

Article

Public Perceptions of Flood and Extreme Weather Early Warnings in Greece

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Abstract: A crucial component for the success of any early warning system for flood and extreme weather phenomena is understanding people's perceptions and views of the warning processes and approaches. This paper aims to explore public perceptions on flood and extreme weather warnings as well as factors that influence these perceptions in Greece, a characteristic example of a country that has suffered several climate-related disasters in the recent past. To this end, a survey of 427 residents of the country was conducted between April 2021 and June 2021. The collected data were analyzed by using both descriptive and inductive statistics. The results showed that certain factors affect participants' views on early warnings, including demographics, perceived knowledge on floods, flood risk perception, and perceived self-efficacy. The above factors present statistically significant correlations with the perceived reliability and effectiveness of warnings, as well the degree to which participants perceived the expected phenomena as a threat to their well-being or a signal to take preventive actions. These correlations are described in detail in the present study, together with certain exceptions that exist. The findings are a strong indication that public perception has the potential to impact early warning systems' actual effectiveness, leading to certain practical implications for their improvement, particularly in multi-hazard, climate change-sensitive areas like the Mediterranean region.

Keywords: early warning; flood warning; risk perception; floods; extreme weather; public perceptions



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1. Introduction

Despite the significant technological advances in flood forecasting, warning, and visualization in recent years [1–3], as well as information reach [4–6], floods remain one of the deadliest natural hazards [7], even in parts of the world with sophisticated flood-risk prevention and warning measures [8,9].

Recent literature has provided strong evidence that a large portion of flood fatalities are related to underestimation or misjudgment of the risks of entering a flooded area [10–12]. A portion of victims choose to come in contact with floodwaters voluntarily despite being in an initial position of safety and being aware of the flood, pursuing what the literature describes as a “risk-taking, dangerous, or inappropriate behavior” [13–16] leading to accidents that were probably avoidable [17]. This is a strong indication that there is considerable room for improvement when it comes to preventing individuals from coming in contact with floodwaters and to the overall reduction of risk.

The above evidence also raises questions as to the efficiency and reach of flood and extreme weather warnings, including their reception and understanding by the general public. For example, previous works have shown that extreme weather and flood warnings can fail to trigger a reaction or elicit the desired behavior [18], can be misinterpreted, or even fail to reach people [5,19].

In addition, deficiencies can happen when people fail to personalize the warnings [18,20], when individuals underestimate the risks [21], or feel they are not able to take effective measures [22–24]. Other factors have been shown to influence the effectiveness of warning communications directly or indirectly, including the level of trust in authorities [25–28], the source of information [29], warning methods or media [30], the message content and shaping [31,32], and the knowledge or relevant training of people who receive them [33,34] among other factors.

The literature has shown that the effectiveness of communication on various threats also depends on the reliability of the messages and authorities [35]. Previous works have presented evidence showing that personal attributes of the warning receiver (i.e., demographic elements) [36,37] and the way individuals perceive the risk of floods and their knowledge have the potential to influence the way they receive warning messages [38–40]. In addition there is strong evidence that past flood experiences affect risk perception [41]. However, there is limited evidence on the role of past flood experiences and risk perception on how individuals perceive flood early warnings. In addition, there is limited understanding on whether or not demographics affect the views on the reliability and effectiveness of the messages.

Nevertheless, the perception that individuals have of the processes of early warnings issued by the authorities is a crucial part of their success. Even the most accurate warning has the potential to be ineffective if people choose to ignore it or do not trust its message. Despite its significance, the effectiveness of flood warning communication is poorly explored in parts of the world.

In the Eastern Mediterranean region, an area with a very rich record of catastrophic floods [42] and sensitive to climate change-related threats [43], studies on what influences the perception and views of the public on flood warnings are, to the best of our knowledge, very scarce. As a characteristic example of the region, Greece is a country that is often susceptible to catastrophic floods that on some occasions induce tragic life loss [44] as authorities and the public face the challenge of the rapid onset of floodwaters.

Based on the lack of evidence highlighted above, especially in the Eastern Mediterranean region, the following research hypotheses can be drawn:

- H1.** *Respondents' demographics are correlated with early warnings' perceived reliability and effectiveness.*
- H2.** *Respondents' demographics are correlated with the degree to which people upon hearing a warning feel threatened by the expected extreme event.*
- H3.** *Respondents' demographics are correlated with whether or not they feel they need to take action upon receiving a warning.*
- H4.** *Respondents' past flood experience is correlated with warnings' perceived reliability and effectiveness.*
- H5.** *Respondents' past flood experience is correlated with the degree to which people upon hearing a warning feel threatened by the expected extreme event.*
- H6.** *Respondents' past flood experience is correlated with whether or not they feel they need to take action upon receiving a warning.*
- H7.** *Respondents' flood risk perception is correlated with warnings' perceived reliability and effectiveness.*
- H8.** *Respondents' flood risk perception is correlated with the degree to which people upon hearing a warning feel threatened by the expected extreme event.*
- H9.** *Respondents' flood risk perception is correlated with whether they feel they need to take action upon receiving a warning.*
- H10.** *Respondents' perceived knowledge is correlated with warnings' perceived reliability and effectiveness.*

H11. Respondents' perceived knowledge is correlated with the degree to which people upon hearing a warning feel threatened by the expected extreme event.

H12. Respondents' perceived knowledge is correlated with whether or not they feel they need to take action upon receiving a warning.

