

**Social Amplification of Air Pollution Risk:
A Cross-National View on Institutions and Media**

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Word count (excluding tables and figure captions): 7394 words

Social Amplification of Air Pollution Risk: A Cross-National View on Institutions and Media

Air pollution is a major public health concern in Europe, yet risk perception varies widely across regions. While previous studies have explored individual-level risk perceptions, less attention has been paid to how levels of perceived risk are amplified or attenuated in different regional contexts. Using the Social Amplification of Risk Framework, this article addresses that gap by examining how institutional context and media framing influence the perception of health risks from air pollution in four European regions: Catalonia, Skåne, Estonia, and Kosovo.

Using a mixed-methods approach, the study combines survey data, air quality levels, policy document analysis, media content analysis, and expert focus groups. Findings reveal that perceived risk does not correlate directly with measured pollution levels. In Kosovo and Catalonia, perceived risk is high, and amplified by media coverage, but institutional contexts differ: Catalonia shows high trust and visible, though climate-framed, policies, while Kosovo faces weaker enforcement and low institutional trust. Skåne and Estonia show lower risk perception, shaped by technocratic governance and lower institutional trust, along with media that include fewer amplifying elements. The study indicates that institutional context and media—through framing and symbolic or emotional elements—jointly shape how air pollution risks are interpreted by the public.

Keywords: air pollution, risk perception, exposure, media framing, institutions, the social amplification of risk framework

Introduction

Air pollution is among the most pressing global health concerns, causing an estimated 8.1 million premature deaths annually (Health Effects Institute, 2024). According to the World Health Organisation, 99% of the global population lives in areas where air quality exceeds recommended guideline limits (WHO, 2023). In the European Union, despite years of mitigation efforts, exposure to harmful pollutants such as PM_{2.5}, NO₂, and ozone remains widespread (EEA, 2024).

While scientific and policy efforts have traditionally focused on measuring pollution levels and estimating physiological health impacts, increasing attention is now being paid to how the public perceives and responds to air pollution risks. Although risk perception is frequently studied at the individual level—often in relation to behavioural responses—this study focuses on societal risk perception, that is, the shared understanding of risks within a community or society (Bickerstaff, 2003; Kim and Kim, 2019). The Social Amplification of Risk Framework (SARF) highlights how risk perceptions are shaped by media, institutional communication, and social interaction (Kasperson et al., 1988; Renn, 2011). The Social Amplification of Risk Framework (SARF) highlights how risk perceptions are shaped by media, institutional communication, and social interaction (Kasperson et al., 1988; Renn, 2011).

Understanding these processes is crucial. Even in areas with low pollution levels, perceived pollution and risk can cause significant health impacts due to mental distress (Kamimura et al., 2017; Orru et al., 2018). Conversely, poorly communicated or mistrusted air quality data can lead to misperceptions that may amplify health impacts (Huang, 2020). At the same time, public concern can drive political action and create demand for curbing emissions (Kenis and Barratt, 2022; Boso et al., 2024; Hart, et al 2008). Cultural values, public beliefs, and trust in

institutions can be as influential as formal regulatory mechanisms in shaping environmental outcomes (Pahker et al., 2024).

Existing research has highlighted the role of societal contexts in shaping individual risk perception (Orru et al., 2022; Kamimura et al., 2017). However, there is a lack of in-depth understanding of how institutional context and media narratives interact to shape collective perceptions at a regional level. Few studies on air pollution risk perceptions have been conducted across multiple countries (Bahrami, et al., 2024). Moreover, much of the existing literature relies on quantitative survey methods, while qualitative and mixed-methods studies remain underrepresented (Völker & Sujaritpong, 2024).

This study addresses these gaps, with the aim of clarifying the significance of context-specific institutional and informational agendas in shaping the levels of environmental health risk perception.

The primary research questions are:

- What is the level of perceived health risk, and how do these levels differ with regard to regional air quality?
- How does institutional context associate with the level of perceived health risk from air pollution?
- How is media framing associated with the level of perceived health risk?

To answer these questions, the study applies a mixed-methods approach—combining document analysis on policies, survey data analysis, media content analysis, and focus group interviews. This approach allows the integration of quantitative indicators (e.g., pollution levels, survey data) with qualitative insights (e.g., expert views, media framing) to better

understand both the chemically measurable and socially constructed dimensions of health hazard.

The analysis focuses on four case study regions: Catalonia (Spain), Skåne (Sweden), Estonia and Kosovo. The regions were selected to represent contrasting institutional models, cultural settings, and pollution profiles. Public concern about health risks from environmental problems also varies notably across regions. In Spain, 93% believe such issues affect their health and daily life, compared to 66% in Sweden and 60% in Estonia (European Commission, 2023a). PM_{2.5} concentrations are highest in Kosovo (15.2 µg/m³), exceeding WHO guidelines threefold, while levels are moderate in Catalonia (10.4 µg/m³) and Skåne (6.7 µg/m³), and low in Estonia (4.5 µg/m³) (EEA, 2023).

The article proceeds as follows: We first introduce the conceptual framework; then describe the methodology and case selection. We then present the results and discuss the findings in relation to existing literature, followed by conclusions.

Theoretical framework

The theoretical framework integrates research on environmental risk perception, the Social Amplification of Risk Framework (SARF), and the roles of institutional and informational contexts in influencing risk perception.

Air pollution can be assessed both objectively, via pollutant concentration data (e.g., PM_{2.5}, NO₂), and subjectively, via individuals' perceptions and experiences of air quality. While EU regulations have tightened in recent years, harmful exposures remain common (EEA, 2024). Subjective perceptions are shaped by sensory experience, awareness, and trust in monitoring systems (Song et al., 2020) and may influence health outcomes independently of measured pollution (Orru et al., 2018).

