Chapter 3
Perception of the Self-Exposure to Geohazards in the Italian Coastal Population of the Adriatic Basin

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Abstract People living by the coast are particularly susceptible to natural hazards because of the proximity to the sea, in terms of dangerous (often deadly) and costly possible floods. Such condition, together with personal factors, can possibly influence their perception of self-exposure in the sense that other hazards may be perceived as the most impacting and the perception of the exposure to geohazards might be veiled. Therefore, we investigated the perception of self-exposure to geohazards of coastal residents of three Italian municipalities along the Adriatic Basin, involved in the European Project RESPONSe, namely, Lignano Sabbiadoro (Friuli-Venezia Giulia Region), Montemarciano (Marche Region), and Brindisi (Puglia Region). We investigated the possible influence of climate risk awareness, personal factors, namely, gender and age, and proximity of their house to the coast, on the variation of geohazards perception. Results indicate that in general people have a limited perception of geohazards, except for hydrological hazards, but the climate crisis is not fully recognized as a possible driver. Moreover, although barely recognized, age and gender influence the level of perception of geohazards. Additionally, at relatively small distances from the coast, the perception of geohazards shift to those more contingent to the respondents. Such findings suggest to the managing authorities the urge to customize different disaster risk reduction approaches to local peculiarities.

Keywords Risk perception · Self-exposure · Geohazards · Physical proximity · Adriatic basin

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3.1 Introduction

The Italian territory, given its geological complexity, is subject to geohazards such as hydrologic, landslide, seismic, and volcanic ones. Such multiplicity is included in the global background of climate change, which brings new impacts on the territory and adds to the complex tectonics. As a matter of fact, it is now evident that climate change is not just related to the increase of temperature or the intensification of rainfalls, but affects the way other events, such as floods and landslides, occur locally (Gariano and Guzzetti 2016; Blöschl et al. 2019; IPCC 2019). Such link is profusely studied in Italy (Messeri et al. 2015; Alvioli et al. 2018; Tiranti and Cremonini 2019; Orombelli and Pranzini 2020) and is expected to become potentially stronger in the future (Comegna et al. 2013; Gariano et al. 2017; Rianna et al. 2017; Sangelantoni et al. 2018). In addition, more and more people are exposed to geohazards as a consequence of the misuse of the territory (Alexander 1985; Wasowski et al. 2010; Cendrero et al. 2020; Gong et al. 2021), the progressive abandonment of mountain and hilly areas (Agenzia per la Coesione Territoriale 2014; Teti 2017; Reynaud and Miccoli 2018), as well as the fast population growth and urbanization in coastal areas (Nicholls and Lowe 2004; Romano and Zullo 2014; Orombelli and Pranzini 2020). Although the Italian territory experienced a considerable and variegated number of disasters (Guzzetti 2000; Barredo 2007; Giovannetti and Pagliacci 2017), the perception of being exposed to natural hazards changes over time, and some people still cling firmly to the idea that disasters can only happen to others (Burningham et al. 2008; Calandra 2012; Gugg 2022). Perception, indeed, is shaped by personal and direct experience of a specific event or can be the result of indirect information acquired by others' experience (Wachinger et al. 2013). The factors considered as influencing the level of perception have been largely investigated, in the sense of both increasing and decreasing the awareness of self-exposure. For example, several studies consider that personal factors, such as gender, age, education, and employment status, positively influence the understanding of being personally exposed to geohazards (Akşit et al. 2005; Armaş 2008; Armaş and Avram 2009), while several others support the opposite hypothesis (Plapp and Werner 2006; Siegrist and Gutscher 2006; Burningham et al. 2008; Tekeli-Yeşil et al. 2010). Similarly, several studies support the idea that being proximal (Spence et al. 2012; Wachinger et al. 2013; Brody et al. 2017; Liu et al. 2018; Zabini et al. 2021) and directly exposed to hazards increases the fear of being damaged and encourage to act to prevent such damages (Plapp and Werner 2006; Siegrist and Gutscher 2006; Miceli et al. 2008; Heitz et al. 2009; Wachinger and Renn 2010; Harvatt et al. 2011; Terpstra 2011; Ayal and Leal Filho 2017; Liu et al. 2018), while others support the idea that having experienced a disaster creates a sense of protection linked to the assumption that the same event cannot happen again (Halpern-Felsher et al. 2001; Burningham et al. 2008; Esteban et al. 2017). Therefore, the proximity to the coast can possibly influence the perception of self-exposure in the sense that other hazards may be perceived as the most impacting (Milfont et al. 2014) and the perception of the exposure to geohazards might be therefore veiled.

Several studies explored the way geohazards are perceived by the Italian population (Salvati et al. 2014; Antronico et al. 2017, 2020; Gravina et al. 2017; Avvisati et al. 2019; Cerase et al. 2019; Gioia et al. 2021), but the perception of the self-exposure to geohazards in the coastal population, proximal to specific contingent geohazards (e.g., coastal floods), needs to be deeper explored.

The aim of the study is to investigate the perception of self-exposure to geohazards, focusing on the coastal residents of three municipalities, Lignano Sabbiadoro (Friuli-Venezia Giulia Region), Montemarciano (Marche Region), and Brindisi (Puglia Region), respectively, in the Northern, Central, and Southern Adriatic. We investigated the possible influence of climate risk awareness, personal factors, namely, gender and age, and proximity of their house to the coast, on the variation of geohazards perception. The final purpose is to understand whether the range of geohazards perceived by the population varies with personal characteristics and moving from the coast toward the hinterland. Our findings can reveal pivotal information to help decision-makers designing effective local planning that considers specific social and territorial peculiarities.

3.2 Methods

3.2.1 Study Areas

The research presented in this chapter is part of the Interreg Italy–Croatia Project RESPONSe (Strategies to adapt to climate change in Adriatic regions). The project started in January 2019 and ended in April 2022, and involved four Italian and three Croatian partners. The project integrated scientific evidence regarding the future expected impacts of climate change in the Adriatic Basin and the direct involvement of local stakeholders. The final aim was to provide local policy makers of the selected pilot areas with the tools necessary to ensure climate-smart governance approaches. For project purposes, the Adriatic basin was divided in three macro areas, Northern, Central, and Southern Adriatic, and for each macro area one pilot area was selected for Italy and one for Croatia. Lignano Sabbiadoro, Montemarciano, and Brindisi are the three Italian pilot areas involved in the RESPONSe Project, respectively, located in Northern, Central, and Southern Adriatic (Fig. 3.1).

