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What does Germany think about radiation? Survey 2024

Final report
Project 3623S72213

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1 Summary

1.1 Background

A key component of radiation protection is the education of the population about the effects and risks of radiation and about the correct protective behaviour in this respect. In order to gather information on society's handling of selected radiation topics as a basis for this educational task, the Federal Office for Radiation Protection (BfS) has for many years commissioned socio-scientific studies on how society and individuals deal with selected radiation topics as well as on risk and information perception – e.g. on the topics of mobile communication, power grid expansion, UV protection, communication of scientific uncertainties in the area of electromagnetic fields, knowledge of general practitioners regarding electromagnetic fields, reflected way of dealing with risks in radiation protection.

1.2 Objective

The objective of this research project is to detect the anchoring in society of radiation and radiation protection, the perceptions, knowledge and information needs of the population in Germany and to derive perspective recommendations for action and information. The reliability of the results on how the population deals with radiation and radiation protection is ensured by means of a method triangulation from a qualitative and a Germany-wide representative quantitative survey.

The focus is on the following questions:

- What are the views and opinions existing in Germany on the subject of radiation and radiation protection?
- What do respondents know about selected radiation protection topics?
- In which areas have the respondents already dealt with protective measures and which specific protective measures have already been taken?
- How well do citizens feel informed and protected by government radiation protection measures and what are their information needs?

The survey also intends to provide insights into the environment in which the BfS operates with its scientific work as well as its information and communication measures. The results should thus provide impulses for the design of the BfS's science and risk communication as well as for the elaboration of radiation protection concepts. This study is part of a series of surveys entitled "What does Germany think about radiation?", which is carried out by the BfS at regular intervals approximately every two years, with the first survey having taken place in 2019. Another survey followed in 2022, and the series is now being continued with the current study in 2024. This third survey builds on the surveys from 2019 and 2021/2022.

1.3 Summary of the core results

In general, citizens feel better informed by state institutions in the area of radiation in 2024 than they did two years ago: in 2024, 40% of respondents feel "well" or "very well" informed by state institutions in the field of radiation protection, compared to only 31% in 2022 (top2 box, 4pt. scale). In addition, the majority (52%) of the population generally feels well or very well protected by the state (2022: 51%). When asked specifically about their sense of protection against various types of radiation, it was found that as many as 81% feel well or very well protected by state institutions when it comes to medical applications and a good half when it comes to UV radiation, high-voltage power lines, mobile phone masts and radioactive substances in the event of an accident. Only when it comes to radon, less than half of the population feel well or very well protected

by state institutions (45%). This may also be due to the low level of awareness of radon in general and thus of the risk posed by radon (see chapter 3.3.1): when asked about the risk, which is unknown to them, respondents tend to feel rather poorly protected.

People generally want more education and information from state institutions in the area of radiation protection: whenever people are asked what could be done so that they feel better informed or protected by state institutions – whether in general or in relation to specific radiation issues such as *radiation from high-voltage power lines* or *radon* – respondents generally are most likely to wish for more education and information on the topic (see chapters 3.3 and 4.2.3 and 4.4.2.3). Information behaviour on the topic of radiation is predominantly passive – this was shown in the qualitative surveys in both 2024 and 2022. The sources through which information on radiation is obtained are essentially no different from sources that are also consulted for other topics (see Chapter 3.3.8). The majority of the population places great trust in scientific and official information. The assessment of the brochure on radiological emergencies shown in the group discussions is good overall. In the view of many respondents, it offers a comprehensible and compact presentation of sound scientific information (see chapter 3.3.10).

What issues relating to radiation currently concern people in Germany and what changes can be identified compared to the 2022 survey?

- The perception of risk in relation to **ionising radiation or radioactivity** is very pronounced: when asked for spontaneous associations, respondents particularly frequently mention terms from this topic area, and they also express most concerns regarding health in this context. The qualitative survey shows that, due to the war in Ukraine, the topic of radioactivity has gained in importance compared to the survey from two years ago. The topic is much more present in the media and the perception of risk with regard to radiological emergencies as well as the perceived need for protective measures have increased among some respondents. In quantitative terms, the desire for more education and information is particularly pronounced when it comes to the topic of radioactivity.
- The topic of **UV radiation** and UV protection has moved more into the focus of the population. The qualitative survey shows a new trend: younger women in particular have become more aware of UV protection as a **preventative anti-ageing measure**.
- Polarisation on the subject of **mobile phone radiation** has increased, as the qualitative survey has shown. This relates to increasing criticism and concern on the one hand, and increasing carefreeness and support for technology on the other. Quantitatively, it can be seen that although mobile phones are often associated with radiation, only a few are very concerned about them in comparison to other radiation-related health concerns.

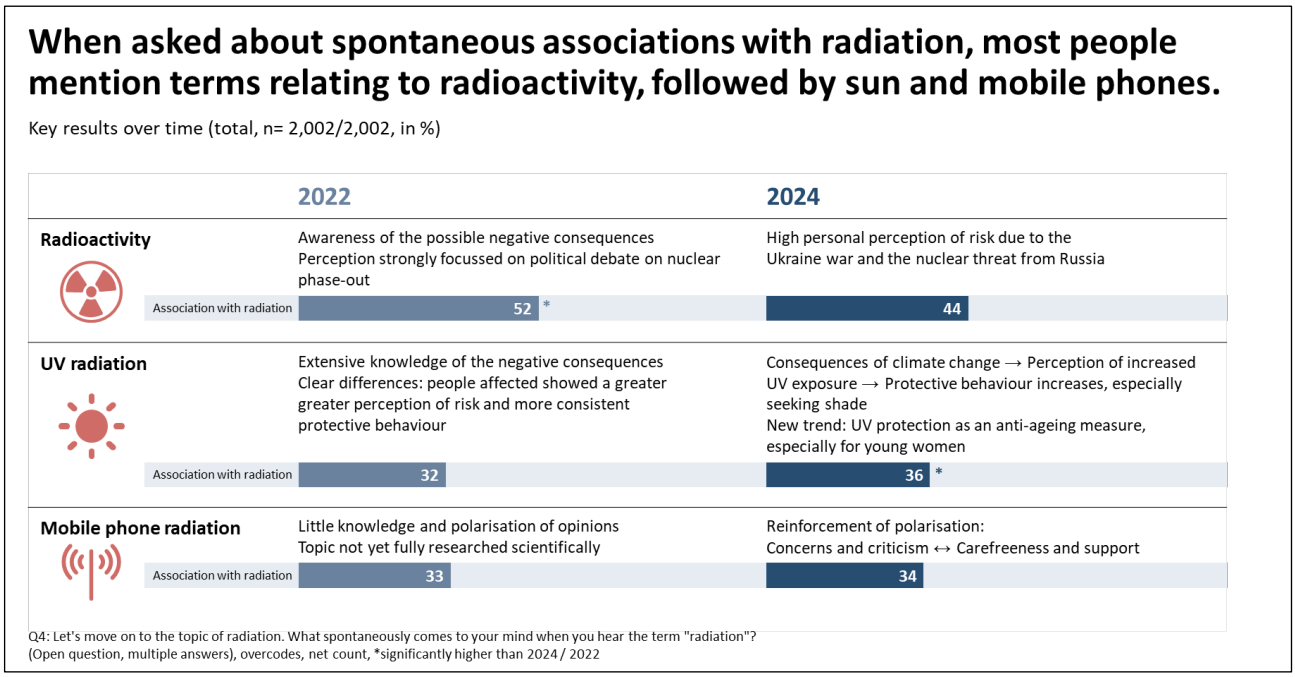

Figure 1 Overview of the results on radioactivity, UV radiation and mobile phone radiation

The **relevance of ionising radiation** and radioactivity in the perception of the population can be seen in the frequency of spontaneous associations with the topic of radiation (the most frequently mentioned association at 44%) as well as in the relations of topics causing health concerns among respondents: a possible nuclear accident and nuclear weapons are the biggest modern health concerns (see Figure 2). When asked about their concerns about various health issues, respondents most frequently rated radioactive contamination from nuclear power plants after an accident and nuclear weapons as (very) concerning (accident: 76% top 2 on a scale of 5, nuclear weapons: 67%). This is followed by non-radiation-related issues such as multi-resistant germs in hospitals (59%), nanoparticles and plastic in food (55%) and the ever-present issue of air pollution from cars is only (very) concerning for 31% of respondents.

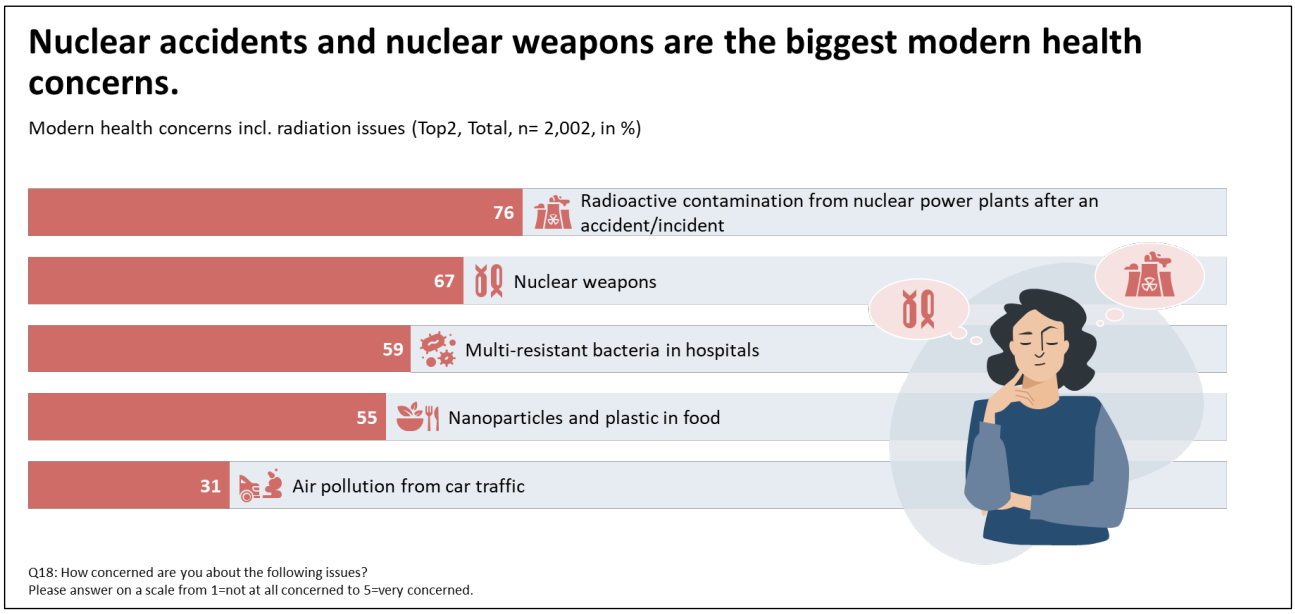

Figure 2 Percentage of the population concerned about the health issues presented

Accordingly, more than half of the population is highly concerned that nuclear weapons could be used in current conflicts and wars (58% top 2 on a scale of 5) or that a nuclear accident could be triggered as a result of these conflicts and wars (57%). Concerns about an accident have increased despite Germany's decision to phase out nuclear energy: at 35%, the proportion of those worried about a nuclear accident during *regular* operation is higher in the current survey than it was in 2022 (28%) – the cause could be the war in Ukraine.

The willingness to follow government instructions in an emergency is generally high: in the hypothetical scenario of how people would behave in the event of a nuclear accident at a nearby research facility, or whether they would follow government instructions, there is a high willingness to follow government instructions in the event of a nuclear accident. This changes significantly when the behaviour of friends and family competes with recommendations from the authorities: the greater the perceived opposing social pressure from acquaintances and friends, the more the willingness to follow instructions decreases: when asked about their willingness to follow the instructions of the civil protection authorities and not leave the house in the event of a nuclear accident, 87% of citizens said they would follow them (top 2 on a scale of 5). In two follow-up questions, additional information was used to increase the social pressure from people in the environment who do not follow the instructions: first, respondents were asked to imagine that people from their distant social environment (neighbours) do not follow the instructions, then that family members or closest friends call and ask them to leave the region together. With each level, the proportion of those who wanted to follow the instructions decreased (to 74% for the extended environment and 49% for the closest social environment). The proportion of those who wanted to continue to follow the instructions even under social pressure was highest among people who felt both well protected and well informed by state institutions for radiation protection (81% for the extended environment, 59% for the closest social environment). More information and a greater sense of protection could further increase the willingness to comply with instructions. Civil protection exercises, which some participants in the qualitative survey remembered positively from the GDR era, could possibly also contribute to this (see also chapter 3.3.5).

After radioactivity, **sun, light and UV radiation** are the second most frequently associated with radiation (36%). When it comes to UV protection, more and more people are protecting themselves by avoiding longer stays in the sun (82% "always" and "sometimes", 2022: 76%), while the proportion of those who always or sometimes use sun cream remains high at 73%, but is declining (2022: 77%). Overall, climate change and

increased communication, for example by influencers on beauty topics, appear to be leading to increased knowledge and protective behaviour when it comes to the topic of UV radiation and the need to protect against it (see chapter 3.3.4 and 4.3.3). The qualitative survey shows that changes in UV protection behaviour can be observed particularly among the group of young women: awareness of the risks of UV radiation has increased and is particularly taken into account in the context of skin care and anti-ageing measures.

Nevertheless, misconceptions do still exist in this area: a good quarter of the population (27%) agree that a certain amount of tanning of the skin is healthy, and UV protection is sometimes considered to be the same as heat protection – which gives rise to concerns that UV protection will be neglected on cooler days despite possible high exposure.

Almost three quarters of the population (74%) know the UV index at least by name or better and 38% try to stay informed about it at least occasionally, but only 7% try to do so at all times. Also in the qualitative phase, there were people who were familiar with the UV index, but they stated that, when it comes to UV protection, they relied more on their feelings or a "look out of the window" than on objective measurement. Further education on the necessary separation of "perceived" and actual UV radiation could help to further improve the protective behaviour of the population in this field.

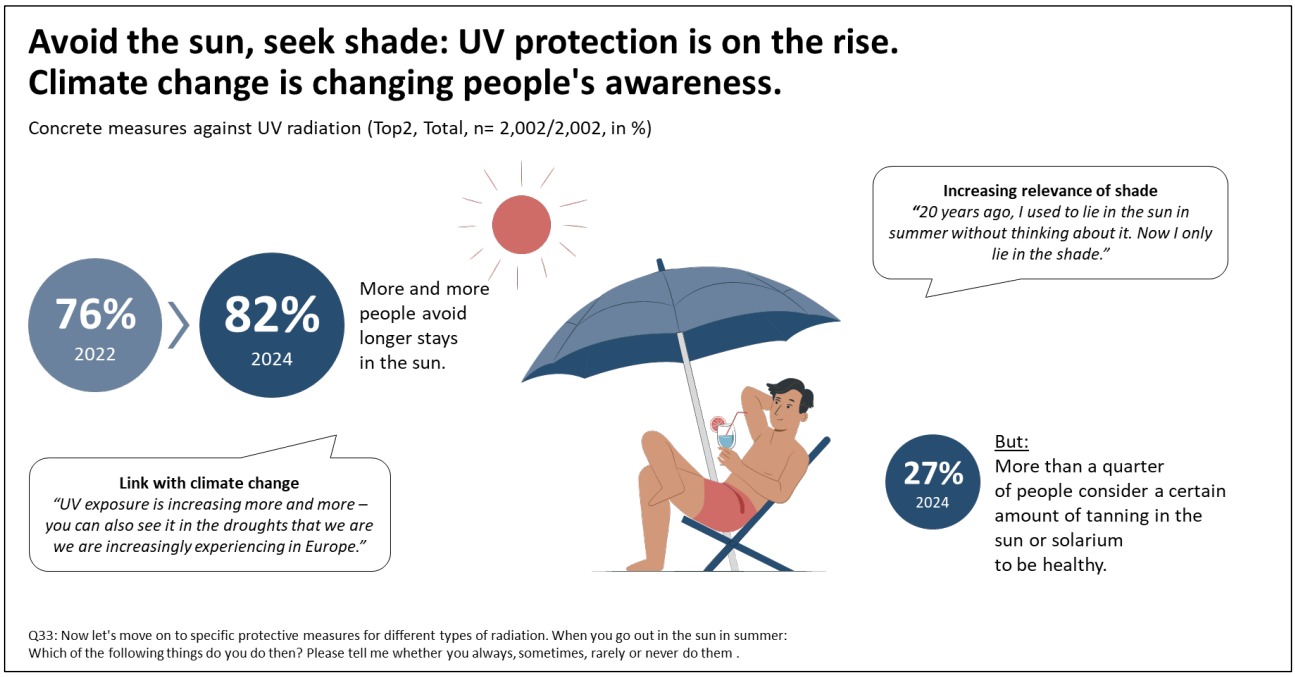

Figure 3 Overview of key findings on the topic of UV radiation

Associations with the topic of **mobile phones** follow in third place after radioactivity and sun or UV radiation: terms relating to mobile phones are spontaneously mentioned by just over a third as an association with the topic of radiation. Nevertheless, only 21% of respondents are concerned by radiation from mobile phone masts, and only 15% by radiation from their own smartphone (see chapter 4.4.1). This also confirms the misconception often mentioned in the qualitative phase that mobile phone masts lead to higher exposure to electromagnetic fields than one's own mobile device – on average, the opposite is the case (see chapter 3.3.6). A lack of knowledge on the subject is also evident when, for example, "mobile phone radiation" is mixed up with the topic of blue screen light as a possible cause of sleep disorders. Despite the rather low level of concern about smartphones, a relatively high proportion of respondents take protective measures in this

area (compared to protective measures for other radiation issues): just under a quarter of people protect themselves from mobile phone radiation, for example by banning mobile phones from their bedrooms. This proportion is presumably so high because measures to reduce radiation from one's own mobile phone are well known and easy to implement, whereas measures against mobile phone masts, for example, are not easy for individuals to implement.

Overall, there is a great deal of polarisation among the population in the context of mobile phones, which could also be seen in the qualitative survey: some consider the risk to be underestimated or feel poorly informed about the 5G expansion and therefore exposed to unknown dangers, while others consider the risk to be low and accept it in view of the desire for omnipresent availability of mobile network and internet (see also chapter 3.3.6). In addition, the protective measures taken suggest that despite a lack of conviction that there really is a risk and despite gaps in knowledge about the topic, many people still have an unpleasant feeling about the omnipresence of "mobile phone radiation" in the everyday lives of most citizens.

Medical terms are spontaneously mentioned by a third of the population as a general association with the topic of radiation. This means that a large part of the population is well aware of the potential danger of radiation in medicine. Nevertheless, only 12% of respondents are concerned about X-rays at the doctor's office and radiation from computer tomography, and 81% state that they feel well protected against radiation from medical applications by the measures taken by government institutions.

When it comes to a specific examination, 74% of respondents state that they follow their doctor's recommendations for an X-ray examination. At the same time, 61% said they would decide for themselves. This apparent contradiction is probably due to a high level of trust in doctors: if they suggest and give reasons for an examination, patients often follow this recommendation with the feeling that they are making a well-informed decision.

The population's knowledge of the various radiation issues in medicine is rather low. Although an overwhelming majority of 80% correctly state that the radiation from computer tomography (CT), X-ray, magnetic resonance imaging (MRI) and ultrasound is different in terms of both type and exposure, only a few can distinguish between CT and MRI, for example (see chapter 3.3.7). The proportion of those who are worried is also almost the same for each of the to types of examinations (CT: 12%, MRI: 11%), although in the first case it is ionising radiation, in the second it is electromagnetic "radiation".

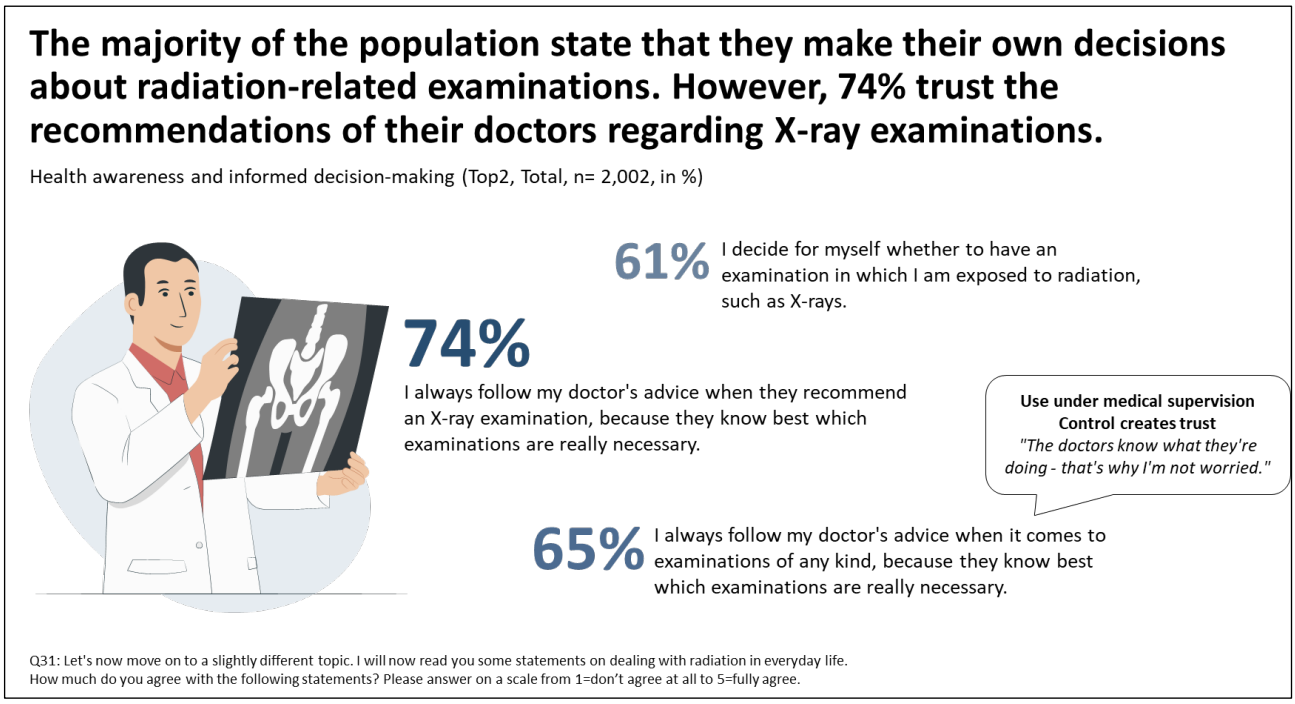

Figure 4 Key findings on health awareness in relation to radiation in medical applications

Only a few are worried about **radon**: as in previous surveys commissioned by the BfS, radon is little known and therefore not associated with much concern. Only 3% spontaneously mention it when asked about association with the topic of radiation, 5% spontaneously mention it as a potentially harmful source of radiation and when asked specifically about it, only 16% of respondents are concerned about the topic (top 2 value on a 5-point scale). At the same time, the proportion of respondents answering with “don't know” (9%) is by far the highest compared to all other health concerns, which suggests that the topic is unknown to many. In view of the fact that radon is the second most common cause of lung cancer in Germany after smoking, more education would be desirable in this regard so that citizens can better assess or minimise the risk (see chapter 4.4.1).

2 Research design

A two-stage research design was chosen to answer the research questions: a qualitative primary data collection was followed by a quantitative primary data collection.

2.1 Work package 1 (WP 1): Qualitative survey

The qualitative exploration focuses on the general perception of the importance of radiation, the risk perception regarding different radiation topics, knowledge of protective behaviour and protective logic as well as the use of relevant information channels on the topic of radiation.

In order to understand the collective discourse on radiation, two group discussions of two hours each were held in a face-to-face setting in a studio in February 2024. The scenario of a radiological emergency was also discussed and an information brochure from the BfS on radiological emergency protection was presented and explored in both groups.

In a second step, a total of 40 individual interviews lasting one hour each were conducted at four survey locations in March 2024. They were used to probe the individual perspective on radiation and radiation protection and to explore individual topics such as barriers, motives, fears, individual knowledge and individual handling of radiation-related risks in greater depth.

2.2 Work package 2 (WP 2): Quantitative survey

The quantitative survey started at the end of May 2024. The questionnaire designed for this purpose was developed on the basis of the earlier surveys and with the help of the results of the qualitative study, putting the results on a broader data basis. At the same time, the quantitative survey was intended to update the key findings of the previous study from 2021/2022 over time.

2.3 Work package 3 (WP 3): Final report

The findings from the qualitative and quantitative surveys have been summarised in this final report.

3 WP 1: Qualitative survey

3.1 Research design

3.1.1 Research questions for the qualitative survey in WP 1 (according to the terms of reference)

The following research questions and aspects were the focus of the qualitative survey in accordance with the terms of reference:

- What are the knowledge and perception as well as myths and fears in the population regarding radiation in general and related to individual radiation protection topics?
- What is the relevance of radiation protection in the context of health protection?
- What is the radiation protection behaviour or behavioural intention?
- What are the sources of information used on the topic of radiation?
- To what extent do awareness, attitudes and behaviour change over time?
- How important is the work of the BfS in the eyes of the public? How is the BfS perceived in terms of awareness, credibility and trust? What expectations are placed on the BfS? What is expected when it comes to comprehensibility of BfS information materials and information measures?
- How much trust is there in science?
- What is the connection with relevant socio-demographic characteristics?

3.1.2 Method: Combination of group discussions and individual interviews

In order to understand the collective discourse relating to radiation, two group discussions lasting two hours each were conducted in a face-to-face setting in the studio in February 2024.

In a second step, a total of 40 individual interviews lasting one hour each were conducted at four different locations in March 2024.

3.1.3 Target criteria for sampling for the qualitative survey in WP 1

The target group for the qualitative survey was put together using a 20-question screening questionnaire. The objective of the recruitment procedure was to ensure that opinions were as heterogeneous as possible. According to grounded theory, which follows the principle of permanent comparison, heterogeneous contrast cases (“maximum contrast”) can provide a particular gain in knowledge and should therefore be selected as part of the theoretical sampling.

As in the previous study from 2021/2022, the following criteria were considered for sample composition:

- Gender mix: 50% men, 50% women
- Age mix: good distribution of people aged 18 - 70 years
- Mix of household size and marital status: approx. 50% households with children < 16 years in the household
- Net household income: 50% below national average; 50% above national average
- Mix of educational background and occupational groups
    - Exclusion of 'risk experts', i.e. people who have a lot to do with risks in their professional lives (e.g. firefighters, police officers, actuaries, risk analysts)

    - Exclusion of 'radiation experts': i.e. people who have to do with radiation in their professional lives, such as radiologists and other medical professionals specialising in radiology, dermatologists (as specialists in UV radiation) as well as architects / civil engineers with a focus on radon remediation of buildings
- Professional backgrounds
    - 50% with a scientific / technical background
    - 50% without a scientific / technical background
- Mix of urban & rural population
    - 50% urban population (per survey location)
    - 50% population from the surrounding area (resident in a medium-sized town, small town or village from the area surrounding the survey locations)
- Good mix of people who live in a rented flat or house and people who live in their own flat or house
- Good mix regarding technical affinity
- Good mix regarding health awareness and awareness of health risks
- Good mix regarding trust in authorities & institutions
- Good mix regarding general life satisfaction
- People with and without a migration background
    - Definition of migration background: not born in Germany and living in Germany for at least 5 years

3.1.4 Sample description

The sample consisted of 16 participants, who were divided into two focus groups of 8 people each. One focus group consisted of participants aged 18-39, the other group of people aged 40-70. Another 40 people aged 18-70 were surveyed in individual interviews.

3.1.5 Survey locations and time period for the qualitative survey in WP 1

The group discussions took place in Mannheim in February 2024. This was followed by 10 individual interviews at each of the survey locations in Erfurt, Mannheim, Munich and Berlin in March 2024.

3.1.6 Research techniques for the qualitative survey in WP 1

Both the group discussions and the individual interviews began with getting to know the ways of thinking, the lifeworlds and the current state of mind of the participants. This made it possible to (better) classify the knowledge gained from the discussions and interviews. The actual content-related introduction took place with an exploration of perception and knowledge related to radiation using mind maps. With the help of the mind maps, free associations in the areas of emotions, perception and semantics regarding the keyword radiation could be collected and visualised and also used as a memory aid in the further course of the survey.

This was followed by a brief excursus on the topic of risk in the individual interviews. Personal attitudes to the topic of risk were explored, as well as how individuals deal with general life risks. The general discussion on the topic of risk was followed by an exploration of the perceived risks associated with radiation issues. In the groups, the risks associated with radiation were explored directly and compared with other life and health risks, as in the individual interviews.

The next part of the interviews and group discussions focussed on attitudes and knowledge about radiation protection measures. First, prevention and protection measures in the context of the previously discussed radiation topics were collected in an open exploration. The second step aimed at exploring the individual logics of when protective measures are actually taken and when they are not.

This was followed by an in-depth discussion of the topic of relevant sources of information, which was focussed more strongly compared to the previous study. The role of science and authorities were explicitly explored as well as the requirements that information should meet.

The last part of the group discussions consisted of a new topic compared to the previous 2021/22 study: the scenario of a radiological emergency was briefly addressed in an open discussion, before a brochure from the BfS on radiological emergency protection was presented and explored.

Following the qualitative maxim of openness, both survey forms started each thematic chapter with open exploration. After the open exploration, the contents were examined in greater depth, so that the quality criterion of depth of content was taken into account in addition to the criterion of openness. Initially, only the radiation topics that the respondents themselves mentioned in the individual interviews and group discussions were explored. In this way, an individual knowledge horizon, which was as uninfluenced as possible, was determined. Only the in-depth topics of 'UV radiation' and the topic of 'medical examinations and treatments using ionising radiation', which represented a new focus compared to the previous 2021/22 study, were explored at a later stage of the discussion – unless already mentioned by participants before.

3.1.7 Explanation of the analysis

The method used for conducting and evaluating the interviews follows the principles of grounded theory. Against this background, data collection and analysis were not separated. In the spirit of grounded theory, the data material was continuously analysed during the field phase already. The continuous analysis process during data collection consisted in the writing of memos in the form of pre-structured result tables in Excel and the preparation of transcripts of the group discussions as well as their analysis even before the beginning of the individual interview field phase. A separation of data collection and analysis was also counteracted at the personnel level, as the interviewers or moderators also took over the analysis.

A debriefing was scheduled at the end of the field phase in order to achieve intersubjectivity and comprehensibility through a transparent and participatory analysis discourse. The grounded theory strategy of permanent comparison and the associated search for "similar and dissimilar" was used throughout the whole analysis process.

3.2 Summary of the results of the qualitative survey in WP 1

With regard to the results of the current qualitative survey, it can be stated that, overall, there has been no major change in the level of knowledge on radiation topics compared to the previous qualitative survey in 2021/22. For some specific radiation topics, however, it can be seen that the general perception, the perception of risk, the perceived need for protective measures and information behaviour have changed in some respects. This applies in particular to the topics of radioactivity, mobile phone radiation and sun/UV radiation. The latter was one of the main topics of the current qualitative survey. The topic of radioactivity has gained in importance due to the increased nuclear threat situation, particularly in connection with the war in Ukraine. The media have increased their focus on this topic and the perception of risk with regard to radiological emergencies as well as the perceived need for protective measures have risen among some respondents. With regard to mobile phone radiation, the two opposing positions, which were already predominant in the 2021/22 survey, have shifted even further towards the extremes: on the one hand,

concern about mobile phone radiation and its risks has increased even more, while on the other hand, the lack of concern about mobile phone radiation seems to have increased due to the benefits of technology. When it comes to sun/UV radiation, changes can be observed in the group of young women in particular: awareness of the risks of UV radiation has increased due to the increased presence of the topic on social media and the intensified exchange within the peer group on this topic. Especially in the context of skin care, information and measures to protect against UV radiation are actively sought and protective measures (for example the daily use of sunscreen to prevent skin ageing) are consistently taken. The second main topic of the current qualitative survey, ionising radiation during medical examinations and treatments, shows that the term is largely unknown. The majority of respondents perceive radiation in a medical context as positive, since the benefits are clearly in the foreground for the respondents. Besides, there is a high level of trust in doctors when it comes to reducing risks by taking protective measures. For other radiation topics mentioned by respondents, such as microwave radiation, electrosmog, high-voltage power lines, laser radiation, satellite radiation, radon or infrared radiation, there were no significant changes in terms of general perception, risk perception, the perceived need for protective measures and information behaviour compared to 2021/22.