Although objective pollution levels reflect public health risks, subjective air pollution influences how individuals understand and respond to those risks. Studies link perceived pollution to increased symptoms and stress, suggesting that risk perception has both psychological and behavioural consequences (Clougherty and Ocampo, 2023; Kamimura et al., 2017).

Risk perception

Perception of air pollution often diverge from objective measurements, influenced by personal characteristics (e.g., age, education, health), environmental factors (e.g., visibility, odor), and psychological mechanisms such as habituation or confirmation bias (Bickerstaff, 2004; Guo & Li, 2018). Risk perception refers to how individuals or communities judge the likelihood and severity of harm associated with hazards (Slovic, 1987). This study defines it specifically as perceived health risk from air pollution, shaped by cognitive, emotional, social, and contextual factors (Boso et al., 2024; Oltra and Sala, 2018).

Risk perception is closely linked to environmental annoyance, since people who believe a pollutant is harmful are more likely to feel annoyed by its presence and vice versa (Nordin & Liden, 2006; Petrie et al., 2001). Perceptions may also vary depending on the visibility of pollution, familiarity, and economic dependency on polluting industries. For example, communities reliant on such industries may downplay risks due to economic benefits or social normalisation (Knight, 2018; Luís et al., 2018). Risk perception is therefore shaped both by individual-level factors and broader institutional and environmental contexts.

The social amplification of risk framework

The Social Amplification of Risk Framework (SARF) (Kasperson et al., 1988) explains how risk signals—such as air pollution data—are interpreted and reshaped as they move through ‘amplification stations’, including institutions, media, and social groups. These stations filter, frame, and communicate risk in ways that can either heighten (amplify) or downplay (attenuate) public concern.

Risk perception is not solely based on objective exposure but is influenced by how risk signals are presented via probability, controllability, familiarity, and moral or symbolic framing. Media and institutions thus play a central role in transforming technical data into social meaning (Renn, 2011; Slovic, 2016).

SARF identifies four key informational mechanisms through which amplification or attenuation occurs:

- *Volume of information*: the frequency and prominence of risk-related content;
- *Contestedness*: the presence of conflicting perspectives or uncertainty;
- *Dramatisation*: emotional language, metaphors, and imagery;
- *Symbolic connotations*: links to broader values like fairness or health justice.

Recent adaptations of SARF emphasise the active role of institutional actors in shaping concern through their visibility, communication strategies, and responsiveness (Dow and Tuler, 2022). Trust in institutions operates as a heuristic for judging the legitimacy of both the message and the messenger (Earle and Siegrist, 2008; Bearth and Siegrist, 2022). When institutions are seen as transparent, competent, and aligned with public values, they can mitigate concern, even

under high exposure. Conversely, opaque or fragmented governance can amplify public concern, regardless of actual pollution levels.

This study applies SARF to examine how risk signals are processed through institutional and media contexts in four regions, paying attention to the amplification and attenuation mechanisms outlined above.

[Insert Figure 1 here]

Mechanisms of societal amplification

SARF (Kasperson & Kasperson, 1988) explains the societal dynamics that may shape public perceptions of health risks from air pollution, particularly through media and institutional contexts.

Media coverage of air pollution incidents and health studies can have a significant impact on public perception and concern (Hart et al., 2011; Kenis and Barratt, 2022). SARF identifies four key informational mechanisms that shape how risks are amplified or attenuated: volume of information, contestedness, dramatisation, and symbolic connotations (Kasperson et al., 1988). Media coverage of pollution events and health studies can significantly raise public concern (Hart et al., 2011), especially when linked to themes like children's health or environmental justice (Kenis and Barratt, 2022; Kenis and Loopmans, 2022). Framing air quality policies as economic burdens, for example, can generate concern and resistance, as seen in Estonia's energy transition debates (Pahker et al., 2024). Conversely, framing pollution as a matter of justice or collective responsibility may mobilise public engagement.

Institutional actors influence how risks are amplified through communication strategies and the visibility of policies (Bickerstaff, 2004; Dow & Tuler, 2022). When policies lack local resonance or symbolic clarity, they may fail to amplify concern effectively, even if technically

sound. Trust in institutions plays a key role: Finnish respondents, who trusted public authorities more than Estonians, perceived lower risks from pollution despite similar or lower exposure levels (Ortu et al., 2022). Trust acts as a heuristic for evaluating both the credibility of information and the legitimacy of risk managers (Bearth & Siegrist, 2022). Transparent, value-aligned institutions tend to dampen concern, while perceived failures intensify it.

The theoretical insights presented in this chapter highlight that air pollution risk perception is shaped through dynamic interactions between subjective experience, communicative framing, and institutional credibility. This perspective helps explain how perceptions of health risks from air pollution vary across different institutional and media contexts.

Methods

Case selection and conceptual approach

The four study regions were selected to represent a diversity of socio-political contexts and air quality profiles. **Catalonia**, an autonomous region in northeastern Spain, is a densely populated and industrialised region with persistent urban air quality challenges. **Skåne**, Sweden's southernmost county, features relatively low average pollution levels alongside high environmental monitoring capacity. **Estonia**, a northern European EU member state, records among the lowest ambient air pollution levels in Europe. However, significant regional disparities exist: in Ida-Viru County, air pollution is considerably higher due to the concentration of oil shale industries. **Kosovo**, a non-EU Western Balkan country, experiences some of the highest ambient air pollution levels in Europe. The country's pollution profile is closely linked to its energy sector, in which a significant proportion of the workforce is also employed (Kosovo Agency of Statistics, 2020).

