they will have higher perceptions of flood risk in terms of the probability that they will be affected by a flooding event in the near future, where they live.

Conversely, a final ordinal logistic regression model with the consequence variable as the dependent variable was conducted. Like the other models, several goodness-of-fit tests were carried out. The Omnibus test was significant $X^2(6) = 46.684$, showing that the model was an improvement in fit over the intercept-only model. Pseudo R^2 values for Cox and Snell (0.158) and Nagelkerke (0.165) show that the strength of association of the model is 15.8% and 16.5% respectively. Finally, the Pearson test of goodness-of-fit of the model was $X^2(546) = 567.609$; $p = 0.253$ showing that the model was not a good fit. However, just like the previous two models, the Deviance goodness-of-fit test $X^2(546) = 436.593$; $p = 1.000$ was significant. Results of the ordinal logistic regression in Table 4, show that *flood severity* ($p = 0.000$) and *proximity* ($p = 0.003$) were statistically significant predictor variables of flood risk perception – measured in terms of how seriously people feel the negative consequences of future flooding are to them or their households. The parameter estimates on *proximity* (representing people that live on the island considered to be more physically vulnerable because of its closeness to the Atlantic Ocean) results in a predicted increase of 0.920 in the log-odds of being in a higher level of the dependent variable (consequence), when all other predicting factors are controlled. The Exp (B) coefficient is greater than 1, suggesting that the odds ratio of being on a higher level of the consequence variable increases by a factor of 2.510 for those who live on the island. That is, people who live on the island are more likely to rate their flood risk perceptions (measured by consequence) of future flooding events as being higher than those who live on the mainland. With respect to the flood severity independent variable, the parameter estimate predicts an increase of 0.843 in the log-odds of being in a higher level of the dependent variable (consequence) when all other predicting factors are controlled. The Exp (B) coefficient is greater than 1 suggesting that the odds ratio of being on a higher level of the consequence variable increases by a factor of 2.324 as people rate the severity of their past flood experiences (flood severity) to be higher. This implies that the higher people rate the severity of their past flood experiences, the higher they are to have higher flood risk perceptions, measured in terms of the possible severity of future flooding events (consequence).

4.4. Flood risk perception and future migration intentions

In this subsection, we present results of a correlation analysis where we examine the relationship between flood risk perception (affect, probability, and consequence) and future migration intentions by survey respondents in the study area. Other predictor variables included in the models are age, homeownership, employment status and proximity to coast. Overall, results in Table 5 below show a positive relationship between flood risk perception (for all measures) and future migration intentions. Inversely, for people who are unsure about migrating, there is a negative relationship with all measures of flood risk perception. On the other hand, the same negative effect is seen with people whose choice is not to migrate. For this group of potential non-migrants, there is a negative correlation between movement and flood risk perception (for all measures). While this analysis does not indicate causality, it does confirm that potential linkages between flood risk perception and migration are present. Further research using regression analysis will be needed to explore the predictability of flood risk perception on migration.

Table 2
Summary statistics of key variables.