Information behaviour on the topic of radiation continues to be predominantly passive, as it was in the 2021/22 survey. Information on radiation is generally obtained from standard sources that are also used for other topics. Scientific and official information is trusted by the majority of respondents. However, a small subgroup of respondents seems to lose more and more trust in the government and government institutions, authorities and information. Most respondents have not yet used the BfS as a source of information, as many are simply not familiar with it. However, respondents were mostly open to obtaining information on the subject of radiation from the BfS in the future, as it is generally regarded as a competent, scientifically orientated and trustworthy authority. The BfS brochure presented in the group discussions was also met with openness – partly due to the relevance and topicality of the subject of radiological emergencies in the context of the war in Ukraine. The overall assessment of the brochure on radiological emergencies is good and, in the view of many respondents, it fulfils exactly what they want from authorities, namely a comprehensible and compact presentation of well-founded, scientific information.

3.3 Detailed results of the qualitative survey in WP 1

3.3.1 Radiation: Spontaneous associations, contact points and the role of radiation in the own life

As was already observed in the previous study, the term “radiation” evokes a broad spectrum of conceptual and emotional **associations** that are orientated towards the respective realities of the respondents' lives. For example, people who had recently undergone radiation-based medical examinations or treatments spontaneously mentioned this type of radiation. The majority spontaneously named the topic of radioactivity, which is very present in the media due to the events in Ukraine and Russia. Other frequent spontaneous mentions were solar radiation, mobile phones and the personal aura of people.

For the vast majority, radiation plays little or no role in everyday life. *“I've never really thought much about radiation.”* At the same time, it became clear in the interviews and group discussions of the current survey – as in the previous study 2021/22 – that the respondents perceive radiation as omnipresent: *“When I think about it, we are actually surrounded by radiation everywhere: solar radiation, radiation from the many technical devices in everyday life and all the networks. If you could visualise radiation, it would be a dense network that surrounds us.*”

The omnipresent radiation, which is rarely thought about in everyday life, manifests itself on demand in many *points of contact*: first and foremost in mobile phones and WLAN networks as well as in various technical devices at home (e.g. tablets, microwaves, smartwatches, smart home applications). Due to the seasonal recurrence of UV radiation, there are regular and repeated points of contact with this type of radiation. For

example, the topic of UV radiation and UV protection is heavily covered by the media in summer: *"The topic of solar radiation and the need for sun protection is a recurring theme in spring/summer – whether in magazines or on talk shows."* The strong presence of sun protection products in drugstores is also a recurring point of contact with the topic. *"The shelf with sunscreens is getting bigger and bigger in drugstores."* Unlike other radiation topics, UV radiation can also be experienced and perceived more physically – for better or for worse: *"The first sunny day after winter feels so good!" "I've already had a bad sunstroke."* At the same time, the example of solar radiation illustrates that radiation begins to play a role as soon as it is perceptible and that this is the earliest point at which protective measures are considered. The new nuclear threat, which has become increasingly present in the media since the outbreak of the war in Ukraine, has also become a new point of contact with the topic of radioactivity – a point of contact that could not be identified in the qualitative part of the previous study. *"Who would have thought that we would ever have to worry about such a threat [...]."* Mobile phone masts are more likely to be perceived as a point of contact with radiation by people living in the city, while those living in rural areas are more likely to mention high-voltage power lines as a point of contact with radiation. Finally, a few people in the qualitative survey reported work-related contact points with radiation: *"I work in a laboratory and my colleagues use lasers.*"

The interviews and group discussions have shown that radiation is generally not a *topic of conversation* among friends or family. The topic that respondents are most likely to talk about with friends, partners or family is solar radiation and the need for sun protection when reminding each other to use sun protection in certain situations. As the need for sun protection is generally known and proven, it seems socially acceptable to address this topic in certain situations. The results of the qualitative survey even suggest that young respondents in particular remind each other about sun protection in certain exposure situations (e.g. when going swimming at the lake together) more frequently than in 2021/22. In contrast, only very few people talk about radiation in the context of mobile communications: the majority feel no need to discuss this topic and attempts individual worried people to talk about it are quickly stifled, as the lack of clarity about possible effects and protective measures quickly makes the discussion appear to be the conjecture and fears of overly concerned people from the respondents' points of view.

The topic of radiation also plays only a limited role in everyday *media consumption*. Reports on the topic of radiation tend to be consumed passively and randomly instead of being actively sought out. However, the topic of the nuclear threat from Russia, which is very present in the media, is also strongly perceived in passive media consumption, which is reflected in a change in risk perception compared to 2021/22 as well as in parts in an active information behaviour (see chapter 3.3.5).

3.3.2 Radiation: perception and knowledge, role of influencing factors

Similar to the qualitative results from the previous 2021/22 study, the qualitative part of this study also produced a very heterogeneous range of results. Knowledge, evaluations and associated emotions vary greatly between respondents and also within individuals when it comes to comparing radiation topics. This heterogeneity can be explained by a number of influencing factors that were already identified in the qualitative survey in 2021/22, namely: informedness, concern, risk affinity, trust in state institutions, general attitude towards life, educational background, gender, geographical proximity to potential radiation sources,

controllability of exposure, cost-benefit analysis, perceptibility of radiation, knowledge of protective measures and media presence of the topic.[1] The influencing factors mentioned are shown in Figure 5:

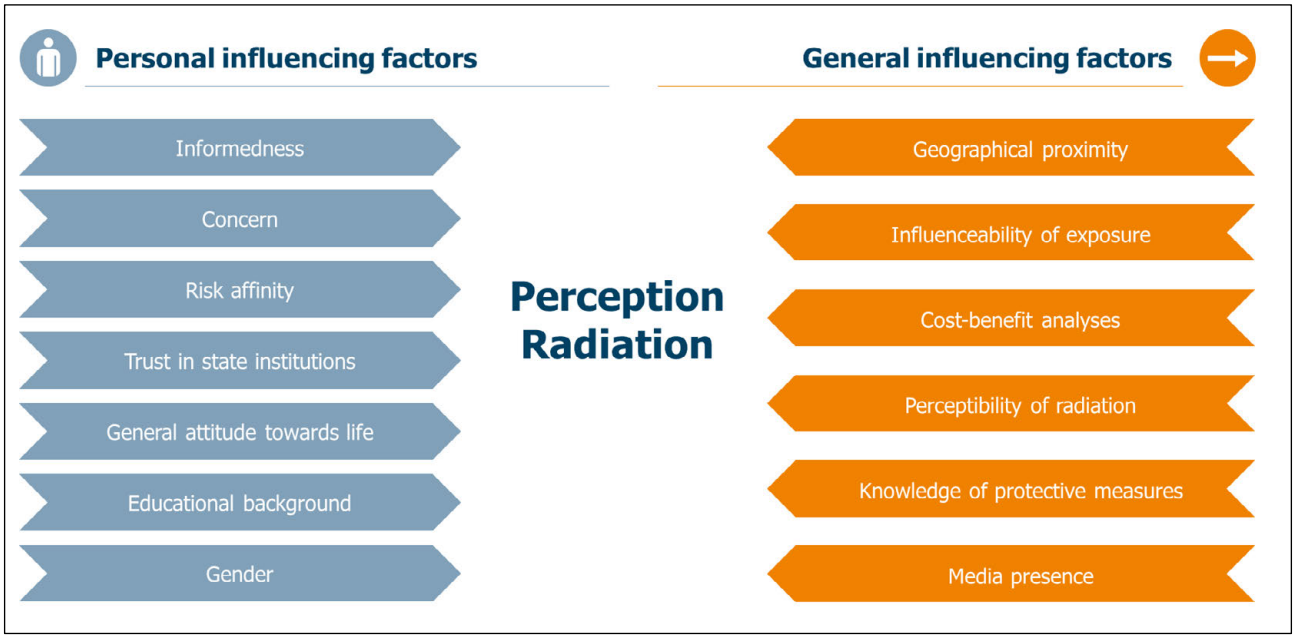

Figure 5 Factors influencing the perception of radiation

The qualitative part of the current study has once again shown that there is a mixture of knowledge, ignorance and misconceptions in the context of radiation: respondents have a higher knowledge about some radiation topics, such as UV radiation, whereas they know little or nothing about other topics or terms, such as ionising radiation. Misconceptions exist for various radiation topics – examples are given below. Compared to 2021/22, neither an increase nor a decrease in knowledge can be identified in the qualitative survey.

3.3.3 Radiation: risk perception and perceived need for protection, role of influencing factors

The extent to which a need for protection is perceived depends on a number of factors, which are assessed differently depending on the radiation topic. These factors follow up on the influencing factors mentioned above and shown in Figure 5.

Compared to 2021/22, the current study found a slight change in the perception of risk for some radiation topics. This concerns radioactivity, mobile phone radiation and UV radiation. The latter is also an in-depth topic of the 2024 qualitative survey. The second in-depth topic of the current qualitative survey was 'medical examinations and treatments using ionising radiation'. These topics are therefore presented in more detail in this report:

[1] For more details, please refer to the final report: Was denkt Deutschland über Strahlung? Umfrage 2021". Huber et al. (2022): Was denkt Deutschland über Strahlung? Ergebnisse 2022. Vorhaben 3621S72210. BfS-RESFOR-201/22URN: urn:nbn:de:0221-2022081833825 BfS - Was denkt Deutschland über Strahlung 2021

- UV radiation in chapter 3.3.4
- Radioactivity in chapter 3.3.5
- Mobile phone radiation in chapter 3.3.6
- Medical examinations and treatments using ionising radiation in chapter 3.3.7

In contrast, radiation topics where little or nothing has changed compared to the previous study from 2021/22 are presented more briefly in chapter 3.3.8 with regard to respondents' knowledge, risk perception and protection and information behaviour.

An initial overview of the changes and trends identified in comparison to the previous study can be found in the following chart:

Identification of changes and trends compared to the previous study:

	2021/22	2023/24
UV radiation	All respondents were very aware of the negative consequences of UV radiation, but there were clear differences in personal risk perception and protective behaviour depending on whether they were affected or not: people who were more strongly affected (e.g. by sunburn, or by a skin cancer experience, either personally or in their surroundings) showed more consistent protective behaviour than those not affected	General perception of increased UV exposure due to the tangible consequences of climate change (drought, heat records) with influence on protective behaviour (seeking shade becomes more relevant for everyone) New trend: UV protection as an early and preventive anti-ageing measure as a new key (!) driver for young people (especially women) to consistently use UV protection
Radioactivity	Awareness of the possible massive and negative consequences, but subjectively low risk perception. Perception focussed more on the political debate surrounding the nuclear phase-out	Strong increase in personal risk perception due to the war in Ukraine and the nuclear threat from Russia
Mobile phone radiation	Polarisation of perceptions and opinions on a topic that has, in respondents' perception, not yet been fully researched scientifically	Increasing polarisation: rising criticism and concern meet increasing carefreeness and support for mobile communications technology

Figure 6 Changes and trends in the perception of radiation in 2023/2024 compared to 2021/22

3.3.4 UV radiation: knowledge and perception, risk perception, relevance of protective measures and information behaviour

UV or solar radiation is one of the best-known radiation topics. In terms of *general perception*, a distinction must be made between the terms UV radiation and solar radiation. The term "solar radiation" tends to be perceived positively: solar radiation is considered essential for life and spontaneously evokes positive associations: *"Especially after winter, the first rays of sunshine feel particularly good." "The sun is so beautiful!"* The term "UV radiation" in contrast is perceived as more threatening "*UV radiation sounds more threatening to me than solar radiation. There's also UV-A and UV-B and one of the two is really dangerous."* Overall, there is a high level of awareness and sensitisation to the fact that excessive doses of UV and solar radiation can be (severely) harmful. In the following, we will use the term UV radiation.

Compared to other radiation topics, **knowledge** about UV radiation is relatively extensive. This is due to the fact that it comes from many sources and has been built up over a long period of time (see comments below on information behaviour). The interviewees emphasised that UV radiation is natural and vital, as it is required for growth and life in general and specifically for vitamin D production. And the human psyche

cannot do without UV radiation either. *"You simply feel better on a sunny day."* The respondents' knowledge base also includes knowledge of the negative and proven consequences of UV radiation: as in the previous study, all participants were aware that (too much) UV exposure can cause skin cancer in the long term. Compared to the previous study from 2021/2022, this qualitative survey also revealed a much greater awareness of the acceleration of skin ageing due to UV radiation among young respondents, especially young women. Although a sensitisation to the topic of skin ageing was already evident among female respondents in 2021, at that time it was more pronounced among middle-aged women who were already experiencing the first signs of skin ageing. The significant increase in awareness of skin ageing among young women is linked to their general interest in skin care, skin health and beauty. There is also knowledge about higher UV exposure in some regions, e.g. in Australia due to the ozone hole as well as in southern or tropical countries. The distinction between UVA and UVB radiation was made by some respondents, but without further knowledge on the topic *"I don't remember which of them was better or worse."* The sun was identified as a source of radiation, as were some technical devices, particularly solariums.

Overall, there is little knowledge about the **UV index.** Many respondents were unfamiliar with the term; some confused it with the sun protection factor indicated on sunscreen products. Only few respondents knew that the UV index is displayed in weather apps and is an indicator of the strength of UV radiation.

In the context of UV radiation, the same **misconceptions** as in 2021/2022 were identified, albeit among fewer respondents overall: the myth that pre-tanned or dark skin does not need sun protection appears to be more prevalent among older respondents and men. Young women in particular debunked this myth as false in the interviews and emphasised that dark skin also needs to be protected from UV radiation. The idea that sun protection is not needed in Germany because UV radiation is not as intense in these latitudes was expressed only occasionally, i.e. much less frequently than in the previous study.

With regard to the **perception of risk** in the context of UV radiation, the opinion of the participants in the qualitative survey was just as clear in this survey as in the previous 2021/22 study. Nowadays, the actual risks are generally recognised and proven: in the long term, there is a risk of developing skin cancer; in the short term, there is a risk of sunburn and/or sunstroke. In addition, there is the medium-term risk of accelerated skin ageing – often mentioned by female respondents in particular. The risk of UV radiation damaging the eyes was mentioned only by few respondents.

Participants emphasised that their awareness of the dangers of UV radiation had developed over time: *"In the past, people didn't know this and just went out into the sun."* The perception of the actual risks in the context of UV radiation is also reinforced by the perception that exposure to UV radiation has increased over time, e.g. due to global warming and the enlarged ozone hole. This correlation, which was already established in the previous 2021 study, was further reinforced in the current qualitative survey: the stronger personal experience of climate change with periods of heat and drought in Germany – phenomena that are also heavily discussed in the media – leads to a higher perception of risk in the context of UV radiation.

However, the extent to which respondents perceive these actual risks associated with UV radiation to be risks to their own health is less uniform. Different factors are mixed up in their perception: on the one hand, the feeling of self-efficacy reduces the perception of risk – after all, a wide range of protective measures in the context of UV radiation are known and easy to implement. On the other hand, skin cancer, a long-term effect that only occurs much later, and the general perception that skin cancer rates are rising are worrying – both of these aspects tend to promote risk perception. Risk perception in the context of UV radiation is very individual and differs depending on how affected people are: people who have experienced skin cancer (themselves or in their surroundings) and who have frequently experienced sunburn or sunstroke have a higher risk perception than people who have not been affected. In contrast to the previous study from 2021/22, it was noticeable that more and broader examples of being affected by UV radiation were mentioned in the current survey: the perception that respondents are sweating more than before, feel

uncomfortable in the heat or that they have recently started suffering from sun allergies increases their risk perception in the context of UV radiation. *"I now notice in summer that sometimes it's just too hot for me and I feel unwell." "My husband had sun allergies for the first time last summer – he's never had that before."* Interestingly, the logic of being affected no longer fully applies to the perception of the risk of UV-induced skin ageing: while in the previous 2021/2022 study, middle-aged women with the first signs of skin ageing were more sensitised to this risk than unaffected people, in the current survey, very young women in particular, who do not yet experience any signs of skin ageing themselves, expressed a strongly pronounced perception of risk for UV-induced, accelerated skin ageing. Finally, the individual approach to long-term risks also influences risk perception in the context of UV radiation: some men, for example, were less concerned than women, as men tend to ignore possible long-term risks.

The **need for protection** from UV radiation is perceived differently. As was already clear in the previous study, the perceived need for protection depends on various factors for the majority of respondents. A high need for protection is perceived especially in the case of deliberate exposure (e.g. when gardening, at the lake, in the outdoor swimming pool, on the beach). In this case, the assumption of prolonged exposure reinforces the need for protection. The majority also see a high need for protection at certain times of the year (spring and summer) and when travelling to southern and tropical countries, where the UV radiation is perceived as more intense and therefore more harmful. In some cases, the need for protection is also considered to be particularly high when practising outdoor sports, especially in the water: *"You have to be particularly careful when sailing because the water reflects the radiation."* In contrast, the need for protection from UV radiation is perceived as low for the majority of people in the case of unconscious exposure, during everyday activities (shopping, walking around in town) and in autumn and winter. However, the current qualitative survey shows that these described logics in the context of UV radiation do not (or no longer) apply to all people. The group discussions and individual interviews in the current survey showed that especially young women generally feel the need to protect themselves from UV radiation, regardless of factors such as conscious and unconscious exposure and also regardless of the duration of exposure *"I also apply sun cream on regular office days."*

Various **measures** are known to **protect** the skin from UV radiation. These range from reducing exposure – e.g. by seeking shade and avoiding the midday sun – to regularly applying cream with a high sun protection factor and wearing light-coloured, long-sleeved clothing and headgear (hat or cap). In contrast to the previous study from 2021/2022, special UV clothing was also increasingly mentioned as a protection option. To protect the eyes from UV radiation, wearing sunglasses and avoiding looking directly at the sun were also mentioned in isolated cases. However, the majority mentioned wearing sunglasses more as a reason to be able to see better in blinding light.

The qualitative survey revealed that the majority of people take protective measures in the context of UV radiation, albeit to varying degrees and with varying consistency. The same influencing factors could be identified as in the previous 2021 study. On the one hand, the factor of being affected leads to protective measures being taken: people having experienced skin cancer (themselves or in their surroundings) take protective measures more consistently than people without this reference or previous experience. The same applies to people with frequent experience of sunburn or sunstroke. In the current survey, a broader definition of concern in the context of UV radiation could be observed among qualitative respondents, leading to the fact that seeking shade is considered as a protection option more frequently than in the previous study from 2021/22. For example, respondents in the current qualitative survey reported that they deliberately seek out shady spots (e.g. at the lake) or that they spend the particularly hot midday hours indoors more frequently. In addition to the factor of concern, individual cost-benefit analyses can lead to taking or not taking protective measures. This means that the risk of sunburn is assessed before taking sun protection measures: *"I never get sunburnt, so I don't apply sun cream. With my grandchild, however, I'm very careful because children's skin is much more sensitive."* The long-term risk of skin cancer is assessed in a similar way:

"I used to go out in the sun and even to the solarium because I wanted to be tanned, but now I'm very careful." The previous study already showed that when thinking about taking sun protection measures, middle-aged women also factor the risk of premature skin ageing into their cost-benefit considerations. In the current qualitative survey, this consideration even proved to be the key driver for young women to take sun protection measures very consistently: *"I don't want any wrinkles. I once saw pictures of how ageing differs with and without sun protection – since then I've been consistently applying sunscreen. It shocked me how old the skin looked – especially on the hands, which are often forgotten when applying sunscreen."* The focus here is on attempting to take anti-ageing measures at an early stage in order to maintain youthful, wrinkle-free skin for as long as possible. The qualitative results indicate a social change in this respect: it is increasingly important for skin to look youthful and wrinkle-free in the long term and young women in particular are willing to give up tanned skin for it (although they still find it beautiful). *"I had to get used to my white skin first." "You used to have to come back from holiday with a tan. It's completely different now."* The qualitative results suggest that young women are particularly consistent in taking protective measures. *"I apply sun protection factor 50 every day, even in winter." "I have dark skin, but the radiation still damages my skin, so I regularly apply sunscreen or go into the shade."* Some young men reported that they are experiencing social pressure from female friends of the same age to take protective measures against UV radiation. *"I have a friend who takes great care of her skin and always urges me to use sunscreen."* Older men show the least protective behaviour overall when it comes to UV radiation.

Finally, the correct assessment of a situation also leads to protective measures being taken. Few respondents reported misjudgements that led to protective measures not being taken, e.g. in spring when the strength of the radiation was underestimated: *"I thought the sun wasn't that strong yet".* Occasionally, health reasons were cited for not taking protective measures: in particular, the need for vitamin D supplementation was cited as a reason for unprotected exposure to UV radiation. On one occasion, the microplastics contained in sunscreen were cited as a reason for not using it.

The UV index played no role as an indicator for taking or not taking protective measures – even for the few respondents who were aware of it: *"I use sunscreen every day, I don't need a UV index for that." "I let my gut feeling decide whether and which sun protection to use."*

As in the previous study from 2021/22, the **information behaviour** of many participants is passive. Typically, awareness of the topic of UV radiation is raised as part of socialisation: *"My mother used to warn me a lot that UV radiation can cause skin cancer and that I should use sunscreen."* In addition to conversations with family and peer groups, educational campaigns by official bodies, dermatologists, doctors and mainstream media serve as sources of information and often play a key role in the continuous development of awareness of UV radiation over time. Active engagement with the topic is particularly evident among two groups: firstly, people often carry out an active search for information on UV radiation who have been prompted to do so by specific events such as being affected by skin cancer personally or in the family: *"My father always did a lot of sport outside and never used sunscreen. And then he actually got skin cancer. Since then, he always applies sunscreen. So I'm already sensitised in this regard."* The previous 2021/22 study already revealed that this group of people actively seeks information about UV radiation. Secondly, compared to the 2021/22 survey, the current survey identified another new group of people actively seeking information, namely young women. As already mentioned, they are often very interested in skincare in general and specifically in measures and products to achieve clear, radiant skin and prevent skin ageing: *"I did a lot of research on how to achieve a 'glowing skin' and the topic of sunscreen kept coming up."* In this context, they also deal specifically with the topic of UV radiation and UV protection. The main sources of information are social media, where the topic is experiencing a real hype: *"I watch lots of stuff on Instagram and YouTube. You come across it a lot there too. There's much more awareness of it."* In addition, young women are increasingly talking about UV radiation and UV protection with friends and exchanging ideas: *"I've talked a lot with friends about how UV radiation can change the skin and what you can do about it."*

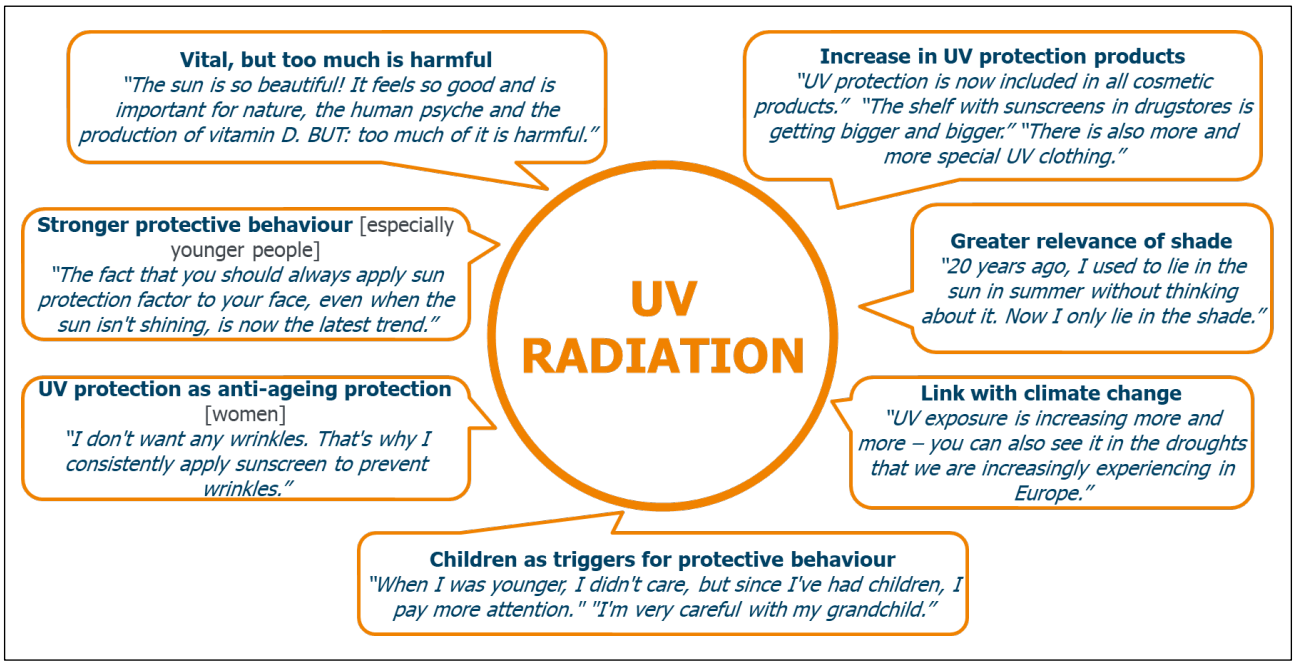

Figure 7 In-depth topic UV radiation

3.3.5 Radioactivity: knowledge and perception, risk perception, relevance of protective measures and information behaviour

In **general perception**, radioactivity is a very present radiation topic. On the one hand, radioactivity is considered highly dangerous, evokes negative associations across generations and is quickly linked to catastrophic images of reactor accidents: *"This is the most toxic radiation of all." "I have to think of Chernobyl. We couldn't eat mushrooms in Bavaria for a long time after the accident."* On the other hand, the advantages of radioactivity are also weighed up rationally: *"We need nuclear power as a source of energy. Personally, I am against nuclear phase-out."*

The respondents had a **broad general knowledge** of radioactivity**.** All respondents were aware that humans make use of radioactivity in various areas: in energy provision, nuclear energy is an economically interesting and CO2-emission-free form of energy, which, however, entails the problem of final storage and the risk of reactor accidents. In medicine, radiotherapy is known as an aggressive but possibly necessary form of therapy in oncology. Some respondents also mentioned the medical use of ionising radiation for thyroid diseases. Finally, the use of radioactivity in the form of plutonium in nuclear weapons is also a well-known field of application.

It is also common knowledge that radioactivity harbours great potential dangers and can cause serious damage to humans, animals and the environment. Burns, genetic changes, DNA cell damage, cancer, thyroid problems, deformities, shortened lifespan and ultimately death are cited as specific negative consequences. There is a high level of awareness that the consequences of radioactivity are both short and long-term, as shown by the persistently high levels of exposure in areas where reactors or nuclear bombs have exploded, which was cited by respondents. In some cases it was mentioned that genetic changes occur not only in those affected, but also in future generations. Major historical events such as the reactor accidents in Chernobyl and Fukushima and the atomic bombs in Nagasaki and Hiroshima are also considered to be common knowledge in the context of radioactivity. In the context of radioactivity, many people know that ionising radiation can be measured with a Geiger counter. Further knowledge that goes beyond general knowledge – such as the

distinction between alpha, beta and gamma radiation – is only sporadic and rather superficial: *"I heard about that in physics class."*

No noteworthy **misconceptions** in connection with radioactivity were identified in the qualitative survey.

When it comes to the **perception of risk** associated with radioactivity, the qualitative survey reveals clear differences to the previous study. In 2021/22, many respondents saw radioactivity as a rather low risk for them personally – despite the objectively existing risk associated with radioactivity. The assumption of a lack of exposure – *"You don't usually come into contact with it"* – and the low probability of reactor accidents, coupled with trust in the state and in strict established safety measures for a radiation protection issue that has been existing for a long time, conveyed a feeling of risk controllability in 2021/22. The current qualitative survey clearly shows an increased personal perception of risk in the context of radioactivity. This is triggered by the war in Ukraine and a potential nuclear threat. *"When the nuclear power plant in Ukraine was bombed, we were worried."* The scenario of a radiological emergency has become more present and more real for the respondents, which is also reflected in the positive reception of the BfS brochure on radiological emergency protection (see chapter 3.3.10). The fact that nuclear power is being further expanded in Germany's neighbouring countries also tends to create a greater perception of risk among some respondents. *"All these nuclear power plants being built in Poland, the Czech Republic or France – a reactor accident could happen there, too, and then the German nuclear phase-out won't help us at all."*

In the context of radioactivity, the **need for protection** is perceived as very high. The risks and potential damage of radioactivity are perceived as very high, so that any contact with radioactivity must be avoided at all costs. Many protective measures are known in this context, especially protective measures that are not taken individually, but at government level: the strict security of nuclear power plants and political diplomacy to prevent (nuclear) wars. Due to the new threat posed by Russia, the current qualitative survey reveals an increased need for protection in the event of a radiological emergency at an individual level compared to the previous study. This increased need for protection and the desire of individuals to be prepared for a radiological emergency was expressed several times, particularly at the eastern German survey location (Erfurt). *"We need risk protection training again, like we used to have in GDR times: we still had civil defence back then, everyone knew what to do. Now I wouldn't even know which bunker I would have to go in? We don't even have bunkers anymore!"*

Other protective measures that can be taken at an individual level include not consuming food from contaminated regions and taking part in anti-nuclear demonstrations – both measures are taken by a small number of people in the qualitative sample. However, there is great uncertainty regarding the safe final storage of nuclear waste. No protective measures are known here, which is causing concern among many of the respondents: "*This is an issue that urgently needs to be resolved."* Finally, a few people also said that some things are beyond all protective measures: *"You can't protect yourself 100% against natural disasters (e.g. earthquakes, tsunamis)."*

As the previous study from 2021/22, the current qualitative survey shows that **information behaviour** on the topic of radioactivity is predominantly passive and that the consumption of different media plays a central role. However, while respondents rarely encountered the topic back then, and when they did, it was mainly in the context of reports about past nuclear disasters (especially in Chernobyl), it has had a high media presence in the recent past due to the war in Ukraine and the associated nuclear threat. For some respondents, this triggers specific fears and concerns about their own lives and leads them to actively seek information about radiological emergencies and behaviour during such disasters. The need for information on radiological emergencies has therefore increased compared to 2021/22 and participants responded with corresponding openness and interest to the BfS brochure on this topic (see chapter 3.3.10).

3.3.6 Mobile phone radiation: knowledge and perception, risk perception, relevance of protective measures and information behaviour

Mobile phone radiation is perceived as a rather "new" radiation topic that polarises **the general perception** more than other radiation issues, as it was already the case in the previous 2021/22 study. The polarisation already observed in the 2021/22 survey appears to have intensified further, as the current qualitative results suggest. Many respondents emphasise the practical benefits associated with mobile phone radiation and deliberately ignore uncertainties and thoughts about possible negative effects: *"I always say that we should not get carried away. We can't avoid it anyway, because mobile phone radiation is everywhere, even when we go for a walk outside. Mobile phone reception is a must, everyone wants it, and WLAN is available in more and more places." "You can't shut yourself off from technological progress."* In contrast, others perceive mobile phone radiation as "bad" and dangerous radiation and have increasing concerns. "*Mobile phone radiation worries me because it is increasing more and more, and we don't know much about it."*

The polarising perception of mobile phone radiation is certainly also related to the fact that the majority of respondents in the qualitative sample have **little factual knowledge** on this radiation topic. The minority of particularly critical respondents also miss long-term studies: "*It's still a young technology and there are more and more devices – it is impossible to have long-term results already."*

The respondents in the qualitative sample identified mobile phones, WLAN networks / internet, smart watches, Bluetooth headphones and other devices as well as mobile phone masts as sources of mobile phone radiation. The perception that mobile phone masts emit more radiation than mobile devices was unanimous. Beyond this, however, the perception of this radiation issue seems to be characterised less by knowledge than by assumptions and rumours – in particular also by assumptions about possible negative effects of mobile phone radiation, the verification of which does not seem possible: *"You always hear that men should not carry their mobile phones in their trouser pockets because it can lead to infertility." "You shouldn't put your tablet on your belly during pregnancy because the radiation is not good for the unborn child."* Occasionally, knowledge and assumptions are also based on negative experiences made by respondents themselves or people around them: *"My wife doesn't sleep well when the mobile phone is in the room. Without it, she sleeps much better."*

Only a few respondents who were actively looking for information on the topic of mobile phone radiation on a specific occasion showed more in-depth knowledge: *"I run a digital get-together for senior citizens and a lady who gets headaches from mobile phone radiation once asked me about the dangers of mobile phone radiation. To dispel her worries, I went to find out more. The Federal Office for Radiation Protection publishes measurements, e.g. if you use this and that device, the radiation was measured, both when you hold it directly to your ear and when you just carry it with you. The measured values are well below the limit values for all devices. I presented this at the next meeting and that was the end of the matter."*
A few respondents who live in the city shared the observation that the number of transmitter masts in their neighbourhood is increasing. However, this phenomenon could not be categorised and explained and was not associated with 5G by these people.

