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Evaluation of Information Systems Relevant to Climate Change and Health

Volume 1: Adaption to Climate Change: Evaluation of Existing National Information Systems (UV-Index, Heat Warning System, Airborne Pollen and Ozone Forecasts) from a Public Health Perspective – How to Reach Vulnerable Populations

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Volume 1: Adaption to Climate Change: Evaluation of Existing National Information Systems (UV-Index, Heat Warning System, Airborne Pollen and Ozone Forecasts) from a Public Health Perspective – How to Reach Vulnerable Populations

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Abstract

Climate change affects human health through more frequent and/or more severe extreme weather events and increasing climate variability.

National information and early warning systems (UV index, heat health warnings, pollen and ozone forecasts) can potentially prompt protective or adaptive measures by the population and thus protect health from environmental factors.

The information and early warning systems were evaluated by polling the population, the authorities and the agencies for environment and public health.

The result formed the basis for a communication concept.

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List of Abbreviations

AFK	Adaptation to the impacts of climate change
APA	Action plan: adaptation
AWMF	Association of the Scientific Medical Societies in Germany e.V.
ÄZQ	German Agency for Quality Assurance in Medicine (ÄZQ)
BB	Brandenburg
BBK	German Federal Office of Civil Protection and Disaster Assistance
BE	Berlin
BfR	German Federal Institute for Risk Assessment
BMBF	German Federal Ministry of Education and Research
BMG	German Federal Ministry of Health
BMUB	German Federal Ministry for the Environment, Nature Protection, Building and Nuclear Safety
bpa	German Federal Association of Private Social Services e.V.
BVL	German Federal Office of Consumer Protection and Food Safety
BW	Baden-Wuerttemberg
BY	Bavaria
CATI	Computer Assisted Telephone Interview
DAS	German Strategy for Adaptation to Climate Change
DBfK	German Professional Association for Nursing Professions
DEGAM	German Society of General Medicine
DNQP	German Network for Quality Development in Nursing
DWD	German Weather Service
FKZ	Research code
FuE	Research and Development
H	Heat Alert System
HB	Bremen
HE	Hessen
HH	Hamburg
HUPO	Heat Warning system, UV-Index, Pollen forecast and Ozone Forecast
IMA	Inter-ministerial working group
IPCC	Intergovernmental Panel on Climate Change
KBV	German National Association of Statutory Health Insurance Physicians
KNMI	Koninklijk Nederlands Meteorologisch Instituut
KomPass	Competence Centre on Climate Impacts and Adaptation at the German Federal En-

	vironment Agency
Mac	Apple Macintosh computer
MV	Mecklenburg-Western Pomerania
MVZ	German Health Care Centre
NI	Lower Saxony
NW	North Rhine-Westphalia
O	Ozone Forecast
ÖGD	Public Health Services
P	Pollen Count Forecast
PC	Personal computer, a stand-alone workstation computer
PID	Foundation German Pollen Information Service
QM	Quality Management
RKI	Robert Koch-Institute
RP	Rhineland-Palatinate
SH	Schleswig-Holstein
SL	Saarland
SN	Saxony
ST	Saxony-Anhalt
TH	Thuringia
THW	German Technical Relief Agency
U	UV-Index
UBA	German Federal Environment Agency
UTCI	Universal Thermal Climate Index
UV	Ultraviolet
UVI	UV-Index
VLA	Veterinary and Food Control Office
VLÜA	Veterinary and Food Control Office
WaBoLu	German Institute for Water, Soil and Air Hygiene
X	Extreme weather events

Summary

Introduction

Climate change is a continuing, long-term alteration of weather patterns with more frequent and/or more severe extreme weather events which affect human health with heatwaves, increased exposure to ultraviolet radiation, high airborne pollen counts and ground-level ozone.

For these environmental factors there are national systems which provide information and early warnings (UV index, heat health warning systems, pollen and ozone forecasts). The German Weather Service (Deutscher Wetterdienst/DWD) offers newsletters with UV index warnings, heat health warnings and pollen forecasts and the Federal Environment Agency (Umweltbundesamt/UBA) offers a newsletter with ozone forecasts.

Subscriptions to these newsletters are available on the Internet sites of DWD, respectively of UBA; these also provide the forecasts and warnings directly.

This data is intended to enable adaptation by the population. The implementation of adaptive measures should prevent negative health consequences.

The systems providing the information and warnings were evaluated with regard to how well known they are, their utilisation by the population and environment and health care institutions, and the adaptation procedures that they prompt.

In performing this evaluation, a distinction was made between institutionalised communication, for example from the health ministries of federal states (Länder) to health care institutions (especially for inpatient care) and, on the other hand, non-institutionalised communication as by subscription to newsletters by citizens or information disseminated by the media.

The results of this evaluation were the basis for devising a concept for communication.

This investigation was carried out as part of the project “Adaptation to Climate Change: Evaluation of Existing National Information Systems (UV-Index, Heat Health Warning System, Airborne Pollen and Ozone Forecasts) From a Public Health Perspective – How to Reach Vulnerable Populations?”, short title: “Evaluation of Information Systems Relevant to Climate Change and Health” of the environmental research plan of the Federal Ministry for Environment, Protection of Nature and Building and Reactor Safety (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit) under the research ID 371262207.

The present volume contains an abbreviated and revised version of the final report of the project (Capellaro and Sturm 2015a).

The second volume, “Adaptation to Climate Change: Strategy for Provision of Health Care in Case of Extreme Weather Events” (Capellaro and Sturm 2015c), examines health care structures for old and sick citizens and assembles a strategy to ensure provision of health care in extreme situations such as heatwaves, storms and heavy rain.

Methods

The following methods were used:

- A comprehensive search of the German environmental webportal (www.portalU.de) was performed to identify target groups and adaptive measures.
- The scientific literature was reviewed and sorted.
- DWD and UBA were asked for circulation data of their newsletters.

- State (Land) health ministries were asked by questionnaire which newsletters were received and which health institutions were directed to receive them.
- Several health department offices (Gesundheitsämter) were interrogated by means of a questionnaire.
- The media were observed during summer 2013 to determine the extent to which they reported the early warnings and forecasts.
- The physicians as well as nursing services and nursing facilities were requested to complete an online questionnaire.
- An extensive, representative poll of the population was carried out in summer 2013. In the main questionnaire, 4,000 people answered questions about their health, their behaviour with regard to information, their perception of risk and their awareness of warning systems. Further, special questionnaires about the four information and early warning systems and appropriate protective actions were answered by groups of up to 400 people who met the criteria for vulnerability (Table 1).
- The average length of an interview was about 30 min. After validating the data, they were weighted with respect to demographic and regional characteristics according to current population projections.

Table 1: Assignment of poll participants to the special questionnaires

Criteria	Questionnaire
Age over 60	Heat
Allergic asthma by pollen	Pollen
Hay fever	Pollen
More than 15 hours per week outdoors	UV
More than two hours per week strenuous exercise outdoors	Ozone

Results

The utilisation of institutionalised information[1] is extremely inconsistent. Only heat health warnings are received by almost all federal states but the forwarding of the information is not uniform. In some states the public health agencies distribute the information to old people's homes and nursing facilities, while in other states such facilities are required to use the heat health warnings of the weather service directly. In yet other states there is no directive and health care facilities obtain information about extreme weather events at their own discretion.

Unrepresentative questioning of health department personnel at various levels did not disclose a uniform mode of communication. However, the information won in this way shows that the heat health warnings cascading from the DWD, via state health ministries to the subordinate health department offices, and from there to the nursing facilities, can function, at least for heat health warnings.

[1] The Umweltbundesamt (UBA) and the Deutscher Wetterdienst (DWD) are the origins of the institutionalised information channels. Heat warnings are sent (independent of a subscription to the newsletter) to the agencies of the states. For example, heat warnings in Thuringia are sent to county administrations and non-county cities, which in turn forward them to nursing homes and hospitals (Sperk & Mücke, 2009). Health facilities in some states subscribe to the heat newsletter. These communication channels are regulated by administrative arrangements and are referred to in the following as "institutionalised communication channels". The non-institutionalised information channels are other possible ways in which a warning or a forecast can reach health facilities or the population.

Whether or not the arrival of heat heath warnings in old people's homes and nursing facilities leads to practical consequences could not be determined by the research project. Further, it must be critically noted that physicians, who have an important role because of possible interactions between certain medications and hot weather, are neither integrated in the institutionalised information channels nor do they broadly subscribe to heat health warnings.

Information and early warnings about the other environmental factors (UV radiation, ozone and pollen) are subscribed to or forwarded by way of institutionalised communication in only a few states.

Warnings and forecasts reach the population primarily by way of non-institutionalised communication. Public awareness of information and warning systems is strongly dependent on the information system involved. 86.8 % have heard or read about pollen forecasts, but only 29.5 % about the UV index. Heat health warnings (71.0 %) and ozone forecasts/warnings (54.2 %) lie in-between.

Those questioned became aware of warnings and forecasts most often through television, radio, newspapers or magazines, or the Internet.[2]

The observation of the media performed in the project showed that the media inform primarily about heat, but neither ubiquitously nor reliably.

The number of subscribers to the newsletters of the information systems is negligible compared to the size of the population.

In order to determine to what extent warnings and forecasts lead to adaptation measures, a logical framework was developed which included various factors favourable to the implementation of protective measures. Models of health communication and factors identified in the scientific literature formed the basis of this framework. The factors of the framework were operationalised for the representative poll of the population.

Based on the data derived from the poll of the population, the factors influencing the implementation of protective measures were identified with the aid of statistical regression models.

