Risk communication: An international analysis of radon coverage in selected newspapers

Tania Forja-Pena*, Paula Martínez-Graña ** Lucía Ortigueira-Piñeiro*** Berta García-Orosa****

* Departamento de Ciencias da Comunicación, Universidade de Santiago de Compostela (tania.forja.pena@usc.es)

** Departamento de Ciencias da Comunicación, Universidade de Santiago de Compostela (paula.martinez.graña@rai.usc.es)

*** Departamento de Ciencias da Comunicación, Universidade de Santiago de Compostela (lucia.ortigueira@rai.usc.es)

**** Departamento de Ciencias da Comunicación, Universidade de Santiago de Compostela (berta.garcia@ucs.es)

Abstract

This study aims to analyze risk communication through a case study that provides a comprehensive examination of how media coverage of radon has evolved from 1925 to February 2023. Using quantitative and qualitative content analysis, it explores four dimensions: the evolution of coverage, thematic focus and perceived risk magnitude, reliability and credibility of sources, and authorship. The sample includes 445 news articles published in twelve international outlets from Europe and the United States. Results show that radon has remained largely invisible in the media, with attention concentrated around key scientific milestones. Coverage mainly frames radon as a residential and health hazard, while technological innovation and interactive formats are practically absent. Despite the frequent citation of expert and governmental sources, misinformation persists in a small yet concerning number of articles, particularly those suggesting health benefits of radon. The findings also reveal a lack of specialised journalism and limited preventive information. This study contributes to understanding how the media shape collective awareness of long-term environmental health threats and emphasises the importance of accurate, ethical, and evidence-based reporting to improve public knowledge.

Keywords: digital communication; digital media; journalism; online communication; radon; risk communication.

Introduction

The media have traditionally played a key role in shaping public opinion. Although the hegemonic actors are currently seeing their role as opinion shapers undermined, and part of their influence is shifting to more volatile actors (Mancini, 2020) amid the search for a new media identity (García-Orosa et al., 2020), the media continue to play a fundamental role in risk and crisis situations.

Human existence is constantly exposed to diverse risks, environmental, technological, health-related, and social, that affect individuals and communities globally. In this context, risk communication has become a crucial field for understanding how societies perceive, interpret, and respond to threats that endanger collective well-being. The media, as key mediating agents between scientific knowledge, public institutions,

and citizens, have a significant responsibility to communicate risks accurately, transparently, and ethically. Their role is not limited to transmitting information but extends to framing risks, contextualizing scientific uncertainty, and fostering informed public debate.

In recent years, much research has underlined the importance of understanding risk and being aware of its influence on health (Khan & Chreim, 2019). The scientific literature contains numerous studies on risk communication in crises (Boyd & Furgal, 2019; Gerdes, 2022), but analysing these situations is insufficient, as they often entail significant changes in the usual behaviour of the different actors involved. For example, journalists' roles shift when covering health crises; they become more cooperative with public institutions and abandon their traditional role of watchdog (Klemm et al., 2019), and sometimes crises can even be a social construct. That is why for this research, rather than focusing on crises, we conducted a longitudinal study that allowed us to fully observe the subject of analysis.

Within this broader framework, it is essential to recognise that some risks—despite their significant impact on human health—remain underrepresented in the media. Radon constitutes one of these invisible yet persistent threats to human existence worldwide.

While it has been scientifically proven to be a leading cause of lung cancer among non-smokers, its social visibility and media coverage are still remarkably low. Understanding how the media portray radon and whether they fulfil their communicative responsibility under the principles of risk communication becomes a key question for both journalism and public health.

In this article, we present data from research analysing risk construction in a transversal way, through a specific case study: that of radon. There is a worrying lack of knowledge of this gas and its link to health problems (Vázquez-Herrero et al., 2025).

This study closely examines the importance of understanding the risk from radon exposure, how this risk is conveyed in the media, and the need to raise public awareness of this invisible, yet significant threat to public health.

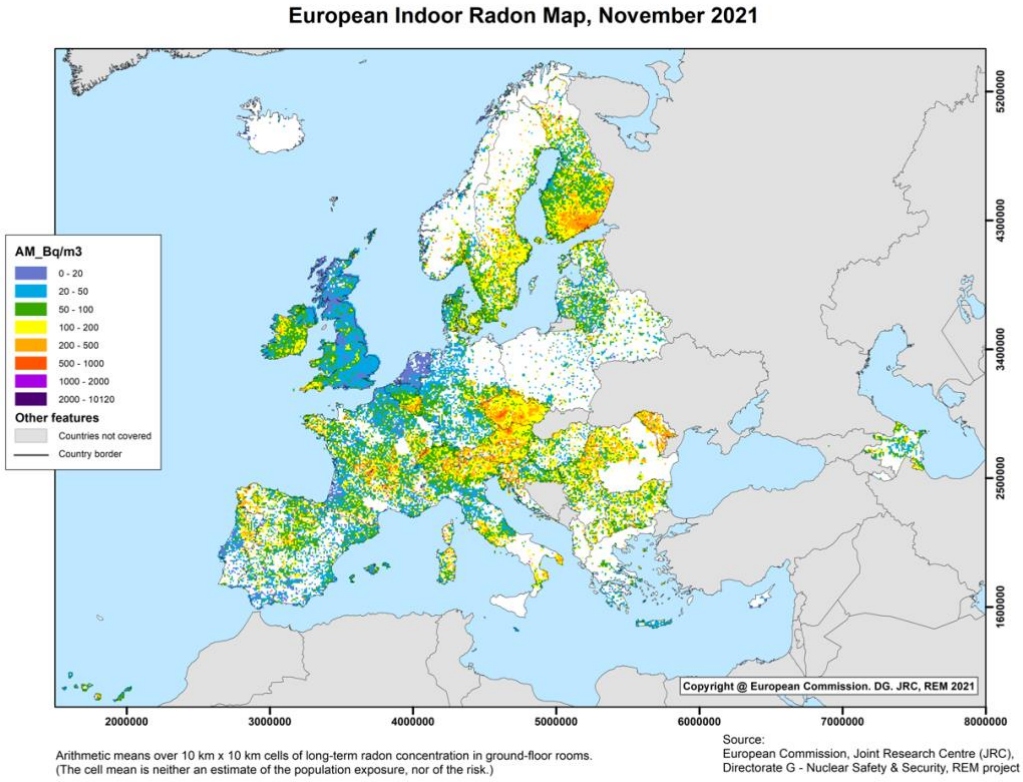
Thus, the objective of this research is to analyse how risk is conceptualised and communicated in the digital media, both digital-native and digitalised outlets, by examining radon as a paradigmatic case of environmental and health risk. Specifically, the study seeks to identify the dominant frames, sources, and thematic priorities in global news coverage, in order to understand the role of journalism in raising awareness and fostering public understanding of scientifically proven but socially underestimated risks.