This study employs a mixed-methods approach to examine how institutional and informational contexts relate to public perception of air pollution risks across four European regions. The approach combines quantitative indicators with qualitative insights. **Figure 2** presents the conceptual model guiding the study, linking exposure, institutions, and media to perceived health risks.

[Insert Figure 2 here]

These variables jointly inform our understanding of how risk perception emerges and varies across contexts. The model also reflects the operationalisation of the three research questions listed in Table 1.

[Insert Table 1 here]

Survey on risk perception

A regionally administered online questionnaire was conducted across Catalonia, Skåne, Estonia and Kosovo as part of the international research project ‘Methodologies for Assessing the Real Costs to Health of Environmental Stressors - MARCHES’ in 2024. Health-risk perception was assessed with the question ‘How would you rate the risks to your own health caused by air pollution?’. The question was responded to on a five-point scale ranging from ‘No risk at all (1)’ to ‘Extremely high risk (5)’.

Additional variables were assessed through questions:

- Perceived exposure to air pollution

‘How would you rate the extent of your exposure to air pollution in your living environment?’ with a five-point scale ranging from ‘No exposure at all (1)’ to ‘Extremely high exposure (5)’.

- Perceived annoyance

‘How would you rate your annoyance when exposed to air pollution?’ with a five-point scale ranging from ‘Not annoyed at all (1)’ to ‘Extremely annoyed (5)’.

- Institutional trust

The respondents were asked to rate to what extent they agree with the following statement: ‘I trust that the authorities take care of the healthfulness of my living environment’ with a five-point scale ranging from ‘Fully disagree (1)’ to ‘Strongly agree (5)’.

Ethical approval for this survey was granted on 26.08.2024 by the University of Tartu Human Research Ethics Committee (Approval number: 392/T-1).

Under the administration of the research company Kantar Emor, persons in a pool who were willing to participate in research studies were invited to take part in the study. An invitation to participate was sent by e-mail to the potential participant. Altogether 4,000 respondents answered the questionnaire. Based on the collected data, descriptive statistics were calculated to demonstrate country differences.

Levels of objective air pollution

Annual mean concentrations of PM_{2.5} and NO₂ were used to represent air pollution exposure, based on data from the European Environment Agency (EEA, 2023). To ensure regional comparability, data for Spain and Sweden were filtered to include only cities within Catalonia and Skåne, while national-level data were used for Estonia and Kosovo due to limited monitoring coverage.

Policy and documentary review

To understand the institutional context, we analysed both formal policy documents and broader institutional frameworks. The analysis focused on air quality strategies and action plans, governance structures relevant to air quality management, fiscal and spatial planning measures and public access to air quality data.

Media analysis

To address the third research question, a qualitative content analysis was conducted, following prior SARF-based studies on media framing of risk (e.g., Bakir, 2005; Rooke, 2021). The analysis focused on widely read national or regional daily newspapers with strong digital presence in each of the four case study regions (Table 2).

[Insert Table 2 here]

Articles were retrieved from the digital archives of the outlets using built-in website search engines. Region-specific keyword combinations were used in the original language(s). The articles were then translated into English.

Given the increasing reliance on digital platforms for news, online sources were prioritised (Reuter Institute, 2024). This is further supported by Eurobarometer (2024) data showing high weekly use of online news across all regions, and varying levels of trust in online sources—highest in Kosovo (57%) and Estonia (51%), lower in Spain (34%) and Sweden (28%).

The analysis proceeded in two stages:

1. Framing analysis, following Entman's (1993) definition, identified dominant thematic frames in how air pollution was presented.

2. SARF-based analysis assessed informational mechanisms that influence risk amplification or attenuation:

- *Volume of information,*
- *Contestedness,*
- *Dramatisation,*
- *Symbolic connotations.*

Focus groups

Semi-structured focus group interviews were conducted in each region to explore how institutional and societal actors perceive health risks from air pollution. Participants included policymakers, environmental and public health experts, and civil society representatives, ensuring a diversity of perspectives on governance, communication, and lived experience (Bickerstaff and Walker, 2003).

Four focus groups were held between March 2024 and March 2025—three on-site in Pristina, Barcelona, and Tallinn, and one online with participants from Skåne. Each session included 6–8 participants, lasted 90–120 minutes, and followed a standardised guide covering: (1) societal concern, (2) triggers of concern (e.g. visibility, odour, knowledge), (3) institutional perceptions, and (4) issue framing (health, environmental, technical).

Discussions were recorded with consent and analysed thematically (Braun and Clarke, 2006), aligning with the study's research questions.

Results

This chapter presents the analysis results organised by three research questions.

Objective versus perceived air pollution

As for objective pollution levels, across all regions, PM_{2.5} concentration levels remain above the WHO guideline (5 µg/m³), particularly in Kosovo and Catalonia. NO₂ concentrations remain higher in urbanised regions, especially in Barcelona and Malmö, though they stay largely below EU thresholds in Skåne and Estonia. Table 3 provides a comparative overview of objective PM_{2.5} and NO₂ levels alongside key survey indicators of perceived health risk across the four regions.

[Insert Table 3 here]

The document analysis demonstrated that pollution sources have varied economic significance across the studied regions. For instance, Catalonia has a relatively high share of employment in transport and manufacturing, both significant pollution sources (Statistical Institute of Catalonia, 2024). Skåne is more service-oriented, though urban transport and port activity still contribute to local pollution (Region Skåne, 2023). In Estonia, pollution stems from construction and transport, particularly in urban areas like Tallinn. Meanwhile, oil shale energy production in Ida-Viru County is a major regional source of income and revenue, but also of particulate and sulfur emissions (Statistics Estonia, 2023; Dahal et al, 2024). Kosovo's energy sector, heavily reliant on coal-fired plants, is the largest pollution source, accounting for 87% of climate-related emissions, followed by transport, which is hampered by an outdated vehicle fleet (Kosovo Environmental Protection Agency, 2022).