Among the factors considered, the suitability of a measure *("Would this measure be suitable for you personally?")* and the nature of the measure[3] has the greatest effect on the probability that a protective measure against heat would be implemented: if a measure is considered suitable, the probability that it will be implemented increases.

Since the perceived suitability of a measure depends on personal attitudes and on a person's actual situation, individual communication must be taken into consideration. Conversation (for example with a physician) was often named as a desirable source for warnings.

The presumed effectiveness of measures *("Do you think this measure is effective?")* Is also an important predictor: measures considered "very effective" are implemented more often.

Resulting recommendations for a communication concept entail certain consequences. Explicit mention of effectiveness implies that it has been investigated. In the context of "evidence-based patient information", the degree to which information is based on scientific evidence must be included in a

[2] The websites of the DWD and the UBA were excluded for this question.

[3] "Nature of the measure" is a so-called dummy variable, i.e., it does not represent a question of the questionnaire. The measures are differentiated according to multiple factors. They can be executed acutely and/or before the stressor takes effect and have variably strong direct and indirect effects on well-being. Furthermore, they differ with respect to the extent of planning or preparation required and also in their accessibility as well as in the effort required to execute them, and in the constraints that may result. The variable "nature of the measure" explains the variance of utilisation which results from special characteristics of the individual measures.

generally understandable form. This in turn requires that the knowledge necessary for the communication is available and is kept current.

The perception of risk *("How high do you think your risk from [heat, UV radiation, pollen, ozone] is?")* has significant and moderate influence on the utilisation of protective measures.

Awareness of risk depends on other factors. Further analysis showed that the presence of risk in daily life[4] and the degree of personal involvement[5] had the greatest influence on the perceived degree of risk.

Awareness of risk is most pronounced in the case of heat. 51 % of the vulnerable people and 39 % of all participants thought of heat at least once during the two weeks before the poll. UV radiation takes second place for immediacy with 37 % of participants overall (36 % of the vulnerable). Pollen (22 % overall, vulnerable: 17 %)[6] and ozone (21 %, vulnerable: 23 %) have immediacy for far fewer people.

The project comes to the conclusion that there is a necessity for continuous disclosure. The concept of health-relevant disclosure can and should be extended to include a concept of health literacy. In addition to ordinary knowledge and abilities, knowledge of risks and protective measures are components of health literacy. The concept includes the ability to find and use health-relevant information. The goal of improved health literacy can be achieved only by continuous education.

Awareness of protective measures and of the information systems have no statistically confirmed influence on the performance of adaptive measures by the poll participants, i.e., people who are aware of the information systems do not protect themselves better than those who are ignorant of them. This result can be explained by an analysis of the content of the newsletters: three newsletters make no specific recommendations for behaviour; the exception is the newsletter for the UV index.

The project proposes that the content of the newsletters should be complemented with behavioural recommendations, which should be as specific as possible. Other parts of the communication concept are intended to convey concrete protective measures and enable their execution. The information and warning systems mainly provide information about dangers. The goal of enabling the population to carry out protective measures should be more strongly emphasised in the newsletters and in the accompanying communications.

A further concern is the connection between the presence of risks and possible undesirable effects of the communicative measures. Health-relevant communication and warnings can cause apprehension in the population. Apprehension can initiate preventive measures but it is itself an impairment of well-being, and thus of health.

This dilemma can be countered with a salutogenic approach. Salutogenesis, in contrast to pathogenesis, does not seek to avoid illness but promotes and preserves health: aspects of well-being caused by the preventive measures should be emphasised, not the dangers for health due to the environmental influences.

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[4] The presence of risk in daily life is documented by the response to the following: "Please tell me how often you have thought of risk during the last two weeks. Answer with: not at all, once or twice, 3 to 5 times, or more often!"

[5] Personal affliction was documented inconsistently. (For heat: "Do you personally tolerate heat very well, well, less well, or not at all?"; for UV radiation: "Has skin cancer or cataract been diagnosed among your friends and relatives (yes, skin cancer/yes, cataract/both/no, neither one nor the other)?"; For pollen: "How high do you estimate the risk for your own health if you had contact with allergenic pollen (high/fairly high/fairly low/very low)?" Personal affliction was not documented for ozone.

[6] The scant perception of risk in relation to pollen may be due to the time of the interrogation (August 26, 2013 to October 8, 2013), when the main season for airborne pollen was already past.

Further noteworthy is that protective measures against heat and pollen are implemented much more often than those against UV radiation and ozone. This is due to the inherent qualities of the environmental factors and to the nature of the protective measures. Heat and pollen afflict vulnerable people rapidly and some protective measures provide immediate improvement.

Communication Concept

The communication concept has essentially two objectives. On one hand, the protection of public health should be improved by adaptive measures, applied to vulnerable people and those under care, to cope with acute warning situations. On the other hand, through ongoing teaching of the necessary health literacy, the population should be enabled to execute the adaptive measures.

The target groups of the communication concept are the general public as well as professional medical and nursing care givers. The general public must be included, in addition to the vulnerable groups, because all citizens are part of the social environment of vulnerable people and may be called upon to perform or support protective measures and they may themselves become vulnerable in the future. Professional medical and nursing care givers are partially responsible for the execution of adaptive measures. A setting-based approach introduces further disseminators.

Two principles of the "German Strategy for Adaptation to Climate Change" (Deutsche Anpassungsstrategie an den Klimawandel, DAS) are specially emphasised and considered in the communication concept, namely that endeavours should be knowledge-based and guided by the precepts of frankness and cooperation.

The concept has the following components:

- Basis in knowledge
- Optimisation of warnings
- Improvement of public health literacy
- Formulation of a setting approach (frankness and cooperation)
- Enhancement of the institutionalised communication channels

In order to *base the communication concept on knowledge*, the available scientific information should be systematically searched and evaluated. The resulting knowledge management can be compiled, updated and made available as a "body of knowledge" (BoK). Conceivable content of this body of knowledge could include, for example, relevant diagnoses, causes, epidemiologic data, risk factors, vulnerable groups, protective measures, recommendations for specific target groups, sources of reliable information and possibly secondary preventive procedures.

The recommended *optimisation of warnings* concerns content and form. For example, in addition to behavioural recommendations and their proven effectiveness, points of contact, references to further information as well as graphically pleasing illustrations (as recommended for the warnings concerning airborne pollen) should also be included. Furthermore, the newsletters should be advertised in the media and recommended by journalists and the warnings should be more intensely disseminated, for example through social media or applications for smartphones, such as that for heat health warnings by the DWD (Google Play, 2014).

The warnings and forecasts are intended to prompt acute adaptive measures, for which an *improvement of health literacy* must be in place before the warning situation occurs in order to enable execution of the measures.

Access to these abilities can be through people's own choice of sources, including websites and printed material from the relevant agencies and institutions. Other means of communication such as social media, apps and multi-media formats such as videos and animations are also suitable. Media

work is an important supporting activity to intensify utilisation of the sources of warnings and forecasts.

The *setting-based approach* pursues both goals of the communication concept and excels especially in its access to socially disadvantaged people, in its direct communication with the participants and in their involvement. A central feature of the setting-based approach is the education of the agents who, with the aid of other offerings of the communication concept, instruct and enable the vulnerable. The agents can answer questions and help overcome individual hindrances. Existing structures are utilised and the participants are interconnected.

An improved realisation of the integrated approach (cf. Deutsche Anpassungsstrategie an den Klimawandel, DAS) must be aspired to. From a citizen's perspective, it is probably desirable to have *one* contact for health hazards. An offering which combines various health relevant information is conceivable. In addition to information from the four information and early warning systems, the integration of further health relevant information is possible. This might include environmental threats to health such as storm warnings or information about the activity and infectiousness of disease transmitters such as ticks.

The proposed *enhancement of the institutionalised communication channels* includes the following measures. In addition to the heat health warnings, also other warnings and forecasts should be forwarded to public agencies and health facilities. The question as to which additional facilities can be included as recipients must be examined. The execution of adaptive measures in the facilities in response to warnings should be promoted by modifications of the regulatory framework.

1 Background and objectives

1.1 Background

Climate change also affects the human health through continuous changes, with more frequent and / or increased incidence of extreme weather events and by increasing climate variability. This health related vulnerability comprise infectious diseases, non-communicable diseases and injuries resulting from extreme weather events.

The health consequences can also be alleviated by an adaptation to climate change. Such adaptation is intended to reduce the frailty or vulnerability.

“In terms of the principle of self-provision, this means in essence that the responsibility for adaptation to climate change ultimately lies with the citizens and enterprises themselves.” (APA)

Communication and education is the way by which citizens are to be empowered to exercise such responsibility. The word “competence” is very apt in this context, since it combines the aspects of responsibility and ability.

The existing national information and early Warning systems (UV-Index, Heat Warning system, Pollen Count and Ozone Forecast) shall enable the population to adapt. The population is to carry out adaptation measures to protect themselves from the negative health effects resulting from climate change.

1.2 Objectives

The evaluation of information and early Warning systems performed in relation to the degree of penetration, the range and clarity of the offer as well as with regard to the adaptation intentions and the adaptive behaviour of the population. Therefore, a special focus was paid to those parts of the population that can benefit from such information systems the most. Account was taken of that part of the population (e.g. sick people, individuals in need of care) that are dependent on the support of doctors as well as relatives or services providing care. Therefore, it was also investigated whether these groups are being reached and in which way this is achieved.

The derived findings were used to develop a communication concept for such information systems.

2 Introduction

The German Weather Service (DWD) offers the following Newsletters relevant to the project.

- Newsletter – Heat Warnings
- Newsletter – UV-Warnings
- Newsletter – Pollen Count Risk-Index

The German Federal Environment Agency (UBA) offers a Newsletter containing Ozone Forecasts.