Radon is a colourless, odourless, and tasteless radioactive gas, and exposure to it is one of the leading causes of lung cancer after smoking, according to the World Health Organization (WHO, 2023). This naturally occurring radioactive gas may be found in high concentrations in indoor environments, such as homes or workplaces, constituting a public health problem (WHO, 2021). In 1979, the WHO focused on the harmful effects of radon for the first time by creating a working group to evaluate indoor air quality (WHO, 2015). Radon was first declared a human carcinogen by the U.S. Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC) in 1987 and 1988, respectively (EPA, 1987; IARC, 1988).

Early research into the effects of radon exposure on health identified excess mortality from lung cancer among miner cohorts (Darby et al., 1995; Hunter et al., 2013; Kreuzer et al., 2015; Rage et al., 2018), while recent studies estimate lung cancer mortality attributable to radon at 3.8% among the population in

countries like Spain. This figure increases to 7% in regions like Galicia and can range from 0.15% to 25% at the global level (Pérez Ríos et al., 2021).

Figure 1: European Indoor Radon Map

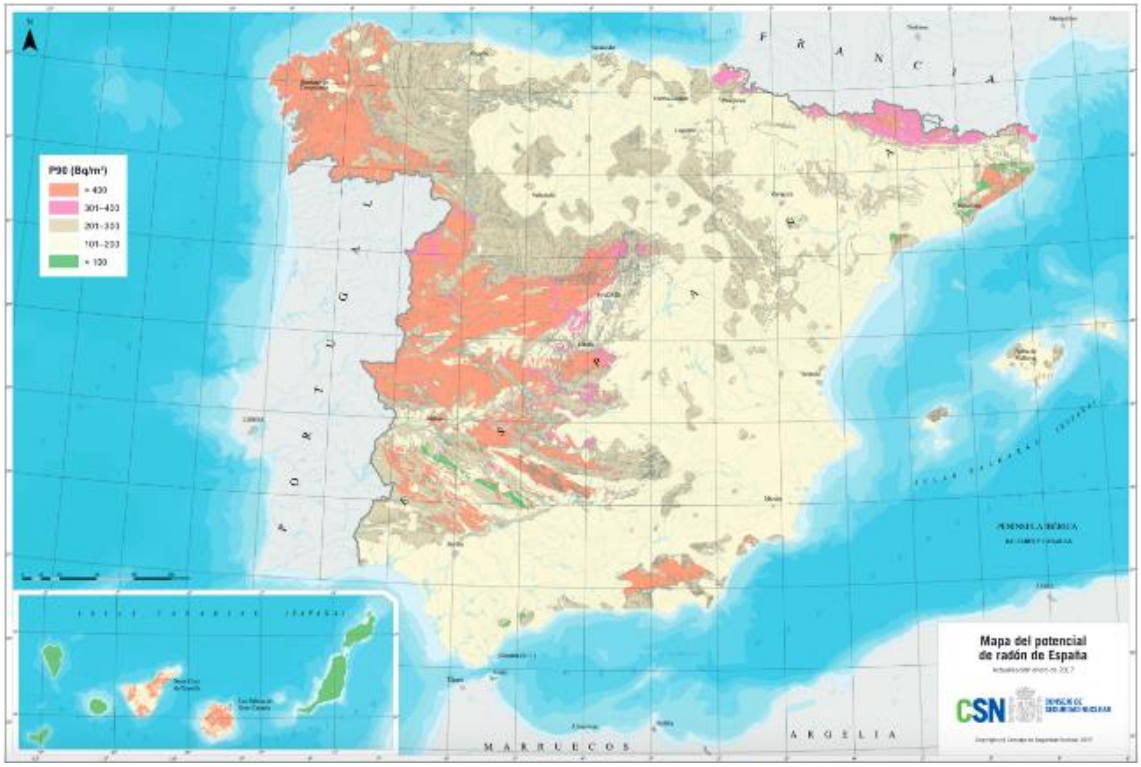


Source: European Commission

European legislation requires Member States to implement Council Directive 2013/59/Euratom of 5 December 2013, laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation (Official Journal of the European Union, 2014) (Figure 1).

Among the lines of action is a communication strategy to increase public awareness of the risks of radon, for the purpose of informing decision makers as well as people who could be affected by exposure to this toxic gas.

Figure 2: Map of radon potential in Spain



Source: CSN

In Spain (Figure 2), Royal Decree 1029/2022, of 20 December, transposes the European directive into Spanish law. The National Radon Plan (Ministry of Health, 2024) establishes that risk communication should be based on the following parameters: assessment of the public perception of risk, use of clear and understandable messages, and identification of the groups receiving the information.

In the process of raising public awareness of the risks from radon exposure, the media play an essential role due to their ability to produce positive changes in the population, and also to prevent and reduce the occurrence of illnesses like lung cancer (Apers et al., 2024; Wakefield et al., 2010).

Framework

Risk and risk communication

The concept of risk has been defined as the possibility for human actions and events to harm essential aspects of things that people value (Rasmussen & Ihlen, 2017), and it is often described in terms of probability of loss (Stern et al., 1996). However, to understand the concept of risk, we must go beyond the technical definition, that is, the product of probability and magnitude, to integrate the influence of psychological, social, institutional, and cultural factors, making it a social construct.

The nature of risk is not merely probabilistic, but also communicative: more than mathematical calculations, what leads people to perceive a nuclear facility as dangerous are its background history, its cultural interpretation, and how it fits into the ideology of the region in question (García García, 2014). Therefore, this research considers risk perceptions as shared cognitive schemas that are refined through mediated

communication and interpersonal interaction (Young et al., 2021). Risk is defined, negotiated, and shaped through communication (Rasmussen & Ihlen, 2017).