The Northernmost pilot area is Lignano Sabbiadoro, a flat municipality of 6948 residents and a density of about 442 people per km^2, located in the province of Udine, Friuli-Venezia Giulia Region, North-East of Italy. Lignano Sabbiadoro has a peculiar shape of a small strip of land surrounded by the sea. Moving toward south, Montemarciano is a municipality of 9872 residents and a density comparable to Lignano Sabbiadoro (about 443 people per km^2), located in the province of Ancona, Marche Region, Central Italy. Although mostly hilly, Montemarciano has a small flat resident village by the sea, Marina di Montemarciano, where the tourist activities are mainly concentrated. The southernmost investigated area, Brindisi, is a flat

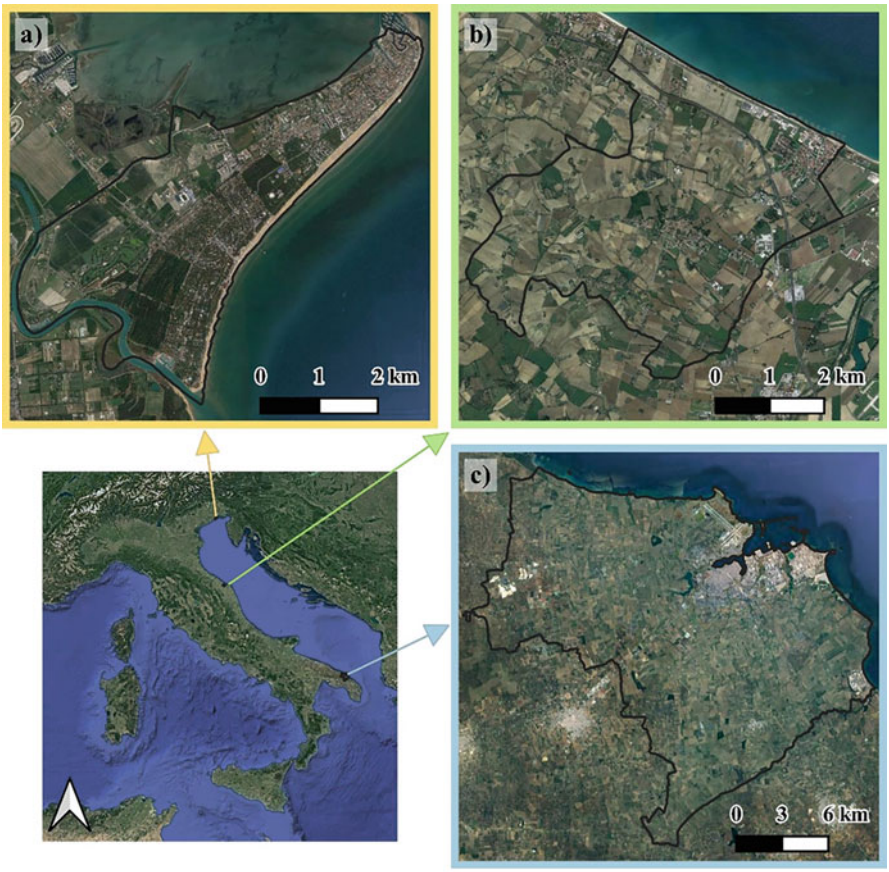

Fig. 3.1 The geographic location of Lignano Sabbiadoro (**a**), Montemarciano (**b**), and Brindisi (**c**)

Table 3.1 Overview of the geohazards to which the three pilot areas are exposed (Istat 2017; DPC 2021)

Pilot area	Hydraulic hazard (territory km^2)			Landslide hazard (territory km^2)			Seismic hazard	Volcanic risk
	Low	Medium	High	Low	Medium	High		
Lignano Sabbiadoro	1.44	0.52	0.35	–	–	–	Medium-low	–
Montemarciano	–	0.59	–	–	–	–	Medium-high	–
Brindisi	4.46	4.16	3.84	–	0.17	0.14	Low	–

municipality of 87,141 residents and a density of about 262 people per km^2, located in the homonymous province in Puglia Region, South-East of Italy. Brindisi is one of the main cities of Puglia Region and has one of the main important tourist and commercial ports of the Adriatic (Table 3.1).

3.3 Data Collection

To investigate the level of perception of self-exposure to geohazards of the population of the three pilot areas, we analyzed the responses provided to a questionnaire (available at https://bit.ly/3CsQqga) distributed to the population of the three municipalities as part of the RESPONSe project during the period March 2020–September 2021. For each question, a brief explanation of the key terms used (e.g., adaptation, mitigation) was included in order for respondents to provide consistent responses. The ongoing COVID-19 pandemic excluded the possibility to administer face-to-face questionnaires, which were therefore administered to the population through the websites and media channels (such as WhatsApp and Telegram) of the municipal authorities. The involved administrations promoted the questionnaire to the population through their own communication tools. Although having limitations (e.g., citizens without Internet access or not familiar with technology may be excluded from the survey a priori (Denscombe 2009)), online surveys are becoming an important tool for researchers (Minnaar and Heystek 2016) and are expected to definitely replace face-to-face surveys in the near future (Lefever et al. 2007).

The questionnaire was structured in two parts:

- Perception part, aimed at gathering information about the understanding of the exposure to the effects of climate change and the predisposition of the population to act to mitigate and adapt to climate change
- General part, aimed at identifying the demographic characteristics of the participants

The questions included in the questionnaire and considered for this analysis were of three types:

- Single answer questions for which respondents can select only one choice
- Single-answer questions on a psychometric scale for which the respondents are required to express their level of agreement with a stated assumption on a "Likert" scale
- Open questions

3.4 Data Analysis

The analyses were carried out to verify whether the degree of perception of self-exposure to geohazards is influenced by (a) demographic characteristics, such as gender and age; (b) the distance from the coast; and (c) the presence of other types of hazards in the surrounding area. To qualitatively verify the above hypotheses, five questions, two perception questions, and three demographic questions were selected from the questionnaire created for the purposes of the RESPONSe Project. The analyzed questions are shown in Table 3.2.