H13. Respondents' perceived self-efficacy is correlated whether or not they feel they need to take action upon receiving a warning.

The scarcity of data on how laymen perceive extreme weather and flood warnings highlights the need to explore the field, especially in light of the possible impacts of climate change on extreme flood frequency. This work focuses on examining the perceptions of the general public on flood and extreme weather early warning processes in Greece, based on a questionnaire survey (for the questionnaire please see Appendix A), as well as on exploring possible statistical correlations with personal attributes and views of the participants. The rest of the study is organized as follows. We present the research sample and the factors analyzed, followed by a detailed description of our data and the approach used. Then, we present and discuss the findings and their practical implications.

2. Data and Methodology

To measure and analyze public perceptions on flood and extreme weather early warnings in Greece, an empirical study was carried out, using a structured questionnaire as the main research tool. Sample size was estimated by using the following equation of simple random sampling with substitution [45]:

$$n = \frac{(Z_{1-\alpha/2})^2 \times \bar{p} \times (1 - \bar{p})}{e^2}.$$

In the above equation, n refers to the total sample size, p to the pre-study estimate of the proportion to be measured, e to the accepted error and, $Z_{1-\alpha/2}$ to the standard normal deviate which takes a standard value based on the significance level set [45].

Thus, we primarily carried out a pilot study so as to estimate the percentage of people who have experienced a flood event in the past, because this is the variable of interest in our research. In the pilot study of 50 participants, we obtained that 40% of them have experienced a flood in the past. Thus, taking into consideration that the accepted error of our research is set at 5%, we use the following equation for the minimum acceptable sample size:

$$n = \frac{1.96^2 \times 0.40 \times (1 - 0.40)}{0.05^2} \cong 368.$$

Alternatively, the appropriateness of the sample size is also confirmed by other sources of theory. More specifically, according to Saunders et al. [46] the selected sample size is sufficient taking into account both the population of the country and the significance level of the research.

The questionnaire contained 16 questions and was distributed electronically by using a simple random sampling during the period between April 2021 and September 2021. As far as the random sampling is concerned, it was carried out on a national level by using email catalogues. To randomly select the sample, we numbered all the registered emails and, to ensure randomness, we have applied the RANDBETWEEN function of Microsoft Excel—Microsoft Office 2019 version, which produces the desired number of random registrations. This method is followed in other cases as well, and it is considered effective [47,48]. However, it should be noted that this process was run several times because not everyone responded to the invitations they received. Thus, a total of 9470 invitations were sent in order to obtain 427 valid responses, meaning a 4.5% response rate approximately.

The first part of the questionnaire contained questions about participants' demographics and the experience of a flood event in the past. The second part of the questionnaire was dedicated to participants' perceptions, views, and knowledge on extreme weather

and flood early warnings, whereas the third part was dedicated to the actions taken upon receiving a warning. Most of the questions were based on a 5-point Likert scale where items were coded from 1, referring to “strongly disagree,” to 5, referring to “strongly agree”. Furthermore, there were dichotomous and multiple response variables.

All the research data were statistically analyzed with both descriptive and inductive statistics, including correlation coefficients and statistical hypotheses tests. It is noted that the significance level of the research is set at 5% at which all the statistical tests are run.

Initially, a reliability test was run, in order to measure the questionnaire’s internal consistency. The Cronbach’s alpha values of the following table reveal an acceptable level of reliability (Table 1).

Table 1. Cronbach’s alpha values for the questionnaire used in the present study.

Parts of the Questionnaire	Cronbach’s Alpha
Perceptions and knowledge on extreme weather early warnings	0.765
Actions taken in case of extreme weather early warnings	0.798

Furthermore, in order to remedy of non-response error, the method of Armstrong and Overton [49] is used. As far as it is concerned, the first and the last 30 questionnaires were tested using the Mann–Whitney U test which did not reveal any statistically significant difference, meaning that the possibility of non-response error is low.

As far as the participants are concerned, their demographics are provided in the following table (Table 2).

Table 2. Participants’ demographics.

		Percent (%)
Gender	Male	45.1
	Female	54.9
Level of education	Primary education	1.4
	Secondary education	5.4
	Associate’s degree	10.8
	Bachelor’s degree	53.3
	Master’s degree/Doctoral degree	29.1
Family status	Unmarried	56.8
	Married	10.3
	Married with child/children	32.9

Concerning participants’ age, the mean value is equal to 37.16 years and the standard deviation is equal to 11.31 years meaning an almost equal distribution of the values. Lastly, it is found that the youngest participant is 19 years old, and the oldest one is 83 years old.

Given that official warnings in Greece do not differentiate between different types of floods, in the present survey we did not distinguish between these types, and we only used the generic terminology “flood” and “extreme weather” included in the official messages. It should be also noted that in Greece, according to the regulations, official flood and extreme weather warnings are issued by the Hellenic National Meteorological Service and the General Secretariat for Civil Protection. The warnings contain information on the location and timing of the expected phenomena, and they are usually announced by the majority of national or local media. At the same time, the warnings are sent to local authorities that upon receiving them are set in different levels of preparedness depending on the forecasted severity of the expected phenomena.

In addition, to confirm the representativeness of the sample through the abovementioned calculation of its size, the sample’s demographics are also compared with those of other surveys. It is found that the obtained results are close to the demographics of other papers concerning the case of Greece [50] and at the same time close to the data provided by the Hellenic Statistical Authority [51].