As a social construct, it is often created by social, political, or media actors who may conceal, bring visibility to, or even invent risk.

Developing risk communication is key, because risk perception is associated with risk response: a greater perception of risk implies a greater willingness to perform, in this case, radon measurements (Cori et al., 2022). Furthermore, increased evidence-based information is associated with more effective communication strategies in the health field (Bouder et al., 2021).

The purpose of risk communication is to provide the public with the knowledge it needs to make decisions freely (Aven & Renn, 2010), because only through access to reliable, proven, and accurate health data can journalists—and professionals in the health field—guarantee citizens their right to information (Elías, 2018; Kovach & Rosenstiel, 2003).

The psychometric paradigm, developed by researchers like Slovic et al. (1978) and Tversky & Kahneman (1974), explains how people construct their own perception of risk through subjective processes conditioned by cultural, psychological, and social factors. Additionally, in the case of invisible risks like radon, people lack sensory cues, so their risk perception depends on information provided by third parties, causing them to underestimate its severity or long-term effects. (Skotnes et al., 2021).

In the case of radon, although there is much knowledge and scientific evidence of its harmful effects, this does not equate to a greater awareness of the problem. In fact, the high level of scientific knowledge contrasts with the low level of risk perception among the population, especially compared with other environmental risks (Cori et al., 2022) that receive more media attention, thus influencing public opinion (McCombs & Shaw, 1972).

Among radon communication strategies, using maps that communicate health risk with numeric frequencies has proven effective (Timmons & Lunn, 2023), as have providing perspectives and real comparisons, such as radon's risk equivalent with smoking (Kerry Smith et al., 1990), and personal testimonies from people diagnosed with lung cancer from radon exposure (Perko et al., 2024).

A study by Vogeltanz-Holm & Schwartz (2018) suggests that the low awareness of the risks associated with radon exposure is a real problem that can be addressed by assaying the public's understanding of radon, and that the real estate and construction sectors can serve as intermediaries to increase radon testing and remediation.

The role of specialised health journalism

Medical and health-related news are among the topics that generate the most interest in the population, with over 70% of the public acknowledging that the Internet is their primary source of information (FECYT, 2022). Amid technological advances and digitalisation processes, the media must reinforce the intrinsic principles of journalism in order to defend their credibility on the Internet, setting themselves apart in the face of the large volume of information available online (Marcos-García et al., 2021; Moreno Gimeranez, 2017).

Specialised health journalism has a distinctive advantage: its ability to report on health topics rigorously, distancing itself from anti-journalistic practices, such as the use of sensationalist headlines to generate

impact, covert advertising, or failing to provide information corroborated by multiple experts (Barrera-Páez, 2016).

Credibility is based on values such as trust, independence, veracity, and transparency (Soengas-Pérez et al., 2023). It is also defined by distinguishing between fact and opinion and the rigorous use of reliable sources (Balsebre, 1994; Mauri-Rios et al., 2020). Credibility is directly related to the use of expert sources, such as medical professionals or members of the academic community in the health sciences (Lopes et al., 2023).

Journalism depends on its code of ethics (Cruz-Álvarez & Suárez-Villegas, 2017) in a context in which rumours and speculation have begun to make the news (Carrillo, 2013). Even opinions are being used to justify interpretations of information when there are no factual arguments to support them (Ruiz, 2008). When journalism departs from its ethical principles, there are cases of fake news spread with the intent of misleading (disinformation) or without such intent (misinformation) (Aïmeur et al., 2023). The research by Salaverría et al. (2020) identifies four kinds of health-related hoaxes, ranging from jokes and exaggerations to decontextualization and deception.

In a communication scenario where reporting is not synonymous with journalism, the media must be a point of reference against the plethora of fake health news being shared over social media, for example (Suárez-Lledo & Álvarez-Gálvez, 2021). People demand knowledge and want to understand the world around them, but fake news can constitute a public health threat. The spread of misleading health information jeopardises scientific advances and limits their actual effectiveness in society, with serious repercussions on human health and well-being (Catalán Matamoros, 2021). In the face of this, journalism's function must be to find answers to the public's questions in scientific evidence, so that people can make decisions that impact their health based on accurate and proven information.

Risk and the media

The media play an important role (Zhao et al., 2019) in the Social Amplification of Risk (SARF) when the response to public information is likely to be amplified or attenuated (Kasperson et al., 1988). In conveying a message, the media shape part of the context in which it will be interpreted, and they influence how the message will be perceived (Horlick-Jones et al., 2001; Kasperson & Alabama, 1988).

People's concern over a determined risk grows as media coverage increases and public debate intensifies (Rowe et al., 2000; Yim & Vaganov, 2003). Several research studies have demonstrated that news reports have a positive impact on risk perception (Hong et al., 2019; Frewer et al., 2002; Vries et al., 2021; Dryhurst et al., 2020; Abrams & Greenhawt, 2020; Malecki et al., 2021). A study by Fleming et al. (2006) identified an influence on food risk perception after it was covered in local newspapers. In addition, a study by Morton & Duck (2001) observed a link between news reports on skin cancer and the perception of this risk among the population.

However, when examining risk communication in the media, we must also consider the hypothesis of impersonal impact, where the media present problems as a threat to others, or to society in general, but the news has no impact on the personal level. The individual perceives that the risk is not to themselves, but to others (Lee et al, 2020; Tyler & Cook, 1984). Another problem derived from risk communication is the development of stigmas (Flynn et al., 2001) that affect how some illnesses, or the people who suffer them, are perceived at historic times of intense media attention.

Increased media coverage of a health issue does not imply better treatment of health information. The media construct narratives that are amplified on social media, a space where discussions that are harmful to health also arise (Gabarron et al., 2021). Reporting takes place in a communicative context where the digital media can be even more effective than the traditional media in amplifying health risks (Ng, Yang, & Vishwanath, 2018).

Despite the changing roles and apparent decrease in centrality in the public discourse (García-Orosa, 2021), the media are the main channel for the dissemination of health information to the general public. Leading newspapers played a key role in disseminating information about scientific advances on the human genome, personalised medicine, graphene, and emerging biotechnologies (Prados-Bo, 2022).