In Catalonia, perceived health risk is high, alongside elevated exposure and annoyance, reflecting a strong subjective response to air pollution as shown in Table 3. In Catalonia,

experts observed that concern is fragmented and often conflated with climate change discourse (FG CAT, 07.06.2024). Skåne shows the lowest perceived health risk of the four, aligning with low pollution. The focus group participants also perceive concern to generally be low and too limited to specific local situations (FG SKA, 14.03.2025). In Estonia, perceived health risk is moderate, but relatively high annoyance suggests that certain localised exposures may heighten discomfort despite the best overall air quality among the studied regions. Although pollution levels are low, dissatisfaction is rising in urban areas like Tallinn (FG EST, 04.03.2024). Also sensory or localised experiences—such as odour or traffic—may strongly shape risk perception. In Kosovo, perceived health risk is markedly high and accompanied by strong annoyance and exposure, indicating a heavy subjective burden in a context of persistent pollution and institutional challenges. The informants noted, though, that concern peaks during smog episodes but fades quickly (FG KOS, 17.04.2024).

The observed mismatch between objective pollution and subjective concern led to exploring how social stations, such as institutional context and media, filter, reshape, or reinforce risk signals.

Institutional context

In SARF terms, institutions act as central amplification stations, responsible for how risk is framed, addressed and communicated. The institutional context varies widely across regions.

Table 4 outlines five key dimensions of the institutional context: (1) strategic frameworks, (2) governance structures, (3) fiscal measures, (4) spatial planning, and (5) public access to air quality data.

[Insert Table 4 here]

All regions have adopted strategic documents, yet implementation varies. Estonia and Kosovo use centralised governance models with limited municipal initiative, whereas Catalonia and Skåne operate within decentralised, multi-level systems that grant more autonomy to municipalities.

In Catalonia, ambitious policies are embedded in the Climate Change Law. However, document analysis shows that these initiatives are often framed primarily around climate mitigation or mobility rather than public health. This emphasis was also echoed in focus group discussions, where participants noted that health impacts tend to be under-communicated in comparison to climate or transport-related goals (FG CAT, 07.06.2024).

In Skåne, inter-municipal coordination is strong and supported by solid technical infrastructure. While data is accessible, public awareness and political engagement are low, with policies often perceived as technocratic and depoliticised (FG SKA, 14.03.2025).

Estonia's National Air Pollution Control Programme sets goals to reduce emissions of key air pollutants by 2030 in line with EU targets. Focus group participants highlighted that responsibilities for air quality management are fragmented and that local governments often receive limited guidance from the national level. They also noted a general lack of public engagement in air quality planning processes (FG EST, 04.03.2024).

Kosovo faces serious institutional limitations. While strategic frameworks exist, enforcement is weak and monitoring is inconsistent. International monitors are often perceived as more reliable than national systems, and public engagement with air quality issues is inconsistent, often peaking during winter smog episodes but fading quickly thereafter, reflecting a reactive rather than sustained pattern of concern (FG KOS, 17.04.2024).

SARF (Kasperson & Kasperson, 1988) also claims that fiscal measures have a role in reinforcing or muting policy signals. Catalonia and Skåne frame vehicle-related charges as climate and mobility incentives, enhancing normative resonance. Estonia's upcoming vehicle tax lacked such resonance, and in Kosovo, fiscal tools exist on paper but are unenforced, attenuating signals through implementation failure. Access to real-time air quality data functions as another amplification channel. In Catalonia and Skåne, data is actively disseminated, supporting risk salience. Estonia uses passive systems with minimal outreach, and Kosovo suffers from data credibility issues, undermining both awareness and institutional legitimacy.

Survey results further show that levels of trust in authorities vary. Catalonia exhibits relatively high trust (43.2%), which may be supported by the visibility of urban policies. In contrast, Estonia reports the lowest level of trust (13.3%) that authorities take care of the healthfulness of the environment. This aligns with fragmented responsibilities, limited municipal guidance, and a general lack of public engagement, that focus group highlighted. Institutional opacity and low resonance of fiscal measures (e.g., vehicle tax) may contribute to undermining. In Skåne, moderate trust (29.8%) corresponds with a technically robust but depoliticised policy environment, where data is accessible but engagement and resonance are limited. In Kosovo, trust is somewhat higher (34.4%) despite severe pollution and enforcement weaknesses—likely reflecting broader political dynamics. According to SARF, low institutional trust may lead to amplified risk perception, even in contexts with relatively low objective pollution.

The role of informational agendas

The final research question explored the media coverage regarding air pollution. Across all four regions, focus group participants agreed that media attention to environmental problems has increased in recent years.

The prominent media frame overall is health impacts - air pollution was frequently linked to respiratory illness, asthma, and children's vulnerability. However, regional media landscapes differed in how risks were framed and communicated. Figure 3 illustrates the dominant framings of air pollution across media coverage in the four regions.

[Insert Figure 3 here]

In **Catalonia**, coverage emphasised urban transport, health, and climate, embedding air pollution within broader narratives of mobility and decarbonization. Traffic-related framing was particularly prominent, reflecting ongoing debates around Low Emission Zones (LEZ). Although health was the dominant frame, focus group participants noted that health messaging can become emotionally taxing, especially when centred on child vulnerability, leading to disengagement. They also highlighted confusion when air quality was presented primarily through abstract climate goals and criticised episodic warnings for downplaying the chronic nature of pollution (FG CAT, 07.06.2024).