3. Results

3.1. Perceived Reliability

To begin with, regarding the perceived reliability of flood and extreme weather warnings, the respondents were split into positive (27.46%), negative (30.52%), and a large portion of neutral answers (42.02%) (Figure 1), illustrating balanced views amongst the participants and indicating that at least a significant part of the participants do not consider the warnings reliable.

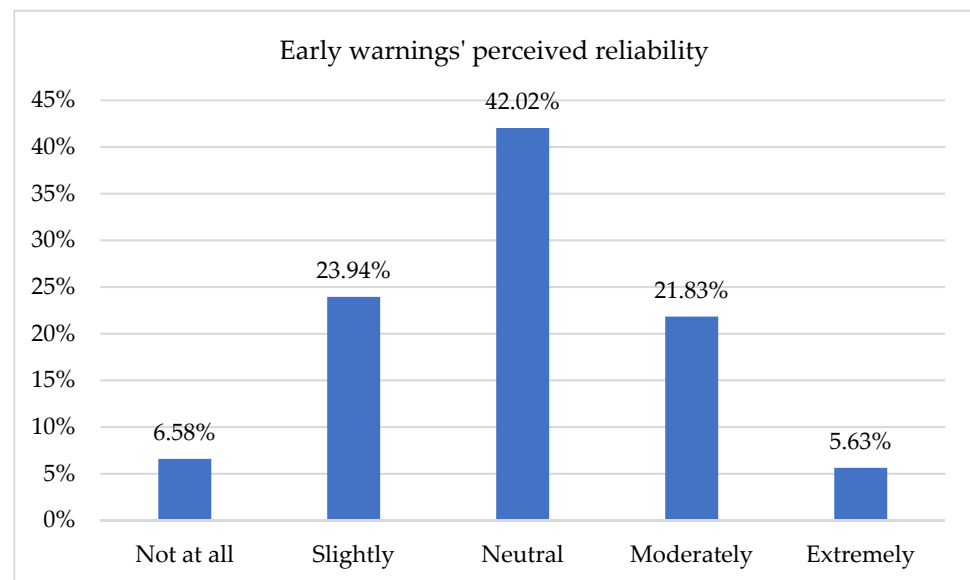


Figure 1. Distribution of answers regarding the reliability of flood and extreme weather warnings.

Figure 2 shows a variability of ratings in terms of reliability of the different sources of warning (official or not). Based on the respondents' views, the weather bureau (the Hellenic National Meteorological Service) is the most reliable source of early warning. On the contrary, relatives were found to be the least reliable sources of early warnings in the eyes of the participants.

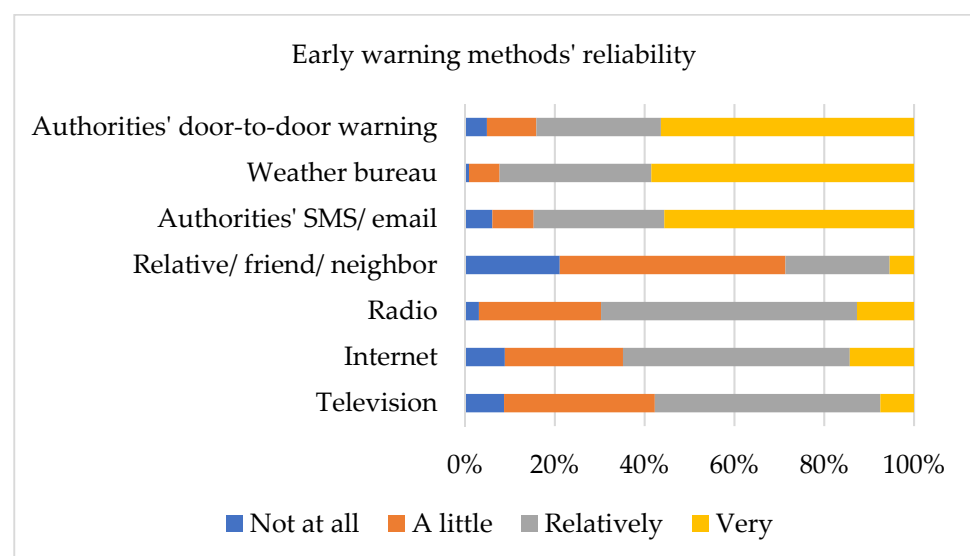


Figure 2. Early warning methods' perceived reliability.

The views on reliability of warnings were examined against various answers and attributes of the participants. In particular, by using Spearman's correlation coefficient it

was found that the respondents' educational level had a statistically significant correlation with their views on reliability (Table 3). The same result was obtained concerning respondents' family status based on the results of a Kruskal–Wallis test (Table 3). Following the Kruskal–Wallis test, successive Mann–Whitney U tests revealed that parents and people with higher education viewed the warnings as more reliable (Table 3). On the contrary, gender and age of the participants did not show any relationships (Table 3).

The impact of a flood experience on the perceived reliability of early warnings was examined as well, through Mann–Whitney U tests. Based on their results, we concluded that previous flood experience does not play a statistically significant role in the perceived reliability of the early warning methods (Table 3).

Furthermore, perceived reliability was found to be correlated with the perceived knowledge of the participants. In detail, we found that the higher the level of perceived knowledge that individuals have on the actions that need to be taken in case of a flood warning and on the flood phenomena themselves, the higher is their assessment on the reliability of flood warnings. In addition, participants who correctly acknowledge in another question that the state agencies actually issue warnings on extreme weather and dangerous phenomena, are the ones who evaluate the reliability of these warnings higher than the ones who answer wrongly or respond that they are not sure (Table 3).