Variable	Codes	Frequency	%
Age	1 = 18–24	70	19.9
	2 = 25–34	172	48.9
	3 = 35–44	77	21.9
	4 = 45–54	22	6.3
	5 = 55–64	7	2.0
	6 = 65–74	2	0.6
	7 = 75 and above	2	0.6
Gender	0 = Female	147	44.7
	1 = Male	182	55.3
Education	1 = None	1	0.3
	2 = Primary	1	0.3
	3 = Secondary	51	14.9
	4 = Vocational training	12	3.5
	5 = HND/OND/Undergrad	34	9.9
	6 = Bachelors	194	56.6
	7 = Post-Graduate (Masters/PhD)	50	14.6
Monthly Income	1 = Less than N18,000	72	21.1
	2 = N18,000 – N50,000	117	14.6
	3 = N50,001 – N100,000	71	20.8
	4 = N100,0001 – N200,000	41	12.0
	5 = N200,001 – N500,000	30	8.8
	6 = Above N500,000	10	2.9
Housing Arrangement	1 = Renting	259	75.5
	2 = Owner/Landlord	42	12.2
	3 = Family House	31	9.0
	4 = Squatting	11	3.2
Proximity[a]	0 = Outside 5 km of coast	156	47.7
	1 = Within 5 km of coast	171	52.3
Prior Experience (Flood Severity)	1 = Not Severe	17	8.9
	2 = Slightly Severe	26	13.7
	3 = Moderately Severe	59	31.1
	4 = Very Severe	52	27.4
	5 = Extremely Severe	36	18.9
Trust in Government	1 = No trust	76	39.8
	2 = A little trust	49	25.7
	3 = Moderate trust	40	20.9
	4 = High trust	14	7.3
	5 = Very high trust	12	6.3
Information Sources	1 = My own opinion	69	23.6
	2 = Communications with my family	30	10.3
	3 = Communications with my peers	42	14.4
	4 = Information from the government	51	17.5
	5 = Information from media outlets (TV, Internet, Radio, etc.)	92	31.5
	6 = Others	8	2.7

[a] 1 km equals 0.6213 mile.

5. Discussion

Affect, probability and consequence are popular constructs used in assessing risk perception [16,35], although probability and consequence are the most used constructs, based on [36] 's review. Other studies have highlighted the role of the affect measure of risk perception on adaptive behavior, particularly negative emotions associated with a risk [37].

In this study, affect had the highest mean of 3.64 over consequence at 3.39 and probability with the least mean value at 3.09. These findings are supported by Ref. [16]; whose results show that affect and consequence were more significant measures of risk perception over probability across all hazards, including extreme weather events. Although affect can be expressed through positive and negative feelings about a risk [38], shows that negative affect, results in increased risk perception. In this study, worry was used as the phrase to delineate negative affect feelings through the survey. In the interviews, participants described risk perceptions with other terms used in

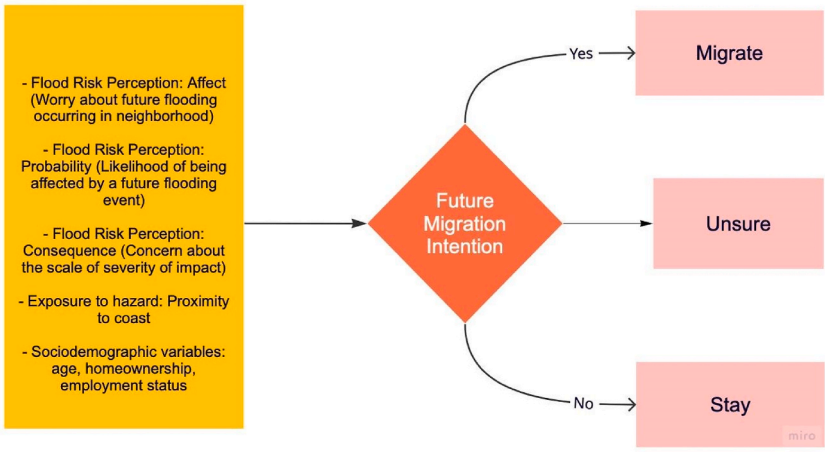

Fig. 2. Conceptual model of factors that influence future migration intentions.