Table 3.2 Questions of the RESPONSe Project questionnaire selected for the study

Questions of the RESPONSe Project analyzed	Type of question
What are the main hazards (not only climate related) in your territory?	Open
Climate risks are becoming more important than others in your territory	Likert
Gender	Single answer
Age	Open
How far do you live from the coast?	Single answer

Using the IBM SPSS Statistic software, contingency tables were constructed to verify the degree of association between two of the variables under consideration. This methodology made it possible to evaluate the number of responses observed for all combinations of the categories of the two variables and to determine the relations between the analyzed variables. The results of the contingency table that showed the changing perception of self-exposure related to the distance from the coast was mapped using the QGIS software in order to visualize the differences in the way different geohazards are perceived.

For analytical purposes, the question asking what hazards persist in the local area was regrouped by the authors into the seven categories of hazards or impact proposed for the Emergency Events Database (EM-DAT) by the Centre for Research on the Epidemiology of Disasters (CRED): meteorological (e.g., intense precipitations); climatological (e.g., increasing temperatures); hydrological (e.g., flooding); geological (e.g., landslides); geophysical (e.g., earthquakes); environmental/biological (e.g., air/water pollution); and technological/anthropogenic (e.g., industrial accident) (CRED 2021). The choice was forced by the necessity to facilitate the interpretation of the responses, provided as open answer.

3.5 Results and Discussion

A total of 205 respondents filled in the questionnaire, reached through the media channels of the municipal authorities to stir the highest possible interest of the local communities. Consequently, 32 (15.6% of the total) questionnaires were collected from Lignano Sabbiadoro, 75 (36.6% of the total) from Montemarciano, and 98 (47.8% of the total) from Brindisi. Respondents were almost equally distributed between male and female (respectively, 51.7% and 48.3% for Lignano Sabbiadoro, 50.7% and 49.3% for Montemarciano, and 47.3% and 52.7% for Brindisi), though mostly adults between the ages of 35 and 64 years (73.3% for Lignano Sabbiadoro, 54.7% for Montemarciano, and 62.6% for Brindisi). The majority of respondents lives between 200 m and 1000 m from the coast in Lignano Sabbiadoro (42.9%) and farther than 1000 m from the coast in Montemarciano (46.7%) and Brindisi (50.6%).

Given the number of respondents related to the overall population in each of the three municipalities, the answers are considered strictly representatives of the involved respondents.

3.5.1 *Influence of Personal Factors and Climate Risk Awareness on the Perception of Self-Exposure to Geohazards*

3.5.1.1 Lignano Sabbiadoro (Friuli-Venezia Giulia Region)

Examining the perception of how the local hazards are framed into the climate crisis in Lignano Sabbiadoro (Table 3.3), hydrological hazards appear to gather the highest awareness of the respondents (63.3% of the total preferences), as they are always selected in spite of the importance associated to climate risks. On the contrary, meteorological and climatological hazards tend to receive higher awareness with the growing relevance recognized to climate risks. Such trend appears in the opposite direction for the geophysical hazards, as the associated preferences decrease with the greater importance expressed to climate risks. Significantly, geological hazards are rarely selected (4 times out of 30 respondents), regardless of the perceived importance of climate risks, and technological/anthropogenic hazards are never selected. In addition, among those who express a strong disagreement with the growing importance of climate risks, the most perceived hazards are the geophysical ones (6.7%), while the strong agreement tends to be associated with the hydrological hazards (13.3%), thus suggesting that acknowledging climate risks might be related to a higher sensitivity to their most immediate effects. Consequently, in general terms, results appear to suggest that geohazards are always the cluster with the highest preferences, independently of the perceived importance of climate risks.

Following, the investigation explored if and how gender influences the perception of local hazards (Table 3.3). In this case, it is possible to observe that males and females tend to recognize a similar relevance to hydrological hazards (31.0% and 34.5%, respectively) and to geological and geophysical ones (6.9%). Nevertheless, such hazards are followed by meteorological and climatological ones for males, while females reverse those positions. These results appear to suggest that gender indeed plays a role in the perception of local risks in the respondents of Lignano Sabbiadoro, aligning with the previous findings (Lindell and Hwang 2008; Keul et al. 2018; McDowell et al. 2020), especially highlighting the higher propensity of females for acknowledging local threats (Raška 2015). It is also worth to highlight the identical perception of geological and geophysical hazards for males and females. In such cases, it might be relevant to consider that in spite of the reported influence of gender on risk perception, such bias seemed to be limited if not invalidated by the common experience of disasters (Wachinger and Renn 2010). Hence, it might be assumed that in Lignano Sabbiadoro previous extreme events might have similarly affected males and females. Anyhow, it should be also taken into account that in this case the sample was rather restricted, hence a broader involvement might have led to different results and especially evidence a greater effect of gender on hazard and risk perception.

Analyzing the perception of geohazards among young (18–34 years), adult (35–64 years), and elderly (>64 years) respondents (Table 3.3), young and adults

Table 3.3 Cross table between the perception of the most relevant hazards affecting the Municipality of Lignano Sabbiadoro related to the perception of the importance of climatic risks, gender, and age. Frequencies (percentages) of the answers are indicated