Finally, perceived reliability of warnings was found to be statistically correlated with flood risk perception of individuals in a positive way. The higher the perception of risk for flooding the participants had, the higher the perceived reliability of warnings stated by the participants (Table 3).

Table 3. Perceived reliability and factors that show or do not show statistical correlations.

Variable 1	Variable 2	Test Value	Sig.	Test Type
Perceived reliability of floods and extreme weather early warnings	Flood event experience		0.427	Mann–Whitney
	Gender		0.059	
	Family status		0.044 *	
	Knowledge of warnings on extreme weather and dangerous phenomena issue by the state		0.001 *	Kruskal–Wallis
	Age	Rho = 0.016	0.742	
	Educational level	Rho = 0.106	0.029 *	Spearman's correlation coefficient
	Perceived knowledge on the actions that need to be taken in case of a flood warning	Rho = 0.281	0.000 *	
	Perceived knowledge on flood phenomena	Rho = 0.269	0.000 *	
	Risk of flood severity	Rho = 0.155	0.001 *	

* Statistically significant correlations at $p < 0.05$.

3.2. Perceived Threat from the Expected Phenomena

Furthermore, we explored the degree to which the participants feel threatened by the expected extreme phenomena upon receiving or hearing an early warning for their area. On a 1 to 5 scale (1 = not at all and 5 = extremely), they gave balanced answers, as 35% of respondents replied “not at all” (7.3%) or “slightly” (27.7%), whereas another 38.5% stated that they are “neutral”. Only 26.5% replied “moderately” or “extremely” (Figure 3).

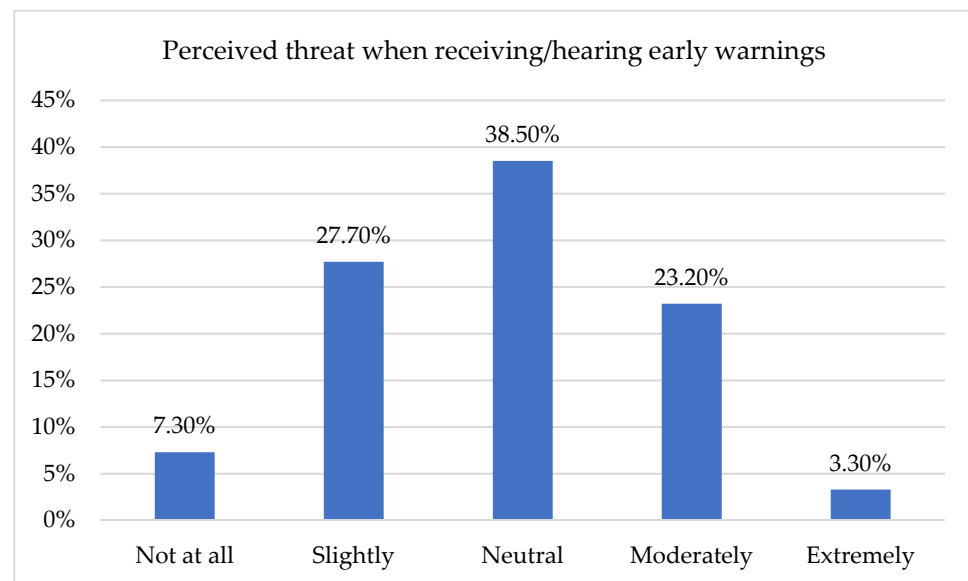


Figure 3. Distribution of answers concerning the degree to which the participants perceived flood early warnings in their area as a threat to their person, loved ones or to their property.

These answers on “perceived threat” were examined against various factors as well. We found statistically significant correlations with gender and family status (Table 4), as women and parents tend to provide a higher percentage of positive answers. In addition, it was found that flood risk perception of respondents showed a statistically significant relationship with the “perceived threat” in a positive way (Table 4). People who perceive flood risk as higher, tend to feel threatened upon a warning at a higher percentage. On the contrary, the “perceived threat” by the expected phenomena felt by the participants when they receive/hear a warning was not found to be correlated with experience of a flood event, knowledge on flood phenomena and flood warnings, age, and educational level of the participant (Table 4).

Table 4. Perceived threat by the expected phenomena upon receiving/hearing a warning and factors that show or do not show statistical correlations.

Variable 1	Variable 2	Test Value	Sig.	Test Type
Perceived threat based on flood early warnings	Flood event experience		0.275	Mann–Whitney
	Gender		0.004 *	
	Family status		0.012 *	
	Age	Rho = 0.016	0.742	Spearman’s correlation coefficient
	Educational level	Rho = 0.106	0.029 *	
	Perceived knowledge on the actions that need to be taken in case of a flood warning	Rho = −0.003	0.957	
	Perceived knowledge on flood phenomena	Rho = 0.000	0.999	
	Flood risk perception	Rho = 0.339	0.000 *	

* Statistically significant correlations at $p < 0.05$.

3.3. Perceived Effectiveness

Concerning the perceived effectiveness of early warnings, we found that SMS warnings (56.80%), sirens (54.50%), and authorities’ door-to-door warnings (51.90%) are rated as very effective at higher rates. On the other hand, email warnings, and radio and TV breaking news were rated lower in terms of effectiveness (Figure 4).