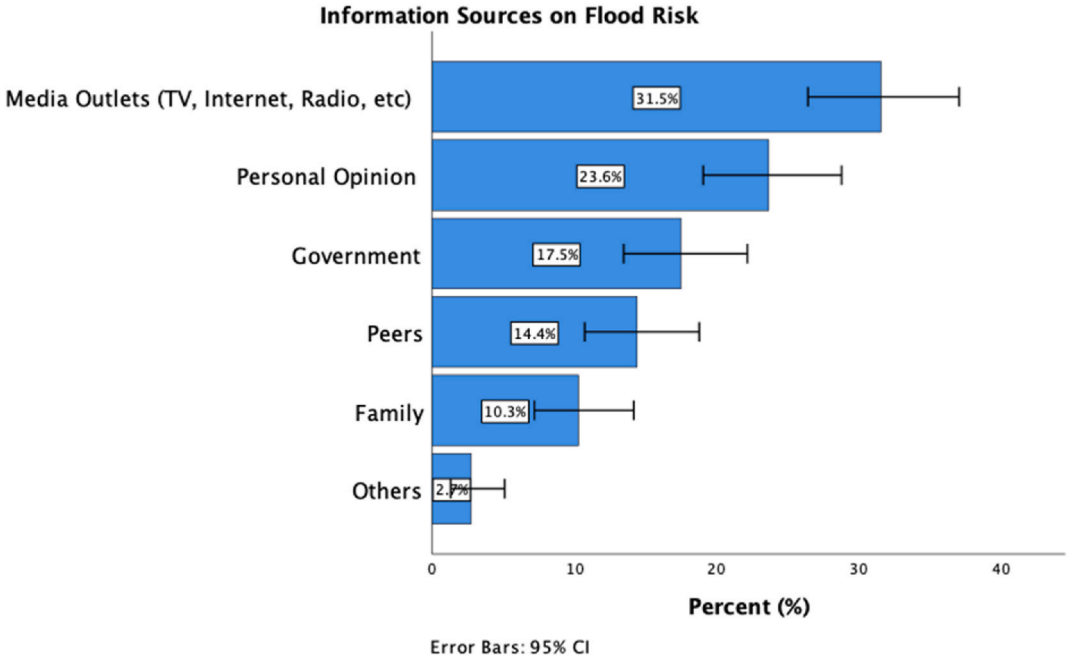

Fig. 3. Distribution of information sources on flood risk.

the literature such as fear, dread, concern [35,38]. For example, Kyle[4] a mainland resident expressed his feelings about flood risk in terms of *concern* and *danger*. He said:

> "So … the concern is not for me alone but for virtually most Lagosians, especially when we begin to talk about climate change, global warming, etc. And then … there are some that if we don't do what we normally do every year … Lagos … some parts of Lagos might be in great danger."

(Interview participant, phone, September 12, 2020).

It is seen through Kyle's statement above, that flood risk is not just a personal concern for him, but a concern for others in the city. Kyle situated his concern for flooding within the context of climate change posing future threats for Lagos. In contrast, a study of Norway by Ref. [23] finds that people were less worried about future climate change impacts on the wider country than for themselves, even when they had personal experience of related events. However, as demonstrated in that study, it could be argued that the

[4] All names from interviews are anonymized to protect the identity of the participants.