	What are the main hazards (not only climate related) in your territory?							
	Meteorological	Climatological	Hydrological	Geological	Geophysical	Environmental/ biological	Technological/ anthropogenic	Total
Climate risks are becoming more important than others in your territory								
Strongly disagree	1 (3.3%)	0 (0.0%)	1 (3.3%)	1 (3.3%)	2 (6.7%)	0 (0.0%)	0 (0.0%)	3 (10.0%)
Disagree	0 (0.0%)	0 (0.0%)	2 (6.7%)	0 (0.0%)	1 (3.3%)	2 (6.7%)	0 (0.0%)	5 (16.7%)
Undecided	1 (3.3%)	4 (13.3%)	5 (16.7%)	2 (6.7%)	1 (3.3%)	2 (6.7%)	0 (0.0%)	8 (26.7%)
Agree	4 (13.3%)	2 (6.7%)	7 (23.3%)	1 (3.3%)	1 (3.3%)	0 (0.0%)	0 (0.0%)	9 (30.0%)
Strongly agree	1 (3.3%)	1 (3.3%)	4 (13.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (16.7%)
Total	7 (23.3%)	7 (23.3%)	19 (63.3%)	4 (13.3%)	5 (16.7%)	4 (13.3%)	0 (0.0%)	30 (100.0%)
Gender								
Male	5 (17.2%)	3 (10.3%)	9 (31.0%)	2 (6.9%)	2 (6.9%)	3 (10.3%)	0 (0.0%)	15 (51.7%)
Female	2 (6.9%)	4 (13.8%)	10 (34.5%)	2 (6.9%)	2 (6.9%)	1 (3.4%)	0 (0.0%)	14 (48.3%)
Total	7 (24.1%)	7 (24.1%)	19 (65.5%)	4 (13.8%)	4 (13.8%)	4 (13.8%)	0 (0.0%)	29 (100.0%)
Age								
Young (18–34 years)	0 (0.0%)	2 (6.7%)	3 (10.0%)	0 (0.0%)	2 (6.7%)	0 (0.0%)	0 (0.0%)	6 (20.0%)
Adult (35–64 years)	6 (20.0%)	5 (16.7%)	16 (53.3%)	4 (13.3%)	2 (6.7%)	4 (13.3%)	0 (0.0%)	22 (73.3%)
Elderly (>64 years)	1 (3.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (3.3%)	0 (0.0%)	0 (0.0%)	2 (6.7%)
Total	7 (23.3%)	7 (23.3%)	19 (63.3%)	4 (13.3%)	5 (16.7%)	4 (13.3%)	0 (0.0%)	30 (100.0%)

seem to perceive more hydrological hazards (10.0% and 53.3%, respectively), but youngers give to climatological and geophysical hazards the same importance (6.7%), while adults perceive geological and geophysical hazards as less important than climatological and meteorological ones. Elderly respondents only perceive geophysical hazards (3.3%), with the same intensity of climatological ones. Such outcome corroborates the findings in previous studies which see age linked to experience as influencing perception (Wachinger and Renn 2010). As a matter of fact, Lignano Sabbiadoro residents have a low-medium probability of experiencing an earthquake and a higher possibility of experiencing flooding (Table 3.1).

3.5.1.2 Montemarciano (Marche Region)

Examining the perception towards the climatic crisis and the hazards insisting in the territory, results show that a large part of the respondents in Montemarciano is undecided (48.0%) whether climate risks are becoming more important than others in their local area (Table 3.4). Among these, the majority believes that the most threatening hazards are hydrological (36.0%) and, less importantly, environmental/biological (18.7%). Nonetheless, hydrological hazard is the most perceived also within those who strongly disagree/disagree (5.4%) and those who agree/strongly agree (24.0%) with the growing importance of the climate risks. However, compared to the former, these latter respondents are more prone to consider relevant also all the other hazards. On the contrary, geological hazard seems to be equally perceived (4.0%) among both the concordant and the discordant opinions on the climate risks. Such outcomes suggest that the respondents that are not aware of the climate crisis are consequently reluctant to link climate change with their second order effects, such as climate-related geohazards. This is consistent with the results of comparable studies carried out both in Italy (Gioia et al. 2021) and in other countries (Whitmarsh 2008; Damm et al. 2013).

When considering the influence of gender on the importance attributed to local hazards, the respondents of Montemarciano reported a rather varied a picture (Table 3.4). Hydrological hazards tend to receive more consensus compared to other geohazards regardless of gender, though geological and geophysical hazards received more preferences by females (9.3% and 8.0%, respectively) than from males (4.0% and 1.3%, respectively). It might be interesting to observe that gender seems to influence the perception of meteoclimatic hazards, as males tend to give more relevance to meteorological hazards than to climatological ones compared to females. Results from Montemarciano appear to confirm that gender plays a role in risk perception, though it might be tempered by other personal factors. For instance, similar to the respondents from Lignano Sabbiadoro, the common high rate of the hydrological hazards might be due to a significant exposure to such threats, as it has already been cleared out that the effect of gender might be overruled by past experiences (Wachinger and Renn 2010).

With regard to age (Table 3.4), it is possible to observe that young respondents (18–34 years) perceive geological (5.3%) and geophysical hazards (4.0%) more than

Table 3.4 Cross table between the perception of the most relevant hazards affecting the Municipality of Montemarciano related to the perception of the importance of climatic risks, gender, and age. Frequencies (percentages) of the answers are indicated