In **Skåne**, the media adopted a more technocratic framing. Policy and regulation were the most frequently referenced topics, followed by health and climate change. Focus group participants described public engagement as generally low and triggered mostly by specific events, such as preschool-related exposure, while regular reporting (e.g. annual air quality updates) attracted little discussion. They also warned that positive framing of air quality improvements may falsely signal resolution of the problem (FG SKA, 14.03.2025).

Estonian media focused on political accountability and structural issues, such as energy production and compliance with EU directives. Personal health impacts received less emphasis, and climate or traffic-related frames were rare. Focus group participants criticised the lack of clear messaging and poor communication around policy changes, for example, how speed limit reductions in Tallinn relate to pollution control. Public Broadcasting was singled out for inadequate environmental coverage (FG EST, 04.03.2024). While air quality levels are low, high annoyance and moderate perceived risk suggest that weak media framing may contribute to limited public understanding.

In **Kosovo**, coverage was dominated by health-related risks, often in emotive terms. Common keywords included coal, vehicles, illness, and death. However, articles often lacked depth on solutions and regulation. Focus group participants emphasised that while media interest peaks in winter, coverage is often superficial and fails to build long-term awareness. Experts called for better collaboration between journalists and scientists (FG XK, 22.03.2025).

To assess how media content may have amplified or attenuated public concern about air pollution, all articles were coded according to four dimensions: volume of information, contestedness, dramatisation, and symbolic connotations. Figure 4 displays the prevalence of these media mechanisms in each region.

[Insert Figure 4 here]

Volume of information

The prominence of air pollution as a central topic differed significantly. In Kosovo, media tended to frame it as a standalone issue, while Estonian articles more often integrated pollution into broader stories or mentioned it in passing. Skåne and Catalonia fell in between, with a substantial but less dominant emphasis on the issue.

Contestedness

Contested perspectives were relatively uncommon and mainly appeared in opinion pieces or editorials. Estonia featured the most contested coverage, suggesting greater openness to disagreement or policy critique. In contrast, Kosovo's media presented the issue with less visible controversy, often relying on expert sources.

Dramatisation

Emotional language, metaphors, and striking visuals were present in over half of the articles, particularly in Catalonia, Estonia, and Kosovo. Headlines often employed clickbait phrasing, referencing health threats like 'death' or 'cancer', while images of smog, masks, or children conveyed urgency and vulnerability. These elements were typically found in headlines or accompanying photos, reinforcing dramatic framing.

Symbolic Connotations

Articles in all regions sometimes framed pollution as a moral or social justice issue, linking it to children's health, intergenerational fairness, or inequality. This was especially visible in Catalonia and Kosovo, where metaphors like '*invisible killers*' or '*toxic childhoods*' framed pollution as a structural injustice.

Overall, while not dominant, symbolic framings played an important role in emotionally and morally engaged reporting. In line with the Social Amplification of Risk Framework (Kasperson et al., 1988), such cues can heighten public attention by presenting pollution as more than a technical problem, emphasising its societal and ethical dimensions.

Discussion

This study examined how institutional and informational contexts shape air pollution risk perception. By incorporating pollution source profiles and socio-economic dependencies, this study supports calls to embed SARF more deeply in political economy and governance contexts. Risk is not only ‘communicated’, but also shaped by economic structure, spatial inequalities, and regulatory choices (Kenis and Loopmans, 2022).

Survey findings confirm SARF’s main insight: perceived risk does not track linearly with objective pollution. Focus group results reinforce this, highlighting how symbolic cues (e.g. vehicle congestion in Catalonia, smog in Kosovo) trigger concern, while in Skane, technocratic language and dispersed municipal governance appear to attenuate public salience.

In Catalonia, moderately high pollution levels and elevated perceived exposure and annoyance likely contribute to heightened risk perception. While institutional trust is high, which can reduce concern (Earle and Siegrist, 2008), this effect may be offset by visible policies and strong media framing. However, policies are often framed through climate or mobility lenses, and focus groups revealed confusion or disengagement when health impacts aren’t clearly communicated. The media in Catalonia still functions as a consistent amplifier, through symbolic and health-focused narratives.

In Skåne, both pollution and perceived exposure are low, as is annoyance from exposure. Combined with moderate trust, a decentralised and technical governance approach, and neutral media coverage, these factors seem to lead to overall attenuation. Skåne exemplifies how low environmental signals and a subdued institutional and media environment can reduce perceived risk, even in a well-functioning governance setting.

In Estonia, though objective pollution levels are the lowest out of the four annoyance levels are surprisingly high. At the same time, trust in institutions is low, limited media coverage is contested, and focus groups revealed public frustration with a lack of visible local governance. These tensions produce an unstable perception pattern, where institutional neglect, distrust and contested media coverage may amplify concern, despite otherwise weak environmental signals.

In Kosovo, all factors align to amplify perceived risk. Pollution and perceived exposure are high, annoyance is strong, and while survey data suggests moderate trust, qualitative findings point to some distrust in institutions. Air pollution is frequently presented as the main focus in articles, rather than a secondary or background issue. However, it often lacks a solution-oriented frame, which reinforces a persistent sense of crisis. With little institutional buffering, risk signals are left unchecked, driving sustained public concern.

Ultimately, amplification of risk is not just a communication process, but also a governance function, where structure, trust, and symbolic cues shape how societies perceive and respond to pollution risks. SARF remains a useful framework, but must evolve to account for institutional agency and governance dynamics.