These Newsletters can be subscribed to on the website of the DWD or the UBA. In addition, there are agreements between ministries of the German Federal States and the German Weather Service, which regulate the dissemination of Warnings or information.

For the institutionalised information channels (see Chapter 3.1.1) a distinction is made between Heat Warnings and Heat Information

2.1 Fact sheets on information systems

Fact sheet: Heat Warning Newsletter

Publisher	German Weather Service / DWD
Subscribers (Status as of January 2013)	9.737
Sender	German Weather Service Heat Warning ‹DWD-NewsletterAdmin_HZ@newsletter.dwd.de›
Subject	DWD -› Hitzewarnungen - HZ_DWHH
Point of contact	including point of contact e-mail and tele-phone number
Further Information	Note on www.dwd.de
Unsubscribe	direct link
Currentness	for the next day
Confinement	Area unambiguous (County)
Recommendations	None
Information	Letters and combination of numbers, subject taken up, defined date and region
Thresholds	Note on “strong heat exposure“
Classifications	Strong heat exposure: “Apparent temperature” Two consecutive days above 32°C, in addition just minor night-time cooling. Extreme heat exposure: “Apparent tempera-ture” above 38°C.
Notification period	May to August
Language	Abandonment of technical terms
Comprehensibility	not conclusive at first glance -› concrete Warn-ing gets slightly lost
Pictorial clarification	no graphical support
Emphases	without colour highlighting
In operation since	2005
Main communication channels	Newsletter via fax or e-mail, Heat Warning App
directly vs. indirectly addressed to consumers	directly addresses consumers

Fact sheet: UV-Warning Newsletter

Publisher	German Weather Service / DWD
Subscribers (Status as of January 2013)	13.830
Sender	German Weather Service - Pollen Count - Risk-Index ‹DWD-NewsletterAdmin_UV@listen.dwd.de ›
Subject	DWD -› Pollen Count -Risk-Index – UV_ESXX
Point of contact	not explicitly stated
Further Information	no link to further information
Unsubscribe	direct link
Currentness	same day or next day
Confinement	Area unambiguous (German Federal States)
Recommendations	None
Information	Subject taken up, date and area defined, publishing partner stated (German Pollen Information Service Foundation)
Thresholds	Key indicates unusually high values
Classifications	Classification of strain intensity in accordance with the concentrations of Pollen Count (number of Pollen as daily average values per m3 of air)
Notification period	approximately 1st of January to 31st of October
Language	Abandonment of technical terms
Comprehensibility	Information evident at a glance, clear representation by means of a table
Pictorial clarification	comprehensible key
Emphases	Colour highlighted Risk-Index
In operation since	2006
Main communication channels	Newsletter by e-mail
directly vs. indirectly addressed to consumers	directly addresses consumers

Fact sheet: Newsletter Ozone Warning

Publisher	Federal Environment Agency/UBA
Subscribers (Status as of January 2013)	80-100
Sender	abo@liwa.de
Subject	Graphical version: Ozone Forecast
Point of contact	not explicitly stated
Further Information	Reference to the entire forecast with link
Unsubscribe	direct link
Currentness	Four-day forecast, starting on the previous day
Confinement	Area unambiguous (Postcode areas)
Recommendations	None
Information	Warning/Note on risk in the text is not unambiguous -› concrete Warning is not evident
Thresholds	The colour scheme and the key in the appendix provides references to elevated values
Classifications	For Ozone there is an information threshold of 180 µg/m3 (1-hour value) and an alert threshold of 240 µg/m3 (1-hour value)
Notification period	not specified
Language	Technical terms, symbols and abbreviations
Comprehensibility	are difficult to translate for the consumer; confusing appendices
Pictorial clarification	Key is separated from cards
Emphases	without colour highlighting
In operation since	2004
Main communication channels	Newsletter by e-mail
directly vs. indirectly addressed to consumers	directly addresses the consumer, graphics are also intended for further dissemination

Fact sheet: Newsletter Ozone Warning

Publisher	Federal Environmental Agency/UBA
Subscribers (Status as of January 2013)	80-100
Sender	abo@liwa.de
Subject	Graphical version: Ozone Forecast
Point of contact	not explicitly stated
Further Information	Reference to the entire forecast with link
Unsubscribe	direct link
Currentness	Four-day forecast, starting on the previous day
Confinement	Area unambiguous (Postcode areas)
Recommendations	None
Information	Warning/Note on risk in the text is not unambiguous -› concrete Warning is not evident
Thresholds	The colour scheme and the key in the appendix provides references to elevated values
Classifications	For Ozone there is an information threshold of 180 µg/m3 (1-hour value) and an alert threshold of 240 µg/m3 (1-hour value)
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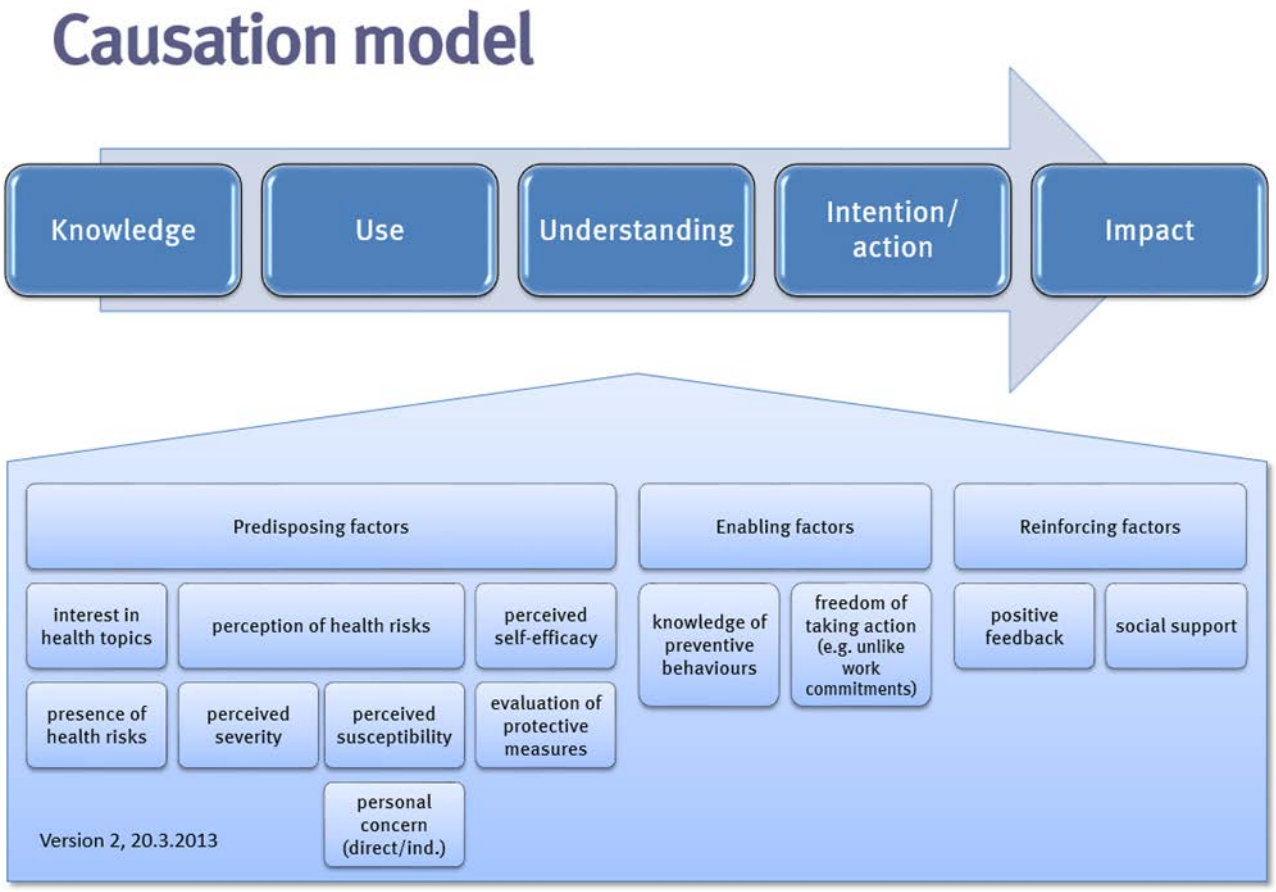
Pictorial clarification	Key is separated from cards
Emphases	without colour highlighting
In operation since	2004
Main communication channels	Newsletter by e-mail
directly vs. indirectly addressed to consumers	directly addresses the consumer, graphics are also intended for further dissemination

2.2 Causation model

A detailed causation model was described in order to illustrate the supposed causal relations between information systems and public health in detail.

Results from the reviewed literature (refer to Chapter 4.7) and the analysis results (refer to Chapter 4.1) are considered in the following representation (Figure 1).

Figure 1: Causation model



There is a superordinate causal relation between the knowledge of information systems, the use of information systems, the understanding of information systems and the intention to take protective measures (intention) and/or the implementation of protection measures (action). The effect refers to the impact of protective measures. In this context, this could mean a lower exposure to harmful environmental factors or reduced health impairment by environmental factors. The impact, i.e. the effect of protective measures on health, was not measured in this project.

Other factors affect one or more of the superordinate causal relations.

Thus, e.g. the (social) support of vulnerable people can encourage the use of information systems or the implementation of protective measures. In accordance with the PRECEDE-PROCEED model (Green and Kreuter, 1999), these factors can be divided into 3 groups (also refer to Chapter 2.3.1).