In short, risk is a social construct, and the media play a fundamental role in its creation, concealment, or reinforcement. Thus, in the face of the danger of keeping the public in the dark about radon, or treating the topic in a way that could fuel dramatisation, distortion, sensationalising, or misrepresentation, the media must be committed to reporting on radon in a manner consistent with the ethical principles of journalism.

Research objectives and questions

This study's main objective was to analyse risk conceptualisation and awareness-raising in the digital media, including digital native and digitalised media, by examining the case of radon.

Secondary objectives were as follows:

1. Analysing how media coverage of radon has changed over time.
2. Studying the topical focus and magnitude of the risk under study in the media.
3. Studying the reliability and credibility of the sources used (and presence of sources with corporate/advertising interests).
4. Studying the authorship of news articles on radon.

We started with the following hypothesis: over the past few decades, a serious health threat, radon exposure, has been made invisible in the media. Based on this hypothesis, the following secondary hypotheses were designed:

SH1. The media define radon as a health risk but barely give it any attention.

SH2. Most articles on radon come from news agencies.

SH3. The knowledge conveyed is mainly technical; it comes from expert sources, and no useful information on prevention is provided.

Methodology

Our study analyses the international media coverage of radon. We chose 12 leading newspapers from around the world, included in the project 'Digital native media in Spain: strategies, skills, social involvement, and (re)definition of journalistic production and dissemination practices (Reference: PID2021-122534OB-C21)', funded by the Ministry of Science, Innovation and Universities, and co-funded by the European Regional Development Fund (ERDF).

Our analysis sample consists of nine digital native media outlets: The Canary UK (UK), Tortoise Media (UK), II Post (Italy), The Journal IE (Ireland), Observador PT (Portugal), The Texas Tribune (USA), SAPO

(Portugal), De correspondent (Netherlands), and Krautreporter (Germany), and three digitised media outlets: The Guardian (UK), The New York Times (USA), and The Washington Post (USA).

This type of non-probability sampling is used in ecosystems with a variable population. Therefore, we selected a sample composed of a small number of media, which allowed us to select representative cases of that environment (Otzen & Manterola, 2017).

We carried out a literature review and a quantitative and qualitative content analysis (Krippendorff, 1990) of all the news articles published and available in the digital editions of the 12 newspapers under study. To select the sample, we identified all articles containing the word 'radon' (Universe=1263), excluding those that do not refer to the radioactive chemical under study.

News articles were retrieved with no time limit, depending on their availability in the digital newspaper libraries and archives of media websites. The analysis period therefore begins in 1925, with the oldest recorded news item on radon, and ends in February 2023.

To analyse the media coverage, we selected a sample (N=445) based on the fulfilment of at least one of the following four criteria (Table 1):

1. Radon appears in the headline.
2. The word radon is mentioned four or more times in the article.
3. Radon is the main subject of the article.
4. Radon is portrayed as a positive element, not in line with the scientific evidence.

Table 1: Sample selection

Media outlet	Universe	Sample (N)
The Canary UK	3	0
Tortoise Media	1	1
II Post	11	0
The Journal IE	39	22
Observador PT	14	4
The Texas Tribune	1	0
SAPO	30	25
De correspondent	1	0
Krautreporter	0	0
The Guardian	125	33
NY Times	745	250
The Washington Post	293	110
TOTAL	**1263**	**445**

Source: Own research

In order to optimise our analysis and obtain representative results, we selected a smaller sample using the formula proposed by Yamane (1967:886), with a 95% confidence level and a 5% precision level/margin of error.

$$n = \frac{N}{1 + N(e)^2} \qquad n = \frac{445}{1+ 445\ (0.05)^2} \qquad n=211$$

These 211 news articles were chosen by means of a random selection over time, so that reports could be collected from different historical periods.

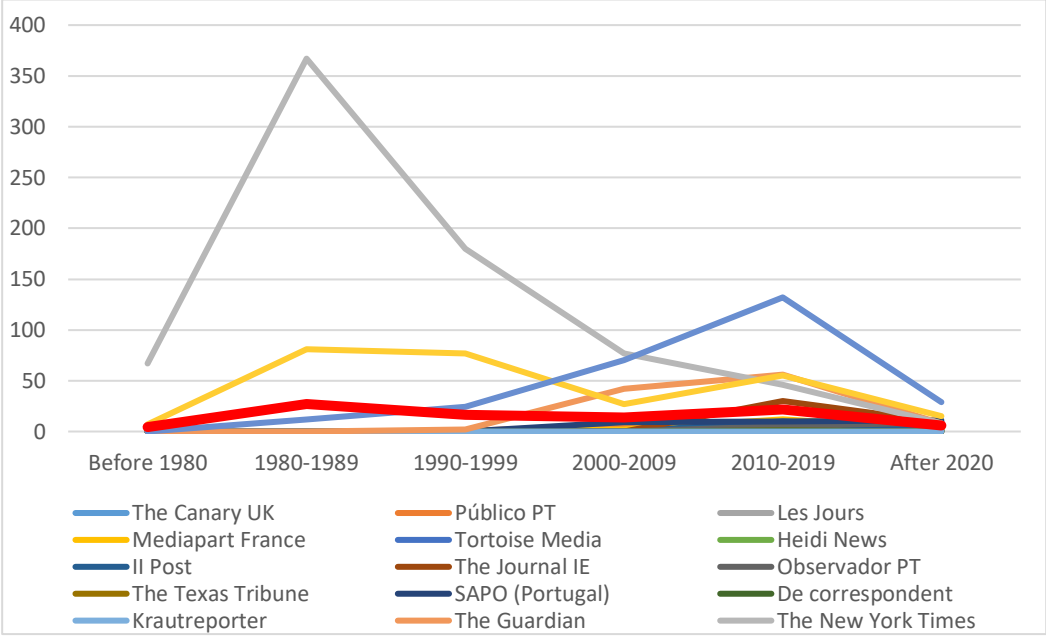
To meet our objectives, we designed an analysis sheet with the study categories and variables: identification data of the media outlet, radon's relevance in the news item, topics and focuses, description of the magnitude of the associated risk, presence or absence of misinformation, detection of innovative content, geographical areas referred to, and sources cited and their type (Negreira-Rey & Vázquez-Herrero, 2022), with a total of eight categories and their corresponding 27 subcategories (Annex 1).