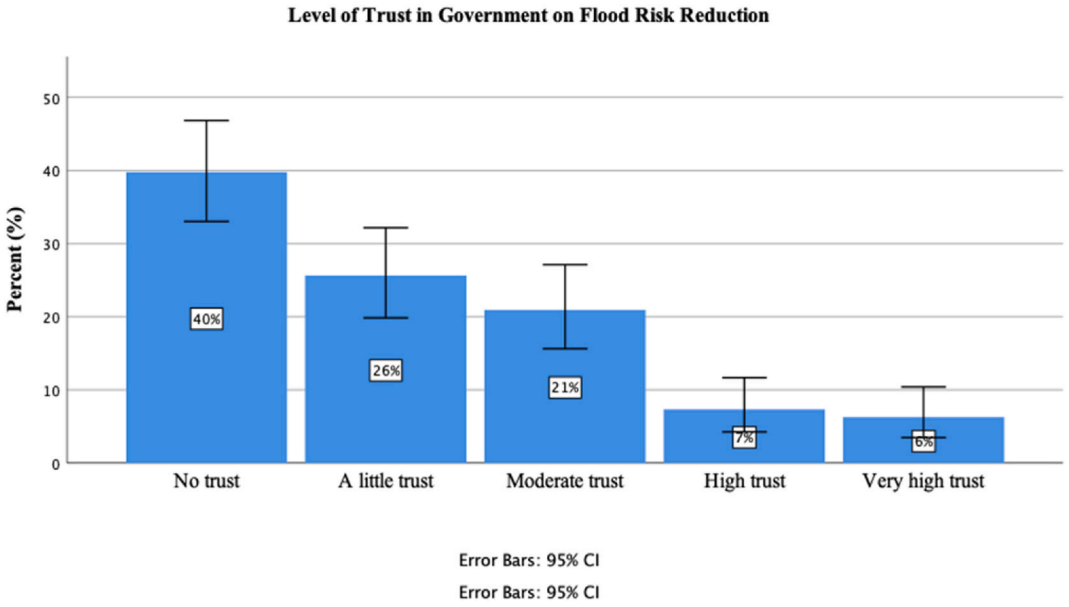

Fig. 4. Distribution of individuals' levels of trust in government on flood risk reduction.

Table 3
Means and Standard Errors of Risk Perception Measures. P < 0.05 significance level.

	N	Mean	Standard Errors
Affect (Worry)	188	3.64	0.095
Probability	188	3.09	0.100
Consequence	188	3.39	0.093

Table 4
Ordered Logistic Regression of Flood Risk Perception and Key Independent Variables. With standard errors in parenthesis. *p < 0.1; **p < 0.05; ***p < 0.01; B = ordered logistic regression coefficients; Exp (B) = Odd ratios.

	Affect (Worry) B.	Affect (Worry) Exp (B)	Future Probability B. =	Future Probability Exp (B)	Future Consequence B.	Future Consequence Exp (B)
Age	−0.065 (0.1637)	0.937	0.071 (0.1621)	1.074	−0.153 (0.1631)	0.858
Gender	0.281 0.3189	1.325	0.188 (0.3153)	1.206	0.075 (0.3077)	1.078
Education	0.056 (0.1256)	1.058	0.063 (0.1214)	1.065	0.160 (0.1153)	1.174
Proximity (Exposure)	0.360 (0.3086)	1.434	0.571 (0.3044)	1.771	0.920** (0.3098)	2.510
Prior Experience (Flood Severity)	0.893*** (0.1472)	2.442	0.587*** (0.1337)	1.798	0.843*** (0.144)	2.324
Government Trust	0.064 (0.1340)	1.066	−0.069 (0.1267)	0.933	0.014 0.1275)	1.015

presence of institutional support such as insurance policies, and trust in government makes people less worried about such impacts into the future. Yet, in Lagos, that would not be the case due to low trust in government and lack of prevalence of flood insurance policies.

This was echoed by some participants. For example, Kola stated:

> "Uhm … looking at the fact that this is still a developing world … I don't think there's an insurance cover for flooding … or maybe it's not highly pronounced. Maybe it could have been in circulation … but maybe it's not highly pronounced. Like, people don't have that orientation … like … it actually exists." *(Interview participant, phone, August 25, 2020)*

Others like *Ife*, a phone interview participant (Aug. 29, 2020) similarly mentioned a lack of awareness of flood insurance. Generally, survey results in Fig. 4 show that about 40% of the surveyed population had low trust in government. Although further analysis in

Table 5
Correlation Analysis of Future Migration Intent and Risk Perception *p < 0.01 **p < 0.05. Migrant (N = 127); Unsure (N = 45); non-Migrants (N = 5).

1. Migrant	1		
2. Unsure	−.748**	1	
3. Non-Migrant	−.350**	−.129*	1
4. Risk Perception (Affect)	.260*	−.180*	−.234**
5. Risk Perception (Probability)	.215**	−.162*	−.147
6. Risk Perception (Consequence)	253**	−.183*	−.194**
7. Age (log)	.047	−.013	.236**
8. Proximity to Coast	.158**	−.083	−.059
9. Homeowner	−.154**	−.030	181**
10.Student/Retiree	−.066	−.008	.199**

Table 4 does not show a statistically significant predicting relationship between flood risk perception and trust in government. The significance of trust as a predicting variable in risk perception studies is not uniform. While studies like [29] find trust to be significant, others like [18] do not find trust to be significant.