According to the PRECEDE-PROCEED model, intention and behaviour can be influenced by different factors. These factors are divided into three groups.[7]

- Predisposing factors
- Enabling factors
- Reinforcing factors

The following factors are among the predisposing factors:

- Interest in health topics
- Presence of health risks in everyday life
- Perception of such risks
- Perceived severity of the risk or the potential negative consequences
- Perceived susceptibility to the risk
- Personal concern (direct/indirect)
- Perceived self-efficacy and
- F1Evaluation of protective measures.

The general interest in health can increase the motivation to carry out protective measures.

According to the "Health-Belief" model, the perception of risk is also determined by the perceived severity of the risk and the perceived susceptibility (Champion and Skinner, 2008). A strong risk perception increases the likelihood that someone implements a protective measure.[8]

The aspect of the presence of risks in everyday life must still be considered for the perception of risk, too. Thus, a risk clearly perceived by a person could be suppressed in everyday life. The lack of presence of the risk would reduce the effect (higher protection probability) of high-risk perception.

Personal concernment, i.e. concrete experiences with illness or health problems may increase the willingness to apply certain protection measures. This may also be the case if such experience is gained indirectly and if another person reports on impairments.

Perceived self-efficacy refers to the expectation of a person being able to do something successfully (Bandura, 1997). In this context, it is the belief in the feasibility and effectiveness of preventive measures. This expectation has a positive impact on the implementation of protective measures.

The evaluation of the protective measures can take very different dimensions into account.

Protective measures may be costly, inconvenient or expensive. Protective measures may differ with respect to direct positive impacts on well-being. Whether a protective measure is considered to be effective, is also an aspect of the evaluation of the protective measures.

Enabling factors include:

- The knowledge of preventive behaviours and
- The freedom of taking action (e.g. unlike work commitments).

The knowledge of preventive behaviours is important for implementing protective measures.

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[7] Predisposing factors—the individual's knowledge, attitudes, behaviour, beliefs, and values before intervention that affect willingness to change. Enabling factors—factors in the environment or community of an individual that facilitate or present obstacles to change. Reinforcing factors—the positive or negative effects of adopting the behaviour (including social support) that influence continuing the behaviour. 's's''''''

[8] A correlation between risk perception and information behaviour was ascertained (Mead et all, 2012).

If someone wants to protect oneself, such person needs to know how to protect oneself.

In addition, the freedom of taking action is required. This means that the person must be able to perform such measures. Thus, working conditions of certain occupations can prevent people e.g. from avoiding midday sun. Even physical limitations such as bedridden conditions can prevent the use of cooler rooms. Supportive factors include:

- Positive feedback and
- Social support.

Social support is even beneficial for implementing health protection measures.

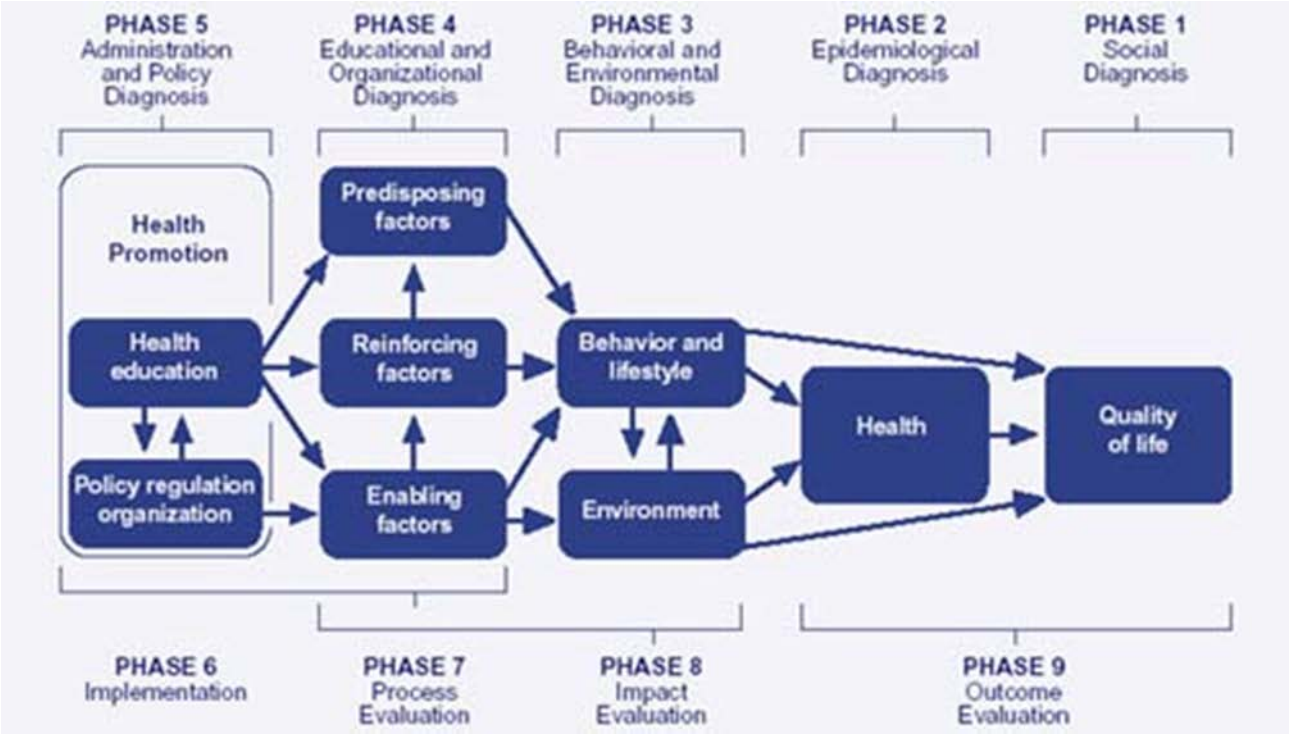
With regard to the representative survey (refer to Chapter 3.8) and in order to identify possible weaknesses in the interactive effects structure of the information systems, the different fields of the causation model have been considered. Several fields in the survey were partly recorded with a summary question because individual fields of the causation model could not be operationalized for this survey.

2.3 Evaluation limitations

2.3.1 Limitation of the evaluation object

The evaluation of information systems focuses on the effectiveness of information systems. The PRECEDE-PROCEED model[9] describes a wider context of health promotion. This model is widespread and is often used, particularly in the planning and evaluation of population-based preventive measures. In this project this model served as theoretical base. The possibilities and limitations of the evaluation based on this model will be presented in the following.

Figure 2: Schematic representation of the PRECEDE-PROCEED model



Quelle: http://www.cancer.gov/PublishedContent/Images/cancertopics/cancerlibrary/pinkbook/precede.jpg, 23.04.2014

The PRECEDE-PROCEED model describes a process, which consists of nine phases. The objects of investigation (shown in blue boxes) are partially regarded in several phases. The model assumes an analysis (Phases 1-5), considers the development and implementation of an intervention (phase 6) and their subsequent evaluation (Phases 7-9).

Although no new interventions are developed and implemented by this project, the model is still useful to systematically analyse the behaviour of the population and to evaluate the behavioural changes initiated by the information systems. The majority of phases will be implemented in the course of this project.

Phase 1 “Social diagnosis” analyses the quality of life and Phase 2 “Epidemiological diagnosis” diagnoses the health of the target group. A limitation of this evaluation will become evident in this phase. The health impairment caused by Heat, UV-Radiation, Ozone and Pollen Count is neither

[9] Green, L.W., & Kreuter, M.W. (1999). Health promotion planning: An educational and ecological approach (3rd ed.). Mountain View, CA: Mayfield

evaluated at the epidemiological level (e.g. by the number of new cases per annum) nor at the quality of life level (e.g., by calculating the "quality adjusted years of life"[10]).

Phase 3 "Behavioural and environmental diagnosis" analyses the behaviour, the lifestyle and influencing environmental factors of the respondents.

According to the PRECEDE-PROCEED model, intention and behaviour are influenced by different factors. These factors are divided into three groups. In Phase 4 "Educational and organisational diagnosis" these factors will be collected:

a) Predisposing factors such as knowledge, attitude or self-efficacy,

b) Behaviour strengthening factors such as social support or benefits and

c) Enabling factors such as availability and access of e.g., protective measures.

Phases 3 and 4 are mainly considered in the context of population surveys.

Phase 5 "Administration and policy diagnosis" is covered by the structural evaluation of the Warning and information systems (DWD/UBA survey for Federal State ministries and for participants in ÖGD-training).

Phase 6 "Implementation" describes the introduction of an intervention that was planned due to the previous results.

The four information systems examined during this evaluation represent the intervention. Thus, Phase 6 is not performed as part of this project.

Phase 7 "Process evaluation", analyses the implementation process and therefore does not have to be considered since the Warning and information systems already exist.

Phase 8 "Impact evaluation" captures the effect of the intervention on the individuals, e.g., whether protective behaviour is applied because of Warnings and forecasts. This will also be collected in the course of the Population Survey.

Phase 9 "Outcome evaluation", the success of the intervention in terms of health and quality of life of the target group is not within the scope of this project.

There is no doubt that health and quality of life of the target groups are impaired by Heat, UV-Radiation, Pollen and Ozone. Since these indicators are not quantified by the present evaluation, the phases "outcome evaluation", "social diagnosis" and "epidemiological diagnosis" are out of scope for this project.

The project provides answers to questions regarding the behaviour and the use of adaptation measures.

However, the extent of the positive impact of such measures on the quality of life and health was not determined. Thus, the benefits are not quantifiable.