Results

How media coverage of radon has changed over time

The oldest article analysed was published in 1925, while the most recent was from February 2023. News on radon from 17 media outlets over the past century provides a historic overview of how this topic has been covered in the media (Figure 3). Through a total of 1,263 articles, we identified periods when the news generated was abundant or scarce, pinpointing key moments in the evolution of media coverage of this topic.

Figure 3: Number of articles published over time



Source: Own research

The graphic shows two peaks in activity. The first, between 1980 and 1989, reflects a significant increase in the news reported. The second peak, while less pronounced, is more generalised between 2010 and 2019 in all the media outlets considered.

The marked increase in radon coverage in the media between 1980 and 1989, which is particularly evident in The New York Times, and more subdued in The Washington Post, is directly linked to radon being declared a human carcinogen. The International Agency for Research on Cancer (IARC), an agency under the World Health Organisation (WHO), acknowledged this in 1988, and it had been previously announced by the U.S. Environmental Protection Agency (EPA) in 1987. The rise in media attention correlates to the growing concern over radon after it was officially declared a carcinogen, as well as the broad media coverage of this development.

The second peak in news activity, between 2010 and 2019, is not associated with a specific event, but rather with an increase in concern about creating safer living and working environments. Most of the articles from this period focus on requests to measure radon levels in buildings, scientific advances in health and lung cancer, and a greater general concern for well-being (Image 1).

Image 1: News on radon from the *The New York Times* archives

Source: *The New York Times*

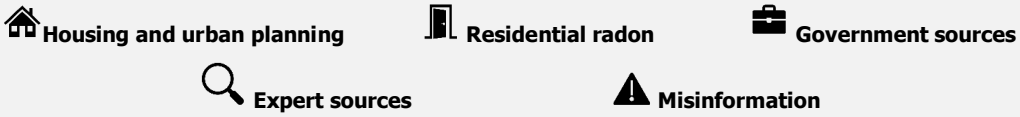
It should be noted that there was no significant increase in the number of radon-related news articles during the COVID-19 pandemic, suggesting that this new risk faced by society did not influence other areas of media interest.

In the news published on radon from 1925 until today, the most frequent topical focus is housing and urban planning, followed by health and prevention (Table 3). Prior to 1987, the housing focus is 39.68% present, decreasing to 36.90% in the 1987-2001 period before increasing to 48.43% between 2001 and today. The second most frequent topic is health and prevention, whose weight in the news gradually increases as a growing body of research confirms radon's harmful effects on health. Therefore, the media's treatment of radon from the health perspective increases from 25.39% before 1987 to 29.68% from 2001 onward.

Table 3: Change in media coverage of radon, 1925-2023

	Before 1987(1)	**1987-2001(2)**	**2001-present(3)**
TOPIC			
RISK			
SOURCES			
MISINFORMATION			

Key:



Source: Own research

1. Before 1987: date when radon was declared a human carcinogen
2. 1987-2001: since radon was declared a carcinogen until the early 21st century
3. In the 21st century

In line with the trend observed in the topical analysis, the news mainly presents the risk associated with radon from the perspective of residential radon. Before 1987, the media presents this type of risk in 44.44% of news articles, which rises to 55.95% between 1987 and 2001 and drops slightly, to 51.56%, in the most recent historical period. After residential radon, in second place, we identify radon as cancer-causing. The exponential increase in news related to this type of risk stands out from 1987 onward, the year radon was declared a human carcinogen. Therefore, articles that present radon as cancer-causing increase from 15.87% prior to 1987 to 36.90% after that year. However, the percentage drops back down to 18.75% in recent decades.

Regarding sources used by journalists to write news, government sources are the most frequent from 1925 to 1987. During this first historical period, they are cited in 73.01% of news articles, but their presence

decreases to 26.56% in recent years. Meanwhile, from 1987 onward, the newswriting process undergoes a transformation: journalists show a preference for expert sources, cited in 83.33% of news, instead of government sources.

Finally, it is worrisome that the growing scientific progress over time, along with greater knowledge of the risks and harmful effects of radon, is not synonymous with higher news quality. In recent decades, there is more scientific evidence about radon than ever before, but also more misinformation than in any other historical period, found in 17.18% of news from 2001 until today.

The topical focus and magnitude of the risk under study in the media

The results are distributed significantly into different categories by topic. Overall, the most prevalent topic is housing and urban planning, predominant in 41.71% of news articles. These pieces highlight the importance of detecting and mitigating radon in residential environments and workplaces.

The second most prevalent topic in the news is health and prevention. A total of 27.96% of the articles focus on aspects related to this area. These reports highlight the importance of raising awareness of the health risks of radon exposure, especially in relation to research, prevention, and lung cancer incidence, as well as preventive strategies recommended to mitigate these risks.

Thirdly, 15.64% of the news articles we examined deal with policy and regulatory issues related to radon. These articles cover government measures and regulations passed to control and mitigate radon exposure, as well as debates on potential legislative reforms to increase public protection. Since the articles were published over a long period of time, they address different regulations in force, and we can observe how they have changed up until the present.

Fourthly, 15.17% of the news analysed was categorised as 'other'. These articles address a wide range of issues related to radon that do not specifically fit into the previous categories, such as the environmental implications of radon signals for the early detection of earthquakes and volcanoes.

When each media outlet is considered individually, the overall data is corroborated: housing and urban planning is the primary topic for all except The Guardian, where health and prevention and housing and urban planning appear with the same frequency, of 50% in each case. This topic does not predominate in Observador PT either; two articles were analysed from this media outlet, and they were associated with health and prevention and policy and regulation. Finally, Tortoise Media did not coincide with the overall trend either, and the sole news report we analysed corresponded to the health and prevention category.

One interesting aspect that we identified in our analysis was the inclusion of opinion genres, such as columns or blogs, in the media coverage. Although they have a limited presence, the case of SAPO is significant, with blog posts related to hot springs and spas in Portugal that provide inaccurate information on radon. These blog posts highlight the supposed health benefits of radon water in these places, suggesting the need for a critical assessment and accurate reporting on radon-associated risks.

Looking closely at the narrative in the headlines, significant clues are revealed about how the topic has changed over time. These headlines are usually direct and clear about the article's content. Prior to 1987, headlines rarely contained the word 'radon'. However, after that year, a significant change is observed in the frequency of this term in headlines.