With regard to **misconceptions** in connection with mobile phone radiation, the qualitative survey showed that other potential negative effects of using mobile devices (e.g. disturbance of the day-night rhythm due to blue light) were mixed with the effects of mobile phone radiation: *"Children should not use their mobile phones so much in the evening because they can't fall asleep so well then."* It was also found once again – as in the previous study in 2021/22 – that the radiation exposure from mobile devices tends to be underestimated, while the radiation exposure from transmission masts tends to be overestimated.

The **risk perception** of mobile phone radiation is very individual. The majority see little to no risk in mobile phone radiation and draw a positive cost-benefit balance, as for them the current benefits outweigh the unproven disadvantages or dangers. People who disagree with this are sometimes ridiculed: *"When a friend*

told me that she gets headaches from mobile phone radiation, I didn't take it seriously at all." Furthermore, a high level of trust in prescribed limit values and state protection as well as a certain feeling of controllability, e.g. by switching on flight mode or making calls with a headset, contribute to a low perception of risk: *"If I switch my mobile phone to flight mode or don't take it into the bedroom, I'm avoiding radiation." "Manufacturers in this country have to adhere strictly to limit values" "There was a case where a new iPhone did not comply with the prescribed limit values. Apple reacted immediately – so the protection worked."* However, the low risk assessment is also partly due to the fact that long-term risks are simply ignored and delegated away*: "If there really were long-term problems, this would affect everyone and politicians and the healthcare system would be called upon to find solutions."* Ignoring possible negative effects is partly due to the fact that it is perceived as impossible to escape the influence of mobile phone radiation and that there is no willingness to forego the benefits of the technology: *"We all want to participate in the digital world, and it is simply not possible without radio communication – i.e. radiation."*

Few respondents, on the other hand, have a higher perception of risk and are concerned about mobile phone radiation. Despite the undisputed benefits of mobile phones, they are concerned about unclear long-term consequences and show a certain fundamental scepticism towards new technologies in general: *"There are always new devices. There's no way of knowing whether there will be long-term consequences."* They also lack confidence in state provisions and would like more information: "*It would be good to inform people instead of introducing new technologies without comment."* These respondents have a feeling of a lack of control or self-efficacy: *"I live in a block of flats. Even if I switch off my WLAN, I'm still exposed to radiation from others."* Some respondents also reported perceived consequences of mobile phone radiation, such as sleeping problems and headaches during long phone calls.

All respondents suspected a (sharp) increase in mobile phone radiation due to the growing number of mobile devices, increasing connectivity, for example due to public WLAN and the rapidly increasing advance of technology in of all areas of life. *"There are more and more smart home applications." "Everyone has a mobile phone these days and wants to have reception everywhere."*

In the context of mobile phone radiation, the perceived **need for protection** is polarised. The majority of respondents in the qualitative sample felt that there was little need for protection in this context. These were primarily people who associate a high level of benefit with mobile phones and who also have a high level of basic trust in government protection measures (e.g. in the form of defined limit values). However, some respondents also expressed a latently perceived need for protection: these were people who have a 'bad gut feeling' about mobile phone radiation but suppress their concerns – not least because of the unclear facts and the high benefits that they also associate with mobile phones. Few expressed a clear need for protection from mobile phone radiation: these were people who feel affected and people who have a strong focus on possible long-term consequences.

Concrete **protective measures** are known to a limited extent in the context of mobile phone radiation. The following protection options were mentioned in some cases: switch your mobile phone to flight mode or switch it off at night, do not take your mobile phone into your bedroom, use your mobile phone less often for making calls, use a headset or loudspeaker for calls, do not carry your mobile phone close to your body (especially not in your breast pocket and not in your trousers if you are a man) and keep your distance from mobile phone masts. Overall, the interviews and group discussions gave the impression that there is also a lot of ignorance about existing protection options and that not everyone is aware of simple measures such as switching the phone to flight mode. And there is another important aspect: in the context of mobile phone radiation, there seems to be a widespread perception that protection is not even possible: *"How am I supposed to protect myself from mobile phone radiation? You're always exposed to this type of radiation. Even if I switch off my mobile phone, many people in the flats around me don't do that."*

As a result, only few people consistently take protective measures in the context of mobile phone radiation. The following logics can be identified: protective measures are taken by people who are personally affected *"I feel that I sleep better when my mobile phone is not in my bedroom"* and by people who generally have a high level of health awareness and pronounced preventive behaviour. *"I was a bit more careful during my pregnancy and didn't put the tablet on my belly, for example."* Furthermore, protective measures are sometimes also taken by other people if it isn't too much of an effort and sacrifice: *"I already switch off the WLAN at night – I don't need it then and it's done quickly."* Against the background of uncertainty about the extent to which mobile phone radiation is harmful at all, the factor of low effort should not be underestimated. In contrast, the following factors lead to protective measures not being taken: convenience, the feeling that one cannot or does not want to do without their mobile phone and ignorance of protection options (e.g. flight mode): *"I like to listen to podcasts on my mobile phone in the evening to fall asleep and I don't want to do without that." "I also use my mobile phone as an alarm clock, so it has to be switched on also at night."* A decisive barrier when it comes to taking protective measures is the lack of perceived need for protection or the suppression of possible negative effects: *"Everyone has a mobile phone and uses it all the time, so it can't be harmful."* Finally, the lack of clarity about the actual radiation exposure associated with mobile phones is also a factor that favours the failure to take protective measures. For example, it was not clear to the respondents how mobile phone radiation can be measured at all, which makes it even less 'tangible' than other radiation topics where measurement options are better known (e.g. Geiger counters for radioactivity).

There is a great **need for information** regarding mobile phone radiation. The unclear facts repeatedly mentioned by all interviewees in this context lead to great uncertainty among some participants with regard to potential dangers. They would therefore like a clear statement on the extent to which mobile phone radiation is harmless to health and the exact dangers that may be associated with it. The high need for information of some respondents can be explained on the one hand by the high relevance in everyday life: "*The mobile phone is always present."* On the other hand, the desire for information can be explained by the fact that 5G in particular is a new technology and therefore possible negative long-term effects cannot be conclusively clarified at the present time – at least from the point of view of some respondents. In addition, some participants reported that 5G involves "more intensive" – meaning more dangerous – mobile phone radiation than previous standards. Irrespective of the respondents' desire for more information, it seems beneficial to provide clarification in order to counteract the spread of rumours. Many participants are currently mostly informed about the topic of mobile phone radiation through conversations in their everyday lives, e.g. with colleagues or friends, or through news programmes. An active search for information on the topic of mobile phone radiation, however, is rather rare.

3.3.7 Medical examinations and treatments using ionising radiation: knowledge and perception, risk perception, relevance of protective measures and information behaviour

The topic of 'medical examinations and treatments using ionising radiation' was a new focus compared to the previous study from 2021/22 and was explored in more detail in both the group discussions and the individual interviews.

When it comes to the use of radiation for medical examinations and treatments, the **general perception** is positive (to neutral): for most respondents, the focus is on the fact that radiation used in the medical field has a clear benefit for the diagnosis and treatment of diseases or injuries: "*CT fulfils a purpose for diagnostics."* Positive emotions such as gratitude are often reported in view of the possibilities offered by modern medicine through the use of radiation: *"When I had a sports injury, I was glad that it could be accurately detected and better treated using X-rays."* However, respondents are also aware of the dangers of radiation in a medical context – mainly because of the protective measures that are taken during relevant examinations and

treatments: *“The fact that medical staff always leave the room indicates that this radiation is not healthy.” “Pregnant women must not be x-rayed and, in general, one should not be x-rayed unnecessarily often.”* However, the use of radiation for medical examinations and treatments is generally seen as necessary and, in this respect, the benefits outweigh the risks for the majority of respondents: *“You only do it when it's absolutely necessary – and, if that is the case, you're grateful that this option is available, for example to detect cancer in the body.” “It's always a question of weighing up the negative consequences against what can be positive.” “I would never give it a second thought to it like, oh my gosh, what about the radiotherapy! I would be more concerned about the diagnosis or the cure.”*

When asking respondents about their **knowledge** of the use of ionising radiation in medical examinations and treatments, it becomes clear that the specific term is largely unfamiliar *“I don't know what ionising radiation is, to be honest.”* Only a few vague fragments of knowledge about ionising radiation are available, which in these cases often date back to school lessons: *“Ionising has something to do with electrons. I had an advanced physics class back in school. Radiation that is somehow charged with electrons or something.”* When openly asked about radiation in a medical context, respondents primarily think of X-rays. Computed tomography and magnetic resonance imaging are also mentioned in some cases.

When specifically asked about three selected medical examination and treatment methods (computer tomography / CT, radiotherapy, radioiodine therapy) respondents mostly state that they have heard these terms before, but that they hardly know anything about it. The respondents' descriptions are often characterised by assumptions and sometimes misconceptions. The decisive factor for the extent of existing knowledge is usually being affected in some way, i.e. the interviewees have either already experienced corresponding medical examinations or treatments themselves or they have been carried out on people in their environment: *“I had some examinations and treatments at the end of last year where a CT scan was carried out and I was injected with medication. In this case, of course, you deal with it.” “Neither I nor anyone in my family has ever been affected so far. That's why I haven't given the subject much thought.*”

Computed tomography is the topic that respondents are most familiar with: some know that computed tomography is an imaging procedure used to diagnose diseases or injuries: *“It's a way of looking inside the body.” “Computed tomography enables very precise scans: there are fascinating images of everything.”* However, the knowledge is usually only superficial and the majority cannot say anything about how exactly the images are generated during computer tomography. Only few are aware of the fact that X-rays are used for the images: *“Many X-ray images are taken layer by layer.”* In addition, many respondents do not know the difference between computed tomography and magnetic resonance imaging: *"I always confuse the two. There is the MRI and the CT.” “Unfortunately, I don't know whether it was an MRI or a CT, but I was once put into one of those tubes that you lie in.”* And it is often assumed that radiation is also used in magnetic resonance imaging: *“Magnetic resonance imaging also involves radiation.”*

Most respondents associate **radiotherapy** with the treatment of cancer: *“It is a way to treat cancer.” “I have only heard of radiotherapy in connection with cancer.”* They know that cancer cells are irradiated and thus destroyed: *“You bombard the tumour and it is then somehow split or damaged so that it cannot spread.”* A common misconception in this context is the assumption that radiation is also used in chemotherapy to treat cancer: *“Chemotherapy radiation is used in cancer therapies.”* However, some people also know that chemotherapy and radiotherapy are different types of cancer treatment and that radiation only plays a role in radiotherapy. *“Radiotherapy is just one of several options, you can also do chemotherapy or surgery.” “Chemotherapy is the infusion that you have to take, and radiotherapy is some kind of radiation that is shot at the diseased area.”*

Very few people are familiar with **radioiodine therapy**: *“Radioiodine therapy? I have never heard of that.”* Some of the assumptions made about this form of therapy are partly correct: *“I think it has something to do with the thyroid.”* However, correct and incorrect assumptions are often mixed*: “I think you probably have to*

take some kind of medication to make the area visible on the images." Only a few people know (at least roughly) about the mechanism of iodine therapy: *"If I'm not mistaken, these are tablets within the radiotherapy. Iodine tablets, radioactive, which are swallowed for treatment."*

As far as the general **perception of risk** is concerned, the majority of respondents are aware that the use of radiation in the medical field also harbours risks. However, it is less clear to respondents what exactly the risk is; descriptions of the potential negative effects often remain rather abstract: *"We know that radiation also destroys quite a lot in the body."* Damage and pathological changes to cells, tissue and organs as well as cancer are suspected: *"I also think that it can have an impact on cell division and that mutations could occur." "You shouldn't do it so often because it could also be carcinogenic."* There are also isolated cases of specific negative effects – particularly in connection with radiotherapy – such as irritation and burns to the skin: *"I had cases of cancer in my family. And you could also see it on the skin, for example in form of reddened skin*." However, the mix-up of radiotherapy and chemotherapy, which was already mentioned above, means that it is not differentiated between the side effects of both forms of therapy: *"You know that if someone has cancer and is treated with radiotherapy, their hair will fall out and other physical sufferings may occur."* Despite being aware of the risks, respondents are hardly or not at alle concerned about the use of (ionising) radiation in medical examinations and treatments. Instead, they draw a positive cost-benefit conclusion for this radiation topic, as it is associated with a medical benefit (in the sense of diagnostics or treatment): *"I believe that the radiation dose is also very high, it has to be in order to have a certain medical success. But you accept that."* The majority feel that this risk is controllable, as the exposure is (usually) rare and the methods are tried and tested, ordered by a doctor and carried out by medical professionals who take into account precautions and protective measures: *"How often do you have a CT scan in your life? [...] If that were really a negative thing, I mean, it's not like it's been around since yesterday." "I think I've had a CT scan once in my whole life." "And X-rays, I can't tell you the last time I had an X-ray." "I actually think it's all safe. I'm not afraid of being exposed to radiation or anything like that. I trust the doctors."*

The **need for protection** against ionising radiation during medical examinations and treatments is perceived as high by most respondents. From the fact that **protective measures** are taken by medical staff, many respondents deduce that risks exist and that protection is sensible and appropriate: *"You don't protect yourself from X-rays for nothing."* Known protective measures include reducing exposure to a minimum – e.g. with the help of an X-ray pass – and, in the event of exposure, making sure that the exposed person is not pregnant, wearing lead waistcoats and limiting radiation to the areas of the body that are concerned. Respondents have often experienced these protective measures in the context of X-ray examinations: *"You are given a lead waistcoat. If, for example, only the abdomen or chest needs to be x-rayed, the rest of the body is protected." "I was given an x-ray pass because I had to be x-rayed several times for a while." "I know that they put some kind of lead belt over the lumbar area*." For the majority of respondents, the protective measures taken by medical staff provide a sense of security and there is great trust in doctors and their decisions on examinations and treatments using ionising radiation: *"I would listen to medical advice, and I really trust that my doctors only do what is sensible." "The doctors know what they are doing."* Only a few expressed doubts and concerns about the lack of documentation: *"I have never had a record of how often I was x-rayed."*

With regard to ionising radiation in the medical field, **information behaviour** is very passive. In most cases, respondents are informed by medical staff in advance of examinations or treatments. Although the information is often perceived as being brief, the majority of respondents do not deal with the topic any further because there is no need for additional information: *"You know that the staff don't have much time, but nevertheless I felt safe."* In terms of the way information is conveyed, respondents perceive information sheets handed out by medical staff to patients to read and sign as helpful: *"I had to read a sheet before the X-ray and fill in the date of my last X-ray. That gave me confidence."* Many respondents would also like to have personal discussions with doctors so that they can better understand information, ask questions and address

any concerns. This is particularly important in the context of more serious illnesses: *"You can ask questions. I think it's easier to understand everything in a personal discussion."* In terms of content, information on benefits, risks (no matter how small) and contraindications should be communicated.

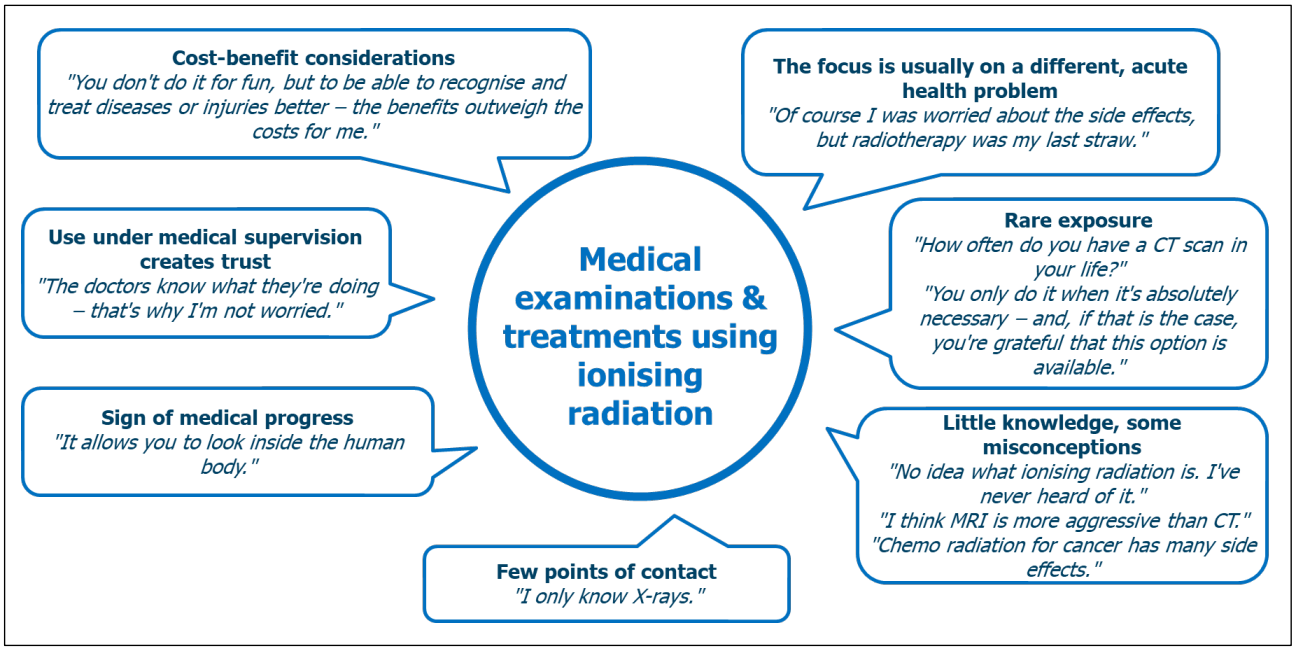

Figure 8 In-depth topic medical examinations and treatments using ionising radiation

3.3.8 Knowledge and perception, risk perception and relevance of protective measures for radiation issues without noticeable changes in perception in the qualitative surveys 2021/22 | 2024

Microwave radiation

As in the previous study in 2021/22, the perception of microwave radiation is largely neutral: *"Just heats food."* The majority of respondents see little to no risk in microwave radiation and are not worried about using a microwave, as it is a long-established everyday object: *"If it were somehow dangerous, not so many people would have it at home."* Only few respondents express slight doubts about its harmlessness which are usually based more on a gut feeling than on actual facts: "*My wife has always been sceptical about radiation from microwaves. And when I give food to our cat that I warmed-up in it, she looks at it and says 'You are completely nuts'.*" In general, there is little specific knowledge on this radiation topic. Only a few respondents have actively tried to find information on it following discussions in their environment and acquired knowledge about the harmlessness of microwave radiation: *"I actually thought about a microwave when I was still living with my mum. We once had a long discussion about whether it was unhealthy and, as far as I know, it hasn't been proven to be unhealthy because the microwaves only set the water molecules in motion. This warms it up, so there is actually no evidence of harmful radiation." "I've read that microwaves are harmless."* The need for protection is mostly perceived as low. Only a few respondents reported taking protective measures such as reducing the frequency of use or using a microwave cover: *"Personally, I try to use the microwave as little as possible." "I have a cover for the microwave, I don't know if it does any good. But in general, I feel a bit safer with the cover."*

Term “electrosmog”

As in the 2021/22 survey, respondents' perceptions of the term “electrosmog” – as they call it – are ambivalent. Many respondents doubt the existence of “electrosmog” or are even convinced that it does not exist*: “It is somehow undefinable for me whether this phenomenon really exists.” “For me, this is a part of the world of myths. Lots of it has its origin in the ‘lateral thinking’ scene.”* Consequently, the majority see little or no risk in “electrosmog” or don't even bring up the subject*: “I'm not afraid of 'electrosmog' or electrical radiation.” “Some people are very sceptical about it. In my eyes, this is overrated and exaggerated.”* Others say that “electrosmog” does exist and is unhealthy, which is why they take protective measures: *“None of this is good. That's why I'm radical and switch off my WLAN at night.” “Besides your mobile phone, you should also switch off your WLAN overnight if you can. If possible, you should avoid all electronic radiation.”* However, the respondents’ understanding of “electrosmog” is vague. The colloquial term is usually understood to mean a conglomerate of radiation from a number of technical devices: *“In my eyes, 'electrosmog' is about WLAN routers, mobile internet, mobile phone use, smartphones – anything that has to do with connectivity. That’s what 'electrosmog' is in my opinion."* Household appliances such as televisions, radios, mobile phones, WLAN, ovens, fridges, microwaves, monitors, robot vacuum cleaners, lawnmowers and smart home applications, and partly also high-voltage power lines, are named as sources of radiation: *“In my opinion, electrical radiation, or 'electrosmog', includes mobile phone radiation, microwaves and stuff like that” “My company has moved to a new building near the main railway station. Of course, there are lots of trains and overhead lines there. And at one point, it actually became an issue if the offices weren't being contaminated by all the 'electrosmog'.”* The negative effects that respondents associate with “electrosmog” include stress, discomfort, insomnia and lack of concentration: *“There are residents who complain that some kind of high-voltage power line runs over their houses and that, as a result, they can no longer sleep or their health is impaired.”* This assumption is often based on experiences made by respondents themselves or people in their environment who react sensitively to “electrosmog”: *“I have noticed this particularly with my older daughter: she sleeps badly and it is hard for her to concentrate on things.”* The majority of respondents came to the conclusion that the perceived radiation exposure from “electrosmog” has tended to increase in recent years due to the higher number of technical devices in everyday life. However, some also said that the radiation exposure of individual devices has probably decreased: “*Technology is advancing!”* The respondents also observed that the perception of "electrosmog" is more and more polarised in society: *“There are two extreme poles: some people say it's really bad and protest against high-voltage power lines passing over their gardens, while others always have their mobile phone in their pocket or charge it right next to their bedside table.”*

High-voltage power lines

The perception of high-voltage power lines – usually referred to by respondents as power pylons or overhead power lines – is very close to the use of the term "electrosmog" (see section above on "Electrosmog"). The general perception of high-voltage power lines is negative: *“I have a bad feeling when I'm near power pylons.”* High-voltage power lines are perceived as a risk if they are in the immediate vicinity. Many people have a bad feeling in such cases: “*I don't like walking under power pylons. You can also hear this buzzing sound – it's kind of unpleasant*.” Others don't want to live near high-voltage power lines. The perception of risk occasionally arises due to safety concerns about the stability of high-voltage power lines and possible (long-term) health consequences. In the context of high-voltage power lines, the need for protection is perceived to be rather high but at the same time, the protection options are perceived as limited. The reduction of exposure is seen to be the only protection option, this means keeping a distance with the logic 'the greater the distance, the lower the exposure' as well as minimising the duration of exposure: *“You shouldn't stay directly under a power pylon for a long time.”*

Laser radiation

Laser radiation is considered to be a highly targeted instrument, which is perceived positively: *“Laser radiation is only applied to very limited areas.”* The respondents of the qualitative survey stated that they were familiar with laser radiation from a wide variety of areas. Laser radiation seemed to be best known in the medical field: *“I had a laser eye surgery*.” Laser barriers (e.g. at airports) and laser-based applications in the cosmetic sector for removing hair or tattoos were also mentioned. Respondents were mainly aware of potential risks in the medical and cosmetic context, especially negative effects on tissue such as increased sensitivity and scarring: *“After I had laser eye surgery, my eyes were more sensitive to sun and UV radiation.” “One risk of lasering can be that you get scars.”* All devices that emit laser radiation are perceived as sources of radiation. The qualitative survey did not reveal any misconceptions with regard to laser radiation.

Radon

As in the survey from 2021/22, respondents who know radon, tend to perceive it as negative: radon is associated with radioactive radiation and therefore with exposure. The few people who are familiar with radon and mention it spontaneously have a higher level of knowledge: they know (from school lessons) that radon is a radioactive chemical element: *“It's a chemical element, I remember that from chemistry class.”* and that the occurrence varies from region to region*. “In some regions it's stronger and in some regions it's weaker.”* For most of the other participants, however, it is clear that knowledge is often vague and that there are gaps in knowledge and sometimes even misconceptions: Among other things, they do not know what radon is exactly “*Is it some type of radioactive radiation?” “Doesn't it have something to do with alpha, beta and gamma radiation?”* and where it occurs *“Does it occur in metals perhaps? Or in the air? I have no idea.”* Nuclear power plants, for example, are named as a possible source of radiation in radiological emergencies – which is a misconception: *“In Chernobyl there was a problem with radon, with radioactive radiation.”* As far as the perception of risk is concerned, radon is generally perceived as dangerous. However, the exact nature of the risk is usually unknown: *“I can imagine that radon is relatively harmful because it has to do with radioactivity.” “All I know is that it's bad for people and their health.”*

Infrared radiation

As in the 2021/22 survey, the general perception of infrared radiation is predominantly positive: it is experienced as "good" radiation that can heal people: *“Above all, I associate infrared radiation with healing*.” Many equate it with heat radiation and therefore also experience it positively due to the positive connotation of heat: *“I think of heat radiation and then also of the sun, for example.”* The fields of application for infrared radiation known to the respondents were primarily located in the areas of medicine/health and wellness. In particular, infrared lamps for medical purposes (e.g. to relieve muscle tension or alleviate cold symptoms) were named as sources of radiation: *“There are these infrared lamps that you can use when you have a cold.” “I'm thinking of devices such as red light lamps that emit heat and thus help the muscles to relax if you have tension.”* In this context, infrared radiation is perceived as harmless, as its healing character is in the foreground. Other sources of infrared radiation mentioned were technical devices that emit it (e.g. everyday objects such as remote controls) or where it is used specifically (e.g. infrared cameras): *“The police, for example, use thermal imaging cameras when they are trying to find someone*.”

Other radiation topics that were occasionally mentioned

Other radiation topics that were only mentioned by individual respondents included “atmospheric radiation”, electromagnetic radiation emitted by induction cookers and “satellite radiation”. In the case of “**atmospheric radiation” or high-altitude radiation**, the atmosphere is generically named as the source of radiation. “Atmospheric radiation” is primarily mentioned in the context of flights. The exposure caused by atmospheric

radiation is experienced to be particularly high during flights, which is why avoiding frequent air travel is seen as a possible protective measure: *"There is this high-altitude radiation, which is why you shouldn't take the plane too often."* The fact that **radiation is emitted from induction cookers** was mentioned occasionally – at least that is how the respondents described it. Knowledge about this radiation topic is primarily gathered when the purchase of an induction cooker leads respondents to look for information about it: *"We bought an induction cooker and then learnt that, unlike a ceramic glass cooktop, it emits radiation and that not all the values are as good as they are said to be."* Respondents search for information via traditional channels such as internet research or watching news programmes or reports on television. For example, the use of suitable pots and pans that fully cover the respective cooking zone and thus reduce the stray fields emitted is mentioned as a protective measure. Another vague term mentioned by respondents *was "satellite radiation"*. In the perception of the respondents, the benefits associated with "satellite radiation" in the context of GPS positioning seemed to dominate.

3.3.9 Information behaviour on the subject of radiation

The qualitative survey pointed out that information behaviour in relation to radiation is mostly passive. Radiation is not a topic on which the respondents feel the need to inform themselves (constantly): *"It's not a topic on which you actively inform yourself. You rather gain information without really looking for them. In the course of life, you hear about it via the internet, press, television."* As a rule, there is no interest or need for information, especially when it comes to radiation topics that are neither particularly risky nor particularly relevant to everyday life: *"People probably don't talk about it much because it's not particularly relevant to* their *everyday lives. And I don't consider microwave radiation and mobile phone radiation to be dangerous – that's why I don't feel the need to find out more about it."* However, in some cases, interest in information can be aroused by external stimuli – namely when a radiation topic is directly relevant to the person's everyday life: *"I only deal with the risks of radiation if they are relevant to me." "You don't deal with it much in everyday life. Unless it's something socially relevant like nuclear threats at a political level [...]."*

Passively generated knowledge about radiation often dates back to school or was passed on by people close to them (especially parents and friends): *"Radioactive radiation, we learned about it in school, in chemistry class." "My mum always insisted, especially when I was a child, that I shouldn't get sunburnt."* When (actively) looking for information on the subject of radiation, people follow their normal research habits. They usually start their search for information with media that they also use as sources of information for other topics and that they trust: *"For me, it's newspapers that I know work according to the principles of proper journalism and that I trust accordingly. For example, the Süddeutsche or New York Times online."* Sources include the Internet (especially Google searches), articles in (subscribed) newspapers and magazines as well as news and TV programmes: *"Spiegel and Zeit online, trade press in general. Pharmacist magazine. Google. Internet and trade journals."* Social media such as Instagram, TikTok or YouTube are also often used as sources of information: *"I read something about mobile phone radiation on social media. TikTok, YouTube or something like that."* However, the majority of social media users surveyed are aware that a lot of disinformation and half-knowledge can circulate on the platforms and that influencers often focus on a certain self-interest and the promotion of sponsored products. For this reason, the information disseminated on social media is viewed quite critically: *"There are many people who get their information from YouTube or something like that. It depends very much on who uploaded the videos and what background they have. In principle, anyone can upload videos there."* Their education and professional qualifications, for example, are often used as an indication of the trustworthiness of influencers and their statements, as well as to assess their expertise in relation to the topic. *"I follow the influencer Leon XSkincare: he educates people about skincare and as he is a biology or chemistry student, he really knows the ingredients of products. He also had a post about UV protection."*

When it comes to radiation, trust in information and information sources plays a particularly important role, as there is usually little personal knowledge on the subject. This makes the need for trustworthy information from competent and official sources all the greater. In this context, medical institutions such as hospitals, doctors or doctors' associations, health insurance companies and their websites are perceived as neutral and reliable points of contact: *"I often look for information on health insurance company websites. You can find helpful information on medical topics there." "Health insurance companies are good sources of information. And websites of clinics." "In think that websites of doctors and hospitals are trustworthy."* Scientific and official information also plays a role when it comes to radiation. For example, people look for information in publications from universities and colleges and scientific papers as well as on the websites of authorities and offices: *"You can find good information on the homepages of universities that conduct research on these topics." "I would go to the website of the Federal Office for Radiation Protection."* Many respondents have confidence in the information provided by the scientific community and authorities: *"I trust scientists because they carry out research and are independent. They don't work for a company and want to sell something." "I place a lot of trust in the authorities when it comes to all topics and they also point the way for me."* However, the trend of eroding trust in the state and state institutions, which was already evident in the 2021/22 survey among certain groups of people, appears to have intensified even further. Among respondents who have always been rather sceptical of the state, distrust has increased even further as a result of the crises in recent years and some of the measures taken by the government: *"So many things have happened in the past, e.g. with COVID. That's why I personally no longer trust the authorities as much." "With the authorities, I always think that they have a certain agenda; they can abuse their power. I used to trust them, but now I'm more sceptical."* This also manifests itself in the form of scepticism towards information provided by state institutions, authorities and agencies. Scientific information is less affected by this trend and is also largely trusted by sceptics*: "Scientists seem very reliable to me because of their arguments, because of what they prove, and the facts sound very plausible and that's why I trust them.*"

Scientific information and its preparation must fulfil certain criteria in order for it to meet scientific standards and be perceived as trustworthy from the respondents' perspective. Firstly, the information must come from people who are considered to have a certain level of expertise in the respective subject area due to their professional experience, education/studies, (scientific) degrees and titles or reputation: *"I would trust specialists, i.e. if they have done studies in this field."* Secondly, it must be clear that the information is well-founded and based on the results of scientific research: *"For me, it is important to have reliable references so that I can see where the information comes from, who made this statement and whether this point of view has been confirmed by several sources." "I always find it reliable or good if they also cite supporting documents, i.e. studies." "I consider information to be scientific and trustworthy if sources are cited that substantiate the statements and that I can read in order to see where this information comes from."* For some respondents, a generic reference to scientific sources is sufficient. However, many also expect sources to be explicitly listed and cited so that it would in principle be possible for them to check and read the primary sources – regardless of whether they actually do it or not: *"I think it's good if studies are referenced so that you can perhaps read through them." "I don't necessarily read the articles. But if information is backed up by studies, it's obviously of a higher quality."* When researching a topic related to science, these criteria of scientific rigour are applied to a wide variety of information sources, channels and media – as mentioned above, sometimes even on social media.