	What are the main hazards (not only climate related) in your territory?							
	Meteorological	Climatological	Hydrological	Geological	Geophysical	Environmental/ Biological	Technological/ Anthropogenic	Total
Climate risks are becoming more important than others in your territory								
Strongly disagree	0 (0.0%)	1 (1.3%)	2 (2.7%)	1 (1.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (2.7%)
Disagree	0 (0.0%)	1 (1.3%)	2 (2.7%)	2 (2.7%)	1 (1.3%)	1 (1.3%)	0 (0.0%)	3 (4.0%)
Undecided	4 (5.3%)	6 (8.0%)	27 (36.0%)	4 (5.3%)	3 (4.0%)	14 (18.7%)	0 (0.0%)	36 (48.0%)
Agree	1 (1.3%)	3 (4.0%)	8 (10.7%)	0 (0.0%)	0 (0.0%)	3 (4.0%)	1 (1.3%)	13 (17.3%)
Strongly agree	2 (2.7%)	5 (6.7%)	10 (13.3%)	3 (4.0%)	3 (4.0%)	7 (9.3%)	1 (1.3%)	21 (28.0%)
Total	7 (9.3%)	16 (21.3%)	49 (65.3%)	10 (13.3%)	7 (9.3%)	25 (33.3%)	2 (2.7%)	75 (100.0%)
Gender								
Male	6 (8.0%)	7 (9.3%)	27 (36.0%)	3 (4.0%)	1 (1.3%)	13 (17.3%)	1 (1.3%)	38 (50.7%)
Female	1 (1.3%)	9 (12.0%)	22 (29.3%)	7 (9.3%)	6 (8.0%)	12 (16.0%)	1 (1.3%)	37 (49.3%)
Total	7 (9.3%)	16 (21.3%)	49 (65.3%)	10 (13.3%)	7 (9.3%)	25 (33.3%)	2 (2.7%)	75 (100.0%)
Age								
Young (18–34 years)	1 (1.3%)	3 (4.0%)	10 (13.3%)	4 (5.3%)	3 (4.0%)	7 (9.3%)	0 (0.0%)	20 (26.7%)
Adult (35–64 years)	5 (6.7%)	9 (12.0%)	31 (41.3%)	4 (5.3%)	4 (5.3%)	12 (16.0%)	1 (1.3%)	41 (54.7%)
Elderly (>64 years)	1 (1.3%)	4 (5.3%)	8 (10.7%)	2 (2.7%)	0 (0.0%)	6 (8.0%)	1 (1.3%)	14 (18.7%)
Total	7 (9.3%)	16 (21.3%)	49 (65.3%)	10 (13.3%)	7 (9.3%)	25 (33.3%)	2 (2.7%)	75 (100.0%)

climatological ones. On the contrary, climatological hazards are more perceived by adult (35–64 years) (12.0%) and elderly (>64 years) (5.3%) respondents. Furthermore, geophysical hazards seem not to be perceived at all by elderly and very little by adults (5.3%). Therefore it is possible to assume that age and individual experience influence hazards perception, as for instance in the case of climatological hazards, an older age corresponds to a longer exposure to the induced changes on the local area, thence a higher awareness (Ayal and Leal Filho 2017).

3.5.1.3 Brindisi (Puglia Region)

Examining the relations between the perceived more recurring hazards and the importance of climate change over other risks in the local area (Table 3.5), results appear to confirm that in Brindisi the perception of hydrological and climatological hazards is higher than other hazards, and, as in Montemarciano, the majority of the respondents are undecided about the importance of climate change over other risks (46.2%). This situation seems to suggest that hydrological hazards could be associated with climatological ones, but it is not clear whether they are considered consequences of climate change. Geological and geophysical hazards are always overcome by other types of hazards. Overall, the perception of climate change impacts is highly associated with hydrological events and little associated with geological and geophysical hazards. This result seems to support the idea that respondents in Brindisi mainly identify the climate crisis with hydrological, climatological, and environmental/biological hazards and not also with meteorological phenomena or geological and geophysical events.

The cross-tabulation reporting the influence of gender on the perceived local hazards shows a significant difference in the expressed preferences (Table 3.5). In terms of most perceived hazards in the local area, males appear to rank first climatological hazards (22.2%), then hydrological (20.9%), and environmental/biological (13.2%). Conversely, females seem to give primary importance to hydrological hazards (28.6%), followed by climatological (22.2%) and environmental/biological (17.6%) ones. It also appears that males tend to perceive similarly the first two hazards, while females provide a smaller gap between the second two. This suggests that though climatological and hydrological hazards remain the highest concern for all the respondents, the relative importance seems to be indeed influenced by gender. An analogous situation emerges in the case of the remaining geohazards. In this case, though hydrological hazards outnumber all the others for both genders, males tend to notice geological hazards more significantly compared to females, who conversely indicate more frequently geophysical ones (3.3% for females, 0.0%, for males). Overall, it might be significant to observe that geophysical hazards received the least preferences from both genders (cumulative 3.3%). The presented outcomes appear to confirm the suggested hypothesis that, as already emerged in Lignano Sabbiadoro and Montemarciano, gender significantly influences the perception of local hazards (Ho et al. 2008; Lindell and Hwang 2008; Goldsmith et al. 2013; Keul et al. 2018; McDowell et al. 2020).

Table 3.5 Cross table between the perception of the most relevant hazards affecting the Municipality of Brindisi related to the perception of the importance of climatic risks, gender, and age. Frequencies (percentages) of the answers are indicated

	What are the main hazards (not only climate related) in your territory?							
	Meteorological	Climatological	Hydrological	Geological	Geophysical	Environmental/ Biological	Technological/ Anthropogenic	Total
Climate risks are becoming more important than others in your territory								
Strongly disagree	1 (1.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.1%)
Disagree	0 (0.0%)	2 (2.2%)	1 (1.1%)	0 (0.0%)	0 (0.0%)	1 (1.1%)	0 (0.0%)	3 (3.3%)
Undecided	5 (5.5%)	19 (20.9%)	20 (22.0%)	1 (1.1%)	2 (2.2%)	10 (11.0%)	5 (5.5%)	42 (46.2%)
Agree	0 (0.0%)	13 (14.3%)	15 (16.5%)	3 (3.3%)	1 (1.1%)	11 (12.1%)	1 (1.1%)	30.8%)
Strongly agree	3 (3.3%)	6 (6.6%)	9 (9.9%)	1 (1.1%)	0 (0.0%)	6 (6.6%)	2 (2.2%)	17 (18.7%)
Total	9 (9.9%)	40 (44.0%)	45 (49.5%)	5 (5.5%)	3 (3.3%)	28 (30.8%)	8 (8.8%)	91 (100.0%)
Gender								
Male	7 (7.7%)	20 (22.0%)	19 (20.9%)	4 (4.4%)	0 (0.0%)	12 (13.2%)	2 (2.2%)	43 (47.3%)
Female	2 (2.2%)	20 (22.0%)	26 (28.6%)	1 (1.1%)	3 (3.3%)	16 (17.6%)	6 (6.6%)	48 (52.7%)
Total	9 (9.9%)	40 (44.0%)	45 (49.5%)	5 (5.5%)	3 (3.3%)	28 (30.8%)	8 (8.8%)	91 (100.0%)
Age								
Young (18–34 years)	3 (3.3%)	13(14.3%)	11 (12.1%)	0 (0.0%)	3 (3.3%)	9 (9.9%)	2 (2.2%)	29 (31.9%)
Adult (35–64 years)	6 (6.6%)	25 (27.5%)	32 (35.2%)	4 (4.4%)	0 (0.0%)	18 (19.8%)	6 (6.6%)	57 (62.6%)
Elderly (>64 years)	0 (0.0%)	2 (2.2%)	2 (2.2%)	1 (1.1%)	0 (0.0%)	1 (1.1%)	0 (0.0%)	5 (5.5%)
Total	9 (9.9%)	40 (44.0%)	45 (49.5%)	5 (5.5%)	0 (3.3%)	28 (30.8%)	8 (8.8%)	91 (100.0%)