There is growing concern over radon exposure due to its adverse implications for human health and the environment. In our analysis of radon in the international news, we examined various topical categories related to different risks identified in order to learn more about the risk constructed around this gas. From its link to cancer to its impact on residential environments, along with its potential association with earthquakes and even the health benefits identified in some news reports, this study provides an overview of the predominant concerns and focuses of radon coverage in the media.

The primary risk perceived in the news analysed is that of radon as a toxin in residential buildings. Most of the articles, 51.66%, point to radon as particularly worrisome in household and work environments. These articles underline the risks associated with residential radon exposure and emphasise the importance of adequate detection and mitigation to protect residents' health.

The second risk is that of radon as cancer-causing; 26.54% of the news articles identify radon as carcinogenic. These news reports underline the risks to health, especially the direct relationship between prolonged radon exposure and lung cancer.

Interestingly, the two aforementioned risks overlap in many of the news articles analysed, with both present in a significant number of cases. Although we have identified a primary risk in our analysis, these two risks are not mutually exclusive, especially in this context.

In 6.16% of the articles studied, radon is not presented as a risk, but rather as beneficial to health. These range from reports recommending spas with radon water with healing properties to articles that not only deny that radon causes lung cancer, but also claim that it is harmless or even salubrious.

In a small percentage of the news analysed, 3.79%, radon is linked to earthquakes. These reports suggest a potential correlation between radon release and seismic activity. Radon levels are measured to detect earthquakes or volcanic eruptions before they occur and to study their development.

Of the articles analysed, 11.37% are classified as 'other'. These articles may address a variety of additional risks and concerns related to radon that do not specifically fit into the aforementioned categories, e.g. news where the risk factor is not presented in any of the ways studied.

The analysis of technological innovation in the news articles on radon shows a clear absence of innovative practices in the coverage. Technological innovation in journalism can be understood as the use of interactive or data-driven formats, the integration of multimedia and transmedia storytelling, or the incorporation of participatory tools that enhance audience engagement. None of these elements are present in the analysed sample.

While this lack of innovation is understandable in the oldest articles, produced in traditional media environments with limited digital infrastructure, it is also evident in the most recent publications. Even in digital-native outlets, the coverage remains highly conventional. Most of the news pieces consist solely of text accompanied by static images, without the inclusion of videos, infographics, hyperlinks, or interactive visualizations that could enrich storytelling and facilitate greater user engagement.

This pattern suggests that, despite the evolution of digital journalism, radon coverage continues to reproduce traditional narrative models and does not take advantage of the technological potential of digital media to communicate environmental and health risks in a more engaging way.

The authorship of news articles on radon

As a part of our analysis of the content of 211 news articles, the authorship of each piece was identified. The results reveal that in the international media, radon is mainly covered by named journalists. The number of articles authored by news agencies is minimal.

Specialised journalists tend to offer more balanced news coverage, avoiding sensationalising or fuelling panic among readers. Based on the findings of our research, journalists who report on radon are not specialised in the subject, so such coverage is simply an addition to their daily reporting work. Media outlets do not have professionals on staff with extensive knowledge of radon and its context.

This is evidenced by the fact that there are few cases where the same journalist writes several stories in which radon is the main topic. The only examples can be found in The Washington Post and The New York Times: nine journalists authored more than one article on radon for the former, and ten for the latter (Table 2). For both The Guardian and Journal IE, one journalist wrote a total of two articles on radon.

Table 2: Authors of more than one news article on radon

The New York Times		***The Washington Post***	
Author	**No. articles**	**Author**	**No. articles**
Alfonso A. Narváez	5	Cass Peterson	2
Andree Brooks	2	D'Vera Cohn	2
Anthony Ripley	4	Donna St. George	2
Bob Narus	6	H. Jane Lehman	3
Jay Romano	3	Lynda Richardson	3
Philip Shabecoff	5	Michael Weisskopf	2
Rachelle Garbane	2	Sally Squires	2
Robert Hanley	3	Sam Hankin	3
Walter Sullivan	6	Wendy Swallow	2
Warren E. Leary	4		

Source: Own research

Although there are no journalists specialised in radon, the background of some of the authors of these articles is relevant and useful. In the case of The New York Times, several journalists have experience in reporting on science and/or health, as well as environmental issues. However, we cannot say this is a significant number.

Despite the clear lack of specialisation detected, it is revealing how infrequently the international media turns to news agencies to generate news on radon. Prior research on the national level detected a marked tendency of the Spanish media to source news from agencies, which contrasts with the findings in this study. Only 6% of the articles come from news agencies, while 94% were written by journalists on staff. By media outlets, The New York Times has nine articles written by news agencies, Tortoise Media has two, and The Washington Post and SAPO have one. Therefore, the weight of news agencies in constructing media coverage of radon is negligible.

The main reporters are journalists, who write directly for their media outlets, so they are the ones who determine the media coverage with the types of articles they decide to write.

The reliability and credibility of the sources used

News sources

Our content analysis reveals a significant presence of expert sources as opposed to other types of sources. Specifically, most of the articles in the media analysed (75%) cite at least one expert source on radon, and, to a lesser yet significant extent, 53% cite at least one government source. Almost 25% of the articles cite non-expert sources, and 21% reference corporate sources.

By media outlets, The New York Times is the one with the largest number of articles citing at least one expert source, 74% of its total articles. This is followed by articles citing government sources (60%) and those referencing non-expert sources (25%); finally, 21% of the journal's articles cite corporate sources.

Meanwhile, 85% of The Washington Post's articles reference expert sources and 62% cite government sources, whereas articles referencing non-expert sources represent only 34% of the total, and 32% cite corporate sources.