2.3.2 Evidence-based adaptation measures

The adaptation measures considered during the evaluation were comprehensible and reproducibly selected. They are considered to be meaningful by the participants of the evaluation. However, it should be noted for the effectiveness of the considered adaptation measures in the framework of the

[10] A quality adjusted life year (or QALY) is a key figure for evaluating a life year in relation to health. A QALY of 1 means one year in full health, while a QALY of 0 corresponds to a decease. QALY is thus a use-value for a living (year). QALY is the most widely used measure in health economic evaluations. (Wikipedia, 2014)

project, that no evidence was researched and evaluated systematically in the sense of evidence-based medicine, such as randomized controlled trials and meta-analyses.[11]

2.3.3 Focusing on behavioural prevention

The four examined information systems aim to control the behaviour under predicted exposure to the four environmental factors (or on the field of "Behaviour and Lifestyle") and therefore relate to the so-called behavioural prevention.

The field "Environment" refers to the environment of individuals and concerns the adaptation measures for situational prevention. Examples of situational prevention are urban development measures, the promotion of green roofs, provision of sunscreen products or changes in law (e.g. occupational safety, minimum residential home standards act). The situational prevention usually concerns long-term and medium-term adjustment measures. Hence, it is not related to the information systems and is not the subject of this evaluation study.

However, the information or Warnings are intended to influence the behaviour of caretakers (for example, adaptation of working time, introduction of measures for individuals in need of nursing care), which then in turn improve the conditions for the wards.

[11] Exceptions are adaptation measures for the protection against skin cancer. The S3 guideline for prevention of skin cancer were considered, which is based on a systematic literature review and evaluation (Leitlinienprogramm Onkologie, Guidelines Programme Oncology).

3 Methods

3.1 Overview of the range of selected methods

The research was performed in four strands:

- institutionalised information channels
- concrete measures
- scientific studies
- other multipliers

3.1.1 Institutionalised information channels

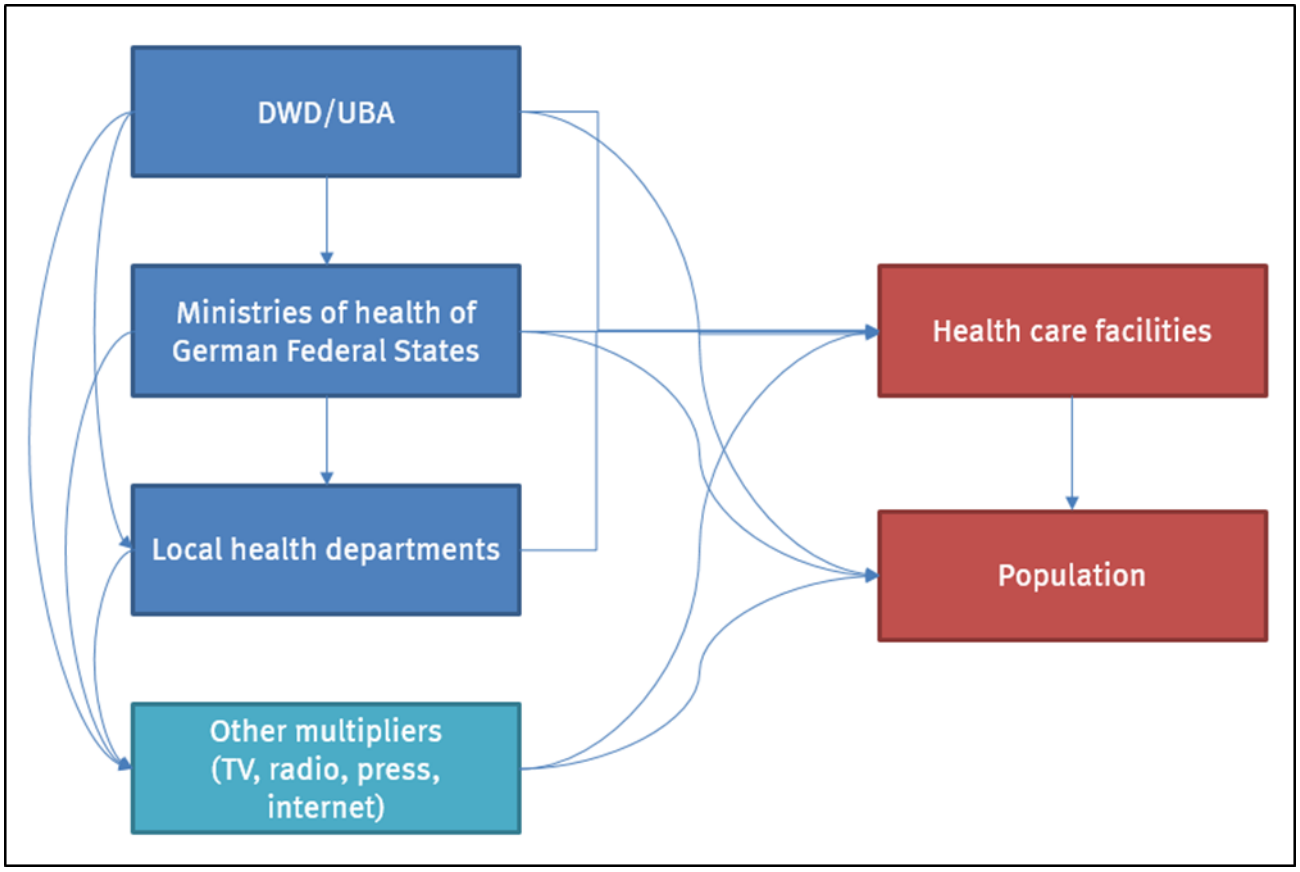
It was attempted to understand the information channels. The UBA (German Federal Environmental Agency) and the DWD (German Weather Service) were the starting points. A particularity is regulated by administrative agreements. Heat Warnings are sent (regardless of a subscription to the Newsletter) to the Federal State authorities. The administrative agreement distinguishes between “Heat Warning” and “Heat Pre-information”.[12] In addition, health care facilities in some Federal States subscribe to the Heat Newsletter. In Thuringia for example, Heat Warnings are passed on to the counties and cities that in turn forward them e.g. to nursing homes or hospitals (Sperk & Mücke, 2009). In the following, these communication channels, which are regulated by agreements, are referred to as “institutionalised channels of communication”.

The methods were chosen in consideration of the communication channels for forecasts and Warnings. These originated from the UBA or the DWD in cooperation with the German Federal Office for Radiation Protection (BfS) and the German Pollen Information Service Foundation (PID).

DWD and UBA offer subscriptions to Newsletters with the forecasts and Warnings, which can be subscribed to by all other communication partners (Refer to Figure 3)

[12] The “Heat Pre-information” is not an official warning. According to the administrative agreement, it serves the purpose of a “general assessment of the weather situation in terms of heat exposure” and as opposed to heat warnings may, according to the pattern of the administrative agreement, contain more long-term forecasts (e.g., six days) (Koppe 2013)

Figure 3: Schematic representation of the communication channels



3.1.2 Concrete measures

In a first step, a systematic research in the Environment Portal Germany (www.portalU.de) was carried out in order to identify relevant target groups and recommended precautions.

3.1.3 Scientific studies

Another research was aimed to identify current scientific literature. Such publications should focus on examining the effects of information (to Heat, UV-Radiation, Pollen Count or Ozone levels) on knowledge, attitude or behaviour of the population, which was used for developing an effect model for information systems (refer to Chapter 2.2).

3.1.4 Other multipliers

“Non-institutionalised information channels” represent all other ways by which a Warning or forecast can be provided to health care facilities or the public. For this purpose, a media monitoring was performed.

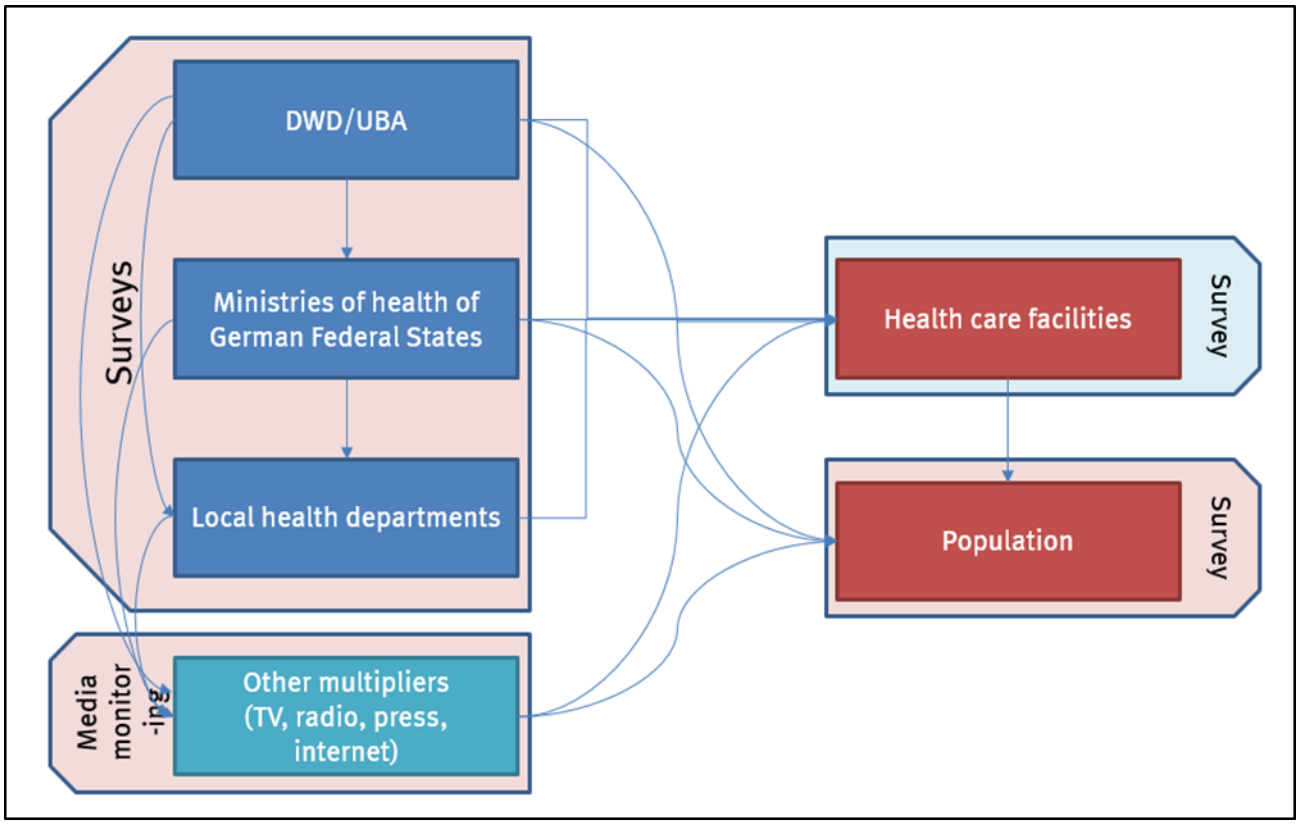
3.1.5 Summary

The communication partners mentioned in the document at hand serve as data provider for different surveys.