Reflections on study methods and future directions

This study's strength lies in its comparative mixed-methods design, combining MARCHES survey data with media analysis, policy review, and qualitative insights to explore risk amplification across varied governance contexts.

However, the analysis is primarily descriptive and does not test causal relationships. Future research could use quantitative models to assess links, for example, between media frequency or economic dependency and perceived risk.

The media analysis focused on major online newspapers, excluding social media platforms, which are increasingly influential. Future studies should explore how digital media shape amplification, especially on platforms like Facebook or TikTok. Lastly, further research should also assess how perceived risk influences policy demand.

Conclusion

This study examined variations in perceived risks from air pollution across four European regions, analysing their alignment with regional air quality conditions, institutional context and media framing. The findings provide comparative insight into how environmental, institutional, and communicative factors interact in shaping air pollution risk perception.

The level of perceived health risk differs notably across the four regions. It is highest in Kosovo and Catalonia, moderate in Skåne and lowest in Estonia. These differences do not directly mirror objective air quality. While Kosovo combines high pollution and high perceived risk, Catalonia exhibits similarly elevated concern despite moderate exposure levels. Estonia's moderate risk perception coincides with low measured pollution but a high level of annoyance, suggesting that localised or sensory experiences of pollution may be particularly salient. Skåne, with low exposure, perceived exposure, and annoyance, corresponds with the lowest perceived risk.

The institutional context shows likely associations with perceived risk. In Catalonia, visible urban policies, decentralised governance and relatively high institutional trust may contribute to sustained attention to air quality, although framing these measures largely in climate terms may limit their impact on health-specific risk perception. Skåne's decentralised, technical governance coincides with low public salience. In Estonia, fragmented responsibilities, low

trust, and a lack of visible local action may produce a more unstable perception pattern. In Kosovo, weak institutional presence and minimal policy response likely contribute to heightened risk perception.

Media framing is associated with the level of perceived health risk through differences in tone, volume, and symbolic content. In Catalonia and Kosovo, frequent media coverage and the use of health-focused and symbolic narratives may reinforce public concern. In contrast, Estonia and Skåne exhibit more neutral and technocratic media discourse with fewer symbolic cues, which may be associated with lower perceived health risk.

This study shows that the perception of air pollution is not merely a response to air quality, but a reflection of how regional institutions and media give visibility, meaning, and urgency to environmental health risks.

Acknowledgements

This work has been by the European Commission with-in the project “Methodologies for assessing the real costs to health of environmental stressors, MARCHES” Project number: 101095430. We would also like to thank Marigone Drevinja, Sara Lasunción and Anna Oudin in help organizing the focus groups in study areas.

Disclosure of Interest

The authors report there are no competing interests to declare.

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Appendixes

Appendix A. Semi-structured interview guide.

1. How big issue is air quality to general public in Skone? Rate 1 to 10?
2. How has public expectation on air quality changed over past 10 years?
3. Are some individuals or groups more concerned about air quality? Who are concerned?
What characterizes those people?
4. What triggers their concerns (toxicity, dust, smell,)?
5. What effects are members of general public concerned about? Acute (physical reactions like headache, coughing) or long-term effects (CVD, asthma) on person? Are mental (e.g. stress, dementia) considered at all? How does the level of concern and pressure compare to other countries in Europe?
6. How about concerns among decision-makers and planners? Concerns among decision-makers on state government and on local level? How does the level of concern and pressure compare to other countries in Europe?
7. Are members of general public considering societal impacts / external costs? How about decision-makers and planners? on state government, local level?
8. Is there pressure for mitigating air pollution through policy-making and planning? Where does the pressure stem from? Individuals? CSO-s? Media? EU directives? New air quality directive?
9. Is there enough pressure for enforcing more demanding policies (individuals? CSO-s? Media? EU directives?). Or there even resistance?

10. Is there trust towards policy makers, officers, planners regarding actions to mitigate air pollution?

Table 1. Overview of research questions, data sources, and methods of analysis

Research question	Data source	Analysis method
What is the level of perceived health risk, and how do these levels differ with regard to regional air quality?	Survey data on risk perception Focus groups Air pollution levels	Descriptive statistical analysis; Thematic content analysis of interviews. Cross-country comparison
How does institutional context associate with the level of perceived health risk from air pollution?	Policy and documentary review Survey data on institutional trust Focus group interviews	Thematic content analysis Cross-country comparison
How is media framing associated with the level of perceived health risk?	Media content analysis Focus group interviews	Thematic content analysis Cross-country comparison

Table 2. Overview of media outlets, search keywords, and the number of articles analysed per region

Region	Keyword	Outlets	Articles
Catalonia	‘contaminació de l'aire’, ‘contaminación del aire’, ‘contaminació atmosfèrica’	La Vanguardia El Periódico Ara 20 minutos	45
Skane	‘luftföroreningar’, ‘luftkvalitet’	Sydsvenskan Helsingborgs Dagblad Skånska Dagbladet	48
Estonia	‘õhusaaste’, ‘õhureostus’	ERR Postimees Delfi/EPL	51
Kosovo	‘ndotja e ajrit’, ‘cilësia e ajrit’	Koha Ditore Gazeta Express Telegrafi	42

Table 3. Comparative overview: measured pollution levels (2023, EEA) and perceived health risk from air pollution.