Examining how age influences the perception of hazards among respondents, it is possible to observe a trend similar to Lignano Sabbiadoro between age groups (Table 3.5). Specifically, young respondents (18–34 years) perceive more climatological (14.3%) and hydrological (12.1%) hazards, but they do not consider geological hazards at all. Adults (35–64 years) prefer hydrological hazards (35.2%) over the others. Elderly people (>64 years) equally perceive climatological and hydrological (2.2%), while geological and environmental/biological (1.1% each) hazards are less perceived. As for youngers, they seem to have no perception of geophysical hazards. Overall, hydrological hazards are highly perceived, while geological and geophysical hazards are scarcely perceived. Results in Brindisi reinforce the evidence emerged from Lignano Sabbiadoro and Montemarciano, confirming that regardless of age, hydrological and climatological hazards are more perceived than the others and the geological and geophysical hazards are barely perceived. This might be due to the direct experience of floods of Brindisi respondents. Indeed, 5.6% of the population lives in areas subject to hydrological risk, and the frequency of adverse events might have blurred the influence of age towards hazard perception (Liu et al. 2018).

3.5.2 Influence of the Proximity to the Coast on the Perception of Self-Exposure to Geohazards

3.5.2.1 Lignano Sabbiadoro (Friuli-Venezia Giulia Region)

In Lignano Sabbiadoro most of the respondents who live closest to the coast believes that the main threatening hazard in their area is hydrological (10.7%), followed by climatological (6.7%) and geophysical (6.7%) (Fig. 3.2a and Table 3.6). Moving away from the coast, the hydrological hazard strengthens (25.0% of the choices for both who lives at 200–1000 m and at more than 1000 m from the coast), while climatological and geophysical hazards lose their importance and are replaced by meteorological, geological, and environmental/biological ones (respectively, 14.3%, 7.1%, and 7.1% at more than 1000 m). This suggests that the close proximity to the coast might weaken the perception of the risk posed for instance by storms, landslides, and pollution, in favor of threats more contingent such as coastal floods, coastal erosion, or sea level rise. As a matter of fact, in Lignano Sabbiadoro, even the inhabitants who declared to live at more than 1 km far from the coast are located in a flat peninsula surrounded by the Adriatic Sea, the Marano lagoon, and the Tagliamento river mouth (Fig. 3.1a). Additionally, as reported in Table 3.1, the probability of earthquakes is medium-low. In this geographic context, among the geohazards, the citizens are indeed exposed only to the hydrological one, which is accordingly the most recognized. Yet, an outwardly change in the living location seems to affect the geohazards perception (Miceli et al. 2008).

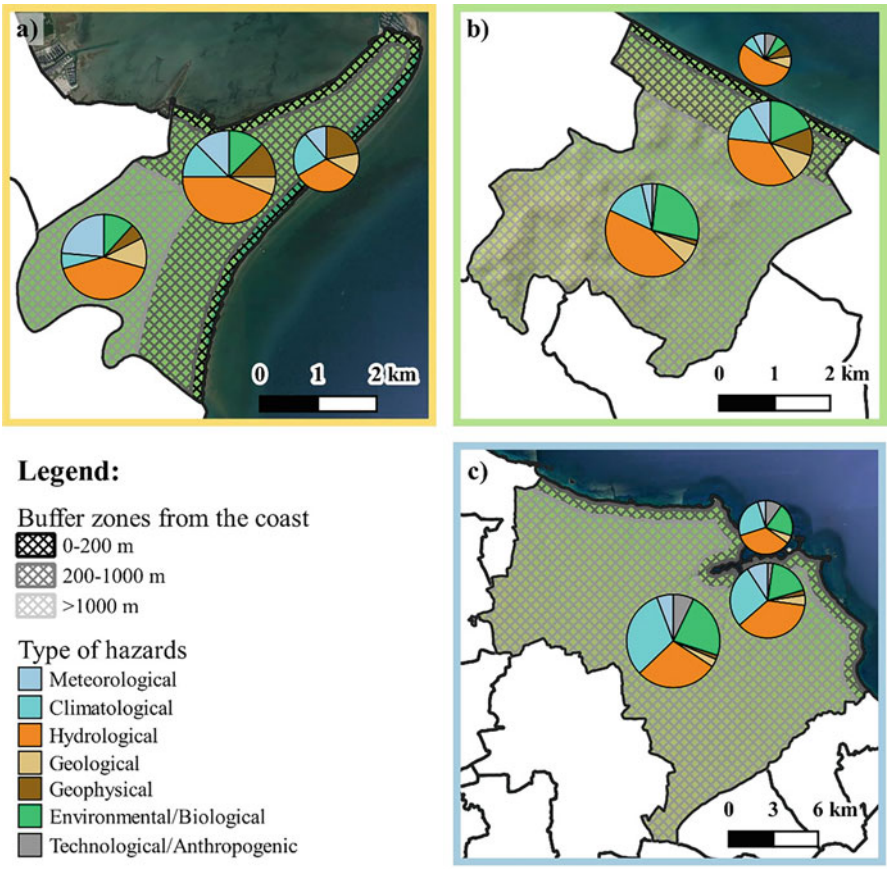

Fig. 3.2 Map of the three buffer zones, namely, 0–200, 200–1000, and >1000 m, and the related hazards perception for the Municipality of Lignano Sabbiadoro (**a**), Montemarciano (**b**), and Brindisi (**c**)