Scientific information on the topic of radiation is generally seen as relevant and interesting, as the topic is perceived to be scientific and is therefore strongly associated with science: *"Science is very important when it comes to radiation, yes. I think it's a very technical topic."* Science and research have become more of a social focus as a result of the coronavirus pandemic. This can also be seen in the search for information on the topic of radiation, as many respondents explicitly look for studies and primary scientific sources when conducting their research or at least state that they would do so: *"Scientific articles and studies are an important source*

for me." The background to this is the idea and conviction that they can gain an overview of the study situation and the topic by reviewing various scientific publications themselves. Among those respondents who are rather sceptic of the state, there also seems to be a strong motivation not to rely on summaries and reports from state institutions such as authorities or public broadcasters, but to form their own opinion based on information gathered from various (primary) sources: *"Some of what the authorities say is certainly true, but if there are many different opinions on a topic, I find that suspicious and tend not to trust the authorities. I'm usually someone who tries to look for information myself and form my own opinion."* However, there are also many respondents who do not trust themselves to review and categorise scientific studies or who find this kind of research too time-consuming and would like to see scientific findings presented in a way that is understandable and compact for laypeople: *"I wouldn't find it very useful to read a paper on radiation. It is not made for the average person. There would be too many details in it; you need it to be summarised and edited but based on sources." "Of course, it would be nice to read the original scientific articles, but to be honest I wouldn't want to do that in the evening. I'd rather read short posts on Instagram." "I don't read reports or scientific articles. I read what is communicated to the public. For example, through public broadcasters."*

In this context, it also becomes clear what is part of the task of public authorities is from the respondents' point of view: authorities should collect the results of scientific studies and prepare and categorise them for readers in an understandable way: *"Well, I theoretically know where to find scientific studies, but I'd like it if they were bundled together and prepared for me in a simpler way." "You always have to make sure that it's not full of foreign words and abbreviations that make it difficult to understand. The research results must be written in such a way that they can be understood by ordinary citizens."* This expectation is occasionally countered by the prejudice of or experience with complicated official letters, which means that some respondents do not trust authorities to write texts that are easy to understand: *"When it comes to authorities, I immediately think that texts are eternally long and so complicated that nobody understands them."* In addition, respondents expressed the wish that authorities should only disseminate reliable scientific information, i.e. the scientific community should already have a clear picture of the topic: *"Authorities should definitely use and disseminate scientific information if there is a relative consensus among researchers."* This wish is based on experiences during the COVID pandemic, where the open communication of the weighing up of pros and cons of certain measures was perceived positively while the transparency regarding the contradictory opinions and findings of various scientists also caused uncertainty, which many respondents were unable to deal with: *"If it's too complex and contradictory, this causes uncertainty. It's great when information is presented in an easily accessible and intuitive way and visualised."* In addition to the clear and understandable communication of reliable scientific findings, many respondents believe that a key task of the authorities is to issue recommendations and instructions for action: *"They should not only warn of the risks of UV radiation, but also give recommendations on what can be done." "I would expect and find it helpful if, for example, they gave clear instructions on how to use your mobile phone without having to worry."* The recommendations and instructions should also be clearly justified and based on the results of scientific studies. Many respondents associate government authorities with science and trust them, as they assume that experts with the relevant expertise work there and that they act in the interests of the population: *"I trust authorities because they deal with such issues and are well-read. They pass on information and experience." "I place a lot of trust in authorities because I believe they have expertise, and that gives me confidence."* For those who are sceptic of state institutions, the trustworthiness and persuasiveness of official information could be increased by emphasising its scientific nature more: *"If authorities were to say that they would like to provide information based on scientific information, this would be a first step towards regaining my trust."*

Role of the Federal Office for Radiation Protection

The information behaviour reported by the respondents points out that the Federal Office for Radiation Protection currently plays a very subordinate role as a source of information. However, it should also be mentioned in this context that those who visited the BfS website to look for information were positive about the information provided*: "The information was easy to understand and well structured. That was very positive."* The main reason for the low importance of the BfS as an information platform lies in the fact that the BfS is largely unknown to the general public: very few people had heard of the BfS prior to the study: *"I have neither heard nor seen anything from them."* Despite its relative unfamiliarity, the BfS is trusted by the public: a clear majority of respondents associate the name Federal Office for Radiation Protection with attributes such as objectivity, competence, scientific rigour, impartiality and a mandate to provide information on radiation protection risks: *"I consider the BfS to be competent on the subject of radiation because I trust the authorities and believe that they work with scientific partners*." Consequently, the BfS is generally perceived as a trustworthy and relevant source in the context of radiation protection: *"The BfS would be a source where I would look for information and which I would also believe.*"

In order for the BfS to actually be used as a source of information on the topic of radiation, the respondents believe it is important for the BfS to become more present: *"They should become more active, present themselves more actively."* Respondents see the use of various channels such as social media and influencers, posters (in the city) and days of action as a possibility to draw attention to the BfS, its activities and its website: *"If you walk past posters, you notice them and then perhaps are more likely to take a look at the website. You don't come across the website on your own, unless you are actively looking for it." "I would become aware of them if, for example, I came across information posts from them on Instagram."* As far as the content disseminated by the BfS is concerned, respondents have the same expectations as they do of public authorities in general: they would like the BfS to provide scientifically sound information on the topic of radiation in an easily understandable way and make specific recommendations for action.

3.3.10 BfS brochure "Radiological emergency – How to protect yourself"

In the last part of the focus groups, the participants were presented with a brochure from the BfS on the subject of 'Radiological emergency protection' and were asked to evaluate it. The participants were first given some time to look at the brochure. They were asked to mark aspects that they perceived as positive or negative with green or red sticky notes. The perceptions and evaluations of the brochure were then discussed in the group.

On average, the evaluation of the brochure was positive. On a scale from 1"very good" to 6 „unsatisfactory", the school grades awarded by the participants for the brochure ranged between 1 and 3 and the average grade across all participants in the two group discussions was 2.1. Overall, the brochure made a serious and trustworthy impression on the participants and the authors and designers of the brochure were considered to be competent: *"I would say it is trustworthy, it is a brochure, somebody worked hard on it, you wouldn't just do this for no reason, someone probably wanted people to know about it." "At first glance, the brochure looks well done per se and that's why I would consider the authors to be competent in this area."*

In the following, general evaluations of the brochure in terms of design and content will be discussed before the evaluation of individual pages of the brochure is examined.

In terms of design, the feel of the brochure was perceived as pleasant and its format as practical: "It has a very handy size*." "Easy to put in your pocket and take with you when you're sitting in the waiting room or something."* With a few exceptions, respondents considered the ratio of text to images in the brochure to be appropriate overall. The text elements were easy to read thanks to the font size. With regard to the image elements, the comic illustrations used were rated as good and appropriate. Respondents positively

mentioned the type of presentation which made the topic of 'radiological emergencies' more accessible and understandable: *"Comics instead of people give the matter an even more easily understandable touch."* This was seen as an advantage for people with a poor knowledge of German in particular: "*I thought the presentation in pictures was very good and it was designed in such a way that anyone can understand it, even without a good knowledge of German."* Besides, it was seen as positive that the comic-style pictures took away the gravity of the topic without trivialising it. Illustrations with real people, on the other hand, would have been perceived as inappropriate or even macabre: *"I don't think the topic is being trivialised. It's just right. You don't see any real persons that might upset some people."*

In terms of content, the brochure was rated as easy to understand and informative: *"Very simple design, easy to read and understand, super informative."* Both the amount and the depth of the information presented was considered appropriate. From the participants' point of view, the brochure is therefore well suited as a tool to inform people: *"I rated almost all the pages positively. I think it's great. Very compact. Not too much, but not too little either. Everything is explained. This means that if you don't have any knowledge at all, you will find everything in there." "It's technical, but doesn't go too deep into the topic."* In addition to the expected content, the brochure also included content that positively surprised the participants. In particular, the participants praised the treatment of fears and how to deal with them, as it is a topic that is somewhat more distant from the main topic of radiation: *"I agree that it is comprehensive. I also thought it was very good that psychological fears were addressed."* From the participants' point of view, this contributed to the harmonious overall impression of the brochure or even enhanced it: *"I think it gives a well-rounded picture and even a little extra, because there was also something about psychological counsel somewhere in here, which is only passively related to the topic of radiological emergencies."* The participants positively mentioned the fact that the brochure successfully arouses interest in the topic and further engagement with it. In this context, the QR codes shown in the brochure were seen as a good way to obtain further information on the topic if desired or needed: *"I really like that, because if you are interested and then there are no sources where you can read more about it, like on a website or so, then I think that's absolutely terrible, and a QR code is the perfect solution. Everyone has a mobile phone, and so you can access it directly."* Another aspect that was particularly positively emphasised in the evaluation of the brochure was the fact that it contains specific recommendations and instructions for action: *"It tells me exactly what I need to do. And I can give it to anybody and say 'Hey, just do what the brochure says'."*

Following this description of the evaluation of general aspects of the brochure, the following section will look at the participants' assessments of individual pages.

Both praise and criticism were expressed regarding the cover of the brochure. The positioning and size of the BfS logo were rated as good and appropriate: "*I think it's actually just right. Not too big, not too small. The logo is catchy, I think it's good."* What the participants liked about the image was that it depicted a diverse society and thus conveyed that the topic affects everyone: *"I think that this is right because everyone is included, young, old, black, white, children, adults. The idea is to express that it affects everyone, young or old, regardless of skin colour or nationality."* Some of the facial expressions of the people depicted were perceived as rather neutral and therefore appropriate, as the participants felt that this emphasised the message, which is to take a radiological emergency seriously, but not to panic: *"And their faces, they're not laughing and they're not scared either, they're calm. Because if they were too serious or laughing, I don't think either of that would be so good. Keeping calm is good for me."* In some cases, however, the mood in the picture was also perceived as too positive and therefore inappropriate for the topic of a radiological emergency: *"It looks very positive. I wouldn't think that the brochure is about an emergency."* Overall, some participants felt that there was too little focus on the topic of emergencies or warnings on the cover. Participants criticised the fact that the brochure did not attract enough attention as a result: *"I would just walk past it."* The suggestion was made to emphasise the topic of emergencies and warnings more by adapting the design of the cover page (e.g. by making the radiation warning sign yellow and/or larger and by enlarging the font of the title

'Radiological emergency'): *"Something that catches my eye. Something that makes clear that it's about a dangerous situation. For example, the radioactivity symbol in yellow."* The title term 'radiological emergency' was unclear to many participants and caused irritation, as it evokes associations with the medical subfield of radiology rather than nuclear radiation: "*Radiology, it makes me think of the doctor, I don't think of the nuclear power plant accident. That's a technical term; it confuses me."* The subtitle 'How to protect yourself' was perceived as appealing, as it implies that the brochure not only provides information about radiological emergencies, but that it also gives recommendations for action: *"I think it's actually quite well done, because it's clear at first glance that it's not just about what a radiological emergency is, but that you are also told what you can do."*

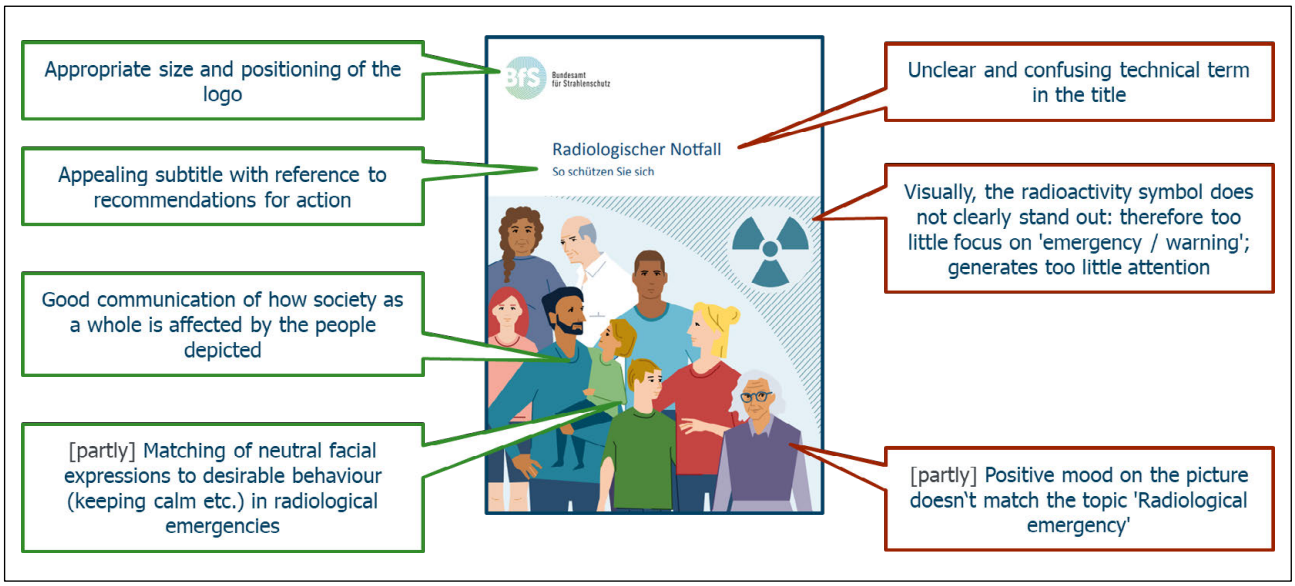

Figure 9 Evaluation of the cover page of the brochure 'Radiological Emergency' of the BfS

Page 2 was the page of the brochure that tended to be criticised the most. The main point of criticism was that there was too much text on this page and that too many abbreviations and technical terms were used on it: *"I actually evaluated page 2 negatively because all these abbreviations annoy and confuse me personally. I don't think that this is necessary, and there's also too much text." "Just text, far too much of it on one page. And then I started reading it, there are lots of expressions with abbreviations in between. [...] Another overview is missing, perhaps an index where you can look up all the terms again. And I also think there's sometimes too much specialised terminology, radiology, for example, right at the beginning."* Some participants felt that the information on the BfS in the right-hand column was too much, superfluous or even self-congratulatory, so they saw potential for shortening it accordingly: *"'Who will protect me in an emergency', the 2nd column, that's just self-congratulation. You could write 'The Federal Office for Radiation Protection'. Full stop. That's too much."* On page 3, the picture with the leaking hazardous goods bin was occasionally perceived as rather off-putting and confusing, as it reminds more of a chemical accident than of a radiological accident: *"Strictly speaking, this is confusing. Looks more like a chemical accident than a nuclear accident."*

Pages 6-7 were rated as well designed, as the participants liked the texts and images and their proportions. The double page 8-9 was named as a highlight by many participants: they liked the fact that the double page provides a good overview of various radiation sources and the radiation exposure they cause: *"Nice overview. I need that for my patients. It shows the amount of radiation you're exposed to during different examinations,*

which I think is great." The images were found to be helpful in grasping and understanding the information: *"Thanks to the images, it is something that everyone understands: what are sources of radiation, how much."* With regard to the amount of information, there was a general consensus that double-page 8-9 contains a lot of information, but that it is important and should therefore not be shortened*: "I haven't read it all the way through, but I would leave it in because I can imagine that many people would be interested. I mean, it's up to you whether you read it through carefully or not."* In few cases, the amount of information on double page 8-9 was also perceived as too much, overwhelming and therefore off-putting: *"It's rather off-putting, there's too much information at first glance."*

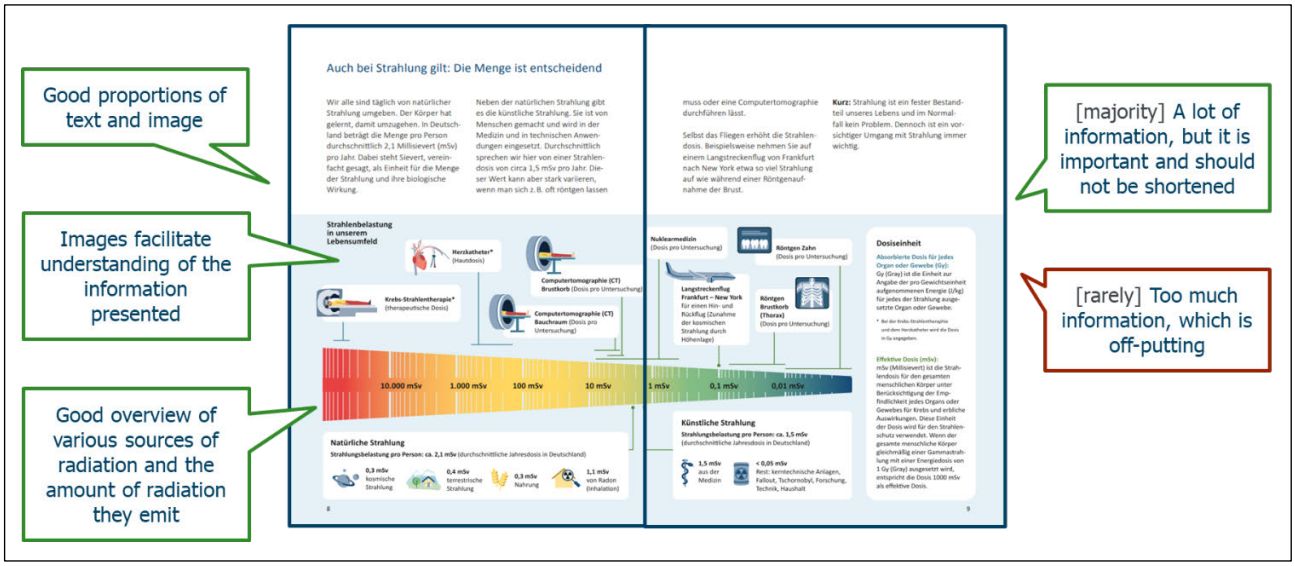

Figure 10 Evaluation of individual pages of the brochure 'Radiological Emergency' of the BfS

The double page 12-13 was also often mentioned positively. Participants particularly liked the fact that precise recommendations are given on possible protective measures: *"What I really like is pages 12 and 13. They tell me exactly what I need to do. And I can give it to anybody and say 'Hey, just do what the brochure says'.* The double-page was also often described as clear, with the symbols making a significant contribution to orientation and getting an overview of the tips: "*I also liked all the examples and the symbols, the radioactivity symbol here, the house there, and here you know directly that it's about clothing, I think that's really great."* In some cases, the information content was perceived as a bit much and the font size as a bit small; however, this was not a major problem: *"Perhaps it could shortened just a little bit. 12/13 is actually quite nice, the font is a little too small, maybe you could leave some things out."*

On page 14, the information on how to find out if you are contaminated by radiation was rated as interesting. The illustration on page 15 was perceived by some participants as frightening and off-putting on an emotional level: *"What I find very terrifying is page 15, I don't know why, but it looks strange to me and not really nice. But it would probably look like that for real. With the gym and the yellow people, it almost looks like in times of COVID." "In case of an emergency, you don't need this picture of a gym, it just makes people freak out. [...] You know, you get scared by the way they're dressed, nobody wants that in such a case."*

The elements on the back of the brochure caused different reactions. The checklist in the dark blue box on the right-hand side was rated positively, as it provides a brief, helpful overview of what to do in an emergency: *"The last page is very nice, just the one box that says what to do in an emergency. If you don't necessarily have the time to read through everything, you can look at it the box and learn everything that's*

important." "Really great. I think it's the best solution because you don't even have to open it; if it's really, really bad, you know that you can just look at the checklist straight away without having to read much more text. I think that's what I like best about the whole brochure." The boxes to be filled in on the left-hand side were often criticised for being unclear as to what or who needs to be entered there and how to obtain this information: *"I didn't understand at all what I was supposed to enter there." "I find it a bit problematic that I have to enter myself which authority is responsible."* Some participants therefore expressed the wish that the information should already be filled in (e.g. by the responsible administrative district office) or that the information that needs to be entered should be accessible via QR code: *"It should already be filled in. [...] Who is the responsible civil protection authority?" "So the information is then sent to a city or administration district office and they fill it in and distribute it."*

Figure 11 Evaluation of the back of the brochure 'Radiological Emergency' of the BfS

After having discussed their evaluation of the brochure, the participants were asked where they would like to find the brochure. Doctors' practices (as well as pharmacies) were often mentioned as a suitable location to display the brochure, as the waiting time there is often used to read brochures and magazines anyway and there is also a connection to the topic of health: *"I think that the doctor's waiting room would be a good place, because you have time there and, personally, I don't look at my mobile phone, I always look around to see what's there. And then I would read it."* For many participants, bridging waiting times was also an argument in favour of displaying the brochure at citizens' offices: *"Citizens' offices. You have long waiting times there."* However, few respondents noted that people rarely or never go to the citizens' office. The possibility of sending the brochure by post to German citizens was discussed controversially. On the one hand, this could reach a large part of the German population: *"You can be sure that it reaches everyone."* On the other hand, brochures in letterboxes are often perceived as advertising and are therefore rejected and thrown away: "*I don't like things in my letterbox. Mostly people just want money. Really bad idea."* In addition, sending the brochure to the entire population could cause uncertainty and fear: *"Everyone would probably panic."* Therefore, when the brochure is sent by post, it should be accompanied by a letter explaining that there is no specific reason for an (imminent) radiological emergency, and that the brochure is purely for (preventative) education: *"So I would like to add something else, in the letterbox, but not just the brochure, because in this*

case, I would probably think: 'Why now, has something happened or something? It would be best if it came from the city or district office with an accompanying letter." Other options for displaying the brochure that were less frequently mentioned were schools / colleges / universities and the workplace.

4 WP2 Quantitative survey

4.1 Research design

4.1.1 Research questions for WP 2 (according to the terms of reference)

The aim of the survey is to determine attitudes and knowledge on the subject of radiation among the population and to analyse possible changes over time. Around half of the questionnaire consists of questions that are asked consistently over time, while the other half consists of new questions.

The following topics were at the centre of the survey in 2024:

- Knowledge and perception, myths and fears in the population with regard to radiation in general and related to individual radiation protection topics;
- The meaning of the term "danger" in this context;
- Relevance of the topic of radiation protection in the context of health protection;
- Radiation protection behaviour and behavioural intention;
- Sources of information used;
- Changes in awareness, attitude and behaviour over time;
- Importance of the work of the BfS in the eyes of the public: awareness, credibility; comprehensibility, trust;
- Expectations of the BfS; expectations when it comes to (the comprehensibility of) information materials and measures;
- Optical radiation: UV radiation;
- Radiation in medicine;
- Radiological emergencies and behaviour, radiological emergency protection, contact points for finding information

4.1.2 Method: telephone survey (CATI) representative of the population

In order to survey a cross-section representative of the German-speaking resident population aged 16 and older, telephone interviews were conducted on the basis of a dual frame sample (combined landline and mobile phone sample). An overview of the study design is described below.

Table 1 Study overview quantitative survey

Quantitative survey elements	Key data
Survey method	CATI survey (Computer Aided Telephone Interviews)
Survey period	Pretest 30 telephone interviews in the period 6.5.-7.5. 2024 Main survey 2,002 telephone interviews in the period 22.5.-3.7.2024
Number of interviews	n=2,002 persons aged 16 and older
Average interview length	24 minutes
Population	German-speaking resident population aged 16 and older
Selection frame	ADM Dual Frame Mastersample

Quantitative survey elements	Key data
Fieldwork	Implemented by: GIM DiCom
Data preparation	Final plausibility check, representativeness check, weighting
Evaluation	Tabulation, descriptive and statistical analyses

4.1.3 Dual-frame sampling

The dual-frame sampling approach was already described in detail in the 2022 study[2] and also applies here:

As a member of the telephone sampling working group of the ADM (Arbeitskreis Deutscher Markt- und Sozialforschungsinstitute e.V.), GIM uses the ADM sampling system for telephone surveys to conduct population-representative studies

The sampling frame for landline and mobile phone samples is based on the number ranges provided for use by the Federal Network Agency, which in principle include all telephone numbers that can be used in the Federal Republic of Germany. The relevant key data from the Federal Network Agency is updated on an annual basis. The landline numbers are assigned to regions to enable a corresponding regional stratification. Samples on a landline basis are designed as a multi-stratified random selection. Regional stratification is not possible for mobile phone numbers due to the lack of regional localisation. Here, it is checked that distribution in the gross sample takes place by provider.

Since the proportion of households that do not have their telephone number published is steadily increasing, the ADM telephone sample includes both registered numbers and telephone numbers generated in accordance with the procedure developed by Gabler-Häder. Generating the telephone numbers ensures that the complete range of numbers is represented and not just the telephone numbers published in telephone directories. For fixed network connections, the numbers that are not assigned are sorted out by the dialler when the contact is dialled and stored and documented as a random sample-neutral failure.

The majority of the numbers generated for mobile phone samples are also not assigned. In order to remove inactive mobile phone connections from the sample, these were checked in advance for activation. For this purpose, a virtual check was carried out to determine whether a randomly generated mobile phone number was assigned or not (HLR lookup). The mobile phone owners are not contacted - the check is purely technical.

For differentiation in sampling, the resident population or private households were subdivided according to the following criteria (regional classification) and integrated in the GIM Sample Management System (SMS): federal states, administrative districts, independent cities, counties, municipalities (with 2000 and more inhabitants), total of municipalities up to 1999 inhabitants per county, differentiated according to BIK municipality size classes.

Since the proportion of people who can only be reached via mobile phone ("Mobile Onlys") or primarily use it ("Mostly Mobile") is continuously increasing, a representative sample can no longer be achieved today on the basis of a landline sample alone. The combination of the sample selection frames contributes decisively to the

[2] Ressortforschungsberichte zum Strahlenschutz: „Was denkt Deutschland über Strahlung? Ergebnisse 2022“ - Abschlussbericht Vorhaben 3621S72210 (bfs.de); 15.08.2024.

proportional representation of the population. In order to take into account the increase in mobile phone use, a dual-frame distribution of 60 / 40 (landline / mobile) was taken into account for the study.

In the dual-frame design, the different selection methods of the target person in the household must be taken into account: While in the fixed-network sample a target person in the household is selected by the last-birthday method, in the mobile phone sample the person who answers the call on the mobile phone is considered the target person. In order to compensate for inequalities in selection chances and design-related skewness, the data were subjected to a weighting in which both subsamples were included in a design and a structural weighting. As reference data, the weighting was based on the distribution of the current microcensus. The following variables were included in the weighting for the German-speaking resident population aged 16 and older: age, gender, West Germany, East Germany, education, household size, political location size, federal state.

4.1.4 Fieldwork

The fieldwork was carried out by GIM DiCom, an experienced telephone studio and wholly owned subsidiary of GIM. The following quality assurance measures were taken into account:

- Computer-assisted telephone interviews with automated sample management system (SMS)
- Intelligent sample control concept for the distribution of calls and processing of the contact scheme per telephone number over different times of day and days of the week for the best possible utilisation of the sample
- Use of permanently employed, experienced, native-speaking interviewers. Continuous support from permanently present supervisors
- Project-specific training.

4.1.5 Survey instrument

The questionnaire was designed in such a way that the main questions and topics from the 2019 and 2022 surveys were taken into account and new questions were added at the same time. New topics that were developed in 2024 together with the BfS were the relevance of UV protection, classification of radiation exposure during various medical examinations and hypothetical behaviour in dealing with a nuclear accident.

The questionnaire was divided into the following topics:

- First contact with the household or the target person
- Target selection based on the last-birthday method
- Interest in topics related to health and consumer protection
- Association with radiation
- Awareness of state institutions
- Sense of information and protection
- Knowledge of radiation and sources of radiation
- Health risks of modern societies including radiation
- Perception of protection in relation to various radiation protection topics
- Measures for one's own protection from radiation and concrete precautions against UV radiation
- Nuclear accident: assumptions and first points of contact for information, scenarios and personal behaviour in the event of a nuclear accident

- Radiation sources in the living environment
- Dealing with radiation
- Socio-demographics and place of residence

4.1.6 Notes on the presentation of results

This final report focuses on the results of the 2024 survey. Subgroup differences are explained, e.g. by age, gender or with regard to differences in personal attitudes towards radiation. In addition, comparisons are made with the 2022 survey and the results of questions that were asked in both waves are compared. Significant differences are shown at 5% level. The results are weighted. Graphs that do not add up to 100% either show questions with multiple answers or the differences to 100% are due to rounding or the fact that the categories "don't know" or "no answer" are not shown separately in some cases. Top2 or Top3 values may also deviate from the sum of the individual values shown for the respective categories due to rounding.

4.1.6.1 Index "Concern"

Some results are shown in two groups, namely *rather concerned* versus *rather unconcerned*. For this purpose, a mean value was calculated from the items on personal level of concern about current crises, the use of nuclear weapons and a nuclear accident in normal operation, as well as items on the extent of radiation-related health concerns. On the basis of the median (2.75 – for all questions, 1 stood for "not concerned", 5 for "very concerned"), the population was then divided into those who were rather concerned on average, i.e. had a higher value than the median, and those who were rather unconcerned (mean <= median). On average, those who are rather concerned are slightly older (54 years) than those rather unconcerned (47 years). Women are also more likely to be concerned: 58% of all women belong to the ‘rather concerned’ group, compared to only 42% of all men.

4.2 Radiation: perception, knowledge and level of information

4.2.1 Interest in and prior engagement with the topic

To what extent does the topic of radiation and radiation protection play a role in the respondents' everyday lives? In order to better understand this, questions were asked about general consumer and health protection as well as about prior engagement with the topic.

In order to generally categorise how relevant radiation protection topics are for the respondents, they were first asked to assess their general interest in consumer and health protection topics and to rate this on a 4-point scale (not at all interested to very interested plus the additional option "don't know"). 81% state that they are interested in consumer and health protection issues. This is a slightly higher proportion than in 2022 (78%) – so interest in the topic has by no means waned. In all age groups aged 40 and older, there is a higher proportion of people with an interest in the topic than in the two younger age groups, but at least around three quarters of respondents are interested in these topics in each age group (16-29 years: 74%, 30-39 years: 75%, 40-49 years: 82%, 50-64 years; 85%, 65 years and over: 85%).

At the end of the interview, all respondents were asked to indicate the extent to which they had already dealt with the topic of radiation before the survey (4-point scale: never / hardly / a little / a lot). As in 2022, the proportion of those who had dealt with the topic at least "hardly" or more often was 42%.

While a larger proportion of women indicated a general interest in health and consumer protection topics (women: 86% | men 76%), a higher proportion of men had already dealt with the topic of radiation in the past (men: 44% | women 39%).

On the basis of two sets of questions on the topic of concern in relation to a nuclear accident or disaster on the one hand and general and radiation-related health concerns on the other, the respondents were divided into the groups 'rather concerned' and 'rather unconcerned' using a median split. A comparison of these two groups shows that those who are rather concerned are more interested in health and consumer protection issues than those who are rather unconcerned (rather concerned: 85% | rather unconcerned: 77%), while those who are rather unconcerned are more likely to have dealt with the topic of radiation before than those who are rather concerned (rather concerned: 37% | rather unconcerned: 47%).

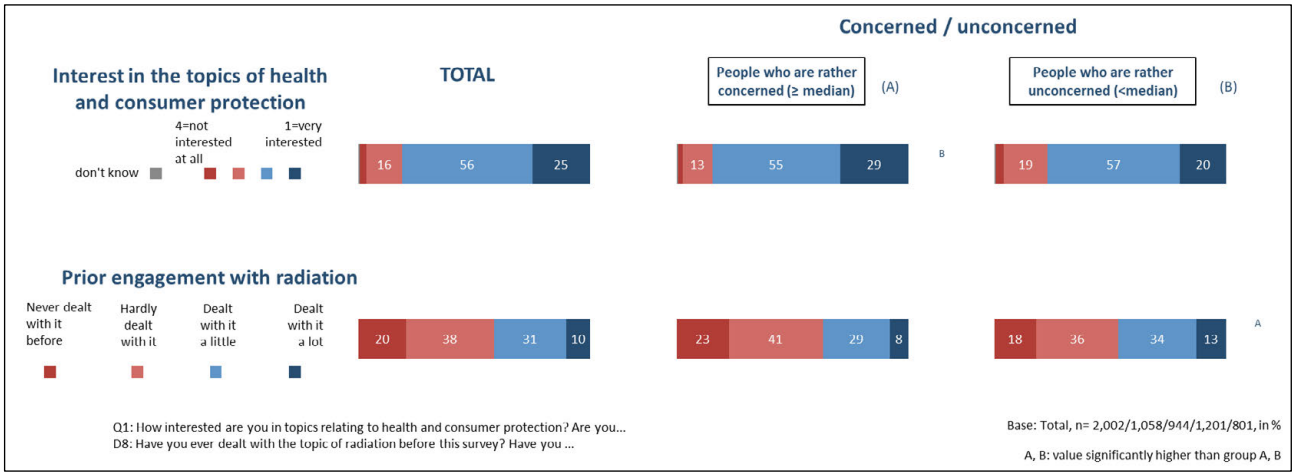

Figure 12 Interest in health and consumer protection and prior engagement with the topic of radiation – people who are rather concerned vs. rather unconcerned

However, this correlation does not contain any information about a possible causality – it is not possible to say whether interest in the topic or low engagement with the topic in the past leads to concern or, conversely, whether concern leads to interest in the topic or avoidance of the topic in the past. Concern, interest and prior engagement with the topic could also possibly be influenced causally by another factor.