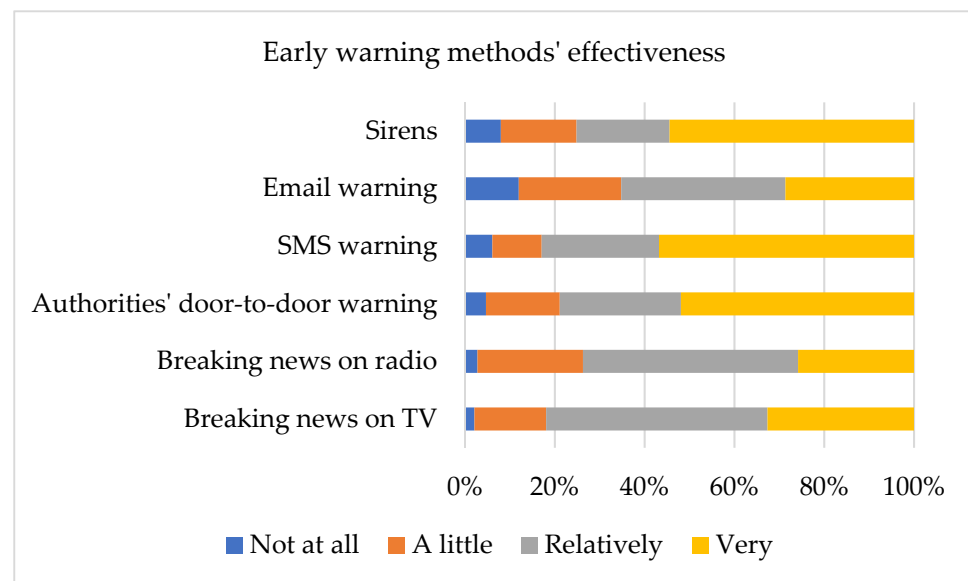


Figure 4. Early warning methods' perceived effectiveness.

Perceived effectiveness showed certain statistical correlations with demographics, flood experiences, and perceived knowledge of the participants. In particular, we found that older individuals tend to perceive the effectiveness of all the above warning methods as being higher. Both married and married-with-children participants perceive the effectiveness of TV breaking news, door-to-door, SMS, and email warnings as more effective in comparison with single respondents with a statistically significant difference as shown by the relevant Kruskal–Wallis tests (sig. < 0.005). On the contrary, gender (Mann–Whitney sig. = 0.059) and educational level (Rho = 0.106, sig. = 0.001) of the participants did not show any correlation with perceived effectiveness.

Previous experience of a flood also showed a relationship with perceived effectiveness of warnings (Figure 5).

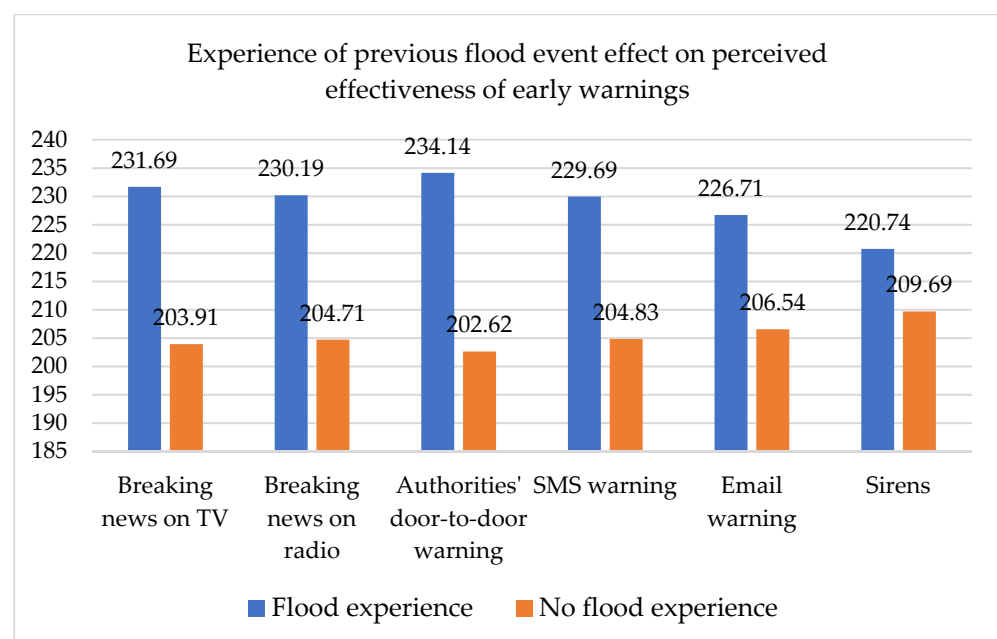


Figure 5. Mean ranks of early warning's perceived effectiveness based on flood event experience.

More specifically, the Mann–Whitney test's results reveal that people who have experienced a flood event tend to have a higher level of perceived effectiveness concerning

breaking news on TV (sig. = 0.016) and radio (sig. = 0.029), authorities' door-to-door warnings (sig. = 0.006), and SMS warnings (0.025). Based on Figure 5, the highest statistically significant difference is recorded in the case of authorities' door-to-door warnings. Moreover, we found that the higher the perceived knowledge of respondents on flood phenomena, the higher they perceived the effectiveness of TV-, radio-, SMS- and email-based early warnings (Table 5).

Finally, flood risk perception was found also to be correlated with perceived effectiveness of warnings. Individuals who assessed flood risk as higher, perceived the effectiveness of radio-, SMS- and email-based warnings as higher with a statistically significant difference (Table 5).