	<i>Measured pollution levels</i>		<i>Perceived exposure, annoyance and risk from air pollution</i>		
Region	PM_{2.5}	NO₂	Perceived high exposure to air pollution	Perceived high annoyance from air pollution	Perceived high health risk from air pollution
Catalonia	10.4 µg/m ³	22.0 µg/m ³	40.0%	42.2%	38.5%
Skåne	6.7 µg/m ³	13.0 µg/m ³	17.8%	16.4%	18.7%
Estonia	4.5 µg/m ³	7.2 µg/m ³	18.9%	29.0%	19.8%
Kosovo	15.2 µg/m ³	24.0 µg/m ³	41.4%	67.3%	62.4%

Note: Perceived high exposure, annoyance, and health risk refer to the share of respondents selecting 4 (high) or 5 (extremely high) on a 5-point scale in the MARCHES survey.

Table 4. Overview of institutional and policy measures related to air pollution across four case study regions

Region	Strategy/action plan	Institutional structure	Fiscal measures	Spatial planning measures	Real-time data / Warning systems
Catalonia	Climate Plan 2018–2030, 2003 Mobility Law, Superblocks Initiative	Multi-level governance (municipal, regional)	LEZ fines for high-emission vehicles; mobility subsidies for EVs	Superblocks (traffic calming zones in Barcelona); LEZ access restrictions	SMS alert subscriptions, real-time air quality websites
Skåne	National Environmental Objectives; Regional Development Strategy 2030	Decentralised municipal implementation	Some local measures (e.g., Malmö electric bike subsidies)	School zones with traffic restrictions (Lund, Malmö); local environmental zoning	SMHI forecasts and warnings; 13+ active monitoring stations; Real-time data via AQICN.org and IQAir
Estonia	National Air Pollution Control Programme 2020–2030	Centralised governance, limited municipal role	Limited: stove replacement (for cleaner heating) and electric car purchase subsidies	No extensive measures	National air quality monitoring - 16 measuring stations; Public maps: ohuseire.ee
Kosovo	Air Quality Strategy (WB/UNEP-supported)	Centralised, top-down governance	No systematic fiscal tools	No extensive measures	Air Quality Portal Kosovo); 6 active monitoring stations; Partial real-time data

Figure 1

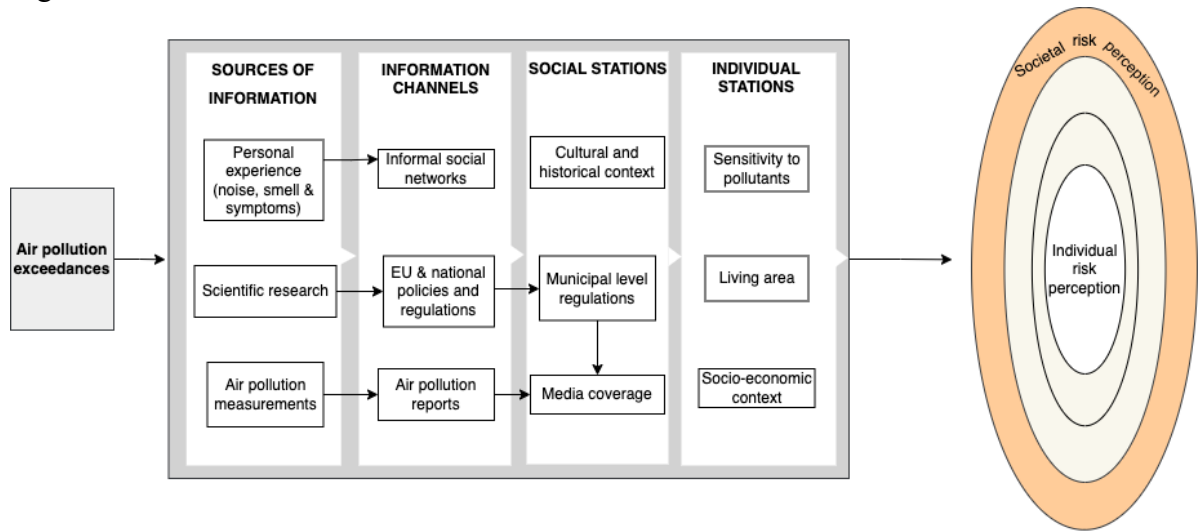


Figure 2:

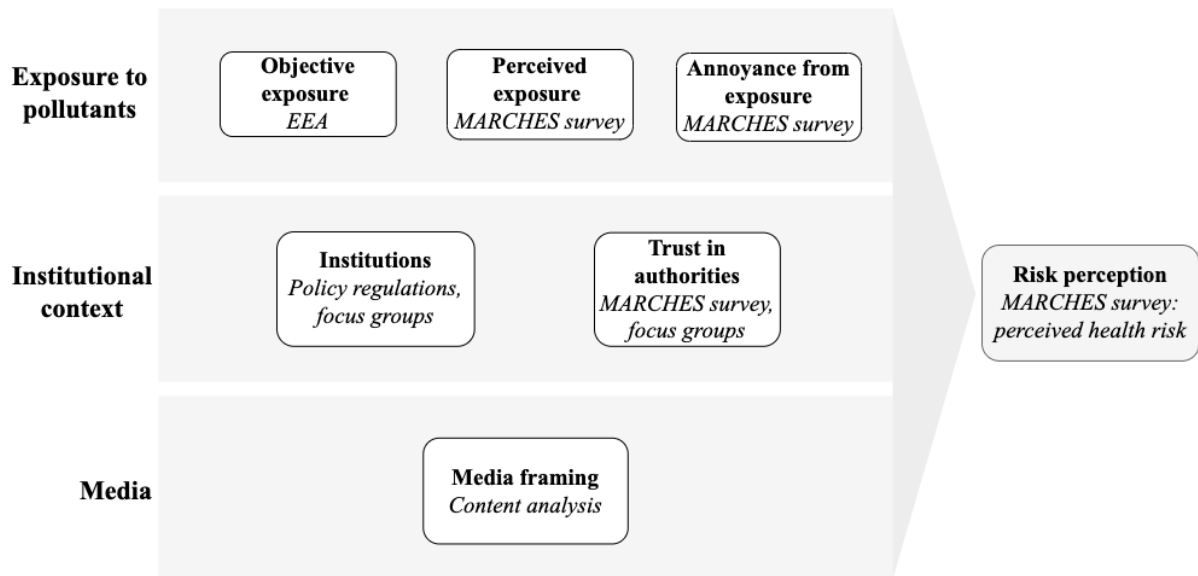


Figure 3:

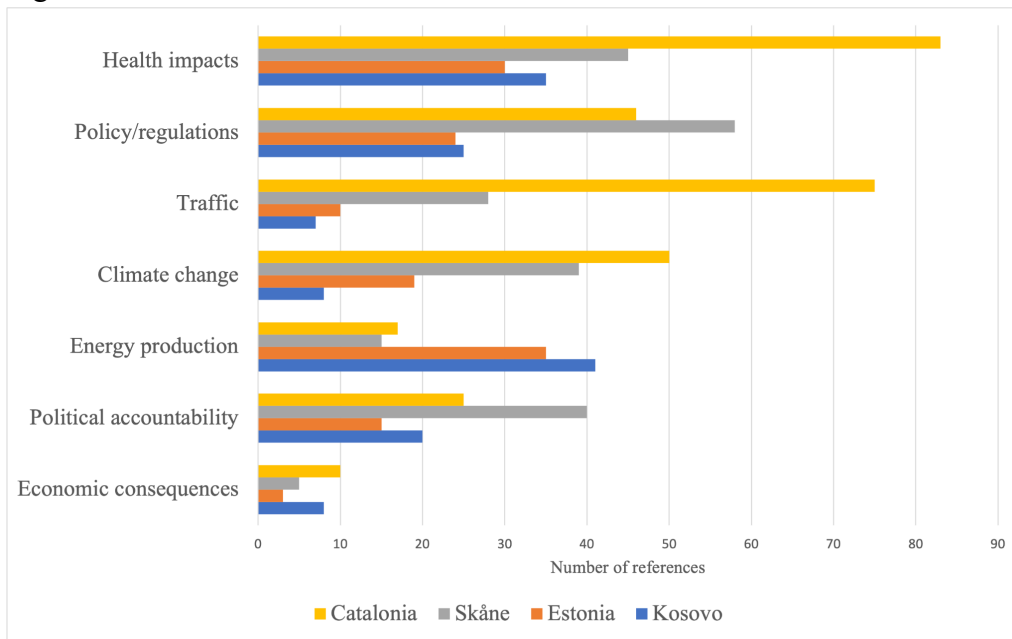


Figure 4:

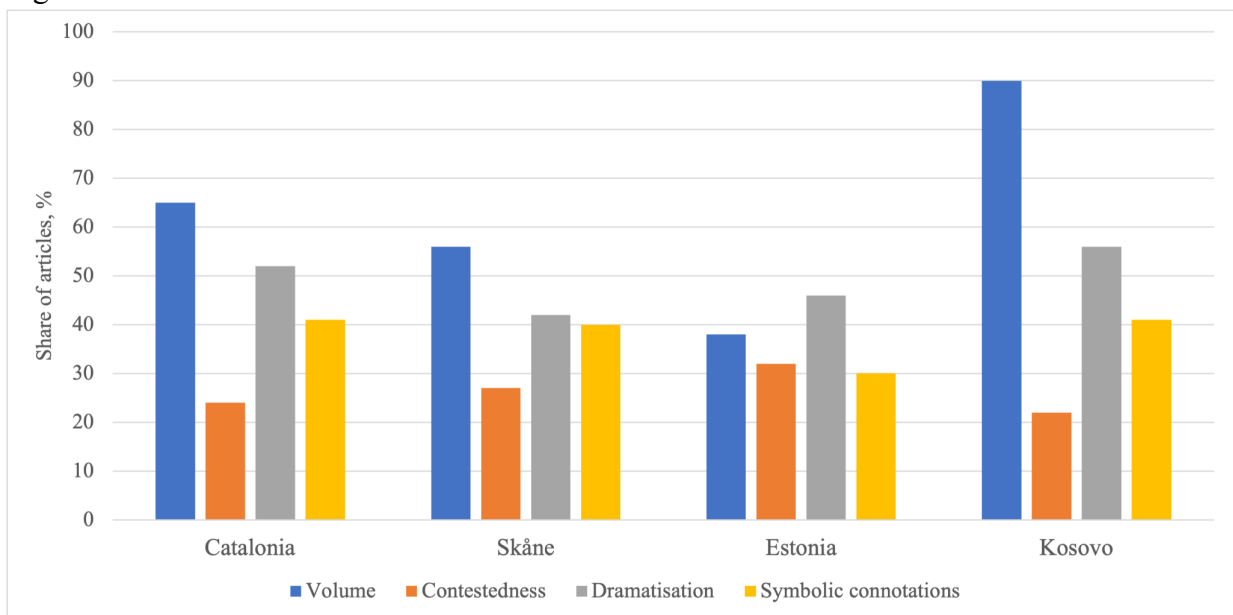


Figure Captions

Figure 1. Adapted SARF model of air pollution risk amplification and attenuation. Based on Kaspersen et al. (1988).

Figure 2. Conceptual model linking exposure, institutional and media contexts to perceived health risks from air pollution and relating these to data sources.

Figure 3. Dominant framings of air pollution across media coverage in four regions: Catalonia, Skåne, Estonia and Kosovo.

Figure 4. Prevalence of SARF-based media mechanisms by region (% of articles).