3.5.2.2 Montemarciano (Marche Region)

In Montemarciano most of the respondents who live closest to the coast believe that the main threatening hazard in their area is hydrological (9.7%), followed by all the other hazards with equal percentages (1.3%) (Fig. 3.2b and Table 3.6). As we move away from the coast, similar to Lignano Sabbiadoro, the hydrological hazard strengthens, with 22.7% of the choices for who lives at 200–1000 m and 33.3% for who lives at more than 1000 m from the coast. Moreover, a specific upward trend can be noted for climatological (1.3%–9.3%–10.7%), environmental/biological (1.3%–12.0%–20.0%), and, even if less distinctly, for geological (1.3%–6.7%–5.3%) hazards. On the other hand, the trends for meteorological, geophysical, and

Table 3.6 Cross table between the perception of the most relevant hazards affecting the three municipalities related to the proximity to the coast. Frequencies (percentages) of the answers are indicated

		What are the main hazards (not only climate related) in your territory?							
		Meteorological	Climatological	Hydrological	Geological	Geophysical	Environmental/ biological	Technological/ Anthropogenic	Total
How far do you live from the coast?									
Lignano Sabbiadoro	0–200 m	1 (3.6%)	2 (7.1%)	3 (10.7%)	1 (3.6%)	2 (7.1%)	0 (0.0%)	0 (0.0%)	6 (21.4%)
	200–1000 m	2 (7.1%)	2 (7.1%)	7 (25.0%)	1 (3.6%)	2 (7.1%)	2 (7.1%)	0 (0.0%)	12 (42.9%)
	>1000 m	4 (14.3%)	1 (3.6%)	7 (25.0%)	2 (7.1%)	1 (3.6%)	2 (7.1%)	0 (0.0%)	10 (35.7%)
	Total	7 (25.0%)	5 (17.9%)	17 (60.7%)	4 (14.3%)	5 (17.9%)	4 (14.3%)	0 (0.0%)	28 (100.0%)
Montemarciano	0–200 m	1 (1.3%)	1 (1.3%)	7 (9.3%)	1 (1.3%)	1 (1.3%)	1 (1.3%)	1 (1.3%)	11 (14.7%)
	200–1000 m	4 (5.3%)	7 (9.3%)	17 (22.7%)	5 (6.7%)	5 (6.7%)	9 (12.0%)	0 (0.0%)	29 (38.7%)
	>1000 m	2 (2.7%)	8 (10.7%)	25 (33.3%)	4 (5.3%)	1 (1.3%)	15 (20.0%)	1 (1.3%)	35 (46.7%)
	Total	7 (9.3%)	16 (21.3%)	49 (65.3%)	10 (13.3%)	7 (9.3%)	25 (33.3%)	2 (2.7%)	75 (100.0%)
Brindisi	0–200 m	1 (1.1%)	5 (5.6%)	7 (7.9%)	1 (1.1%)	0 (0.0%)	4 (4.5%)	2 (2.2%)	15 (16.9%)
	200–1000 m	4 (4.5%)	12 (13.5%)	16 (18.0%)	2 (2.2%)	1 (1.1%)	8 (9.0%)	1 (1.1%)	29 (32.6%)
	>1000 m	4 (4.5%)	22 (24.7%)	20 (22.5%)	2 (2.2%)	1 (1.1%)	16 (18.0%)	5 (5.6%)	45 (50.6%)
	Total	9 (10.1%)	39 (43.8%)	43 (48.3%)	5 (5.6%)	2 (2.2%)	28 (31.5%)	8 (9.0%)	89 (100.0%)

technological/anthropogenic are undefined. This suggests that the hydrological hazard is a widely perceived threat, specifically related to coastal floods and erosion for the inhabitants close to the coast and extended to alluvial floods for the inhabitants of the inland areas. These latter citizens seem more sensitive to the risk posed by landslides, probably because they live in the hilly areas of the municipality (Ho et al. 2008). Additionally, even if the probability of earthquakes for the municipality is medium-high (Table 3.1), the perception of geophysical hazard seems restricted to the middle range, perhaps because the inhabitants are here less conditioned by the surrounding coast and hills. This could indicate that the close proximity to the coast might affect the perception of the risk posed by geohazards.

3.5.2.3 Brindisi (Puglia Region)

In Brindisi most of the respondents who live closest to the coast believe that the main threatening hazard in their area is hydrological (7.9%), followed by climatological (5.6%) and environmental/biological (4.5%) (Fig. 3.2c and Table 3.6). As we move away from the coast, similar to the other study areas, they all increase their percentage, and the climatological hazard becomes the first choice replacing the hydrological (24.7% and 22.5%, respectively). Moreover, a slight upward trend can be noticed in all the other hazards, except for technological/anthropogenic (2.2%–1.1%–5.6%). This suggests that the proximity to the sea influences risk perception so much that, already at 1000 m from the coastline, the importance of the hydrological hazard, mainly related to coastal floods and coastal erosion, is replaced by the climatological hazard, mainly related to rising temperatures and changes in rainfall patterns (Milfont et al. 2014). Minor but still noteworthy effects seem to have the coast for the other geohazards. However, while approximatively the 5.6% of the population is exposed to low, medium, or high hydrological hazard, only the 0.02% of the population is exposed to geological hazard, and the probability of earthquakes for the municipality is low (Table 3.1). Therefore, unlike the other study areas, in Brindisi, the close proximity to the coast might influence the perception of the risk posed by geohazards over the climatological ones, but moving farther away the latter regain importance. This could be due to the difference in total area and population characterizing such municipality (332.98 km^2 and 87,141 citizens), compared to Lignano Sabbiadoro (15.71 km^2 and 6948 citizens) and Montemarciano (22.31 km^2 and 9872 citizens). Indeed, a substantial part of the population does not live close to the coast where the effects of climate change are already part of everyday life (Milfont et al. 2014).

3.5.3 *Overview on Factors Influencing the Perception of Self-Exposure to Geohazards Along the Italian Adriatic Coasts*

The previous discussion explored some of the factors that might influence the perception of the personal exposure of the local populations to geohazards. The focus was placed on three case studies distributed along the Italian coasts of the Adriatic Sea, in the context of climate change.