Overall, it can therefore be stated that the general interest in the topic of health and consumer protection has increased slightly compared to the 2022 survey and that prior engagement with the topic of radiation is equally pronounced. Women show more interest than men in the topic of health and consumer protection, while men are more likely to have already dealt with the topic of radiation.

4.2.2 Associations with radiation

4.2.2.1 General associations with the topic of radiation

What do people think of when they hear the term "radiation"? As was already clear in the qualitative study, the term "radiation" evokes a wide range of associations, most of which are also linked to the realities of life or the everyday lives of the respondents: also in the quantitative study, the topic of **radioactivity**, which is currently very present in the media, was spontaneously associated with radiation very frequently (44%). The qualitative study showed a strengthening of the topic in personal perception, but this cannot be confirmed in

the quantitative study: compared to the previous wave, spontaneous mentions of the topic of radioactivity have fallen (2022: 52% | 2024: 44%), but it is still by far the most frequently mentioned topic. As in the qualitative survey, besides the topic of radioactivity, the topics of **solar radiation** (36%), **mobile phones** (34%) and **medical radiation** (33%) were also often mentioned spontaneously in the quantitative survey. The individual subject areas are analysed in detail below to determine which terms were specifically mentioned in each case and whether there are differences between the various age groups.

If we look at the responses on the topic of **radioactivity** in detail (44%), terms such as "nuclear radiation", "radioactive radiation" or "nuclear power plants" are frequently mentioned spontaneously. This is a decrease compared to the previous survey (2022: 52%) but remains the most frequent association. This association is mentioned particularly frequently by people under 40 years of age (16-29 years: 52%, 30-39 years: 53% | 40-49 years: 44%, 50-59 years: 41%, 65 years and older: 36%). As in 2022, the topic is mentioned more frequently by men than by women (men: 55% | women: 34%), which means that – in contrast to men – it is not the most frequently mentioned topic among women but is roughly on the same level as other topics (sun: 34%, mobile phones: 37%, medicine: 35%).

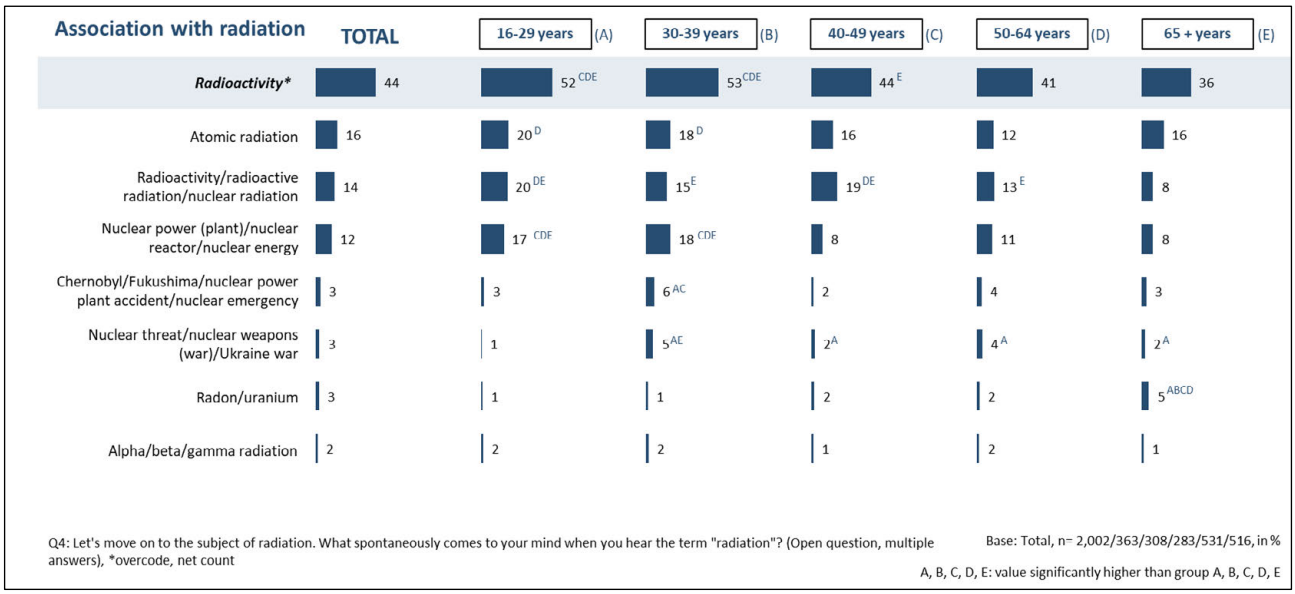

Figure 13 Spontaneous responses on the most frequently mentioned topic of radioactivity in total and by age group

The topics sun, mobile phones and medicine are mentioned with similar frequency across the population (sun: 36% | mobile phones: 34% | medicine: 33%). For the **topic of sun / light** in general, no age or gender-specific differences can be identified regarding the frequency of spontaneous associations. However, a closer look at the sub-codes reveals that the youngest group aged 18-29 in particular spontaneously name associations with UV / UVA / UVB radiation most frequently (18-29 years: 20% | total: 11%). Against the background of the qualitative results, this can be interpreted to mean that protection against UV radiation and thus protection of the skin against premature signs of ageing plays a major role for younger people in particular. The relevance of UV protection for cosmetic reasons is particularly pronounced in this age group of 18-29-year-olds and significantly stronger than in the 2022 study. No differences can be identified here with regard to men and women. Overall, it can be seen that the topic of sunlight and UV protection is generally more present among respondents compared to the 2022 survey: 32% of respondents spontaneously mentioned terms from the area of "sun / light" back then, compared to 36% of respondents in the current survey.

Associations with **mobile phones** decrease significantly with age: people aged 65 and over spontaneously mention mobile phones significantly less often compared to the average (65 years and older: 20% | total: 34%). In addition, women name mobile communications, in particular "mobile phones", more frequently (women: 37% and 30% | men: 32% and 24%).

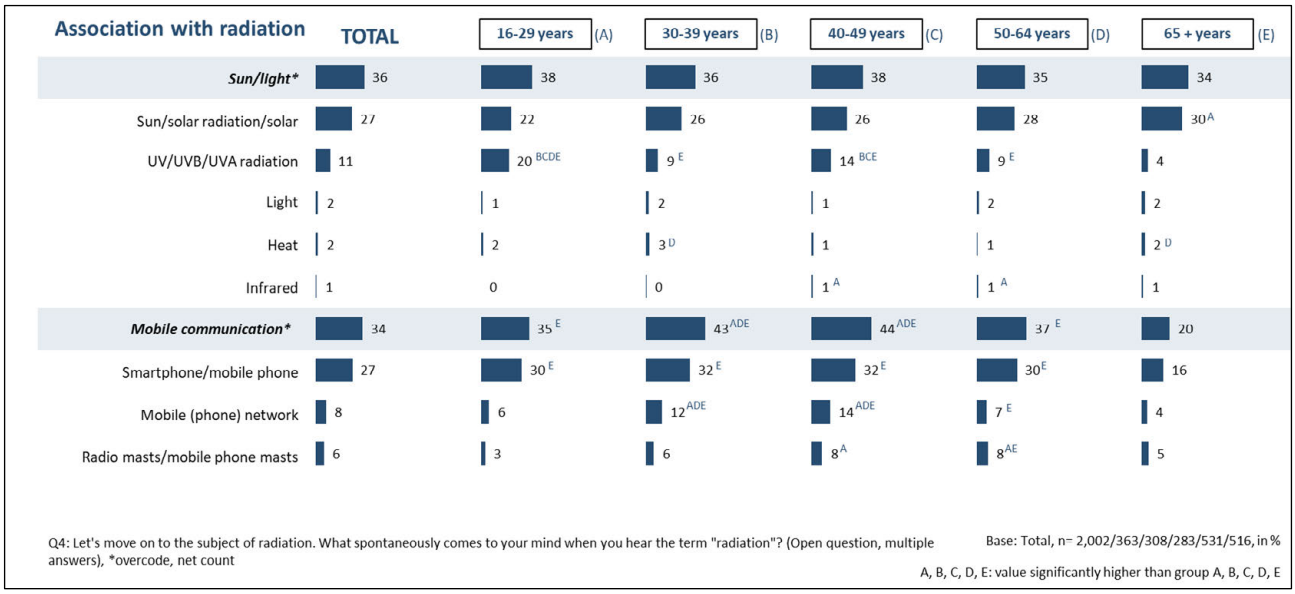

Figure 14 Spontaneous responses on the topics of sun and mobile phones in total and by age group

The younger age groups (16-29 years and 30-39 years) are also more likely to think of terms relating to electromagnetic fields (18-29 years: 25%, 30-39 years: 28% | 21% total); microwaves in particular are mentioned more frequently in these two groups (10% each) compared to all other age groups. Compared to the previous wave, spontaneous mentions of this topic are on the same level.

Terms from the field of medicine have increased compared to the previous wave (2022: 26% | 2024: 33%) and are more frequently mentioned by women (women: 35% | men: 30%). When looking at the age groups, the youngest respondents (16-29 years) were least likely to mention terms from the field of medicine (16-29 years: 27% | total: 33%). This corresponds with the reality of the respondents' lives, as people of an older age are more likely to be confronted with the topic of radiation during medical examinations. It also corresponds to the qualitative observation that women deal with the topic of health and (medical) radiation more often.

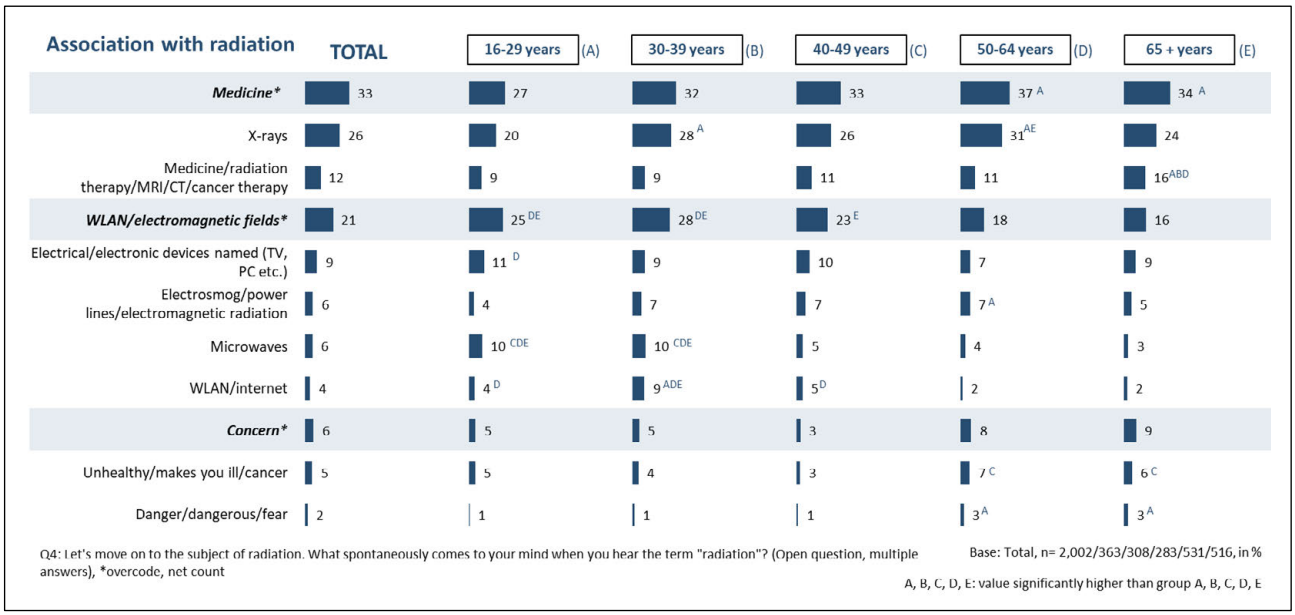

Figure 15 Spontaneous responses on the topics of radiation in medicine and electromagnetic fields in total and by age group

Overall, terms from the area of natural radiation (5%) as well as terms expressing concern (e.g. "makes you ill" or "bad"; 6%) were mentioned rather rarely. It can be seen that even fewer terms expressing concern are mentioned spontaneously than in the previous wave (2022: 11% | 2024: 6%).

4.2.2.2 Associations with the topic of (potentially) harmful radiation

The general associations were followed by question about associations specifically with **potentially harmful radiation topics or radiation sources**. Topics relating to radioactivity were mentioned most frequently (54%) and the sun and UV radiation second most frequently (39%) – again particularly frequently by the younger group aged 18-29 (43%). The particular relevance of radioactivity and UV radiation was already emphasised in the qualitative survey and is also reflected here in the quantitative results.

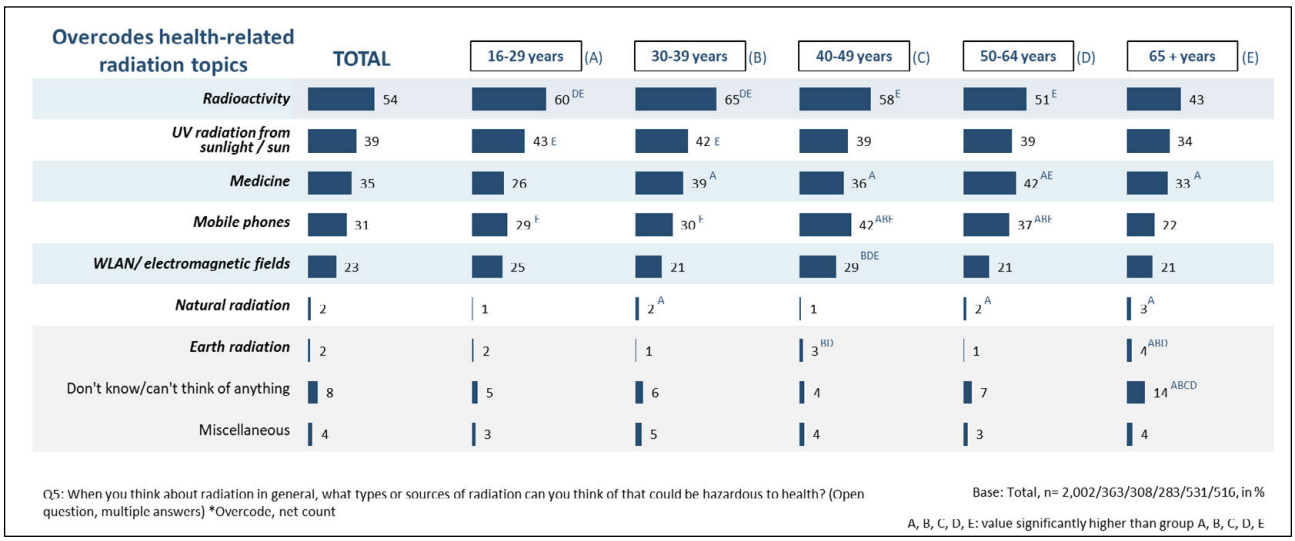

Figure 16 Spontaneous responses on health-related radiation topics sorted by frequency in total and by age group

In contrast to general associations, the third most frequently mentioned topic is radiation in medicine (35%), followed by mobile phones (31%) and electromagnetic fields (23%). The least frequently mentioned radiation topics are forms of natural radiation (2%).

When having a closer look at the age groups, terms relating to radioactivity as potentially harmful radiation are mentioned more frequently by the younger groups (16-29 years: 60%, 30-39 years: 65% | total: 54%). UV radiation is mentioned less frequently by the oldest group aged 65 and over (34% | total: 39%). In contrast, radiation used in medicine is mentioned less frequently by 16-29-year-olds than by all older groups (16-29 years: 26% | total: 35%). People aged 30-39 and 40-49 mention mobile phones more frequently than all other age groups (16-29 years: 42%, 30-39 years: 37% | Total: 31%).

Similar to the spontaneous associations overall, the main difference between the genders in the question about potentially harmful radiation is that radioactivity is mentioned significantly more often by men than by women (men: 64% | women: 44%), while mobile phones are mentioned more often by women (women: 37% | men: 25%). For the other radiation topics, there is no significant difference between men and women regarding the frequency of mentions.

7% of the population spontaneously do not have any association with the topic of radiation overall, a value that is quite similar to the 8% who do not have any association with the topic of radiation that is *hazardous to health*. Most radiation topics that are named as general associations are also named as potentially hazardous to health. For most radiation topics there is a difference of +/- 3 percentage points, only radioactivity is even more frequently named as potentially hazardous than in general (44% in general | 54% hazardous to health). This similarity in the frequency of mentions can be interpreted as an indication that radiation of all kinds is generally also seen as a potential danger to one's own health.

4.2.3 State institutions: awareness, sense of information and protection

To what extent do citizens feel informed by state institutions on the subject of radiation protection and to what extent do they feel protected by state institutions? The prerequisite for both is, of course, that citizens are aware of the institutions in question in the first place.

A closer look at the **awareness** of the BfS among the population reveals that there is a discrepancy between the qualitative and quantitative research approach. The **qualitative** study showed that most respondents were rather unfamiliar with the Federal Office for Radiation Protection. This relative unfamiliarity proved to be the main reason why the BfS has a low status as an information platform for the population when it comes to the topic of radiation protection. In the **quantitative** survey, however, when specifically asked about their awareness of a number of state institutions, a large proportion of respondents think that they know the BfS, a proportion that has also increased compared to the 2022 survey (BfS known "at least by name" 2024: 77% | 2022: 71%). This may be due to the fact that they were specifically asked about the BfS, but also due to the use of the term "Federal Office" – in the qualitative survey, a certain basic trust was placed in the institution based on the name alone. However, the increasing awareness of the BfS compared to the previous wave also shows that the BfS's communication measures are having an effect .

In order to categorise awareness of the BfS alongside other relevant institutions, respondents were also asked about their **awareness of various other state or supranational institutions**. As in 2022, most people stated that they knew the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) (at least by name or even better, i.e. they also knew its tasks and/or had already visited its website (2024: 84%, 2022: 83%)). This is followed by the BfS and the International Atomic Energy Agency (IAEA). The ranking in terms of average awareness has remained the same. Compared to 2022, however, both intuitions are known "at least by name" more frequently in the current study (BfS: 2024: 77% | 2022: 71%,

IAEA: 2024: 72% | 2022: 69%). As in 2022, the Commission on Radiological Protection is the least well known at 48% (2022: 47%).

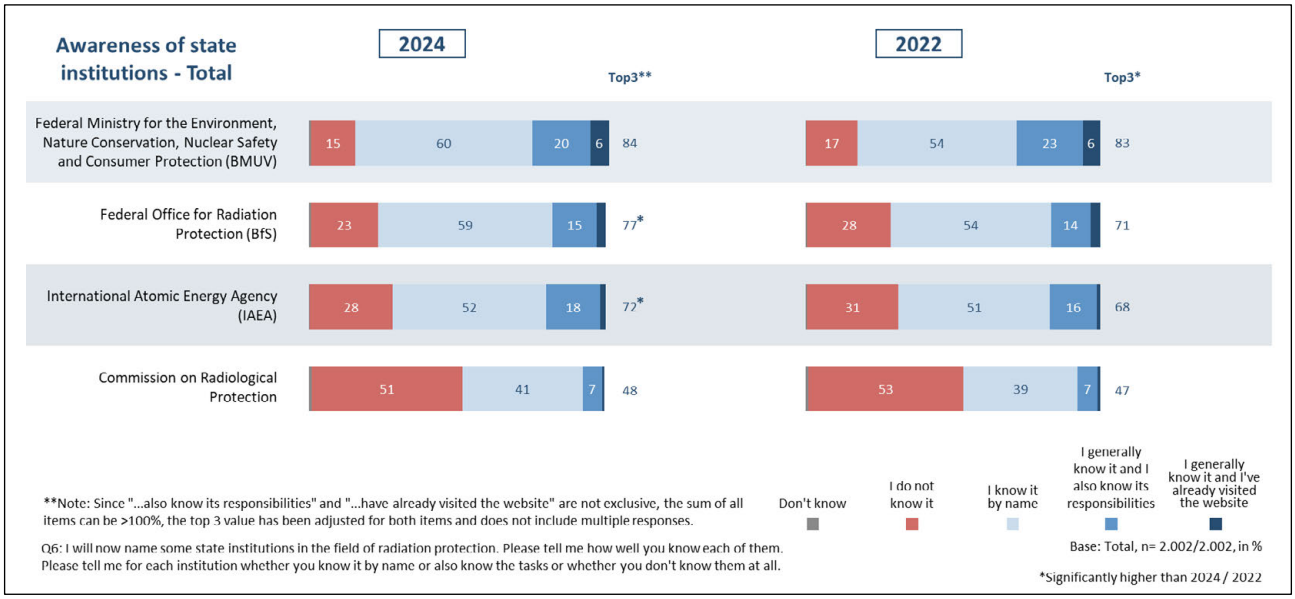

Figure 17 Awareness of state institutions in the field of radiation protection compared over time

As was already clear in the 2022 survey, the aided awareness of all institutions rises with increasing engagement with the topic of radiation. For example, 93% of people who have dealt with this topic a lot know the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (2022: 92%) and 90% know the Federal Office for Radiation Protection (2022: also 90%). Among people who have not dealt with the topic of radiation before, only 78% and 69% respectively are aware of the institutions – although these figures have risen significantly compared to 2022 (2022: 64% and 54% respectively).

The age split shows that, with the exception of the BMUV, the other three institutions are little known among the youngest age group of 16-29-year-olds (BfS: 49% | total: 77%, IAEA: 44% | total: 72%, Commission on Radiological Protection: 35% | total: 48%). Men know the BfS and the IAEA slightly more often than women (BfS: men: 79% | women: 74%, IAEA: men: 79% | women: 64%).

How well informed and protected do respondents feel by state institutions for radiation protection?
Less than half of respondents feel well informed by state institutions: on a four-point scale (very poorly / poorly / well / very well / plus "don't know" as additional option), 40% responded that they feel well or very well informed. Compared to the 2022 survey, however, this is a significant improvement: back then, only 31% felt (very) well informed. A good half of respondents (51%) feel (very) well protected by state institutions in the area of radiation; this figure has remained stable over time (2022: 51%). Overall, as in 2022, it can be seen that the feeling of being protected by state institutions is at a significantly higher level than the feeling of being informed – although the latter has also increased significantly over time. This underlines the trust placed in the Federal Office for Radiation Protection, as was already evident in the qualitative interviews: the BfS stands for objectivity, science, impartiality and has a protective and educational mandate with regard to radiation protection risks. This favours a subjective sense of protection.

Among men, the proportion of those who feel well informed and protected is higher than among women (well informed: men: 44% | women: 35%, well protected: men: 57% | women: 47%). The feeling of being "well" or "very well" informed by state institutions for radiation protection increases slightly with age.

When looking at the age groups, it can be seen that the feeling of being informed is lower in the youngest age group (16-29 years) than in all older groups (16-29 years: 28% | total: 40%), while the feeling of protection is higher (16-29 years: 66% | 52% total). Even if this could be an indication that especially uninformed people feel well protected, the feeling of information and the feeling of protection are generally congruent in the population as a whole: 32% stated that they felt (very) well informed and (very) well protected, 30% (very) poorly informed and (very) poorly protected. Of the people for whom the feeling of being informed and feeling protected are not congruent, only a minority stated that they felt (very) well informed but (very) poorly protected (5%), while a larger proportion stated that they felt (very) poorly informed but at the same time (very) well protected (17%). The latter group is also the youngest on average (40 years | 51 years total). The young age may be the reason for the incongruence: these people have relatively rarely in their lives encountered various topics related to radiation and therefore do not necessarily feel well informed. Nevertheless, they do not perceive this as a problem, as they are also unaware of the potential risk posed by radiation of all kinds.

Specific communication strategies could possibly help to better reach young people and women in order to specifically improve their sense of information and protection.

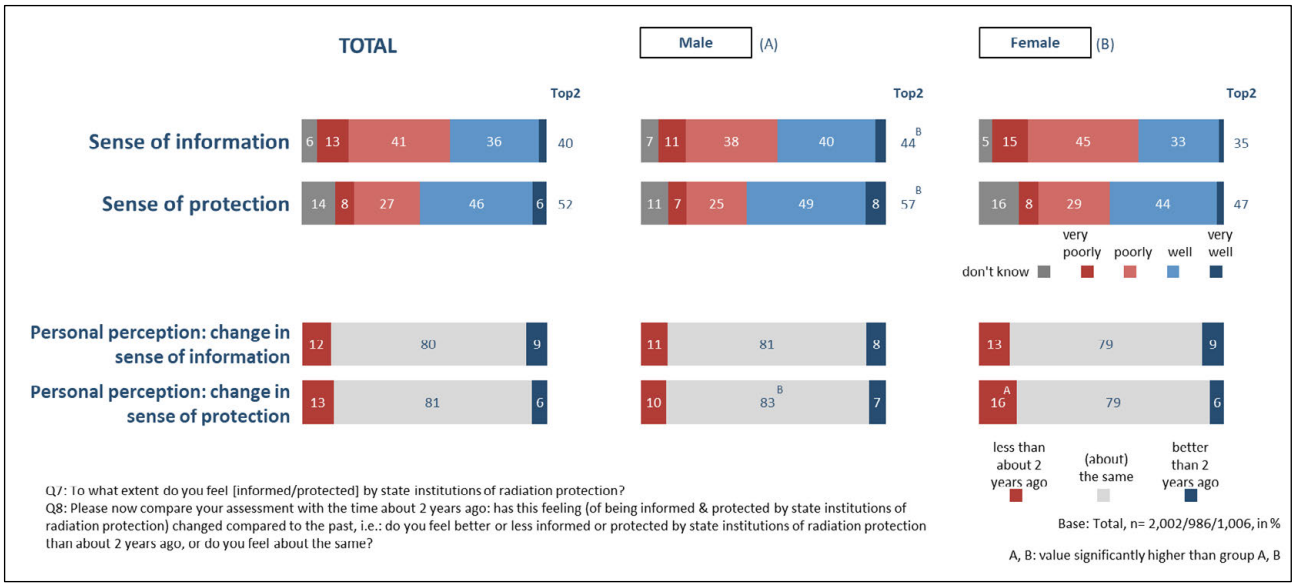

Figure 18 Sense of information and protection in total and by gender

With regard to the level of education, it can be seen that people with a higher level of formal education (highest general school leaving certificate or university entrance qualification) feel better informed and protected by state institutions on the subject of radiation protection than the population average (*sense of information* among people with a higher level of formal education: 46% | total: 40%; *feeling of protection* among people with a higher level of formal education: 65% | total: 52%). This may be related to the fact that people with a higher level of formal education are presumably generally better informed about the topic of radiation and radiation protection and are also presumably more likely to be reached by information campaigns. At 85% (top 2 box), those with a higher level of formal education are more interested in general health and consumer protection issues than the population average (total: 81%) and, at 56% (top 2 box), are also more informed about the topic of radiation compared to the population average (*have already dealt with the topic of radiation "a little" or "a lot" before the survey:* higher level of formal education: 56% | total: 42%).

Furthermore, subgroup analyses show that people who are (very) interested in consumer protection have a higher feeling of information and protection than people who are less interested in this topic.

Sense of information: 43% of people who are very interested in consumer protection feel (very) well informed and 41% of people who are rather interested in consumer protection topics feel (very) well informed. In contrast, only 30% of people who are (rather) not interested in consumer protection feel (very) well informed.

Feeling of protection: 53% of people who are (very) interested in consumer protection topics feel (very) well protected. In contrast, only 45% of people who are (rather) not interested in consumer protection topics feel (very) well protected by the state.

Similarly, the feeling of being informed and protected seems to be related to a person's concern about health risks from radiation and other influences in the sense that people who are rather concerned feel less informed and protected than those who are rather unconcerned (concerned people: 37% feel (very) well informed, 45% (very) well protected | rather unconcerned people: 42% feel (very) well informed, 59% (very) well protected).

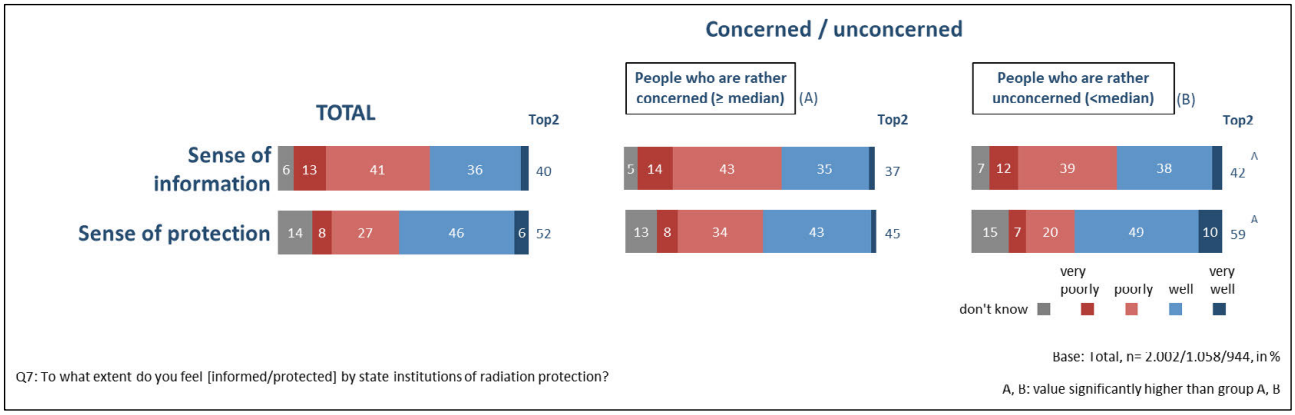

Figure 19 Sense of information and protection in total and among concerned and unconcerned people

In order to obtain another indicator to measure the perception of the sense of information and protection against the background of the current crises, respondents were asked about the subjective change in this feeling compared to around two years ago, i.e. whether they feel better or less informed and protected or whether this feeling has not changed. This shows that the vast majority of the population feels just as well informed (80%) and protected (81%) as before. Among those who perceive a change, the proportion of those who feel less informed or less protected is slightly higher (12% and 13% respectively) than those who feel better informed (9%) or better protected (6%).

All people whose subjective sense of information or protection has changed compared to the past were asked about the reasons for this change. The most common reason given by people for feeling less informed was a low presence of the topic or specific radiation topics in the media (50% of people who gave a reason for feeling less informed). Other reasons such as a difficult access to information on radiation issues (11%) or general mistrust in politics (10%) are cited less frequently. Similarly, people with a lower sense of protection most frequently cite a deterioration in the flow of information (32%), followed at some distance by the current political situation due to the war in Ukraine (12%) and a lack of trust in the government (11%). In contrast, however, 49% of those who stated an improved feeling of being informed also stated that this was due to an increased media presence of the topic, or that they had accumulated more knowledge over time or actively sought it out (15% of responses in each case). Respondents also frequently cited an increased

presence of the topic (30%) as the reason for an increased sense of protection. Only the nuclear phase-out was cited by slightly more respondents (32%) as a reason for an increased sense of protection.

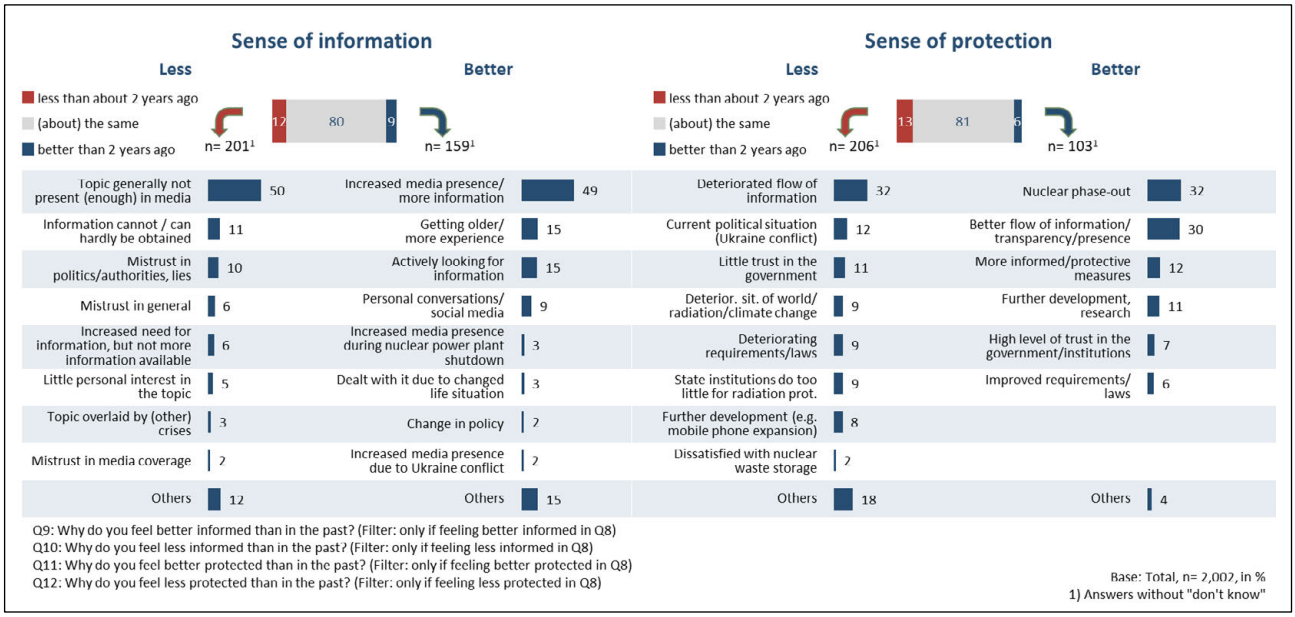

Figure 20 Reasons for a subjective change in the feeling of information and protection over time

The results show that the subjective feeling of protection and information among citizens is on a constant level, with the vast majority perceiving no change. However, among those who perceive a change, there is a slight surplus of those who perceive a deterioration over those who perceive an improvement. Occasionally, people cite the reason that although information and protection have not necessarily changed, there is more reason to be concerned about radiation, for example because more UV radiation is hitting the earth due to climate change. Increased UV exposure due to climate change was also cited in the qualitative study as a reason for increased radiation exposure.