Table 5. Examination of potential correlations of perceived knowledge on flood phenomena and flood risk perception (Variable 1) with perceived effectiveness of warning sources (Variable 2).

Variable 1	Variable 2	Test Value	Sig.	Test Type
Perceived knowledge on flood phenomena	Breaking news on TV	Rho = 0.126	0.009 *	Spearman's correlation coefficient
	Breaking news on Radio	Rho = 0.173	0.000 *	
	Authorities' door-to-door warning	Rho = 0.017	0.721	
	SMS warning	Rho = 0.168	0.000 *	
	Email warning	Rho = 0.184	0.000 *	
	Sirens	Rho = −0.022	0.652	
Flood risk perception	Breaking news on TV	Rho = 0.002	0.972	Spearman's correlation coefficient
	Breaking news on Radio	Rho = 0.107	0.028 *	
	Authorities' door-to-door warning	Rho = 0.062	0.201	
	SMS warning	Rho = 0.102	0.036 *	
	Email warning	Rho = 0.190	0.000 *	
	Sirens	Rho = 0.070	0.150 *	

* Statistically significant correlations at $p < 0.05$.

3.4. Taking Action after Receiving a Warning

With regard to the degree to which the participants feel they need to take action upon receiving a warning, a significant percentage provided positive answers (Figure 6), as opposed to a smaller portion of respondents (16.43%) who responded negatively.

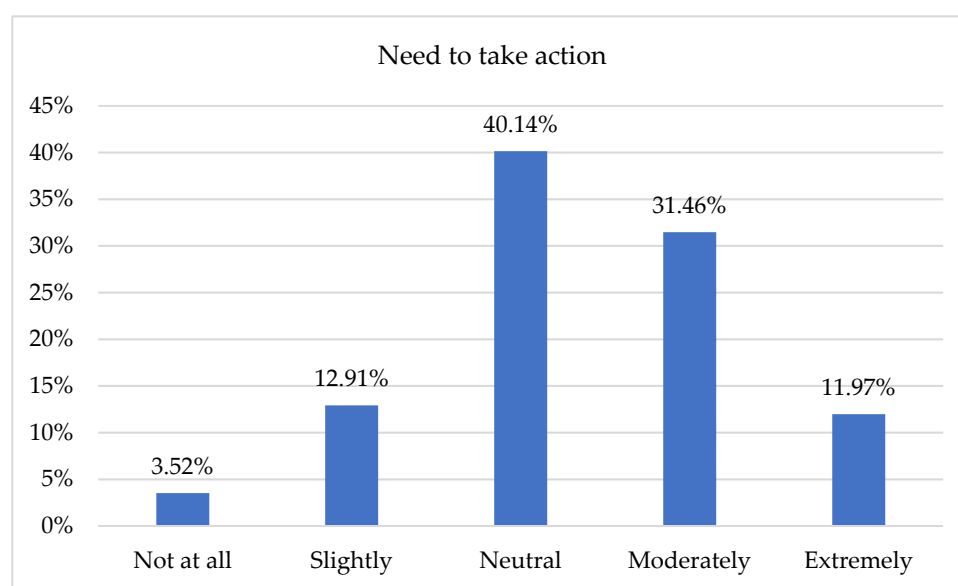


Figure 6. Distribution of answers with regard to the degree to which the participants feel they need to take action upon receiving a warning.

We examined potential correlations of these answers with personal attributes of views of the participants.

Family status and age of the respondents showed a positive statistically significant correlation with their feeling about taking action upon warning. In specific, older and married (or married-with-children) individuals were found to feel to a higher degree that taking action is needed after receiving a flood warning. Gender and educational level of the participants did not show any correlation, as well as previous experience with flood, which also marginally showed no statistically significant correlation (Table 6).

Flood-risk perception was shown to be positively correlated, as the higher the risk perception rated by the respondents, the more positive answers they gave when it comes to taking action upon flood warnings (Table 6). The participants' perceived threat from receiving a warning was also found to have a statistically significant correlation with their answers on taking action (Table 6).

With regard to knowledge, it is shown that individuals who perceive their knowledge as better, and individuals who actually provide more correct answers in relation to official warnings, tend to feel that action is needed upon warning to a higher degree (Table 6).

Finally, it was found that the participants' perception of their ability to cope with the demands of taking action against flood or extreme weather was also correlated with the degree to which they feel that action is needed to be taken upon receiving a warning (Table 6).

Table 6. Examination of potential correlations of different factors with the degree to which participants feel the need take action upon receiving a flood or extreme weather warning.

Variable 1	Variable 2	Test Value	Sig.	Test Type
Perceived need to take action when receiving flood early warnings	Flood event experience		0.052	Mann–Whitney
	Gender		0.110	
	Family status		0.000 *	Kruskal–Wallis
	Knowledge of warnings on extreme weather and dangerous phenomena issue by the state		0.005 *	
	Age	Rho = 0.149	0.002 *	Spearman's correlation coefficient
	Educational level	Rho = 0.051	0.290	
	Perceived knowledge on the actions that need to be taken in case of a flood warning	Rho = 0.256	0.000 *	
	Perceived knowledge on flood phenomena	Rho = 0.186	0.000 *	
	Risk of flood severity	Rho = 0.272	0.000 *	
	Perceived threat based on flood early warnings	Rho = 0.398	0.000 *	
	Perceived ability to cope with the demands of preparing against flood or extreme weather	Rho = 0.171	0.000 *	

* Statistically significant correlations at $p < 0.05$.