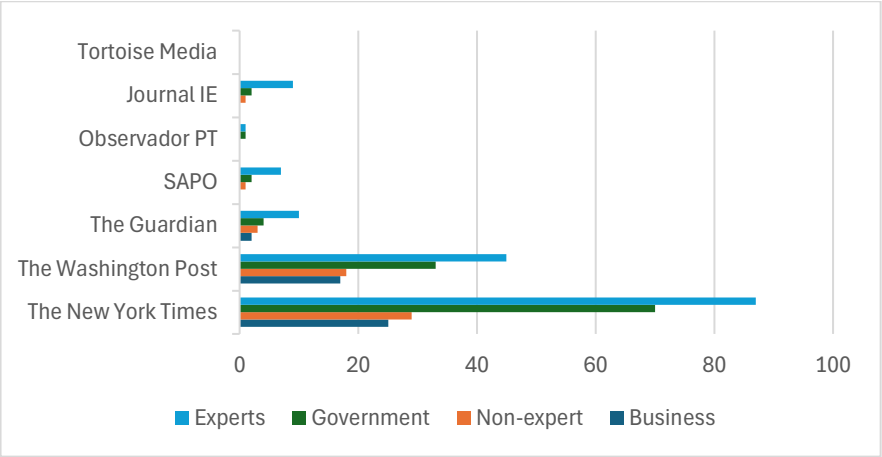
The Guardian stands out for its broad contrast between expert sources, who appear in 83% of its articles, and other sources, including 33% government, 25% non-expert, and 13% corporate sources.

In SAPO's case, 58% of the news articles reference expert sources, 17% government sources, and 8% non-expert sources. Journal IE has nine news items citing expert sources and two referencing government sources. In the case of Observer PT, expert and government sources appear in one news item. In Tortoise Media, no sources are identified (Figure 4).

The expert sources used by the media have national and even international accreditation in some cases and provide relevant information. They are often national scientific organisations (such as the U.S. Environmental Protection Agency) and research groups that provide evidence-based data on the incidence of radon in the countries under their jurisdiction and its effects on the health and daily lives of citizens.

Corporate sources, which are used the least, are often cited merely to supplement the information and for practical purposes, such as informing the reader about options for reducing the adverse effects of radon. Non-expert sources are usually testimonials from people affected by radon.

Figure 4: Number of news articles by information source



Source: Own research

Another interesting finding from the content analysis is the number of sources present in each report on radon. News items tend to contain between one and three sources, although the number does vary between media outlets. Seventeen percent of the articles in The Washington Post and The New York Times have four sources, corresponding to nine stories in The Washington Post and 20 in The New York Times. These two media outlets, along with The Guardian, are the only ones to exceed the ten-source mark in certain cases. In general, news articles citing more than five sources are rare.

Therefore, there are very long news articles that have only one, two, or three sources cited repeatedly in their paragraphs. This makes it difficult to compare and contrast sources and reduces plurality, even if these sources are reliable.

Misinformation

For this study, an operational definition of misinformation was adopted, understood as the dissemination of false, inaccurate, or misleading claims about radon and its health effects, regardless of the sender's intent. This definition was based on scientific verifiability criteria and on the assessment of the level of evidence available at the time of publication. During the coding process, news articles were identified as containing misinformation when they (1) included statements that contradicted the prevailing scientific consensus, (2) omitted warnings about the proven risks of radon, or (3) presented ambiguous information likely to generate misleading perceptions about its danger or its alleged therapeutic benefits. The coding was carried out manually, reviewing each unit of analysis and cross-checking the detected claims against recognized scientific sources, such as reports from the World Health Organization (WHO), the International Agency for Research on Cancer (IARC), and the United States Environmental Protection Agency (EPA).

Of the 211 news articles analysed, we identified 17 with misinformation about radon, corresponding to 8% of the content. Six are from The Guardian, four from The New York Times, three from SAPO, three from The Washington Post, and one from Tortoise Media.

This misinformation is mostly linked to health, as there are claims about the benefits of radon-contaminated hot springs to cure diseases.

Twelve news articles, that is, over 70% of the total articles with misinformation, mention the healing properties of radon. The claims cite the suitability of radon to treat everything from gastrointestinal and liver ailments to rheumatism and respiratory problems. At times, the claims are categorical, and sometimes they indicate a lack of consensus in the scientific community.

One example can be found in quote from a report in The Guardian (Quin, 2005): "anyone suffering from chronic rheumatism and not put off by spending an hour locked in a tiny, radon-gas-infused tunnel 2km inside a mountain, then you're in luck", referring to the possibility of a cure by this process.

In the same vein, there are reports that border on advertising. For instance, an article by Tortoise Media (Solarski, 2019) has a photo gallery featuring a series of Soviet sanatoriums used in their day to cure illnesses with radon and other radioactive elements, without indicating the dangers that such practices are known to have today.

Other times, misinformation is presented indirectly. For example, some fragments of news stories in which radon's actual danger is debated. In an article in The Washington Post (Rovner, 1986), a scientist calls for a review of the figures for lung cancer caused by radon, as 'it is probably not as dangerous as it is believed to be'. Thus, the scientific evidence on the risks of radon is questioned on several occasions.

Based on the data, it is impossible to determine whether or not the intent was to misinform. However, in articles published prior to the 1980s, these cases can likely be attributed to a lack of scientific knowledge, as radon was not classified as a carcinogen until 1988.

Discussion and conclusions

In recent years, numerous research studies have pointed to the importance of understanding risks and being aware of their impact on health in order to remediate them (Khan & Chreim, 2019). Although radon presents a serious risk, public awareness of this risk is limited (Vazquez-Herrero et al., 2025; Khan & Chreim, 2019; Holmgren et al. 2013; Davydov et al., 2021).

Despite the media's pivotal role in this function (Rowe et al, 2000; Yim & Vaganov, 2003; Prados-Bo, 2023), news coverage of radon is quite rare and irregular throughout the years we analysed, and always linked to scientific discoveries.

Radon's invisibility in the media cannot be blamed on the problems affecting other risks, such as limited transparency or scientific uncertainty (radon has been classified as cancerogenic since 1987 by the EPA and since 1988 by the IARC, and it is treated as such in most news reports), or the conveyance of contradictory messages (Marion, 2021). In this case, proven scientific evidence is cited, usually with technical sources, just as Mora et al. (2021) called for, so the media discourse largely coincides with the scientific discourse. However, this leads to a medium or high level of knowledge (Vázquez-Herrero et al., 2025) but a low level of awareness, with radon framed as a risk to society at large (and therefore, unable to impact a person individually) and a distant risk.