- DWD and UBA were queried about the number of Newsletter subscriptions.
- A systematic survey of all German Federal State ministries responsible for health was carried out by means of a questionnaire.
- Some health authorities have been interviewed by means of questionnaires during an event.

- A media monitoring was carried out.
- Doctors, care service providers and facilities were asked to complete an online questionnaire for healthcare facilities. This survey was conducted in the context of another question. Method and results are published elsewhere (Capellaro and Sturm, 2015a).
- A representative Population Survey was carried out.

Figure 4: Utilised methods (selection) and communication channels



3.2 Research in the PortalU

A systematic research was performed via the German Environmental Information Portal (www.portalU.de). This research served different objectives. Firstly, it should contribute to the target group analysis, thus help to identify vulnerable groups of population.

Secondly, the research should identify measures regarding the information systems, which the population can or should implement to protect their health.

3.2.1 Search strategy

The search strategies presented in the following table were used for the research. Thus, for the search of information in the portal regarding the Heat health Warning system, results were sought that contain e.g. the words “heat” and “health”. Results with regards to the UV-Index needed to contain the word “health” and the term “UV-Radiation” or “UV-Index”.

Table 2: Research PortalU, Search strategy

Information system	Search strategy
Heat Warning System	Heat Health
UV-Index	(UV-Radiation OR UV-Index) Health
Pollen Count Forecast	Pollen Count Health
Ozone Forecast	(Ozone Warning OR Ozone Forecast OR Ozone value OR Ozone concentration) Health

The search for “heat” and “health” returned 4,169 results (January 2013), whereby however the number of search results fluctuated. [13] In order to ensure the traceability of the research, the results of the four searches were each transferred into a file. The following table shows the number of retrievable results.

Table 3: Research PortalU, retrievable hits

Information system	retrievable hits
Heat Warning System	825
UV-Index	407
Pollen Count Forecast	519
Ozone Forecast	253

3.2.2 Inclusion and exclusion criteria

The results recorded in the files have been sighted. For this purpose, inclusion and exclusion criteria were specified. The Internet address (URL), the title of the web page, the publisher and the information on the target group and the possible measures were recorded in a table, if the sought information (target group or protective measures) was contained in a search result.

[13] The number of search results varies between 4,241 on 7 January 2013, and 4,182 on 10 January 2013 and 3,715 on 14 January 2013.

The results were only recorded, if a result contained measures to prevent health problems caused by Heat, UV-Radiation, Pollen Count or Ozone (inclusion criterion). A document was excluded in the following cases:

- A result has already been incorporated in the evaluation due to a different search result
- The result only contains a link to a relevant document, which has already been incorporated in the evaluation [14]
- The search hit includes a project description however no results or precaution measures
- The search hit cannot be found / no detailed information available
- The search hit exclusively refers to animal health
- The search hit only contains recommendations for travel
- The search hit only contains recommendations for urban development measures They are not related to the effectiveness of national information systems
- The measures mentioned in a search result were previously found multiple times and with identical wording [15]

[14] Websites frequently contain menus. The website of the Bavarian State Office for Health and Food Safety contains e.g. the menu item “Sun/Heat". Thus numerous web pages of the State Office for Health and Food Safety are found, which however have no relation to the subject of heat and health. The site referenced by the menu item is also recognised as a search hit during the research and will be subsequently evaluated.

[15] For example, many results were found during the search for heat and health, which were pointing to a ban on the employment of pregnant women for work with exposure to the harmful effects of heat (H 149, H 155, H 160, H 166, H 172, 173, H 175, H 178, H 179). Results with such notice are no longer recorded after search result H 175.

3.3 Survey of DWD and UBA

The German Weather Service (DWD) offers the following Newsletters relevant to the project.

- Newsletter - Heat Warnings
- Newsletter - UV-Warnings
- Newsletter - Pollen Count Risk-Index

The German Federal Environment Agency (UBA) offers a Newsletter containing Ozone Forecasts.

DWD and UBA were interviewed in order to capture the institutionalised information channels.

In order to answer the question of whether the information or Warnings actually reach the vulnerable population, it was examined how the dissemination of Warnings takes place in the German Federal States. In general, the German Federal States are encouraged to motivate healthcare facilities to subscribe to the “Newsletter - Heat Warnings” (for healthcare facilities). Alternatively, the German Federal States may also pass on such information.

The purpose of the survey for German Federal States ministries and the survey for participants in the training for the public health service was to identify, how the circulation is handled in the German Federal States.

3.4 Survey of German Federal State ministries

A questionnaire for the German Federal State ministries has been developed for the survey. This questionnaire clarifies the questions on receipt, distribution, other information recipients and/or Warnings. Also measures that may trigger a Warning and the way by which the population will be informed or warned by the German Federal State ministries were queried (refer to Capellaro and Sturm, 2015b).

A presentation of the planned German Federal State ministries survey by the contracting authority UBA to the ad hoc group “Health adaptation to the impacts of climate change”, a sub-group of the IMA 2012, led by the German Federal Ministry of the Environment took place late April 2013 (BMUB IG II 7). The members of this ad hoc group include the German Federal Ministry of Health, some superior German Federal Authorities (e.g. DWD, RKI, BBK) and the German Federal States.

The BMUB department IG II 7 “Health impacts of climate change, environmental food safety” distributed the questionnaires in Q2-2013.

3.5 Survey of participants of the ÖGD-advanced training

Between the 13 and 15 March 2013, BfR, UBA and RKI conducted the "Training event for the public health service 2013" in Berlin. This event was primarily addressed to employees of health authorities and/or subordinate health authorities. In consultation with the contracting authority, this event was used to carry out a short written survey amongst the training participants. The objective of this survey was to identify the institutionalised information channels between subordinate health departments and health care facilities.

For this purpose, a 6-page questionnaire with 14 questions has been developed and printed (refer to Capellaro and Sturm, 2015b). The training participants received the questionnaire upon registration. The participants were able to fill out the questionnaire and to return it either via a dedicated box that was deployed at the venue or to return the questionnaire by the 31 March 2013 by fax, by e-mail or by post using the attached prepaid and addressed envelope.

3.6 Media monitoring

In addition to the receipt of information and Warnings via the institutionalised channels or via the DWD or UBA for private individuals, it is also possible to get informed or warned via other multipliers. This includes in particular the media. Following, the methods of the media monitoring are presented. The aim is the identification of multipliers that are not institutionalised in a reporting chain. In order to identify effective ways of disseminating information, these results are to be set into context with the results from the Population Survey.

In summer 2013, the DWD e.g. published Heat Warnings for Germany regarding the 26 July 2013.

Figure 5: DWD Heat Warning for 26 July 2013

Source: http://www.youtube.com/watch?v=fVmMnpdLVbw, 16 August 2013

A part of the media monitoring refers to this period since the current media, e.g. websites, newspapers and television, only report on such events when there are grounds for doing so and e.g. a concrete Heat Warning is issued. The investigation of applications for computers and smart phones has been carried out independently of this period, since such applications are offered regardless of a current Warning.

3.7 Research regarding scientific studies

A systematic research was performed via the literature database PubMed (www.pubmed.gov), in order to identify scientific studies, which have empirically or theoretically investigated the effects of Heat Warnings on knowledge, behaviour or health of the population.[16] The search hits were reviewed. In this context, publications were excluded, which are not relevant by their title or abstract. Other (not systematically found) publications were also considered, which were found e.g. in reference lists or during the PortalU research.

3.7.1 Literature research: Heat Warning systems

3.7.1.1 Search strategy

A systematic literature search for publications of the last decade (2003-2013) was performed in PubMed. The following search terms were used in various combinations: “hot temperature”, “warning”, “forecasting”, “forecast”, “information”, “knowledge”, “behaviour” and “behavior ” (Table 4). The last search run was performed on 03 February 2014.

Table 4: Search strategy used for the database research in PubMed – Heat

Search step	Search term
1	(“hot temperature”[MeSH Major Topic] OR “heat”[All Fields])
2	(“Warning”[All Fields] OR “information”[All Fields] OR (“forecasting”[MeSH Terms] OR “forecasting”[All Fields] OR “forecast”[All Fields]) OR “forecasting”[MeSH Major Topic])
3	((“knowledge”[MeSH Terms] OR “knowledge”[All Fields]) OR (“behaviour”[All Fields] OR “behavior”[MeSH Terms] OR “behavior”[All Fields]) OR “behavior”[MeSH Major Topic])

3.7.1.2 Inclusion and exclusion criteria

The search strategy for heat in the PubMed database resulted in 252 search hits. 22 publications that corresponded to the search criteria were filtered out during the title and abstract screening.