The investigation allowed to uncover some relevant outcomes. The first common trait among the involved municipalities concerns climate change itself (Tables 3.3, 3.4 and 3.5). Indeed, the respondents appear to share a significant uncertainty on whether risks related to climate change are gaining relevance in their area. This seems to suggest that there is still some hesitation in recognizing the alterations induced by the ongoing climate crisis at the local level. Such outcome seems confirmed when looking closely to the mentioned hazards, especially the geohazards (Table 3.7). Indeed, in this case the perception of the growing importance of climate change appears to be associated with a higher sensibility toward hydrological hazards, whereas the relation with the others is not clear nor defined. Hence, it might be assumed that the nexus between climate change and some frequent, fast-onset, local hazards (i.e., hydrological hazards) is quite consolidated, while it is still necessary to foster the acknowledgment of some second-order events related to climate change (e.g., geological hazards). Nevertheless, in general terms the perception of the growing local relevance of climate change seems to influence also the perception of the personal susceptibility to geohazards.

Similarly, the role of gender appears to play a role in the perception of geohazards, though the effect is not clear (Table 3.7). Indeed, the relative importance attributed to geological and geophysical hazards appears to consistently vary among male and female respondents. Though it is not possible to outline a definite association between gender and such hazards, female respondents appear to be slightly

Table 3.7 Overall trends in the association among perceived self-exposure to geohazards and potential influencing factors

	Geohazard		
Influencing factors	Hydrological	Geological	Geophysical
Growing importance of climate risks compared to other risks in local area	Strongly and positively associated	Scarcely associated	Scarcely associated
Gender	Not associated	Associated, direction not clear	Associated, direction not clear
Age	Scarcely but positively associated	Scarcely associated, direction not clear	Scarcely associated, direction not clear
Distance	Scarcely associated direction not clear	Scarcely associated, generally directly	Scarcely associated, generally inversely

favoring geophysical hazards. On the contrary, gender does not appear to influence the perception of hydrological hazards, as both male and female respondents consistently reported their presence.

The effect of age appears even more challenging. Indeed, respondents belonging to different age groups tended to provide different views on the relevance of geohazards. Nonetheless, it was not possible to identify a clear and uniform trend. Additionally, in this case, the responses significantly varied across the municipalities (Tables 3.3, 3.4, and 3.5), suggesting a prominent role played by other contextual factors (e.g., previous experience) in influencing the perception of geohazards.

Lastly, distance appears to indeed influence the perception of local hazards, though it seems that such relation might be particularly complex and place-related. In relative terms, geohazards apparently lose relevance while moving away from the coast, in favor of other hazards, depending on the studied area (Fig. 3.2 and Table 3.6). In general, such outcome suggests that sea-related phenomena (e.g., coastal erosion, coastal floods) might exert a crucial effect on local populations. When restricting the analysis to geohazards, hydrological hazards showed a slight consolidation while moving inland (Table 3.7). Similarly, geological and geophysical hazards seemingly tended to be increasingly acknowledged with the growing distance from the coast, though it was not possible to outline a common and robust trend. Hence, this appears to confirm that local communities might be commonly responsive to hydrological hazards, whereas other contextual factors (e.g., previous experiences, as mentioned above) might be pivotal in shaping the perception of other geohazards.

3.6 Conclusions

The effects of the changing climate are already visible in the increasing frequency and magnitude of local events, such as flooding and landslides. Consequently, it is essential that the local population is aware of what they are exposed to, especially when living close to areas prone to peculiar hazards, such as near the coasts. Against this background, the susceptibility of the Italian peninsula and islands results particularly significant (Orombelli and Pranzini 2020).

This study explored the characteristics that possibly constitute factors increasing or decreasing the perception of self-exposure to geohazards in the coastal population of three municipalities, Lignano Sabbiadoro, Montemarciano, and Brindisi, respectively, located in Northern, Central, and Southern Adriatic, analyzing the variation of perception considering climate risk awareness, personal factors, namely, gender and age, and the proximity to the coast.

Results from the three municipalities provided interesting considerations. Overall, hydrological hazards are considered the most affecting all the three coastal municipalities, especially compared to other geohazards. It appears significant that

in general terms the uncertainty regarding the climate crisis is strong. Yet, there is a feeble association between low climate risk perception and perceived highly impacting geohazards, thus suggesting that the actual local effects of climate changes might not be commonly recognized. The role of gender and age in influencing perception appears more evident when considering other natural hazards, whereas it is seemingly invalidated by past experiences for geohazards. As a final result, the more we move farther away from the coast, even at small distances such as 1000 m, the more the perceived geohazards shift from those specifically related to the coast to those more contingent to the respondents.

Despite the significant feedback, the magnitude of collected questionnaires limits the representativeness of the outcomes strictly to the respondents. Consequently, future studies might extend the involvement to a broader portion of the local populations, in order to gain an overall view on a specific municipality. Alternatively, further focus might be put on specific groups of stakeholders, such as the most socially or economically vulnerable to geohazards. In general terms, it might also be relevant to adopt different means to deliver the questionnaires, in order to reach those who might not be comfortable with online surveys or who might not access specific websites. Additionally, future research could cover a wider geographical area, especially in the nearby coastal sections, as it might be interesting to evidence the local factors potentially determining in altering (or normalizing) the perception of bordering communities.

Nevertheless, the observed diversity of perception in the three municipalities provides important hints for decision-makers, fundamental for a multi-hazard approach to disaster risk reduction, even at a sub-municipal scale or within the immediate surroundings of the studied areas. It should be considered that the climate crisis is not fully recognized as a driver of geological events as much as for hydrological ones, and in general people have a limited perception of geohazards, except for hydrological hazards. Personal characteristics, namely, gender and age, and proximity, influence the perception of self-exposure to geohazards, but the positive or negative weight of these factors in shaping perception varies locally. Therefore, decision-makers should consider the specific personal and geographic characteristics as pivotal when planning for disaster risk reduction strategies.

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