One argument for a poorer feeling of information and protection is that "the topic of radiation" is currently not very present in the media or the public. At the same time, the same argument can be found relatively frequently as an argument for a better feeling of information and protection – seemingly a contradiction. However, if you look at the current news situation in 2024, there are differences depending on what you associate with the topic of radiation. Some topics associated with radiation are present: the nuclear phase-out in Germany has been a recurring topic of discussion over the last two years, particularly due to the energy crisis resulting from the war in Ukraine. In this context, nuclear weapons and the danger posed by nuclear power plants were also a recurring topic. During the survey period, reports of water seeping into the Asse nuclear waste repository brought the topic of nuclear waste back to mind – which for some also focussed attention on a topic that had long been little discussed in public. This may also contribute to the perception that, in view of the current crises in recent years, many relevant aspects, such as the unresolved issue of the final disposal of German nuclear waste, have been overshadowed in public perception. UV radiation has also been addressed in the media and widely communicated, for example through press work of the BfS in connection with the UEFA European Football Championship 2024. Other topics such as medical radiation or radiation from mobile phone masts or mobile phones do not currently play a major role in public or media perception.

At the same time, the topics that were present during the survey period, i.e. the upcoming US elections, the war in Gaza and the European Football Championship 2024, were topics that are not directly related to a radiation issue. Accordingly, depending on one's own understanding of which radiation topics are relevant and one's own focus of attention, it can vary greatly whether radiation is currently a very present – or, on the contrary, a neglected topic.

4.3 Dealing with various radiation issues

Another important research question in the current survey is how the population perceives and deals with the risks posed by ionising radiation. The current survey focussed on citizens' attitudes and concerns regarding a nuclear accident or another nuclear incident. The aspect of the perceived threat posed by nuclear power in view of global crises and conflicts was also included.

In general, the question of how citizens would behave in the event of a nuclear accident is relevant for the BfS – in particular the extent to which citizens would comply with government instructions from civil protection authorities in such an event. This was analysed in the current survey using the scenario technique: respondents were asked to imagine that a nuclear accident had occurred at a research facility in their neighbourhood and they had received government instructions from civil protection authorities not to leave their homes. The social pressure in the scenario became stronger and stronger: in the second stage, respondents were asked to imagine that the civil protection authorities had given instructions not to leave the house, but that neighbours and friends were now leaving their houses and driving away. In a third stage, respondents were asked to imagine that family members were now also calling and asking them to drive away together.

In addition, citizens should assess their handling of and knowledge about radiation in medicine. The focus here is primarily on ionising radiation, which is used in X-ray examinations, but also in computer tomography (CT) and radiotherapy. Medical applications contribute significantly to the average exposure of the population to ionising radiation[3].

In addition to ionising radiation, UV radiation is also a focus of the survey. This survey investigated how the population protects itself from UV radiation as potentially harmful radiation and to what extent this behaviour has changed compared to the 2022 survey. In addition, the survey examined the extent to which citizens are aware of the UV index as a unit for the current or predicted UV radiation, whether they use it – and if so, what their sources of information are.

4.3.1 Ionising radiation: nuclear accident

How would the population deal with a hypothetical nuclear accident? In this part of the interview, respondents were initially asked about attitudes and concerns on 5-point scales. In part, the same questions were asked as in the 2022 survey, but due to the ongoing wars in the world, in the context of which the threat of nuclear weapons is also discussed, questions on concerns about wars and crises in general and in relation to nuclear dangers were added.

[3] BfS - Strahlenbelastung im Alltag; 30.09.2024.

This was followed by a scenario in which respondents were asked to state whether, under various conditions, they would comply with government instructions from civil protection authorities not to leave their houses in the event of a hypothetical nuclear accident at a research facility in their neighbourhood. Finally, all respondents were asked to indicate where they would go for information in the event of a nuclear incident.

4.3.1.1 Nuclear accident: attitudes

Respondents were asked to indicate the extent to which various statements about possible nuclear dangers apply to them on a scale from 1 (does not apply at all) to 5 (applies fully) in order to understand their attitudes towards a nuclear accident or various kinds of nuclear threats. The results shown here are the top 2 values, i.e. the sum of answers with a value of 4 or 5 on the scale.

Irrespective of the radiation topic, 71% of the population are generally very concerned about the conflicts and wars in the world. When asked specifically about nuclear dangers, a good half of respondents expressed concern that nuclear weapons could be used in view of the conflicts and wars in the world (58%) or that an accident could be triggered in a nuclear power plant as a result of the crises and conflicts (57%). Despite the nuclear phase-out in Germany, 35% of respondents are worried about a possible nuclear accident. 43% of respondents trust that the state would immediately implement all important measures in the event of a nuclear accident, but only 28% believe that Germany is well prepared for a nuclear accident.

The two youngest age groups surveyed are least worried about a nuclear accident in the event of an accident as a result of war and conflict: 43% of 16-29 year olds and 52% of 30-39 year olds compared to 57% in total. Younger people are also least worried about a theoretically possible nuclear accident in Germany (23% of 16-29 year olds and 25% of 30-39 year olds compared to 35% in total). At 62%, an above-average number of 16-29-year-olds trust that the state will immediately implement all necessary measures in the event of a nuclear incident (total: 43%).

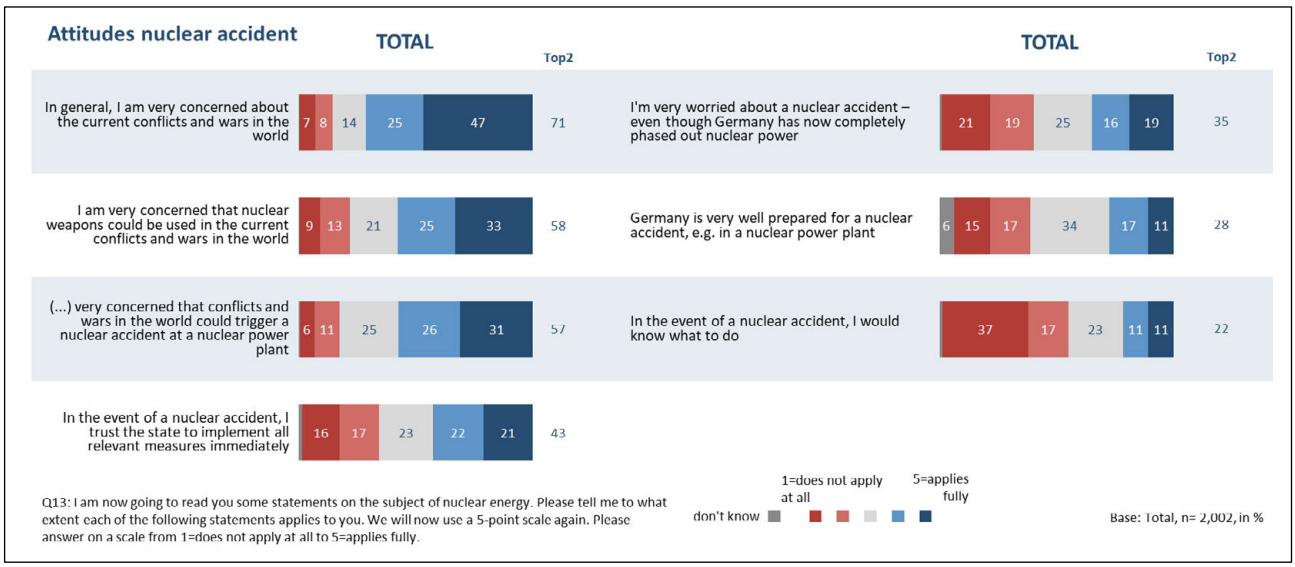

Figure 21 Attitudes towards a possible nuclear accident in total

A closer look at the genders reveals that a higher proportion of women are concerned, both in general about the conflicts and wars in the world (women: 79% | men: 63%) and about a nuclear incident, be it through the use of nuclear weapons as a result of conflicts and wars (women: 68% | men: 47%), an accident in a nuclear

power plant caused by war (women: 62% | men: 52%) or a nuclear accident in Germany (women: 41% | men 29%). In contrast, a larger proportion of men consider Germany to be well prepared for a nuclear accident (men: 32% | women: 23%). And men are also more likely to know what to do in the event of a nuclear accident than women (men: 26% | women: 18%).

As described in the previous chapter, people with a higher level of formal education felt more informed and better protected by the state when it comes to radiation than the population average – this is also reflected in their attitudes towards a hypothetical nuclear accident: for example, 32% of those with a higher level of formal education believe that Germany is well prepared for a nuclear accident (total: 28%) and 47% would trust the state to implement all important measures immediately in the event of a nuclear accident (total: 43%), i.e. a slightly greater proportion compared to the population average. Similarly, people with a higher level of formal education are also less worried than the population average (about a nuclear accident: higher formal education: 27% | total 35%; or that nuclear weapons could be used in the current conflicts and wars in the world: higher formal education: 51% | total 58%).

The results are similar when comparing people who feel (very) well informed or protected by the state with people who feel (very) poorly informed or protected by the state: people who feel (very) well informed or protected by the state are more likely to believe that Germany is well prepared for a nuclear accident ((very) well informed 35% each | (very) poorly informed 21% | (very) poorly protected 17%). People who feel (very) well informed or protected by the state are also more likely to know what to do in the event of a nuclear accident (26% and 25% respectively compared to 19% in the opposite group), or would trust the state to implement all important measures immediately (51% and 54% respectively compared to 36% and 27% in the opposite group). Accordingly, those who feel (very) well informed and (very) well protected are less concerned than people who feel less informed and protected by the state – with regard to a hypothetical nuclear accident, but also with regard to a possible use of nuclear weapons in one of the current conflicts or wars, or a possible nuclear accident at a nuclear power plant triggered by these conflicts or wars. When it comes to general concerns about the conflicts and wars in the world, the two groups of (very) well-informed or protected people do not differ from the (very) poorly informed or protected people. Those with a higher level of formal education also did not differ from the population average for this item. This means that people with a higher level of formal education and people who feel (very) well informed or protected by the state therefore answered this question very similarly, which emphasises the result that people with a higher level of formal education feel better informed and protected by the state than the population average.

Similar tendencies can be seen among people who have already dealt a lot with the topic of radiation compared to people who have only dealt with the topic a little or who have hardly or never dealt with it.

The questions relating to the possibility of a nuclear accident in Germany were also asked in the previous wave and there were no changes in terms of confidence that the state would implement important measures immediately or that Germany is well prepared and that respondents would know what to do in the event of an accident. However, despite the nuclear phase-out, more respondents are worried about a nuclear accident in 2024 (35%) than in 2022 (28%). As already shown in the qualitative survey, the dangers of radioactivity are currently very present in the population. Concerns about the possible use of nuclear weapons or an accident at a nuclear power plant due to the conflicts and wars in the world are particularly striking. And even if there are no comparative figures for the 2022 quantitative survey, the highest approval rates by far for items such as *I am very concerned that nuclear weapons could be used in the current conflicts and wars in the world* (58%) and *I am very concerned that conflicts and wars in the world could trigger a nuclear accident at a nuclear power plant* (57%) speak for themselves. The approval rates for the other items in this context only follow with a clear gap of over 10 percentage points. We will have a closer look at the prominent concern about nuclear weapons in chapter 4.4.1. and put it in relation to other health concerns.

An indication of another possible reason for the reduced confidence that the state will implement all necessary measures can be found in the open responses from people who feel less protected by state radiation protection institutions than in the past when asked where this lower feeling of protection comes from: occasionally, respondents express concerns that with the phasing out of nuclear power, the precautionary measures against a nuclear emergency could also be reduced, while the danger from nuclear power plants in neighbouring countries still exists. This fear could be counteracted with targeted communication measures, although it is not possible to assess with certainty how widespread this fear is among the population based on the individual responses.

The extent to which citizens are concerned seems to be inversely proportional to the extent to which they feel protected by the state: people who feel well protected by the state are less likely to say they are very concerned about the use of nuclear weapons or a nuclear accident as a result of the current crises and conflicts. This applies to both groups – whether they feel well informed about radiation by the state or not. Similarly, a lower proportion of people who feel well protected by the state are concerned that a nuclear accident could be triggered by conflicts and wars. Conversely, a higher proportion trust that the state would take immediate action in the event of a nuclear accident.

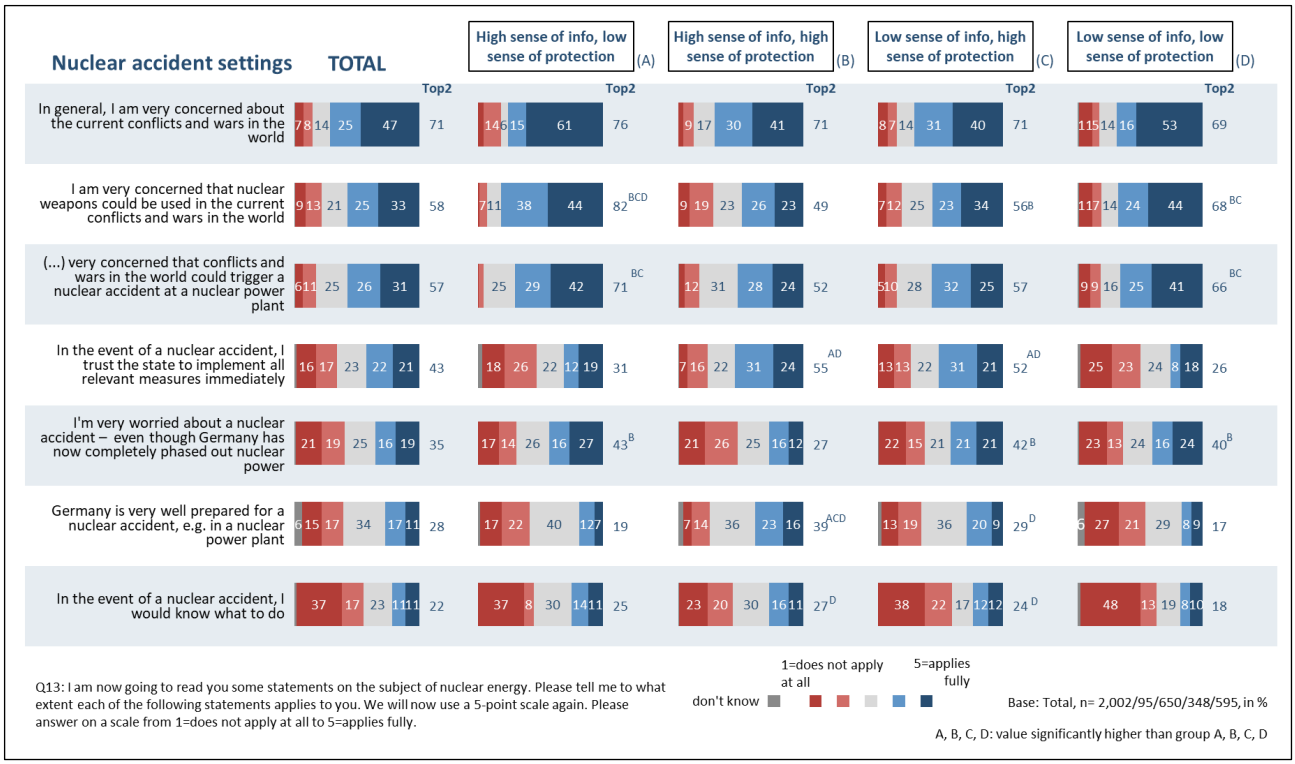

Figure 22 Attitudes towards a possible nuclear accident in total and dependent on personal sense of protection and information by the state with regard to radiation

4.3.1.2 Scenario: behaviour in the event of a hypothetical nuclear accident

In a hypothetical scenario, respondents were asked to imagine how likely they would be to follow government instructions in the event of an accident involving radioactive material. In the first stage, they were instructed as follows: "Please imagine that you receive a warning from civil protection authorities that there has been an accident involving radioactive material and that you should not leave the house". In stages two and three, information about the behaviour of the social environment was added – in stage two: "Now

you see that several neighbours are packing their cars and leaving.", in stage three: "Your closest family/friends call you and ask you to pick them up and leave together." In all stages, respondents were asked to rate how likely they were to follow the instructions of the civil protection authorities and stay at home (scale from 1 – under no circumstances to 5 – definitely, results top 2, i.e. proportion of 4 and 5 on the scale).

The willingness to follow government instructions decreases with increasing social pressure: without further information, 87% of the population state that they would follow government instructions. When respondents imagine watching their neighbours pack their belongings into the car and leave, their willingness to stay drops to 74%. And when respondents imagine family and friends calling and asking them to leave together, their willingness to follow the rules drops to 49%.

In the first 2 stages of the scenario, the willingness to follow the instructions is higher among women than among men (women: 91% | men: 83% in stage 1, women: 77% | men: 71% in stage 2). In contrast, in stage 3 when respondents imagine that family or friends are calling and asking them to leave the area together, i.e. when social pressure is particularly high, the willingness to continue to follow the instructions drops to 49% for both genders equally.

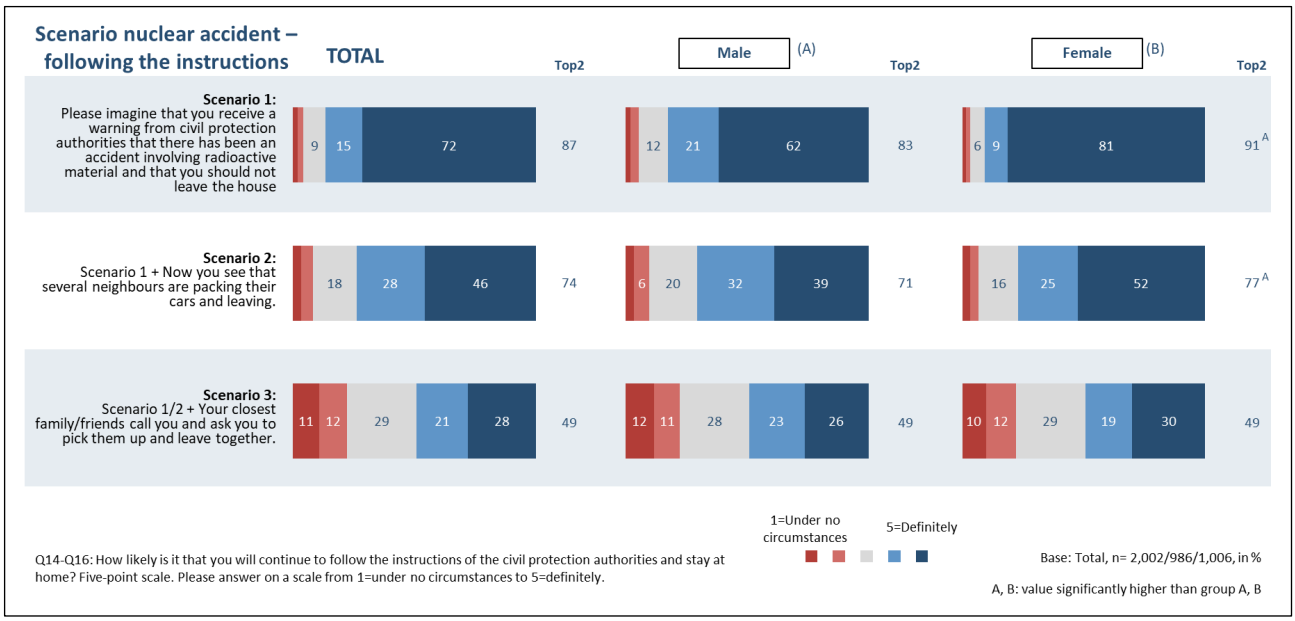

Figure 23 Willingness to follow government instructions under certain conditions in the event of a nuclear accident in total and by gender

With regard to other subgroups, it can be seen that people with the lowest level of formal education (i.e. primary or lower secondary school as highest level of general education) would comply less with government instructions in scenario 2 (neighbours pack the car and drive away) than the population average (scenario 2, people with the lowest level of formal education: 67% | total: 74%). In stage 3 with the highest social pressure, there are no subgroup differences – everyone would comply with government instructions or follow the family's call to the same extent.

It can also be seen that people who feel (very) well informed or protected by the state are also more likely to follow state instructions in all three scenario stages than people who feel (very) poorly protected by the state. In stage 3 with the highest social pressure, 57% of those who feel (very) well informed and 55% of those who feel (very) well protected would still follow the state's instructions and not leave the house, compared to a population average of 49%.

People who have dealt a lot with the topic of radiation or have a very strong interest in health and consumer protection topics would also follow government instructions significantly more often than the population average in stage 3 with the highest social pressure (people who have dealt a lot with the topic of radiation: 63% | total: 49%; people with a very strong interest in health and consumer protection topics: 59% | total: 49%).

The scenario survey showed that although there is a high level of willingness to follow government instructions in the event of a nuclear accident, it decreases the greater the perceived social pressure from friends and acquaintances. It would be advisable to provide information on the topic of a hypothetical nuclear accident, present the measures for the region in question and emphasise the importance of following government instructions in such cases, including the reasons for doing so. This could increase the willingness to follow the necessary instructions in such a case, and, at the same time, it would also increase the personal sense of information. Overall, the state should strengthen the population's sense of information and trust in the state – consequently, in an emergency situation, the willingness to comply with state instructions can be significantly higher than if the sense of information and protection is rather low.

4.3.1.3 Nuclear accident: contact points

The qualitative survey showed that **information behaviour** on the topic of radioactivity is predominantly passive and that the consumption of various media plays a key role (see chapters 3.3.5 and 3.3.10). The topic of radioactivity is currently very present due to the war in Ukraine and the associated nuclear threat. In the qualitative survey, it became clear that this causes such great concern in some cases that people are also actively seeking information on radiological emergencies and behaviour during such disasters and that the need for information on radiological emergencies has increased accordingly in recent times. Places where respondents would like to find relevant information materials would be doctors' practices (as well as pharmacies), citizens' offices or – if accompanied by sufficient information to avoid uncertainty – by post to all households.

The quantitative survey then discussed possible contact points that people would turn to in the event of a nuclear accident. In response to the open question of where respondents would obtain information on topics such as protective measures, radiation exposure or recommended behaviour in the event of a nuclear accident, most people (60%) stated that they would obtain information on the internet. The younger people are, the more likely they are to cite the internet as a source of information – while 80% of 16-29-year-olds state that they would obtain information there, this figure is only 35% for people aged 65 and over. Nevertheless, the internet is still the most frequently cited source of information in this group as well. Overall, the traditional media of radio (15%) and television (13%) were cited as the second and third most frequent sources of information, followed by the authorities in general and the Federal Office for Radiation Protection (9% each).

People who have already dealt with the topic of radiation a lot are also more likely to contact the Federal Office for Radiation Protection (16% | total: 9%), the Federal Ministry for the Environment (8% | total: 3%) or the German Environment Agency (5% | total: 2%). They are also more likely to use an emergency notification app (9% | total: 4%) or to go to the website of the municipality / community / state authority (10% | total: 5%) than the population average.

People who feel (very) well informed by state institutions on the topic consult the BfS more frequently (11%) than people who feel (very) poorly informed by state institutions (7%). The former also use television and the associated online media centres more frequently (16% | 11%). In contrast, people who feel (very) poorly informed by state institutions are significantly more likely to obtain general information on the internet than people who feel (very) well informed (63% | 56%).

In a wave comparison, many sources are mentioned less frequently than in 2022, although the order of frequency of mentions is similar. At the same time, fewer people state that they do not know where they would obtain information (2024: 7% | 2022: 10%). Accordingly, target group-specific information materials that are easy to find online and therefore easily accessible would be very important to reach the population in the event of a nuclear accident.

4.3.2 Medical examinations

One focus of this study was the topic of 'medical examinations and treatments using ionising radiation', which was examined in more detail in both the qualitative and the quantitative part of the study. In the qualitative part, it became clear that the general perception of ionising radiation in medicine is mostly positive to neutral, but at the same time respondents are also aware of the associated health risks. Further, the results of the qualitative survey show that the population's actual knowledge of ionising radiation in medicine is very fragmentary and unspecific.

The results of the quantitative survey underpin this fragmentary and unspecific knowledge: the participants in the survey were first asked which radiation source represents the largest single source of ionising radiation exposure for the population on average. These are medical examinations, which account for an average of 1.7 millisieverts of radiation exposure per year[4] . In fact, only 36% of respondents gave the correct answer (medical examinations), which is only just ahead of the second most frequently chosen answer, nuclear power stations, at 34%. Radon in houses (13%) and natural radioactivity in food (12%) were mentioned less frequently, and 6% stated that they did not know the answer. This means that the responses are at a very similar level to 2022 (2022: medical examinations: 34%, nuclear power plants: 35%, radon in homes: 13%, radioactivity in food: 14%, don't know: 3%). The proportion of those who consider natural radioactivity in food to be the greatest source of radiation exposure has fallen slightly. The other answers have remained relatively constant.

[4] ODL-Info - Strahlenbelastung im Alltag - Strahlenbelastung im Alltag (bfs.de); 30.09.2024.

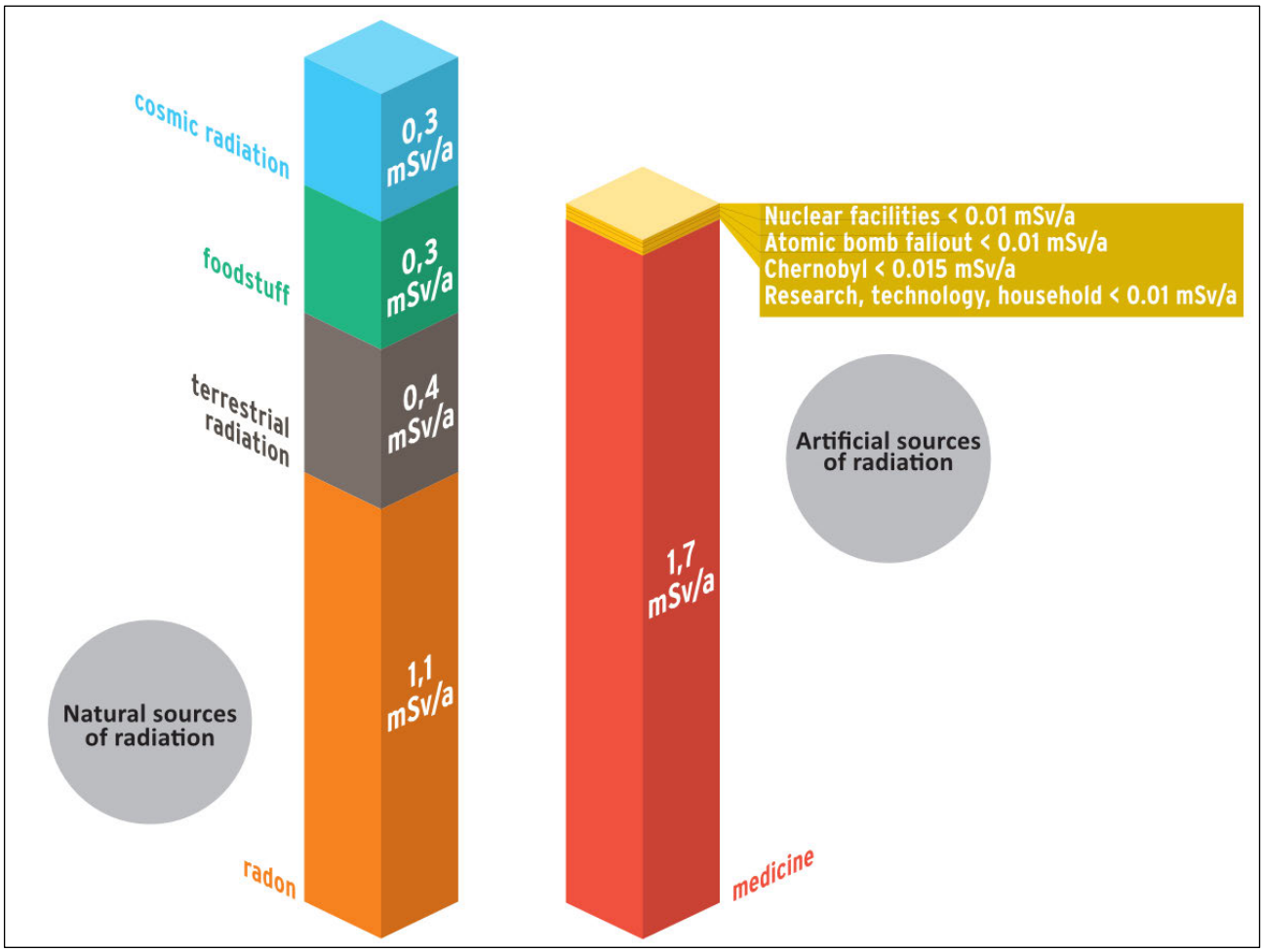

Figure 24 Average annual exposure to ionising radiation per person in Germany. Source: strahlenquellen-en.jpg (1199×900) (bfs.de)

The proportion of those who correctly cite medical examinations as the source of greatest exposure to ionising radiation is higher in the group of 30-39-year-olds (54%) than in any other age group and lower in the 65+ age group (23%) than in any other group. In this group, 43% of respondents wrongly consider nuclear power plants to be the greatest source of radiation exposure, i.e. a higher proportion than in the younger age groups. The number of correct answers also increases with the level of education: 45% of respondents with the highest level of formal education gave the correct answer, compared to only 25% of those with the lowest level of formal education (population average: 36%). And even 49% of people who have dealt a lot with the topic of radiation gave the correct answer. There are no significant differences with regard to the perceived sense of information or protection by the state when it comes to radiation. However, people who feel (very) well informed by the state tend to be more likely to give the correct answer (38%) than those who feel (very) poorly informed by the state (34%); the situation is similar for the personal sense of protection. If we look at the results for people who are (rather) concerned or (rather) unconcerned about radiation, we see that those who are concerned most frequently cite the answer option "nuclear power plants" as the source of the greatest radiation exposure (41%) (population average: 34%; unconcerned: 26%). Those who are rather unconcerned most frequently cite the correct answer option "medical examinations" with 43% (population average: 36%; concerned: 29%).

Women are less likely to name medical examinations as the source of greatest radiation exposure (women: 31% | men: 41%), but more likely to name natural radioactivity in food (women: 13% | men: 10%) and

nuclear power plants (women: 37% | men: 31%). Women also state more frequently that they do not know the answer (women: 7% | men: 5%).

All those who gave an answer to the question about the source of the greatest radiation exposure were then asked to rate how certain they were about their answer on a scale from 1 (not at all certain) to 5 (very certain). This showed that people who had given the right answer "medical examinations" weren't any more certain (top2: 41%) than people who had chosen nuclear power plants (also top2: 41%). In the case of radon in houses and natural radioactivity in food, respondents are slightly less certain about these answers (top2 in both cases: 36%). Otherwise, certainty about the answer increases proportionally with age – although the correct answer is more likely to be given by young and especially middle-aged people. With regard to gender, it can be seen that women state to a lesser extent that they are certain about their answer than men (women: 34% | men: 46%). However, this difference in the certainty about their answers does not necessarily appear to be due to the actual knowledge of male respondents, as it is found for the correct answer medical radiation (women: 35% | men: 46%) as well as for the incorrect assumptions nuclear power plants (women 34% | men 51%) and radon in houses (women: 27% | men: 44%).