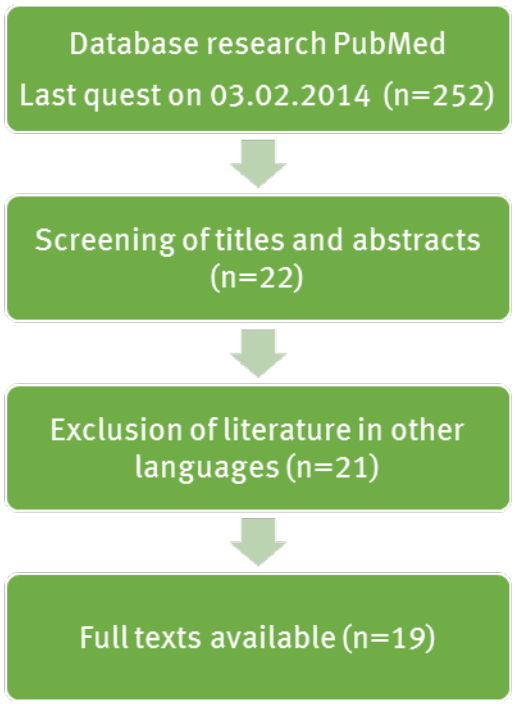
One study was excluded due to language barriers.

German and English literature was included, which related to heat with respect to weather and people. Literature related to hot water, animals, plants or microorganisms, chemical heat, sports events, tropical diseases and medical diagnostic or therapeutic procedures were excluded.

Finally, 19 studies could be used in full-text and 2 were not accessible (Figure 6).

[16] Search strategy: “hot temperature”[All Fields] OR “heat”[All Fields]) AND warning[All Fields] AND ("behaviour”[All Fields] OR “behavior”[MeSH Terms] OR “behavior”[All Fields])

Figure 6: Flow diagram for the literature research – Heat



3.7.2 Literature research: UV-Warning systems

3.7.2.1 Search strategy

A systematic literature search for publications regarding UV-Warning systems for the period 2003-2013 was performed in the PubMed database by using the following terms in different combinations: "UV-index", "UV-Radiation", "UV ray", "Warning", "forecasting", "forecast", "information", "knowledge", "behaviour" and "behavior" (Table 5). The last search run was performed on 03 February 2014.

Table 5: Search strategy used for the database research in PubMed – UV

Search step	Search term
1	("UV radiation"[All Fields] OR "UV index"[All Fields] OR "ultraviolet radiation"[All Fields] OR "ultraviolet index"[All Fields] OR "UV ray"[All Fields] OR "ultraviolet ray"[All Fields])
2	("warning"[All Fields] OR "information"[All Fields] OR ("forecasting"[MeSH Terms] OR "forecasting"[All Fields] OR "forecast"[All Fields]) OR "forecasting"[MeSH Major Topic])
3	(("knowledge"[MeSH Terms] OR "knowledge"[All Fields]) OR ("behaviour"[All Fields] OR "behavior"[MeSH Terms] OR "behavior"[All Fields]) OR "behavior"[MeSH Major Topic])

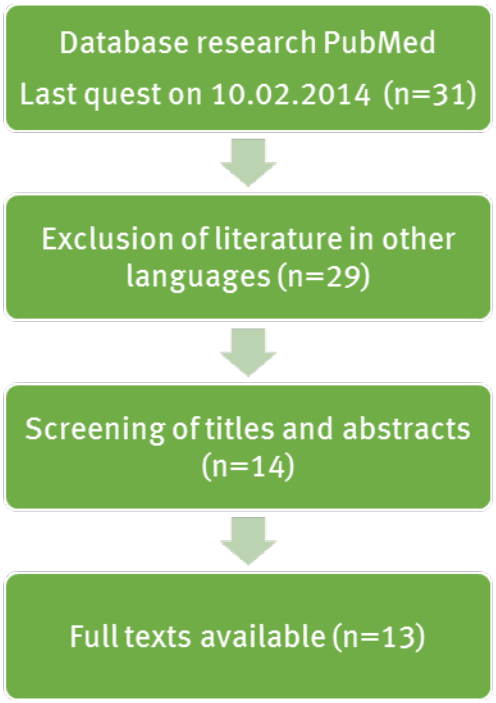
3.7.2.2 Inclusion and exclusion criteria

A database search on Warning systems for UV-Radiation using the mentioned terms resulted in 31 search hits.

German and English literature was included, which related to UV-Index or UV-Radiation with respect to weather and people. Of the remaining 29 studies only literature related to artificial UV-Radiation,

animals, plants or microorganisms, medical diagnostic or therapeutic procedures was excluded. 13 of the remaining 14 studies could be reviewed as full-text. (Figure 7)

Figure 7: Flow diagram for the literature research – UV-Radiation



3.7.3 Literature research: Pollen Count Warning Systems

3.7.3.1 Search strategy

A systematic literature search for publications of the last decade on Pollen Count Warning systems was also performed in the PubMed database. The last search run was performed on 03 February 2014. The following search terms were used in various combinations: “Pollen”, “pollination”, “Pollen Count”, “Warning”, “forecasting”, “forecast”, “information”, “knowledge”, “behaviour” and “behavior” (Table 6).

Table 6: Search strategy used for the database research in PubMed – Pollen Count

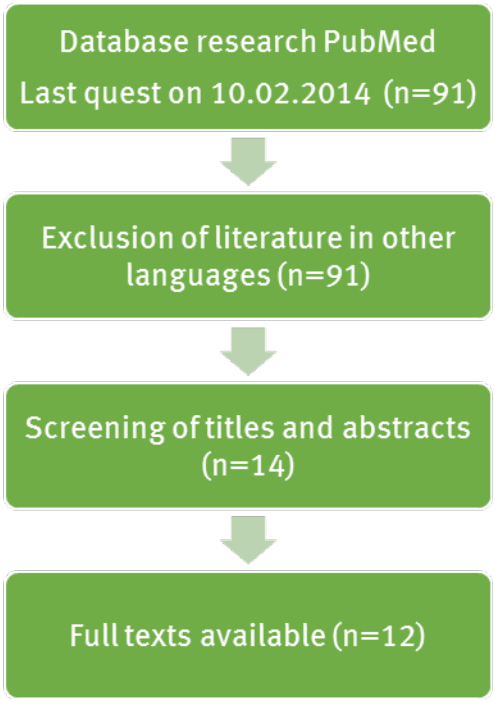
Search step	Search term
1	(“pollen”[MeSH Terms] OR “pollen”[All Fields] OR “pollination”[All fields] OR “pollen count”[All fields])
2	(“warning”[All Fields] OR “information”[All Fields] OR (“forecasting”[MeSH Terms] OR “forecasting”[All Fields] OR “forecast”[All Fields]) OR “forecasting”[MeSH Major Topic])
3	((“knowledge”[MeSH Terms] OR “knowledge”[All Fields]) OR (“behaviour”[All Fields] OR “behavior”[MeSH Terms] OR “behavior”[All Fields]) OR “behavior”[MeSH Major Topic])

3.7.3.2 Inclusion and exclusion criteria

This search returned 91 match results, all written in English or German, hence, no study needed to be excluded due to language. Literature was included, which related to Pollen with respect to weather and people. Literature related to Pollen types, Pollen dispersal, plant propagation, animals, plants or microorganisms, medical diagnostic or therapeutic procedures was excluded.

14 studies remained after the title and abstract screening was performed, 12 of which were accessible as full-text version. (Figure 8)

Figure 8: Flow diagram for the literature research – Pollen



3.7.4 Literature research: Ozone Warning Systems

3.7.4.1 Search strategy

The systematic literature research scheme for the other Warning systems was also applied for Ozone. The following search terms were used in various combinations: “Ozone”, “Warning”, “forecasting”, “forecast”, “information”, “knowledge”, “behaviour” and “behavior ”, whereas the search period was again defined as the period 2003-2013 (Table 7). Again, the last search run was performed on 03 February 2014.

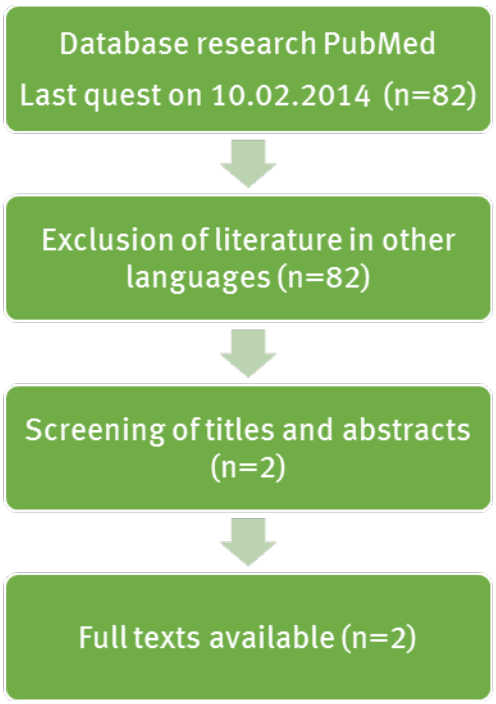
Table 7: Search strategy used for the database research in PubMed – Ozone

Search step	Search term
1	“ozone”[All Fields]
2	(“warning”[All Fields] OR “information”[All Fields] OR (“forecasting”[MeSH Terms] OR “forecasting”[All Fields] OR “forecast”[All Fields]) OR “forecasting”[MeSH Major Topic])
3	((“knowledge”[MeSH Terms] OR “knowledge”[All Fields]) OR (“behaviour”[All Fields] OR “behavior”[MeSH Terms] OR “behavior”[All Fields]) OR “behavior”[MeSH Major Topic])

3.7.4.2 Inclusion and exclusion criteria

The search for the above stated criteria resulted in 82 hits, all of which were in German or English language and were included. Literature that was excluded related e.g. to plants and animals, medical diagnostics or therapy or chemical technical research on Ozone and climate change. As a result of the title and abstract screening, two relevant articles could be filtered out and viewed in full-text. (Figure 9)

Figure 9: Flow diagram for the literature research – Ozone



3.8 Representative Population Survey

3.8.1 Planning

A nationwide representative telephone survey (CATI) regarding total population with 4,000 participants and a disproportionate sample approach of 250 target individuals per German Federal State was performed. The base population for the survey consists of all German-speaking individuals at the age of 14 years and above living in a private household with a telephone (landline). The main questionnaire required an average answer time of about 20 minutes and already included some content regarding all four information systems. During this interview the individuals to be included in the sub-groups “Heat”, “UV-Radiation”, “Pollen Count” and “Ozone” have been identified on the basis of filter questions. The resulting 400 were subsequently interviewed each on one of the four information systems for duration of 10 minutes (supplementary questionnaire). In case a target person belonged to several sub-groups, exactly one supplementary questionnaire was randomly selected for such person. If a specific supplementary questionnaire was already answered 400 times, it could no longer be used, even if another respondent did meet the respective criteria.