Overall, flood risk perceptions among the sampled population in Lagos for this study are moderate. One reason why people might not have high-risk perceptions of flood risk might be due to temporal reasons. In this study, participants were asked about their perceptions of flood risk into the near future. Temporal scales are important when assessing risk perceptions as demonstrated by these studies [23,39] whereby risks can be discounted based on the timescale with which they are being assessed.

Regarding predicting factors of flood risk perception in this study, results show that prior experience in terms of the severity of past flood impacts is the most predictive factor for all measures of flood risk perception. This finding, though not surprising, is confirmed by similar findings in the risk perception literature [22,23,28]. For example [28], reported that people with prior experience of flooding had higher perceptions of risk than those without prior experience, they also were more likely to modify their behavior to avoid future risk. This is important within the context of this study because it means that higher risk perceptions among those who have had severe experiences of flooding might make them more likely to choose migration options as a coping strategy. Although [40] argues that capabilities of individuals also play a role in adaptive behaviors beyond just risk perceptions.

Proximity to hazard (exposure), defined by those who live 5 km from the coast and those who live further apart was also significant in this study. However, proximity was significant only for the probability measure of risk perception. This implies that people who live within 5 km from the coast were more likely to have higher perceptions of the likelihood that a flooding event will affect them where they live in the near future. This could be because residents closer to the coast not only experience floods from heavy rainfall, but they also deal with flooding from storm surges [10]. In terms of probability being the only significant measure of flood risk perception, our finding is like that of [21]; who find that proximity (perceived distance) was not significant for the affective measure of flood risk perception but rather influences the cognitive measure of risk the most. However, they find the affect component of risk relates more to misperception of risk, whereby people who perceive that they live further from a hazard source may not be worried about flooding. The misperception of risk is reflected in the difference between perceived exposure and real exposure [21,28]. Equally important is the relationship between prior experience and proximity. In this study, at least in the case of probability as a measure of risk perception, both variables were significant. Multiple studies have shown that prior experience and proximity play a combined role in influencing risk perceptions [22,23,28]. [22] specifically state that prior experience and exposure interact for perceptions of future risks. This was not directly assessed in this study.

Socio-demographic variables on the other hand were not significant predictors of flood risk perception from data analysis in this study [29] assert that socio-economic variables act more as risk attenuators or amplifiers than as predictors of risk. Likewise, trust in government (social trust) was not a significant predicting variable in this study as expected [18]. show similar unpredictability of social trust. This might be because social trust amplifies or attenuates risk [29]. We argue that social trust likely shapes people's response to risk. Whereby, individuals who lack trust in government are more likely to seek personal risk management strategies. This is echoed through the interview response by Ola, he said:

> "Yes, I will … I'm going to migrate because … waiting for the government is [a] herculean task. Except it involves loss of life … so … that is when they are proactive. So, my safety comes first! So, I would rather leave that area to a less [flood] prone area."

(Interview participant, phone, August 28, 2020).

As results in Fig. 4 show, people indicated that media channels (TV, internet, radio) were most likely to inform their concerns about flooding. Several studies address the role of information channels in informing risk perceptions and how this might help with risk communication or intervention strategies [39,41]. Others assert that risk can be amplified and attenuated through communication [42,43]. Beyond informing risks, media as an information channel also can be used to facilitate coping strategies. For example, Kyle, an interview participant speaking about the role of media on informing flooding, and migration as a response, said:

> "Except that there are some news stations that really look into matters like this … Wazobia FM, for example, they have this program they call … I've forgotten its name … where people talk about the environment … How flooding is disturbing them … and things like that. So … when we get to hear these things, we'll get to know where this … as in these areas where flooding is disturbing, and we will not want to migrate there."

(Interview participant, phone, September 10, 2020).