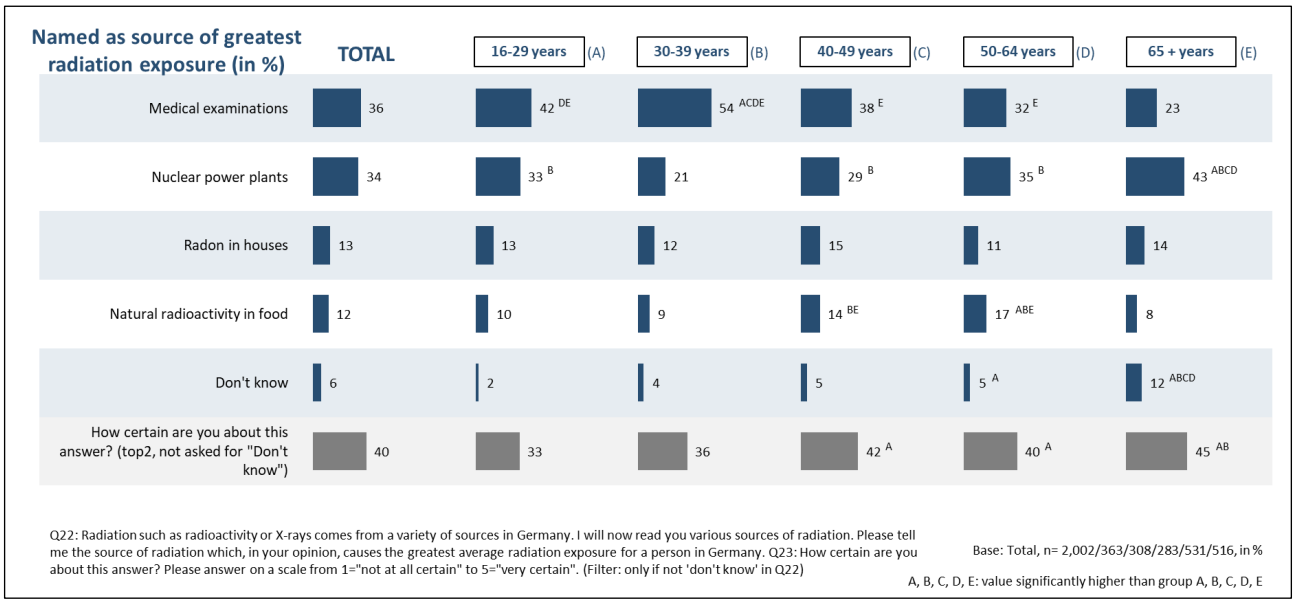

Figure 25 Knowledge question about radiation source with the highest average exposure to ionising radiation in total and by age group

With regard to the various imaging procedures (CT, radiotherapy, radioiodine therapy), the level of knowledge was determined in the qualitative survey. Knowledge of CT turned out to most pronounced, followed by radiotherapy, while very few respondents had specific knowledge of radioiodine therapy. The level of knowledge here was found to be strongly dependent on whether respondents were affected (personally / friends / family).

In the quantitative survey, it was of interest to what extent respondents were able to differentiate between the various imaging procedures (ultrasound, MRI, X-ray and CT; in terms of both 'type' of radiation and radiation exposure). It was correctly categorised by a high proportion of respondents: in a second knowledge question, respondents were asked to state whether they think that different imaging procedures, namely ultrasound, MRI, X-ray and CT differ, both in terms of the type of radiation and radiation exposure. The possible answers were "yes, they are different", "no, they are the same" and "I don't know". 80% of the

population correctly stated that the three procedures mentioned differ both in terms of the type of radiation and the radiation exposure. With regard to the age groups, it can be seen that people aged 30-39 know more often than all other groups that both the type of radiation (89%) and the radiation exposure differ, while people aged 65 and older know the correct answer less often than any other age group (type of radiation: 66%, radiation exposure: 68%). There is no difference between men and women when it comes to the proportion of correct answers. People who have already dealt with the topic of radiation very much are more likely to answer the question correctly than the population average. People with the highest level of formal education are also more likely to give the correct answer than the population average.

To measure the extent to which people make informed decisions about their own health behaviour, they were asked to express their agreement with various statements on a scale from 1 (do not agree at all) to 5 (fully agree). 65% (top2) stated that they always follow the advice of their doctors when undergoing examinations of any kind, as they know best which examinations are necessary. This is a slightly higher proportion than in 2022 (62%). When asked specifically about X-ray examinations, the proportion was 74% (this item was not asked in 2022). In contrast, the proportion of citizens who state that they generally decide for themselves whether to have an examination involving radiation exposure is 61%, which is lower than in 2022 (65%). This apparent contradiction could be explained by the fact that, although respondents generally trust the advice of their doctor and also believe that they have the expertise to best assess the necessity of an examination, the final decision as to whether it should be carried out still lies with the respondents. Younger people are slightly more likely to follow the doctor's recommendation for an X-ray examination than older people (16-39 years: 78% | population average: 74%). There are no differences here with regard to gender or level of education. People who are rather unconcerned follow their doctor's recommendation slightly more often (76%) than those who are rather concerned with regard to radiation (72%), as do people who feel (very) well informed by the state on the subject of radiation (76%) or feel protected (77%) compared to people who feel (very) poorly informed (72%) or protected (68%) by the state.

4.3.3 UV radiation

As already mentioned in chapter 4.2.2, 36% of the population spontaneously mentioned sun / UV as an association with the topic of radiation and 39% said that it is potentially hazardous to health, i.e. at least some of the population is spontaneously aware that UV radiation is potentially hazardous to health. One section of the survey was dedicated to UV radiation in general. The participants were asked whether they take **specific measures against UV radiation** and answered on a 4-point scale whether they "always, sometimes, rarely or never" take the respective measure. The vast majority stated that they take protective measures against UV radiation at least sometimes. The proportion of those who avoid spending long periods in the sun for protection is highest (46% "always", 36% "sometimes"). In addition, the majority say that they at least sometimes use sun cream or sun spray (39% "always", 34% "sometimes"), wear sunglasses with UV protection (40% "always", 26% "sometimes") or wear headgear (26% "always", 33% "sometimes"). Just under half of the population state that they sometimes or always wear long clothing to protect themselves from the sun (14% "always", 33% "sometimes").

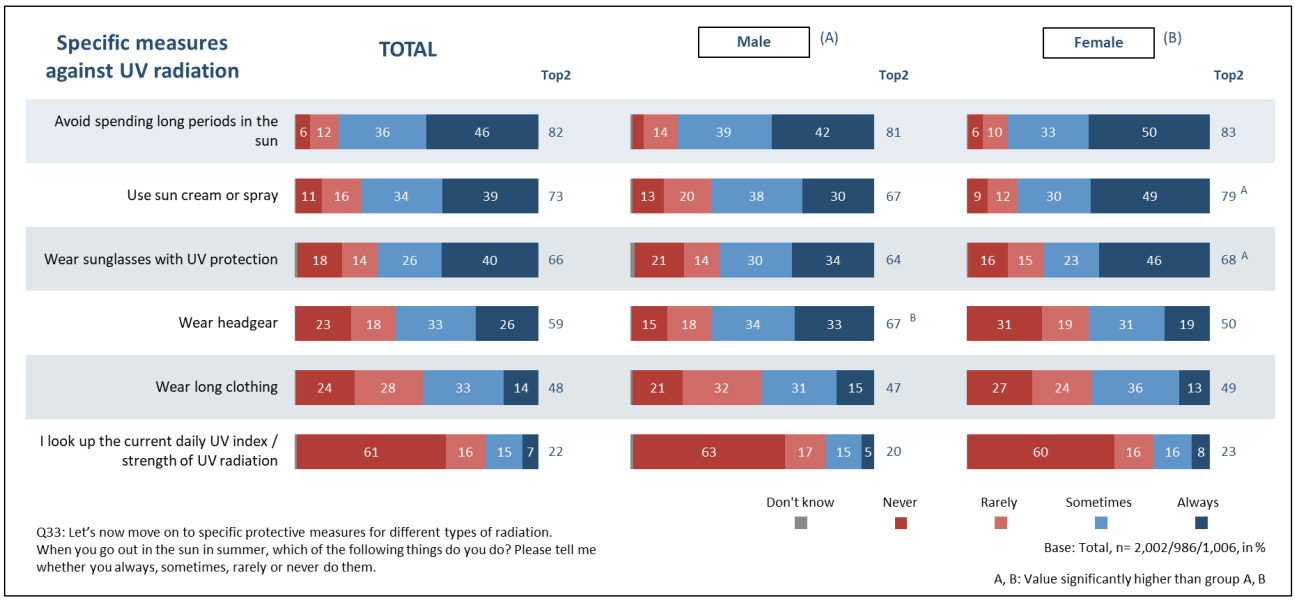

Figure 26 Frequency of taking certain protective measures against UV radiation in total and by gender

In line with the impression in the focus groups that **UV protection** is **especially an issue for women**, women state more frequently that they sometimes or always use sun cream or sun spray (women: 79% | men: 67%) or wear appropriate sunglasses (women: 68% | men: 64%). Men, however, stated more frequently that they wear headgear (women: 50% | men: 67%). As women are more aware of the dangers of UV radiation in other areas, this difference initially seems surprising. It is possible that the gender difference here is due to gender-specific differences in hair growth, with men wearing headgear more often to protect their scalp, which is at least partially bald or only covered by very short hair, while women more often have fuller and longer hair, which means that the scalp is less exposed to the sun.

A comparison of the two waves reveals that respondents in 2024 stated more frequently than two years before that they avoid spending long periods in the sun (2024: 82% | 2022: 76%), but less frequently that they use sun cream (2024: 73% | 2022: 77%). The other measures (wearing sunglasses with UV protection, wearing long clothing) were mentioned equally often in both survey waves as *sometimes* or *always* used ("wearing headgear" was added in 2024, therefore no comparison).

People who describe themselves as (rather) not interested in consumer and health protection topics are less likely to take all the protective measures against UV radiation surveyed: 76% | total: 82% for "Avoid spending long periods in the sun", 63% | total: 73% for using sun cream or spray, 59% | total: 66% for wearing sunglasses with UV protection, 50% | total: 59% for wearing headgear, 38% | total: 48% for wearing long clothing and 12% | total: 22% for looking up information about the UV index. Conversely, people who feel (very) well informed by the government on radiation protection take a range of protective measures more frequently than those who feel (very) poorly informed (sunglasses: (very) well informed: 71% | (very) poorly informed: 64%, headgear: (very) well informed: 61% | (very) poorly informed: 57%, long clothing: (very) well informed: 53% | (very) poorly informed: 44%, information on UV index: (very) well informed: 26% | (very) poorly informed: 18%). In contrast, there is no difference between people who feel (very) well protected and those who feel (very) poorly protected. This means that the feeling of being well informed actually correlates with adequate protective behaviour in terms of UV protection, whereas the feeling of being well protected by state institutions for radiation protection leads neither to improved protection – for example, because people follow the recommendations more closely due to their trust – nor to poorer protection – for example, because people do not protect themselves but rely on being protected.

In the qualitative phase, a number of people already stated that sun protection was an obstacle to vitamin D production and that they therefore did not use it (see section 3.3.4). This result was also evident in the quantitative survey, where 23% agreed with the statement (top 2 on a scale of 1 "do not agree at all" to 5 "fully agree") that they occasionally do not use sun protection in favour of vitamin D provision. Here, the proportion of agreement increases with age and is therefore highest among people aged 65 and over (31%) and lowest in the group of 16-29-year-olds. Overall, 27% also agree with the statement that a certain amount of sun or solarium tanning is healthy.

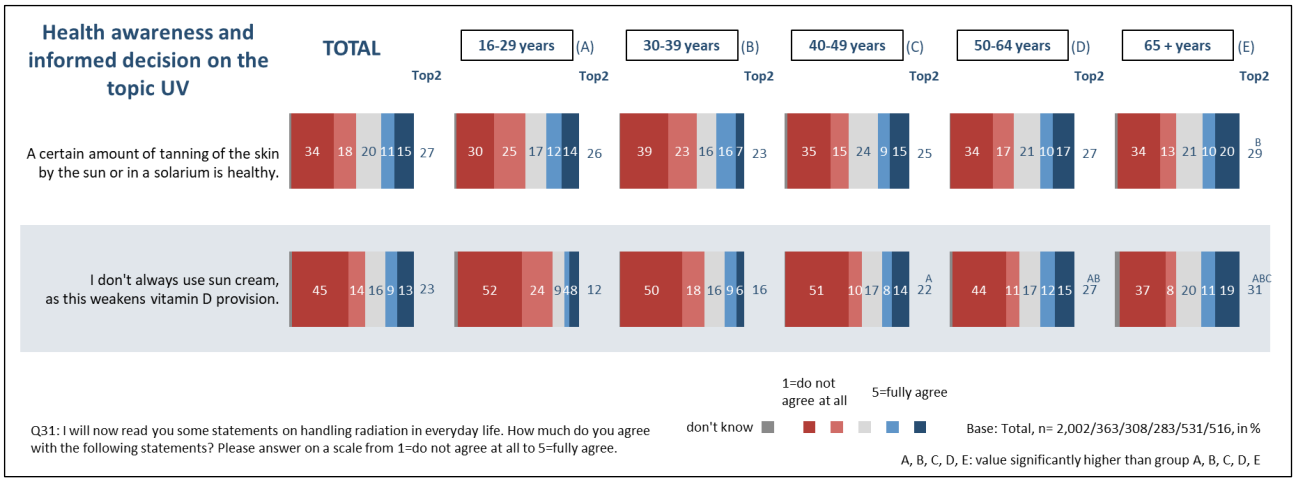

Figure 27 Agreement on questions of health awareness and informed decision-making in relation to UV protection in total and by age group

With regard to the statement that a certain amount of tanning is healthy, the distribution across the age groups is similar, with the only difference being that people aged 65 and over agree with this statement more often than people aged 30-39 (65+ years: 29% | 30-39 years: 23%). In contrast, the proportion of people who state that they do not apply sun cream in order not to weaken their vitamin D provision is lowest in the younger age groups (16-29 years: 12% and 30-39 years: 16% | total: 23%). This is consistent with the results of the qualitative phase that younger people (mainly women in the qualitative phase) are more inclined to see a fundamentally high need for UV protection regardless of other factors than older people (see also section 3.3.4).

Although men and women differ in various aspects of their protective behaviour, there is no gender-specific difference for these two aspects (avoiding sun protection in favour of vitamin D provision and tanning of the skin is healthy). Among people with a low level of formal education, views that are to be regarded as critical in terms of UV protection are particularly widespread: for example, 32% of people with a primary or lower secondary school leaving certificate agree with the statement that they do not always use sun cream in order not to weaken their vitamin D provision (top2 | total: 23%), while 31% agree with the statement that a certain amount of tanning is healthy (top2 | total: 27%).

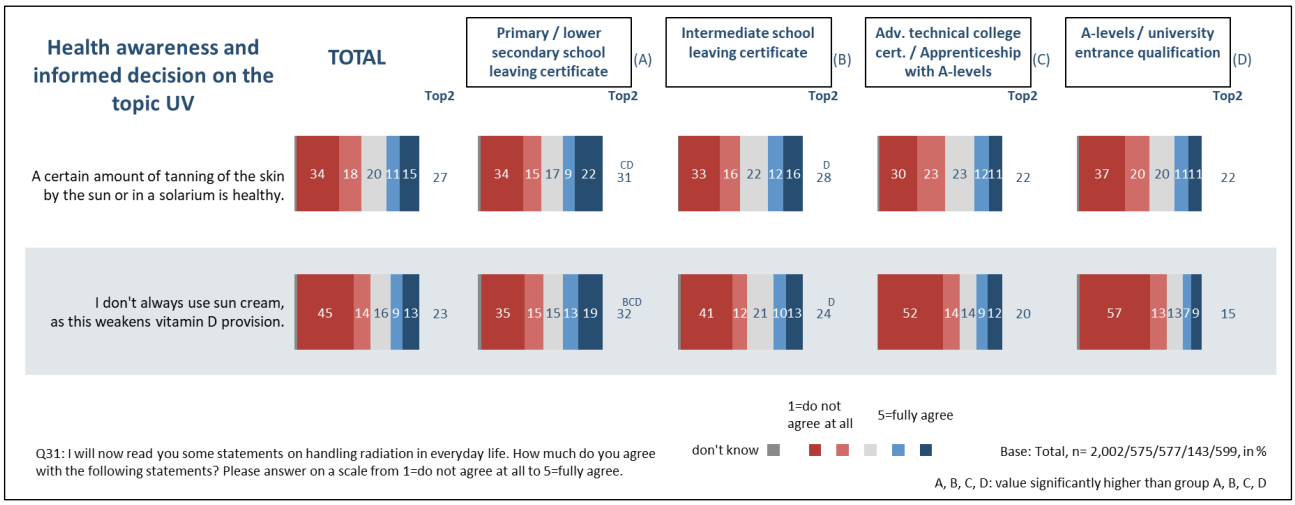

Figure 28 Agreement on questions of health awareness and informed decision-making in relation to UV protection in total and by formal education level

In addition to attitudes, the survey was intended to find out how well-known the **UV index** is among the population and what role it plays in personal UV protection. Around a quarter of respondents stated that they did not know what the UV index is or what it means (26%). Another quarter said they had heard of it but did not know exactly what the UV index is (27%), i.e. just under half of the population are familiar with the UV index and know roughly what it means. The proportion of those who do not know it at all is highest in the oldest age group of 65+, followed by the youngest group aged 16-29 (16-29 years: 30%, 30-39 years: 18%, 40-49 years: 21%, 50-64 years: 20%, 65+ years: 37%). Among people with the lowest level of education (primary or lower secondary school leaving certificate), the proportion of those not familiar with the UV Index is significantly higher (38%) than overall (26%).

When asked how often they are looking up information about the daily UV Index, only just under a quarter of respondents state that they sometimes or always look up the UV Index (22%), a further 16% rarely look it up and 61% say that they never do so. This reflects the findings from the qualitative survey that, the majority of the population is not yet aware of the UV index and even people who are aware of it do not necessarily use it but tend to rely on their instincts.

In addition to these findings, which should be viewed critically from a radiation protection perspective, there are also **indications of misconceptions** about UV protection in the results of the quantitative survey, similar to the qualitative phase: for example, of the 9% of respondents who openly mentioned "other" measures in addition to the possible protective measures surveyed, 15% mentioned measures that are generally associated with health protection in hot weather but are ineffective against UV radiation, in particular staying hydrated. Even if this is a small group of people, it is a further indication that when it comes to UV protection, people sometimes rely less on facts in the form of the UV index than on a feeling for "measures to be taken on hot days" – which could lead to inadequate protection on cooler days, for example. The aim of communication would therefore be to continue to provide information about the UV index and its significance so that people base their UV protection more on facts and less on their gut feeling.

People who at least "rarely" obtain information about the UV index were then asked what their sources are. Weather apps (62%) are the most frequently cited source for the UV index, followed by websites or other sources on the internet (36%). This is followed by the "traditional media", television (18%), radio (13%) and newspapers (12%). There are clear differences between the age groups: in the youngest age group, almost all respondents use weather apps (91%) for information about the UV index, websites are used by 37% of this group, while all other sources are consulted by less than 10% of 16-29-year-olds. In contrast, only 37% of the

oldest group aged 65 and over use weather apps for information about the UV index, 31% use websites or other internet sources, but a similar number of people in this age group use other sources, for example 33% use television and 26% newspapers for information about the UV index – and thus a higher proportion of this age group than any other age group.

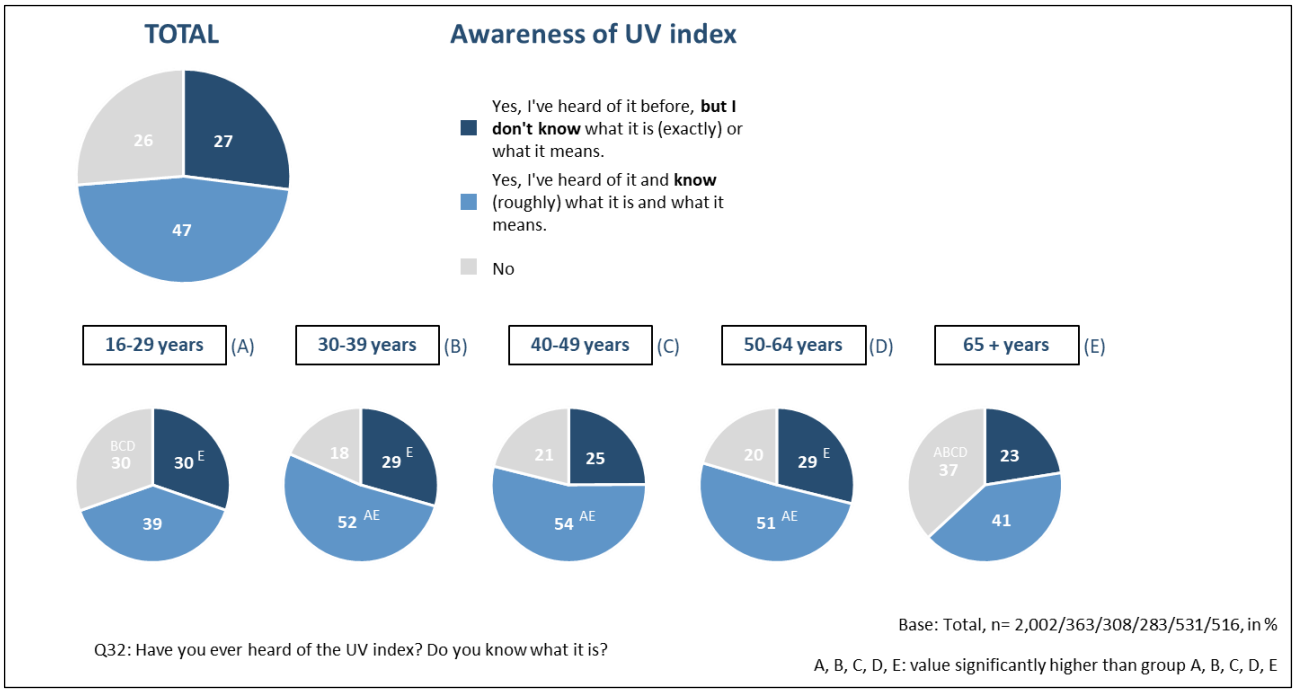

Figure 29 Awareness of UV index in total and by age group

The youngest and oldest age groups in particular (16-29-year-olds and 65+-year-olds) could benefit more from the UV index or integrate it more into their own UV protection behaviour if they were aware of it: the proportion of those who do not know it at all is highest in these two groups. Consequently, measures to raise awareness of the UV index would be particularly worthwhile in these two age groups.

4.4 Concerns, wish for information and protective measures taken in the context of radiation

4.4.1 Modern health concerns

In one question, respondents were asked to indicate to which extent they are concerned about health-related issues. In addition to concerns about numerous radiation topics, they were also asked about other areas, such as pesticides in food, the effects of vaccinations or air pollution caused by car traffic. The respondents rated these topics on a five-point scale from 1= "not concerned at all" to 5= "very concerned". The results show that respondents are most concerned about the topics that they cannot influence at all or only to a very limited extent: the two topics that they are most worried about both have to do with ionising radiation, namely radioactive exposure through nuclear power plants following an accident/incident (76% top2 box) and nuclear weapons (67%). This does not only match the statements made in the qualitative phase on the dangers of radioactivity (section 3.3.5), but also the quantitative results regarding associations with harmful radiation (Section 4.2.2.2) and attitudes towards a nuclear accident (Section 4.3.1.1): radioactivity and the dangers of ionising radiation continue to be very well-known and present topics for large parts of the population.

Compared to other possible risks from sources of ionising radiation, relatively few respondents (16%) are concerned about **radon**. At the same time, the proportion of "don't know" responses (9%) is by far the highest among health concerns, suggesting that the topic of radon is unknown to many. This is in line with the results from the past (2022: 14% concerned and 11% "don't know") and the qualitative study, which also showed a low level of awareness of the risk posed by radon and a high level of ignorance about the topic. This is a worrying result insofar as radon occurs naturally in the environment and therefore potentially affects all citizens and radon is the second most frequent cause of lung cancer in Germany after smoking.[5] Therefore, further education about radon is very important so that citizens can develop an awareness and better assess and, if necessary, minimise their personal risk.

This is followed by four non-radiation-related issues – multi-resistant bacteria in hospitals (59%) as well as three food topics (pesticides: 49%, nanoparticles: 55% and genetically modified food: 43%). **UV radiation** follows with 32% – here, the proven risks of skin ageing and an increased risk of skin cancer[6] are possibly offset by the relatively high scope of action to protect oneself from it, which is a possible reason why the level of concern is not higher. Compared to the sources of ionising radiation and UV radiation mentioned, significantly fewer people are concerned by **electromagnetic fields** – the most frequent cause for concern here are **mobile phone masts** (21%). Possible reasons for the relatively low values are that electromagnetic fields which surround us every day are generally not perceptible and that, according to the current state of scientific knowledge, there is no evidence of an actual risk to health[7]. Only a relatively small proportion of the population is concerned about radiation from **medical examinations** (X-ray and CT: 12%, MRI: 11%, ultrasound: 9%). Although ionising radiation, which is associated with risks, is used in X-rays and CT scans, respondents do not have contact with it on a daily basis, only at doctors' practices in a targeted manner and following strict requirements. Ultimately, everyone can protect themselves here too, as the decision usually lies with the person concerned: either they give their informed consent to the examination because they are convinced that the benefits outweigh the risks, or they refuse the examination in order to rule out exposure to radiation.

[5] BfS - Gesundheitliche Wirkungen von Radon - So wirkt Radon auf die Gesundheit 09.10.2024.

[6] BfS - Langfristige Wirkung optischer Strahlung 25.09.2024.

[7] BfS - Broschüre EMF 25.09.2024.

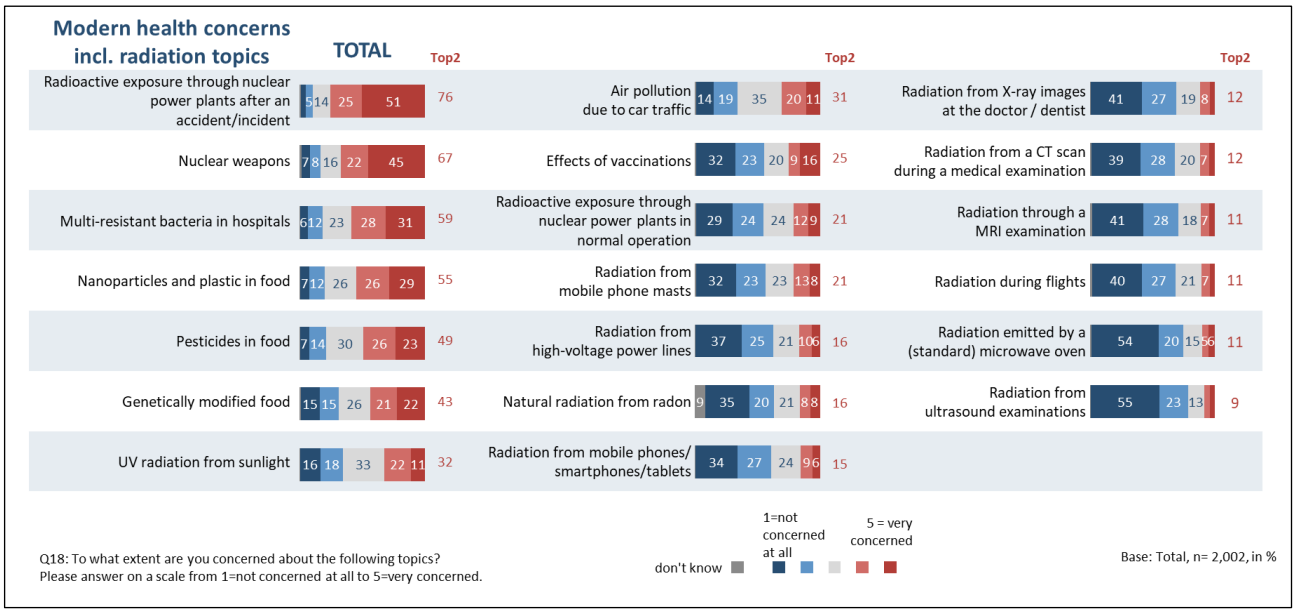

Figure 30 Health concerns in general and in relation to various radiation protection topics

Women are more concerned than men about almost all of the topics surveyed, whereas men are not more concerned than women about any of the topics. Particularly pronounced among the radiation topics, with a difference of over 10 percentage points, is the concern about radioactive exposure through nuclear power plants after an accident/incident (women: 81% | men 70%) and UV radiation (women: 39% | men: 25%)

The majority of aspects are rated similarly over time, but there are also changes compared to 2022. Concerns about pesticides in food (2024: 49% | 2022: 54%) and air pollution from car traffic (2024: 31% | 2022: 44%) have decreased. Concern about **radioactive exposure through nuclear power plants in normal operation** has fallen slightly (2024: 21% | 2022: 27%) – possibly due to the shutdown of the last nuclear power plants in Germany which has taken place in the meantime. However, it is worth noting that a fifth of citizens are still concerned about this, even though no nuclear power plants are in normal operation in Germany during the survey period. Possible reasons for this could be the operation and new construction of nuclear power plants in neighbouring countries such as France or Poland, which were also mentioned in the qualitative study and in open responses (see also section 3.3.5). Likewise, aspects mentioned in the qualitative phase in connection with the former normal operation could also be linked to the term, such as the fact that dismantling is not yet complete and the question of the final storage of nuclear waste remains unresolved[8].

Concern about radiation from **mobile phones** has also decreased slightly (2024: 15% | 2022: 19%). At the same time, the feeling of being well protected by the state from radiation emitted by **mobile phone masts** has increased (see also chapter 4.4.2.2). One reason for these results could be that the topic of mobile communications in general received increased media attention during the time of introduction of 5G in 2020, which has since then waned again due to the lack of novelty value and may therefore be less in the focus of media interest as well as in the focus of citizens' perceptions. The declining perception of danger could also be

[8] BASE - Atomausstieg (bund.de); 15.09.2024.

an ongoing process: after all, mobile phones have been widely used for several decades, but there is still no scientific proof of their general harmfulness[9].

Nevertheless, a part of the population is very concerned about exposure to radiation from mobile phones, and many are unsure about the topic, which also became evident in the qualitative study (see also section 3.3.6). With regard to their own mobile devices, similarly to the qualitative survey, the quantitative survey also shows that a good fifth of respondents at least partially take measures to reduce their personal exposure temporarily (see also section 4.4.2.1), for example by keeping their devices away from their beds at night. Further education can help individuals to reduce their exposure and to make a realistic assessment of the risk from mobile phone masts and their own mobile devices.

With regard to medical issues, concern about **radiation from x-rays** at the doctor's practice (2024: 12% | 2022: 17%) has decreased. Of the topics mentioned, only concern about the **effects of vaccinations** has increased (2024: 25% | 2022: 18%) – this could be a consequence of the public discussion about vaccinations or the (not medically defined) post-vac syndrome, i.e. possible late effects of a vaccination against COVID-19[10]. No time comparison is available for the perception of the risk from nuclear weapons and radiation due to CT, MRI and ultrasound examinations, as these topics were newly included in 2024.

4.4.2 Protective measures for different radiation issues

4.4.2.1 Personal protective measures

Finally, the question of which protective measures the respondents use against various radiation topics was also analysed in more detail. In the case of UV radiation, the measures were formulated as statements and the respondents then indicated on a frequency scale whether they "always", "sometimes", "rarely" or "never" use these measures. The aided enquiry combined with the frequency of taking the measures was not only used to establish comparability with the previous survey waves but also to obtain more detailed results on the UV index. For the other radiation protection topics, respondents were asked about possible protective measures in an open question, which was also done to ensure comparability with the previous waves. Besides, in these cases, it did not make sense to ask about the frequency of the measures, as it was done in the case UV radiation.

UV radiation is the radiation against which the majority of respondents take some kind of protective measures, such as using sun cream or spray ("sometimes" / "always": 73%) or avoiding to stay in the sun for long periods (82%) (on the topic of UV radiation, please refer to chapter 4.3.3).