4. Discussion

This study focuses on exploring the views of the general public on the extreme weather and flood early warning processes in Greece, through a questionnaire survey, as well as the role of potential influencing factors. The work makes certain novel contributions to the literature given the lack of data on the Eastern Mediterranean region, but also records several statistically significant correlations affecting people's perceptions on flood early warning that to the best of our knowledge had a limited literature presence until today.

With regard to the warnings' perceived reliability, it was found that the participants were mostly balanced between positive, neutral, and negative views. The relatively small

percentage (27.46%) that was found to consider the warnings “moderately” or “extremely” reliable is concerning, given the importance of this factor in defining the response of people who receive it [40,52]. When different warning sources are evaluated, participants tend to rate the reliability differently, in agreement with previous findings [53], and assessing the official warnings issued by authorities as more reliable on average. This discrepancy found between official and unofficial warnings can be attributed to differences in the trustworthiness of the sources [54] and is a pattern identified in previous works [55]. It should be noted that responses to this question could be affected by social desirability bias [56] as well, and therefore they should be considered with caution. Further research should be carried out to address this matter and further explore other factors of messaging in relation to the source, including perceived urgency and immediacy.

The perceived reliability was found to be correlated with the educational level (in line with previous findings [57]) and the family status of participants. On the other hand, perceived effectiveness of warnings was found to be correlated with age and family status, thus confirming partly hypothesis H1. Parents tend to find the reliability increased, a trend that is probably attributed to a higher level of trust exhibited by this population group toward extreme weather and flood forecasting correlated by Diakakis et al. [50]. In addition, it was found that perceived knowledge is correlated positively with both perceived warning reliability and perceived effectiveness, confirming hypothesis H10. Further, flood-risk perception was correlated positively, with perceived reliability and perceived effectiveness confirming hypothesis H7, a result that supports previous findings [57].

No correlation was found between perceived reliability and previous flood experience, despite its significant role in flood-risk perception [41,58]. On the other hand, individuals' past flood experience was found to be correlated with the effectiveness of warnings, and therefore hypothesis H4 is only partly confirmed.

With regard to the degree to which individuals feel threatened by the expected phenomena upon receiving/hearing a warning, the participants provided fairly balanced answers. Again, an important (and concerning) percentage (35%) (answering “slightly” and “not at all”) did not consider that receiving a flood warning denotes a threat to themselves, their loved ones and/or their property. In addition, it was found to be strongly connected with the perception of risk that participants had for floods, a finding that confirms hypothesis H8. In addition, it was found that perceived threat upon hearing warning was related also to gender and family status, with females and parents feeling more threatened. This last result is in line with previous conclusions of the relevant literature that finds females and parents exhibiting, in general, higher flood-risk perception and worry in comparison to males and non-parents respectively [37,41,59]. Gender has been correlated in the previous studies with the importance of warnings and their sources as well [60]. Age and educational level do not show any correlation with perceived threat and therefore hypothesis H2 is only partly confirmed, as only certain demographics are found to be correlated. Previous experiences with flood events and perceived knowledge of floods, did not show any correlation with the perceived threat of the warnings, thus rejecting hypotheses H5 and H11 respectively.

With regard to the degree to which the participants feel they need to take action upon receiving a warning, a strong statistical correlation was found with flood risk perception ratings and perceived knowledge of the participants confirming hypotheses H9 and H12 respectively. Past flood experience, marginally, did not show an correlation and thus hypothesis H6 is rejected (marginally). With respect to demographics, age and family status showed a statistically significant correlation, as older individuals and parents were also found to feel to a higher degree that receiving a warning is a call to action. No relationship was found with gender and educational level, contrary to what other studies have found [61]. Therefore, only certain demographics are correlated with whether or not participants feel they need to take action upon hearing/receiving a warning, which only partly confirms hypothesis H3. Moreover, individuals who believed they can cope with

the demands of taking action, were more likely to feel to a higher degree that receiving a warning is a call to action, a finding which confirms hypothesis H13.

In general, demographics were found to be correlated with the factors that were only partially examined. The relationship of family status with certain factors, such as perceived reliability and the perceived threat is in line with previous findings showing that parents are more likely to be aware of warnings, have higher trust in forecasting and authorities, and score higher in flood-risk perception (also acknowledged by Diakakis et al. [50]).

Previous experience of a flood event, despite clearly affecting risk perception of flood and extreme weather phenomena [41,62], was found to have an overall limited influence, supporting previous literature findings in the region [46]. On the contrary, the factor that was shown to be of major importance is individual flood risk perception, which was found to be correlated with all aspects examined in this study, including perceived reliability and effectiveness of warnings, as well as the perception of threat and call to action felt by participants upon receiving flood or extreme weather warnings. Perceived knowledge was also shown to affect responses of participants when it comes to the reliability and effectiveness of warnings as well as their feelings on the need to take action upon receiving a warning. This confirms previous literature [34] and has practical implications in terms of indicating that enhancing knowledge and awareness can have a positive effect on protection of society.

Moreover, one of the important aspects of practical implications of the present study is the realization of the degree to which risk perception is correlated with all the examined dependent variables. This is a strong indication that it is a key factor in improving communication of flood and extreme weather warnings toward the general public. Measures and initiatives have to be taken to enhance the understanding and the risk perception that laymen have for floods, especially in a multi-hazard environment such as the Eastern Mediterranean region, where other catastrophic events (i.e., earthquakes or wildfires) can become more of a threat in public view [41], obscuring the realities of flood risk. Awareness campaigns highlighting the risk of floods and their potential impacts can have a positive impact on this front. Targeting specific population groups—such as males, younger and single individuals—that present shortcomings when it comes to the perception of warnings, (e.g., on their reliability and threat perception) can be also beneficial.