Regarding the relationship between flood risk perception and migration as a future response, we find a statistically significant positive relationship between both variables (see Table 5 above). Although further predictive analysis is needed, results of our correlation analysis, show that an increase in flood risk perception is likely to result in positive intent to migrate in the future. This applies to flood risk perception measured in terms of worry about future flooding events, the probability of future flooding events and the likelihood of experiencing impacts. Studies such as [2] although focused on sea level rise, highlight this relationship between risk perception and coastal hazards. A further correlation analysis of people who choose not to migrate and those who are unsure of migrating, and flood risk perception reveals negatively significant relationships. This means that among people who have intentions to stay, their choice is not dependent on higher flood risk perception. There are several reasons why this might be the case. One reason can be linked to the concept of place attachment. Several studies have linked (im)mobility to place attachment where people choose not to migrate because of connections to their land or habitation [44–46]. A second reason for immobility can be linked to economic reasons. The term *trapped population* has been used by a suite of authors to describe this type of immobility [47–49], although people may be trapped for other reasons. Being trapped due to resource constraints is one where people do not have a choice [50]. However, economic reasons for staying can equally be voluntary. This was highlighted by an interviewee in this study. According to Ade (Phone interview, August 30, 2020) the choice to stay is because of the need to maintain livelihood, irrespective of flooding experiences. It is worth mentioning that in this study, those who intend to migrate, made up the greatest number at 145. Those who chose to stay were only 5. People who were unsure were 45. Crosstab analysis showed that among the 5 respondents who chose not to migrate, they were mostly slightly worried about future flooding events. They were also on lower levels for the probability and consequence measures of risk perception. This would explain the negative correlation for non-migration intentions and flood risk perception.

6. Conclusions

The purpose of this study was to explore flood risk perceptions and the relationship with future migration intentions. This was done through a case study of Lagos, Nigeria, a coastal megacity vulnerable to climate change with experiences of increased flooding events. While a few studies have looked at flood risk perception in Lagos under varying contexts [10,28,51], no study has situated flood risk perception within the context of climate-induced migration. For this study, the first research sub-question sought to reveal what the perceptions of flood risk are among the study population, through a consideration of three measures of risk – affect, probability, and consequence. The choice of all three measures was based on [16]'s. study, which stated that multidimensional models of risk perception are better than unidimensional measures, to capture risk perceptions. Results from the present study support Wilson et al.'s argument. We show that the mean differences between all three measures of affect (worry), probability and consequence were statistically significant. Affect (worry) had the highest mean of the three measures, even though overall results showed that study participants have neither low nor high perceptions of flood risk. Worry as a measure of risk perception has been reported to influence adaptive responses [37]. Specifically, the influence of worry on adaptive responses raises question of whether people who perceive flooding to be a threat are motivated to change their residential location to cope with anticipated future flooding events given climate change. Of which, results in this study suggest a positive relationship between flood worry and future migration intentions among a certain number of the population. Other studies like [52] show that prior flood experience among Lagos residents resulted in the application of adaptation strategies. However, this is not always the case [53]. contend that risk perception and coping strategies are affected by several other socio-economic, cultural, and political factors.

Results also revealed that prior experience measured by flood severity was statistically significant for all measures of risk perception. This influence of prior experience on flood risk perception in Lagos is affirmed by [28]'s study. Likewise, results further contribute to findings that suggest that proximity is a significant factor where personal experience of a hazard has been experienced [23]. In the absence of personal experience or proximity, access to external information such as the media may serve as a substitute [39]. Results from this research also show that media (TV, Radio, Internet) are major sources of information on flood risk. This is relevant because they can serve as platforms for risk communication and to motivate adaptive actions.

Lastly, results from this study show the importance of prior experience, validating parallel findings in the literature [18,22,28]. Having prior experience of a hazard can contribute to the number of adaptive measures people undertake [24,52]. Building on the work of [54] across geographical contexts, future inquiry exploring how historical responsiveness of disaster management and government have been, along with insurance considerations and trust that individuals have in these institutions are needed for further study. Another question needing further exploration is whether people who have had more severe experiences of flooding are likely to choose migration as an adaptation measure. Furthermore, questions on what mobility looks like for residents of neighborhoods within 5 km to the coast, who were found to have higher risk perceptions on average need to be explored. Are these people more likely to migrate elsewhere within the city, or to a different state or country. In addition, how do household income and other socioeconomic factors contribute to decision making?

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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