Radon is framed as a risk linked first to homes, and second to health. The problems identified in the reporting of such news include radon's limited presence and near invisibility in the media and the absence of technological innovation, as if the changes in journalism of the last 40 years had never happened. But the

biggest problem is misinformation, which is not very widespread, but could seriously impact health if radon-based services are offered.

No cases of false plurality are detected in the news classified as misinformation. In most instances, the misinformative parts are not supported by expert sources or by scientific evidence. This lack of expert sources is visible in travel news that covers the beneficial properties of radon water at spas, opinion pieces, and blog posts. In the rest of the news articles with misinformation, we identify the inclusion of only one expert source. In most cases, they cite a supposed lack of firm scientific evidence of radon's harmfulness, and they mostly coincide with the years prior to radon being declared a human carcinogen.

We thus confirmed our primary hypothesis that radon, a serious public health problem, has been made invisible in the media in recent decades. We also confirmed secondary hypotheses 1 and 3: radon is recognised as a serious risk to health, and technical information is conveyed with little or no information about prevention measures. We did not confirm hypothesis 2, as the majority of the articles (94%) do not come from news agencies.

Overall, the analysis reveals that, in digital media, both native and digitalised outlets, the conceptualisation of radon as a risk remains limited and largely framed in informational rather than preventive terms. Coverage tends to portray radon as a collective or distant threat, with little emphasis on personal exposure or actionable awareness-raising. Over time, reporting has been irregular and event-driven, closely tied to scientific milestones rather than to sustained public health communication efforts. This temporal pattern illustrates the media's reactive rather than proactive role in addressing environmental and health risks.

At the thematic level, radon is most frequently associated with housing and indoor exposure, followed by health and prevention, while regulation and policy occupy a marginal space in the news agenda. The reliability and credibility of the information analysed appear generally solid, with a predominant use of expert and governmental sources, although this is occasionally undermined by instances of misinformation or content with promotional undertones. Authorship analysis reveals that most articles are signed by journalists, yet very few show topic specialisation or continuity over time, suggesting that the lack of expertise contributes to superficial or episodic coverage.

Taken together, these findings indicate that the invisibility of radon in the media is not the result of scientific uncertainty but rather of structural routines within journalism that privilege immediacy, novelty, and event-based reporting over continuous, preventive, and contextualised communication. Reducing this gap between scientific consensus and media practice requires renewed approaches to risk communication—ones that integrate technological innovation, media literacy, and specialised training in health and environmental journalism.

In general, we can highlight the following conclusions of our study:

1. The worrisome presence of misinformation in media outlets that should be benchmarks of journalistic integrity. With the vast amount of information available on the Internet, the media must reinforce the intrinsic values of journalism in order to be a benchmark in the dissemination of health information. Reporting is not synonymous with journalism, and the media has a duty to ensure that journalism is practiced in accordance with the ethical principles of the profession.

The findings of our research show a worrisome amount of misinformation (8%) published by media outlets in a historical period when radon had already been declared a human carcinogen, backed by scientific

evidence. For example, the publication of reports recommending spas with radon water, or news mentioning the healing properties of radon without scientific evidence to support it.

Another anti-journalistic practice is the failure to distinguish between opinion and fact. This gives rise to blogs, published under the main media brand, that have become a space for misinformation and the spread of hoaxes and speculation.

2. Residential radon is the priority in terms of topical focus and the magnitude of risk. According to our analysis of radon coverage, spanning from the first recorded news item (1925) until the present day (2023), the media choose to cover radon from the topical perspective of housing and urban planning (41.71%), followed by health and prevention (27.96%), and thirdly, policy and regulation (15.64%).

As the primary risk, most of the news articles, 51.66%, point to radon as particularly worrisome in household and work environments. As the second most common risk (26.54%), radon is presented as cancer-causing, and thirdly, radon is portrayed not as a risk, but rather as beneficial (6.16%).

3. Lack of innovation in the way news is reported: The technological progress throughout the period analysed (1925-2023) contrasts with the lack of innovation in the way that radon-related news is reported. Most of the news consists exclusively of two elements: text and image. Despite the fact that prior studies have identified digital media as more effective than traditional media in amplifying health risks (Ng, Yang, & Vishwanath, 2018), in this analysis of media coverage, no relevant change is observed in the way that news is reported by digital media. On the contrary, there are no possibilities for audience members to co-produce news, or technological innovations to help spread the message.

4. Lack of specialised journalism. Specialised journalists provide better coverage and are less swayed by panic (Klemm, Das, 2019); in this case, on a positive note, most of the news articles were written by named journalists (94%) compared with news reports (6%) from agencies. However, the findings of this study suggest that the journalists who write these news stories are not specialised. Proof of this is the fact that there are few cases where the same journalist has written multiple news articles on the same topic, despite the fact that specialisation is a key requirement for news to be reported in an truthful, credible, and accurate way. The more that a journalist reports on the same subject, the likelier they will be to avoid sensationalist content and alarming people unnecessarily.

5. Significant presence of expert sources. The majority of the articles (75%) cite at least one expert source on radon. Furthermore, 53% of the stories include at least one government source. Non-expert sources appear in 25%, and corporate sources in 21% of the news items.

Also, the articles usually contain between one and three sources. The number varies depending on the media outlet: The Washington Post, The New York Times, and The Guardian are the only journals that sometimes exceed ten sources. In general, news articles with more than five sources are rare.

In the next few years, there will need to be a debate on the coexistence of AI-generated synthetic content and the curating of content using algorithms, as well as the fragmentation of the public sphere online due to social media, and its effects on risk.

Limitations

The study attempts to achieve a greater understanding of how risk is created in the media. In the coming years, it would be interesting to include other risks in the analysis sample, which could be comparable due

to their timelessness and the fact that they are not particularly subject to times of acute crisis. Additionally, the interaction with other entities and factors that influence risk perception is being researched.

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Annex 1

Main categories and variables on the analysis sheet

Identification data	Media outlet Publication date Headline Author Agency URL
Topic/focus	Health and prevention Housing and urban planning Policies and regulation Other
Magnitude of risk	Cancer-causing Residential radon Earthquakes Positive/beneficial to health Other
Description	[Description of news article]
Sources	Number of sources Expert sources Government sources Non-expert/community sources Company
Geographic area	National International
Technological innovation	YES/NO [Description of the innovation]
Misinformation	YES/NO [Description of the misinformation]

Source: Own research