Interventions should be shaped in accordance with the results of the present and other studies, aiming to improve the response of the public to warnings through a targeted approach that capitalizes on particular population group characteristics. In simple words, awareness and educational campaigns should study the target population and select their messaging appropriately depending on its characteristics. Apart from the practical implications, the contribution of the present study lies in providing data for a largely unexplored region—that is, the Eastern Mediterranean. Given the variations of people's perceptions acknowledged by multiple studies for historical, cultural, and environmental reasons [63–68], this study can be considered a contribution to the puzzle of knowledge in the field for the region and for southern Europe. Further research in neighboring countries and across Europe is necessary to acquire a more complete understanding of the relationships explored here. Research could be expanded in terms of demographics exploring the financial capabilities and other social characteristics of individuals surveyed.

Overall, the findings support the general understanding that important changes have to be carried out to strengthen individual and community resilience [69]. Individual characteristics and an improved understanding of the factors that influence how people receive, appreciate, and respond to extreme weather and flood warnings is crucial to their effectiveness and efficiency. The results of the present study strengthen and support previous works conclusions [30,37] that illustrate the importance of individual characteristics and the significance of fine-tuning the communication to the public and the different groups, in order to elicit the appropriate responses [18,20].

5. Conclusions

This work explores the views and perceptions of laymen on extreme weather and flood warnings in Greece, as a characteristic example of the Eastern Mediterranean region. The results show that individuals may perceive differently the reliability and effectiveness of warnings and understand differently warnings as a call to take action and feel or not feel threatened upon receiving a warning, depending on various attributes, including demographics, their knowledge level, and most importantly, their perception of flood risk.

Overall, the low levels of perceived reliability and the high percentages of participants who did not consider the reception of a warning to be a threat to themselves, their loved ones or their property, and other deficiencies, highlighted our strong indications that the current warning efficiency has significant room for improvement.

The importance of influencing factors including demographics and knowledge level, but most importantly risk perception, illustrated in the present study have the potential to shape future interventions aiming to improve messaging and public response to flood and extreme weather warnings.

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Data Availability Statement: Not applicable.

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Appendix A

Questionnaire survey.

1. Have you personally experienced a flood event in the past that had impact on yourself, your loved ones, your property, your work or work environment, your neighborhood or living area?
☐ Yes ☐ No
2. Do you know if authorities issue warnings on flood and/or extreme weather phenomena?
☐ Yes ☐ No ☐ Don't know
3. How adequate would you rate your knowledge in relation to protective actions or measures you need to take upon hearing or receiving a warning regarding floods and extreme weather events?
☐ Not at all ☐ Slightly ☐ Relatively ☐ Very ☐ Extremely
4. How adequate would you rate your knowledge in relation to floods and extreme weather events?
☐ Not at all ☐ Slightly ☐ Relatively ☐ Very ☐ Extremely
5. How reliable do you consider early flood and extreme weather warnings?
☐ Not at all ☐ Slightly ☐ Relatively ☐ Very ☐ Extremely

6. How reliable do you consider early flood and extreme weather warnings when received through the following sources?
(Scale: 1 = Not at all, 2 = Slightly, 3 = Relatively 4 = Very, 5 = Extremely)
- 1 2 3 4 5
- Door-to-door warning by the authorities
Weather bureau
SMS/ email sent from the authorities
Relative/ Friend/ Neighbor
Radio
Internet
Television
7. Upon receiving or hearing a warning, to what degree do you feel threatened by the expected flood or extreme weather impacts on yourself, your loved ones or your property?
☐ Not at all ☐ Slightly ☐ Relatively ☐ Very ☐ Extremely
8. Please rate the importance of the risk of floods and relevant extreme weather events in your area.
☐ Not at all ☐ Slightly ☐ Relatively ☐ Very ☐ Extremely
9. Please rate the effectiveness of the following means/methods of communication of early warning in case of a flood or extreme weather.
(Scale: 1 = Not at all, 2 = Slightly, 3 = Relatively 4 = Very, 5 = Extremely)
- 1 2 3 4 5
- Sirens
Email warning
SMS warning
Door-to-door warning by the authorities
Breaking news on the radio
Breaking news on the TV
TV
10. Upon hearing or receiving a flood or extreme weather warning for your area, to what degree you feel that you need to take action to protect yourself, your loved ones or your property?
☐ Not at all ☐ Slightly ☐ Relatively ☐ Very ☐ Extremely
11. Upon hearing or receiving a flood or extreme weather warning for your area, to what degree you believe you can cope in terms of finances and other various demands of taking protection measures to face the expected phenomena?
☐ Not at all ☐ Slightly ☐ Relatively ☐ Very ☐ Extremely
12. Please indicate your gender:
13. Please indicate your age:
14. Please indicate the highest degree or level of education you have completed.
☐ Primary education ☐ Secondary education ☐ Associate's degree ☐ Bachelor's degree
☐ Master's degree/ Doctoral degree
15. Please indicate your family status.
☐ Unmarried ☐ Married ☐ Unmarried with child/ children ☐ Married with child/children
16. Please indicate where your home is located (municipality):

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