In addition to UV radiation, citizens especially take protective measures in connection with **radiation from mobile phones/smartphones**. For example, 22% of respondents state that they have taken measures to protect themselves from radiation from mobile phones/smartphones. It was already clear in the qualitative survey that respondents were divided as to whether protective measures were actually necessary and, above all, that this depended on the extent to which they feel personally affected by mobile phone radiation (see chapter 3.3.6). In the quantitative survey, 68% of those who take protective measures against radiation from mobile phones / smartphones stated that they keep their smartphone away from their body or switch it off or

[9] The effect of exposure to radiofrequency fields on cancer risk in the general and working population: A systematic review of human observational studies - Part I: Most researched outcomes - ScienceDirect; 15.09.2024.

[10] Positionen des Paul-Ehrlich-Instituts - Stellungnahme des Paul-Ehrlich-Instituts zum Thema "Post-Vac-Syndrom" nach COVID-19-Impfung - Paul-Ehrlich-Institut (pei.de); 15.08.2024.

into flight mode when they do not need it. 16% of those who take protective measures use their smartphone less frequently or do not have a mobile phone at all, while 13% take care not to carry it close to their body (e.g. in their trouser pocket). Few use protective films or special covers or chips to protect themselves from radiation (6% of those who take protective measures) or use headphones or hands-free devices and loudspeakers when making calls (3% of those who take protective measures). This question was included for the first time in 2024, so no comparative figures are available for the previous wave. Similar protective measures were also discussed in the qualitative survey (see chapter 3.3.6).

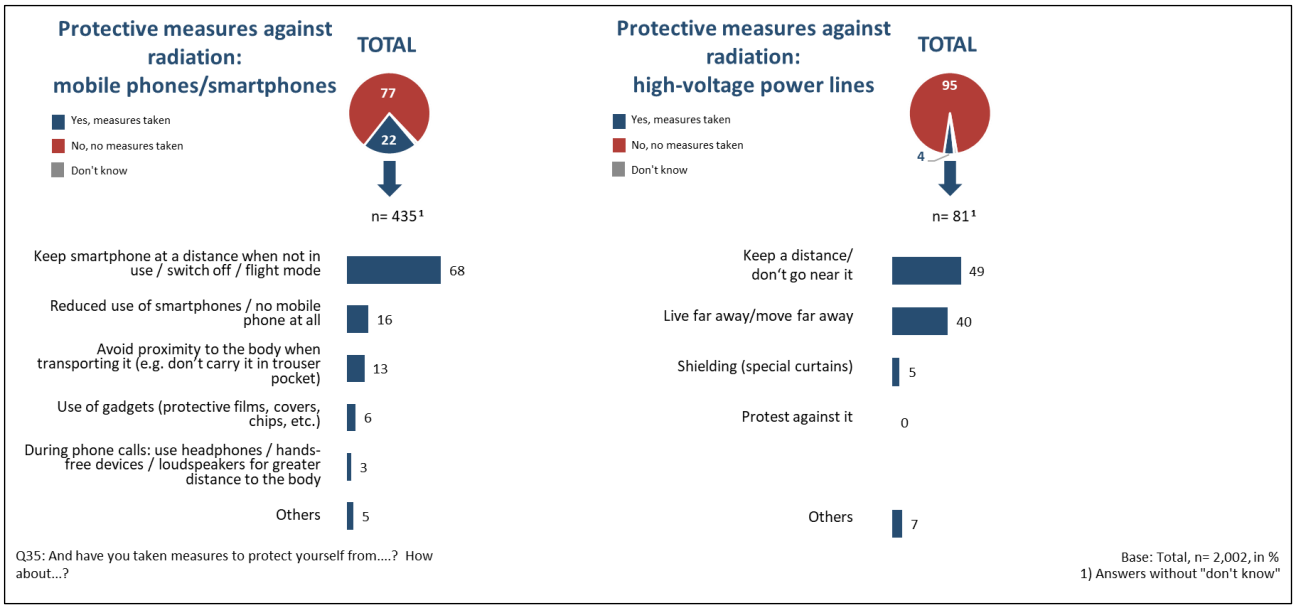

Figure 31 Protective measures against radiation from mobile phones / smartphones and high-voltage power lines in total

In addition to protection from radiation from mobile phones and smartphones, in the context of which protective measures are frequently taken, protective measures against radiation from mobile phone masts, high-voltage power lines and radon are the exception rather than the rule: only very few respondents state that they actively take measures to protect themselves from radiation.

4% of respondents state that they take **protective measures near high-voltage power lines** (2022: 5%), such as not going near them (49% of those who take protective measures | 2022: 57%) or living far away (40% of those who take protective measures | 2022: 44%). Special curtains for shielding are mentioned by 5% (2022: 3%).

In the case of **radiation from mobile phone masts**, 3% of respondents state that they take protective measures, such as living far away (32%), using special shielding (curtains, foil) (24%), not going near them (21%), reducing the use of mobile phones (13%) or protesting against mobile phone masts (2%). A wave comparison shows that living far away or keeping a distance remained at a similar level (32% | 36%; 21% | 22%). The use of special shielding (curtains, foils) has increased in the wave comparison (24% | 8%). Using mobile phones less often has fallen slightly from 19% of respondents who take protective measures near mobile phone masts to 13%.

3% of respondents also state that they take measures **to protect** themselves **from radon**, a figure that is stable compared to 2022 (2022: 4%). Specific examples mentioned here include regularly opening the windows (26%), not going anywhere near radon (22%) or living in a low-radon region (12%). Other measures include having measurements taken (9%), making structural changes such as renovating the cellar (7%), not

living on the ground floor (7%) or using radon-free building materials (3%). The percentages indicated above refer to the people who take measures to protect themselves from radon. Compared to 2022, the specific measures taken are largely stable. Only the value for "have measurements taken" has fallen compared to the previous wave (2024: 9% | 2022: 26%). In contrast, the measure "don't go near it", which was added to the survey in 2024, is taken by 22%.

Similar protective measures against radiation from high-voltage power lines and radon were also discussed in the qualitative survey (see chapter 3.3.8).

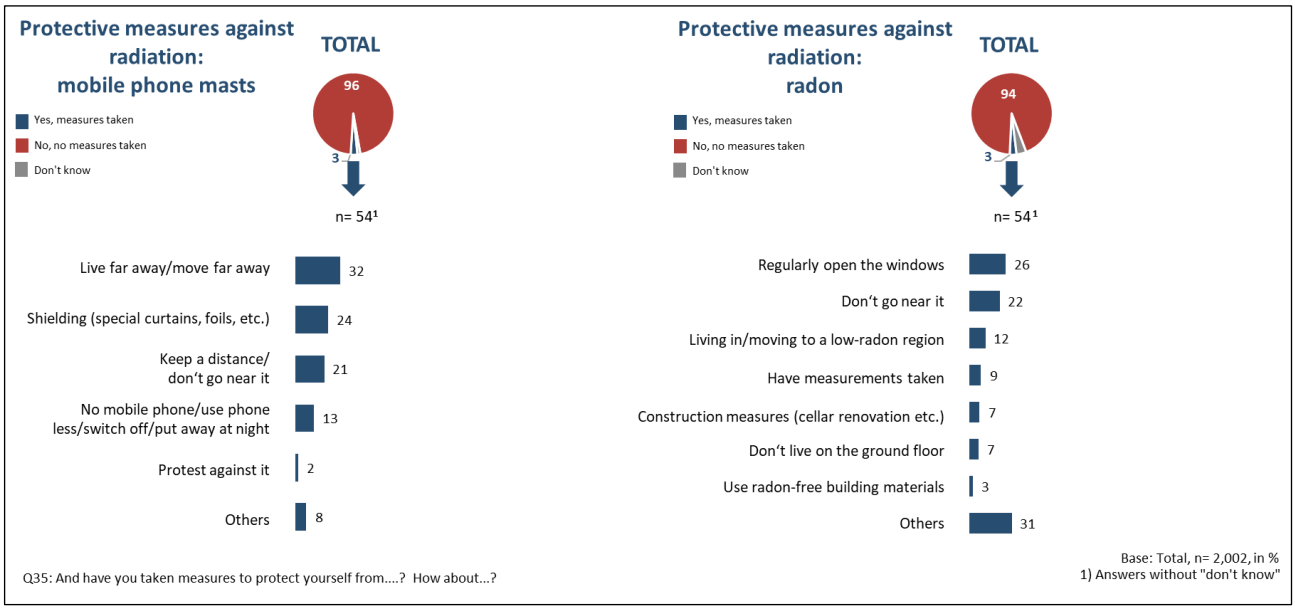

Figure 32 Protective measures against radiation from mobile phone masts and radon in total

4.4.2.2 Sense of protection by the state for various radiation topics

Finally, respondents were asked to indicate on a 4-point scale ("not well at all", "rather not well", "rather well", "very well") how well they feel protected by state institutions from radiation from various sources. The population feels best protected from radiation during medical examinations: 81% of respondents state that they feel "rather well" or "very well" protected by state institutions. This figure is also comparable to the previous wave in 2022 (82%). Respondents feel significantly less well protected from the other sources, namely UV radiation from prolonged exposure to the sun ("rather well" or "very well" protected: 59%), radiation from high-voltage power lines ("rather well" or "very well" protected: 59%), radiation from mobile phone masts ("rather well" or "very well" protected: 54%), radioactive substances in the event of an accident ("rather well" or "very well" protected: 51%) and radon ("rather well" or "very well" protected: 45%). While the feeling of protection with regard to radiation from medical examinations and UV radiation has remained relatively stable (medical examinations 2024: 81% | 2022: 82%; UV radiation 2024: 59% | 2022: 56%), the feeling of protection from the other sources of radiation, i.e. high-voltage power lines, mobile phone masts and radon, has risen slightly (high-voltage power lines 2024: 59% | 2022: 53%; mobile phone masts 2024: 54% | 2022: 48%; radon 2024: 45% | 2022: 41%). No comparative values are available for the item "Radioactive substances in the event of an accident", as it has only been included in 2024.

The age and gender splits show that younger people feel better protected from radiation from the various sources by state institutions than older people. The feeling of protection is lowest in the oldest age group

aged 65 and over, while it is on a similar level in the younger age groups (people aged 65+: protected by state institutions "rather well" or "very well" for medical applications 75% | total: 81%; for UV radiation 53% | total: 59%, for radiation from high-voltage power lines 49% | total: 59%, radiation from mobile phone masts 49% | total: 54%, radioactive substances in the event of an accident 42% | total: 51%, radon 37% | total: 45%).

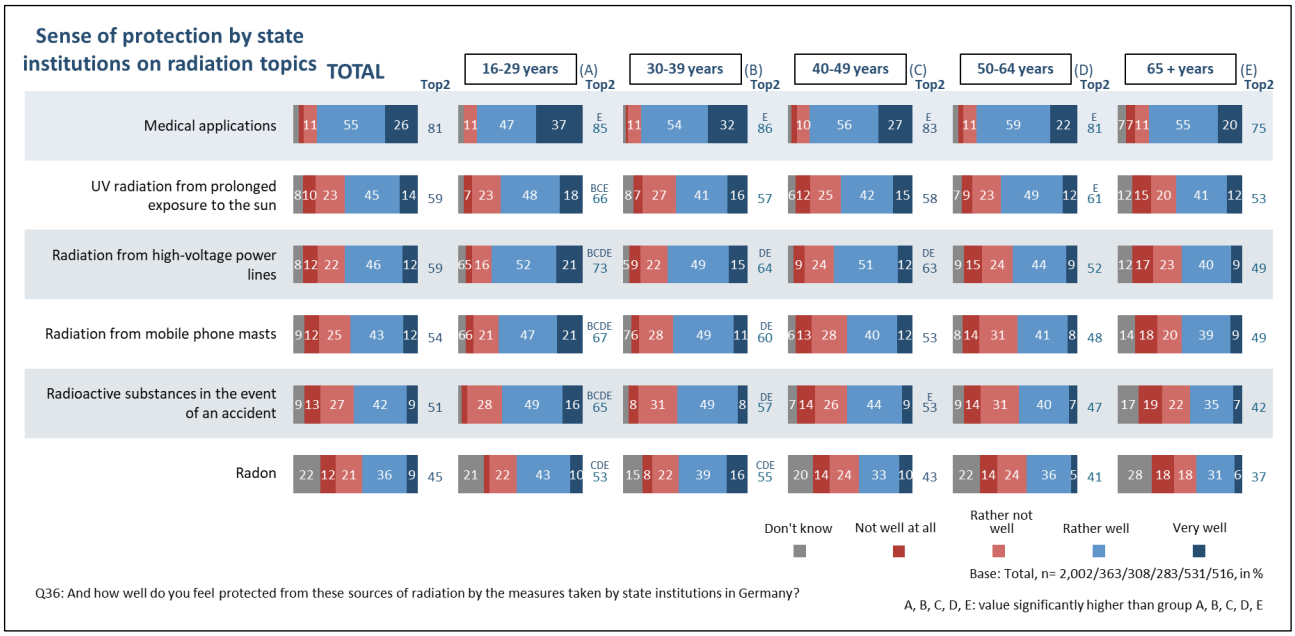

Figure 33 Sense of protection by state institutions on radiation topics in total and by age

Men feel better protected by state institutions than women (apart from medical radiation and UV radiation, where the sense of protection is on a similar level): men: protected by state institutions "rather well" or "very well" for medical applications 82% | women: 80%; UV radiation 60% | women: 58%, radiation from high-voltage power lines 65% | women: 53%, radiation from mobile phone masts 61% | women: 47%, radioactive substances in the event of an accident 57% | women: 46%, radon 50% | women: 39%.

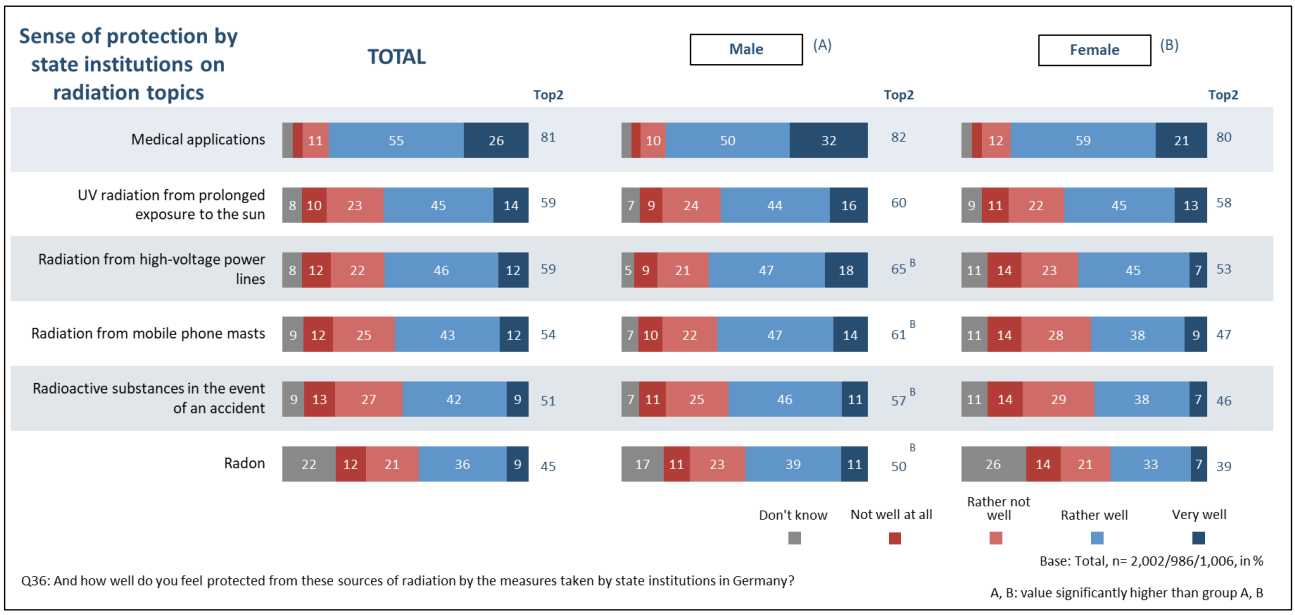

Figure 34 Sense of protection by state institutions on radiation topics in total and by gender

In addition, people with a higher level of formal education tend to feel better protected by state institutions from the radiation topics radon and radioactive substances in the event of an accident than the population average (radon: people with A-levels / university entrance qualification or similar 49% | total 45%; radioactive substances in the event of an accident: people with A-levels / university entrance qualification or similar 59% | total 51%). People who are rather unconcerned feel better protected by state institutions with regard to all radiation issues than those who are rather concerned. Furthermore, people who have never dealt with the topic of radiation feel significantly less protected by state institutions with regard to all radiation topics than people who have already dealt with the topic of radiation.

4.4.2.3 Proposals for improving the sense of protection by the state

Those respondents who expressed a rather low feeling of protection by state institutions with regard to a source of radiation were then asked about specific suggestions for improvement in an open question. Regardless of the specific source of radiation, citizens see potential for improvement in better education and the improved or increased provision of information. More education and information are the most frequently mentioned suggestions for improving protection for all the topics mentioned both in 2024 and in 2022. Depending on the topic, efforts should be made to prepare relevant information tailored to the target groups and their needs and make it available to a broad public via various channels.

When it comes to **radon** in particular, the desire for more education and information is mentioned almost exclusively (77% of respondents who feel less protected by state institutions on this topic and mentioned specific suggestions for improvement). Although this figure has fallen compared to 2022 (2022: 87% of respondents who feel less protected by state institutions on this topic and mentioned specific suggestions for improvement), it is still by far the most frequently mentioned suggestion. On very rare occasions (and also on a similar level to 2022), "more measurements / shielding" (7%), state requirements for the construction of houses (4%) or "subsidies for measurements / refurbishments" (2%) were also mentioned.

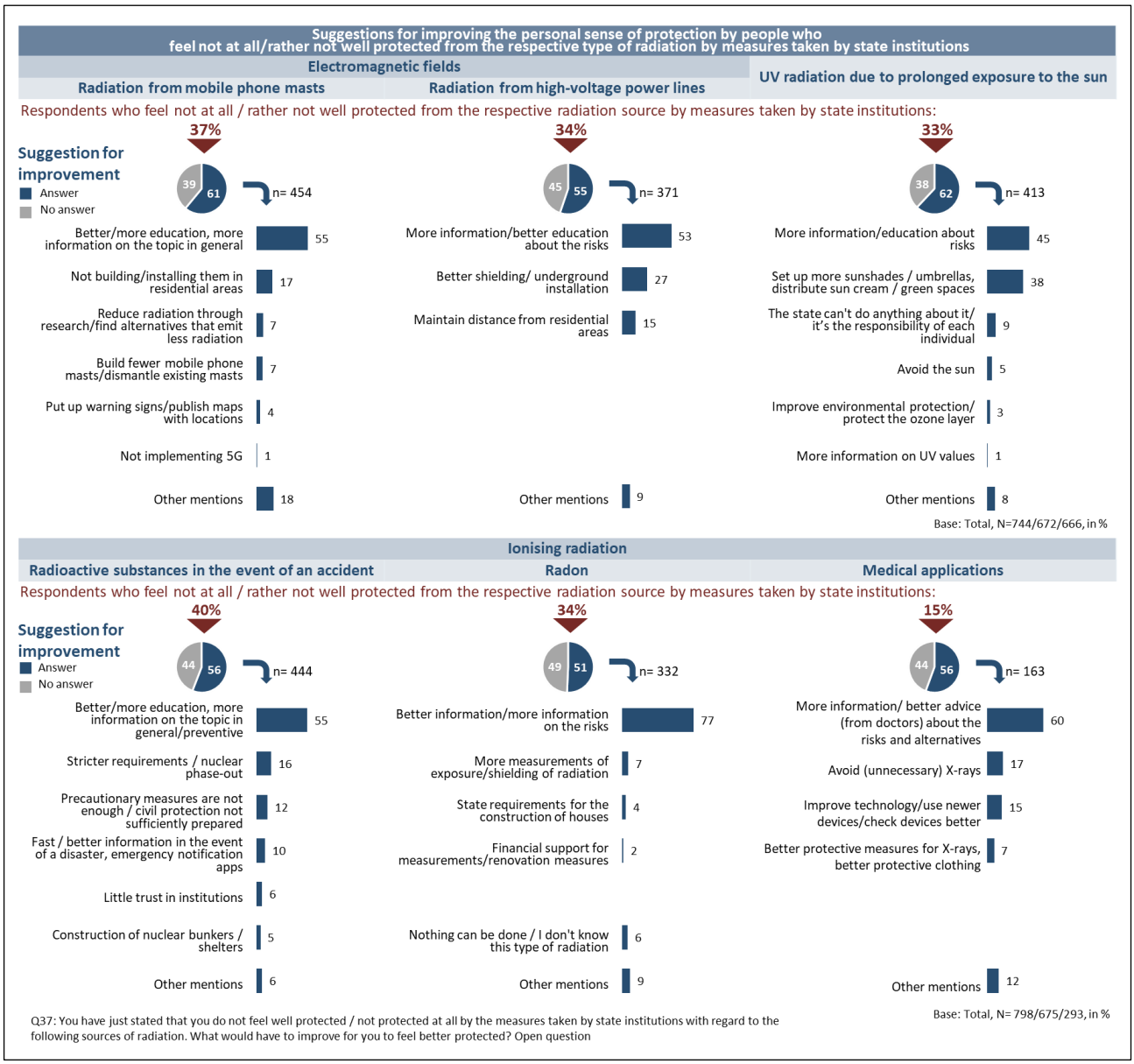

Figure 35 Suggestions for improving the personal sense of protection with regard to different radiation topics (basis: people who feel rather not or not at all well protected from this type of radiation)

The topic of radiation from **medical examinations** is on second rank when it comes to the frequency of mentions of more education and information: 60% of respondents who feel less protected by state institutions on this topic and mentioned specific suggestions for improvement stated that they would like more education and information. This figure is stable compared to 2022 (also 60%). By far less frequent suggestions, the percentages of which are also similar compared to 2022, include avoiding too many X-ray examinations (2024: 17% | 2022: 19%), using new devices and technology with lower radiation exposure (2024: 15% | 2022: 13%) or better protective measures and protective clothing for medical staff (2024: 7% | 2022: 10%).

The third most frequent mention of more education and information was for the new item "**Radioactive substances in the event of an accident**", which was added in 2024, with 55% of those who feel less protected by state institutions on this topic and mentioned specific suggestions for improvement. Further suggestions

for improvement mentioned by respondents in this area are stricter requirements and nuclear phase-out (16%), unspecific precautionary measures and civil protection (12%), fast information in the event of a disaster and the relevance of emergency notification apps (10%) or the construction of nuclear bunkers or shelters (5%).

Respondents also very frequently mentioned more education and information when it comes to **protection against radiation from mobile phone masts**: 55% of respondents who feel less protected by state institutions on this topic and had specific suggestions for improvement named more education and information. This figure was 61% in 2022. Another suggestion made by respondents with this regard was not to install mobile phone masts in residential areas (17%). Reducing radiation in general and finding alternatives is mentioned much less frequently (7%) – this figure has fallen compared to 2022, where it was at 18%. In 2022, 9% suggested installing fewer masts in general – in the current 2024 survey, this figure is at 7%. Putting up warning signs or offering maps with the locations of mobile phone masts was mentioned by 6% in 2022 and 4% in 2024 of those who feel less protected by state institutions and who made specific suggestions for improvement. Very few respondents also suggested not implementing 5G and thus reducing radiation exposure from mobile phone masts (1%) – this figure is identical to the 2022 survey.

When it comes to **radiation from high-voltage power lines**, only a few different suggestions for improvement that state institutions could implement are mentioned overall. By far the greatest desire is for more education and information (2024: 53% of respondents and 2022: 57% of respondents who feel less protected by state institutions and have mentioned specific suggestions for improvement). Better shielding and underground installation of cables are mentioned by 27% of respondents. In 2022, this figure was almost identical (28%). Keeping a distance from residential areas is also mentioned here as a suggestion for improvement (2024: 15% | 2022: 13%).

Compared to the other radiation topics, more education and information on **UV radiation** is mentioned much less frequently as a suggestion for improvement so that people feel better protected (2024: 45% | 2022: 48%), but still ranks first among the suggestions. This is followed by the suggestion to set up more sunshades or umbrellas (2024: 38% | 2022: 9%), to better protect the environment or the ozone layer (2024: 3% | 2022: 10%) or more information on UV values (2024: 1% | 2022: 4%). The open responses also show that a large proportion of respondents think that better protection against UV radiation is the responsibility of the people themselves and not the state (2024: 9% | 2022: 20%) or that people should simply avoid the sun (2024: 5% | 2022: 0%).

4.5 Conclusion

What do citizens associate with the topic of radiation? As in the survey of 2022, radioactivity / nuclear radiation / nuclear threat or nuclear weapons are the terms most frequently mentioned spontaneously (44%). Radiation from the sun / light (36%) and radiation in connection with mobile phones (34%) and medicine (33%) are also very common. The more frequent mentions of radioactivity on average are mainly attributable to men, while the four subject areas are mentioned with similar frequency by women. Citizens mention radiation in connection with Wi-Fi or electromagnetic fields from other sources much less frequently (21%). Around 6% express concerns when they hear the term radiation.

How well known are the state institutions in the field of radiation protection? Overall, the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) is the best known (84%). Among the institutions mainly dealing with radiation protection that respondents were asked about, the Federal Office for Radiation Protection (BfS) is the best known: 77% of citizens say they know the BfS. Compared to the 2021/22 survey, awareness of the Federal Office for Radiation Protection (BfS) and the

International Atomic Energy Agency have increased slightly (2024: BfS 77%, IAEA 72% | 2022: BfS 71%, IAEA 69%), while the BMUV and the Commission on Radiological Protection have remained on the same level.

To what extent do citizens feel informed and protected by state institutions when it comes to radiation? The personal feeling of being informed about radiation by state institutions has improved compared to 2022: in 2024, 40% of respondents felt "well" or "very well" informed by state radiation protection institutions. In the 2022 survey, this figure was only 30% (top2 box, 4-point scale). The personal feeling of protection by state institutions has remained on a similar level compared to 2022 (2024: 52% of respondents who feel "well" or "very well" protected | 2022: 50%; 4-point scale). Men feel better informed and protected than women. Younger people up to the age of 29 are more likely to feel well protected than older people, but at the same time less well informed. Although the feeling of being informed is higher on average in 2024, 12% of the population state that they personally feel less well informed than they did around 2 years ago, and the proportion who feel less well protected is around the same at 13%. In contrast, 9% feel better informed and 6% feel better protected. Reasons for a deterioration in the feeling of information and protection are usually a lower presence of a specific radiation topic in the media or the public discourse as a whole, or the fact that the topic is overshadowed by others. Conversely, an improvement is often justified either by an increased presence of the topic, e.g. a nuclear incident due to war. At 32%, Germany's nuclear phase-out is also cited relatively often by the people as a reason for an improved sense of protection.

Which concerns are associated with the topic of radiation? When asked about various health concerns, radioactive exposure after an accident is most frequently seen as a cause for concern – 76% of the population are very worried about this issue, followed in second place by concerns about nuclear weapons (67%; top2 box; 5-point scale). Among the radiation protection-related topics, concern about UV radiation comes in third place, with one third of the population being (very) concerned about this topic (32%, top2 box). Around one in five (21%) respondents is concerned about radiation from mobile phone masts, putting it on a par with nuclear power plants in normal operation. Concern about radiation issues such as high-voltage power lines, radon and mobile phones/smartphones is on a similar level (16% and 15% respectively, top2 box). At 12% or less, radiation sources used for medical purposes only worry a smaller proportion of the population – the same applies to radiation during flights and radiation from microwave ovens (11% each, top2 box).

To what extent do citizens protect themselves from radiation in everyday life? The radiation issues in the context of which protective measures are most frequently taken are UV radiation and electromagnetic fields from mobile phones. The most common protective measures against UV radiation are avoiding prolonged exposure to the sun ("always": 46% and "sometimes": 36%), using sun cream or spray ("always": 39% and "sometimes": 34%) or wearing sunglasses with UV protection ("always": 40% and "sometimes": 26%). Very few respondents regularly obtain information on the daily UV index ("always": 7% and "sometimes": 15%).

Protective measures are also frequently taken against radiation from mobile phones: 22% of respondents state that they have taken measures against mobile phone or smartphone radiation, such as switching the device off when not in use, leaving it in another room or switching it to flight mode. In contrast, only 3% state that they have taken measures against radiation from mobile phone masts. Also with respect to the other radiation topics, only very few citizens take protective measures. Only 3-4% of respondents state that they have taken protective measures against radon or high-voltage power lines, with the most frequently mentioned measures being to stay away from it or, in the case of radon, regularly opening the windows. The majority of the population feels well protected by the state from almost all the sources of radiation mentioned, with 81% feeling well protected from medical applications and a good half from UV radiation, high-voltage power lines, mobile phone masts and radioactive substances in the event of an accident. Only in the case of radon is the proportion less than half (45%; top2 box, 5-point scale). The most frequently mentioned suggestion for improvement for all the radiation sources mentioned was the desire for more education and information from the state about the risks.

Focus on UV radiation: how do citizens feel about certain aspects of sun protection / UV radiation? As in 2022, only around a third of respondents are concerned about UV radiation. Almost 40% spontaneously think of UV radiation as a potentially harmful radiation topic and around 40%-50% state that they "always" use UV protection measures such as avoiding long periods of exposure, using sun cream or wearing sunglasses with UV protection (scale: always, sometimes, rarely, never). As many as 66%-82% "sometimes" or "always" protect themselves from UV radiation. The proportion of women who regularly use sun cream or wear sunglasses is higher than that of men. In the qualitative survey, young women in particular were more likely to express an awareness of the importance of UV protection to protect themselves from skin ageing and skin cancer. Even though UV protection is seen as very relevant by the population as a whole, there are still misconceptions about sun protection: for example, a quarter of the population consider a certain amount of tanning of the skin to be healthy. Around the same share of respondents state that they do not always use sun cream in favour of vitamin D provision (top2 boxes, 5-point scale). Many also rely on their gut feeling or personal impression based on the weather conditions rather than the UV index when taking protective measures: only just under half say that they know at least roughly what the UV index means, and around a quarter do not know it at all or do not know what it means exactly. The proportion of those who do not know it is particularly high among the oldest group aged 65 and over (37%), but also among the youngest group aged 16-29. Targeted education would be useful here in order to spread knowledge about the UV index to all age groups. Overall, only 22% of the population state that they at least sometimes look up the current UV index, and only an additional 16% rarely do so. A look at the sources of information on the subject of the UV index shows that most people find out about it via weather apps, websites or the internet.

Focus nuclear accident: how do citizens assess the threat of a nuclear accident? As in previous surveys, radioactivity is a topic that is of great concern to respondents overall and is most frequently associated with radiation. The vast majority of respondents (over 70% Top2 box) is very concerned about the current conflicts and wars worldwide. More than half of respondents are specifically concerned that they could lead to either the use of nuclear weapons or a nuclear accident. Overall, people aged 40 and over are more concerned about nuclear dangers than younger people. Respondents aged 16-29 are more confident that the government will implement all necessary measures immediately (62% | 43% and less in other groups). Women are more concerned than men about possible nuclear incidents of all kinds. A smaller proportion of the population is concerned about a nuclear accident during regular operation (35%). Despite the fact that the nuclear phase-out is now complete in Germany, this proportion is higher than in 2022 (28%) – and confidence that the state will implement all important measures is lower (2024: 43% | 2022: 46%). Typical sources of information that would be used in the event of a nuclear accident are the internet, radio and television, as well as public authorities in general and institutions such as local authorities and the fire brigade. Around 9% of respondents would contact the BfS.

Focus nuclear accident: what behaviour can be expected? The scenario questions showed that an overwhelming proportion of the population would follow government instructions in the event of a nuclear incident without further information (87%). However, this proportion falls to 49% as social pressure increases, i.e. if respondents imagine that family and friends ask to leave the area together.

Mobile phones and EMF: Mobile phones and electromagnetic fields were not a focal topic in the current survey – and the results show that even though the topic is present, it does not require increased attention. The topics mobile radio and aspects of electromagnetic fields are mentioned relatively frequently as radiation topics (by approx. 1/3 of the population), but they are mentioned somewhat less frequently as potentially hazardous radiation topics (approx. 1/3 for mobile radio, 1/4 for other topics related to electromagnetic fields). Depending on the aspect, the proportion of the population that perceives aspects of the topic as concerning has remained constant or even decreased compared to 2022. Accordingly, citizens also feel better protected by the state from high-voltage power lines and mobile phone masts than in 2022.

Overall, it can be seen that the way people deal with the topic of radiation and the various radiation issues is very heterogeneous – this is the case for both concerns about various radiation topics and attitudes or knowledge about various radiation topics and their personal protective measures. The perception of radiation does not always correspond to scientific findings and some protective measures could be expanded.

5 List of illustrations