3.8.2 Questionnaire design

The questionnaires have been developed on the basis of the preceded results (refer to Capellaro and Sturm, 2015b).

The following criteria were derived from the target group analysis in order to route respondents to the respective sub-questionnaires:

3.8.2.1 Filter questions Heat

The age (over 60 years) was used as selection criterion for the supplementary “Heat” survey.

Most chronically ill and bedridden as well as individuals in need of nursing care are covered by this criterion.

3.8.2.2 Filter questions UV-Radiation

The filter for the supplementary questionnaire was related to the exposure. A respondent was asked the questions of the supplementary UV-Radiation questionnaire, if at least one of the following questions was answered with an indication of more than 20 hours per week.

- “Please try to estimate how many hours per week you occupationally stay outdoors during the summer season.”
- “Please try to estimate how many hours per week you recreationally stay outdoors during the summer season.”

3.8.2.3 Filter questions Pollen Count

If the question “Do you suffer or have you ever suffered from one of the following diseases?” was answered with “allergic asthma caused by Pollen Count” or with “hay fever”, the respondent was also asked the questions of the supplementary “Pollen Count” questionnaire.

3.8.2.4 Filter questions Pollen Count

People who reported exercising physically strenuous activities outdoors in the summer for more than 2 hours per week were also questioned on Ozone Forecasts and ozone warnings in more detail.

3.8.3 Supplementary questionnaires

The base population consisted of the German-speaking population of the Federal Republic of Germany at the age of 14 years or above. The sample size for the main survey was n=4,000. Target for the sub-groups were 400 individuals each.

Table 8: Allocation of supplementary questionnaires to target individuals:

Question	Criteria	Supplementary questionnaire
1	Age over 60	Heat
5b	Allergic asthma caused by Pollen Count	Pollen Count
5b	Hay fever	Pollen Count
9a) …residing outdoors for occupational reasons?	from 15 hrs/week	UV
9b) Physically strenuous activities for occupational reasons	from 2 hrs/week	Ozone
9c) …Residing outdoors for recreational reasons?	from 15 hrs/week	UV
9d) Physically strenuous activities for recreational reasons	from 2 hrs/week	Ozone

The interviews were conducted during the period starting on 26 August.2013 and ending on 8 October 2013.

In cases where target individuals based on the screening questions could be allocated to more than one sub-group, they were allocated to one of the four sub-groups at random. Once it became clear that people allergic to Pollen represented the rarest target group and the intended target of 400 persons could not be reached by random selection, all individuals vulnerable according to question 5b, were redirected to the Pollen questionnaire with effect of 30 August.2013. And still, only 347 people instead of 400 individuals could be interviewed for this group by the end of the survey period.

The content of the questionnaires was developed, programmed and tested in collaboration with the contracting authority, tested in detail with regard to plausibility, filter management, clarity and interview duration, before the survey commenced.

The number of target individuals who were selected for supplementary questions on the basis of the screening questions is shown in the following table:

Table 9: Number of individuals who meet the criteria for supplementary questionnaires

Question	Criteria	Supplementary questionnaire	Question
1	Age 60 years and above	Age over 60	Heat
5b	Allergic asthma caused by Pollen Count	Hayfever	Pollen Count
9a	Residing outdoors for occupational reasons from 15 hrs/week	from 15 hrs/week	UV
9b	Physically strenuous activities from 2 hrs/week	from 2 hrs/week	Ozone
9c	Residing outdoors for recreational reasons from 15 hrs/week	from 15 hrs/week	UV
9d	Physically strenuous activities from 2 hrs/week	from 2 hrs/week	Ozone

3.8.4 Survey procedure and duration

The telephone interviews were conducted in parallel by three Germany based telephone studios (Güstrow, Parchim, Berlin) utilising a total of about 300 interviewers. All interviewers received intensive training at the start of the interviews. For quality control purposes, interviews were regularly systematically monitored, assessed and recorded during the survey period. Safety of argumentation and survey quality were constantly monitored by supervisors and immediate retraining of interviewers was initiated, if necessary.

Usually, the interviewers started their work at around 16:00 hrs and made phone calls until shortly after 20:00 hrs. During the entire survey period, telephone calls were also made on the weekends, except for four Sundays. A maximum of 10 contact attempts were made per telephone number.

The selection of interviewees was made by means of a random generator:

The respective respondent (youngest, oldest, etc.) was automatically determined by the computer program, if several potential interviewees were allocated to one household.

Based on 4,000 completed interviews, the average interview duration was a good 30 minutes including contact phase and parting words (standard deviation ± 8.3).

Subsequent to a data check, the data collected during the telephone survey was weighted in accordance with the structure of the current population projection in terms of demographic and regional characteristics.

4 Results

4.1 Target groups & Measures

4.1.1 Target groups & Measures – Heat

"In summer 2003 an estimated amount of 35,000 to 50,000 people in Europe lost their lives due to Heat Waves. In Germany, several thousand human lives were also lost (DWD 2012). "

In particular, chronically ill individuals are at risk. A worsening of underlying diseases may occur for patients with impaired ability of their organism to counter-regulation. Drugs possibly amplify this effect. In addition specific disturbance patterns can also occur to otherwise apparently healthy individuals (Mücke & Kirsche, 2008):

- Heat rash, heat pustules
- Swollen legs or "swollen feet"
- Muscle cramps
- Heat stroke or seizures
- Circulatory problems, circulatory collapse, heart problems
- Shortness of breath, states of exhaustion
- Dehydration due to excessive sweating

4.1.1.1 Individuals vulnerable to heat

- Elderly (over 60 years) and very old people (Reid et al. 2009)
- Chronically ill (circulatory, respiratory, etc.) with multiple drug use (Bouchama et al. 2007)
- People with psychiatric primary illness (mortality rate 3.6 times higher) (Hajat et al. 2010)
- Bedridden individuals (mortality rate 6.4 times higher), hospitalized / nursing home residents (Bouchama et al. 2007)
- People not leaving their homes on a daily basis (mortality rate 3.4 times higher) (Hajat et al. 2010)
- Children
- Socially isolated individuals, people with weak socio-economic status, homeless (Reid et al. 2009)
- Workers who under certain occupational conditions are unable to sufficiently protect themselves from heat or to avoid heat
- Individuals who spend their free time outdoors, and possibly perform high physical performance such as athletes

4.1.1.2 Measures regarding Heat

The following measures that can be implemented by the parties concerned have been researched (Mücke & Kirsche, 2008):

- Utilising cooler periods of a day for airing, stepping out and for working
- Repelling the sun
- Switching off all heat sources in living rooms
- Using cool rooms for a few hours
- Wearing appropriate clothing
- Cooling by the use of showers, cold compresses or footbaths
- Proper drinking behaviour: water, juice, no alcohol, low protein and sugar
- Eating small meals more often

Measures are recommended that require at least a daily visit of a "carer" for individuals who are unable or not motivated to apply measures themselves.

In the care sector such measures include the measurement of the body temperature, the monitoring of the circulatory system as well as the support and control of the drinking behaviour. There is a high need for medical advice, especially in connection with medication.

The Regional Office of the World Health Organization for Europe in its paper "Public Health Advice on Preventing Health Effects of Heat" has put together information for the general public, health authorities, health professionals, managers of nursing homes and for family doctors and emergency services, which was last updated in 2011. Hazards and the possible or necessary protective measures are represented for all groups concerned in a differentiated manner. The use of these differentiated representations in Germany seems to be meaningful in order to assist in the prevention of heat damage (World Health Organization 2011).

4.1.2 Target groups & Measures – UV-Radiation

UV-Radiation especially presents the following health risks:

- Sunburn as acute injury with immediate medical condition and a long-term increased risk of black skin cancer.
- Chronic injury (summation effect) with pre-aging of the skin and an increased white skin cancer risk.
- Damage to the eye, especially the cornea with the increased development of corneal opacity (cataract).

4.1.2.1 Individuals vulnerable to UV-Radiation

Basically, the entire population is at risk. However, the hazard potential, depending on skin type, is individually very different (lighter skin types are at greater risk). Also the living habits, such as the slow acclimatization to the sun in springtime, play an important role. High-risk groups include children and young people as well as people who are particularly exposed to UV-Radiation due to their occupational or recreational behaviour.

Immunocompromised individuals and patients treated with certain medications constitute special target groups.

4.1.2.2 Measures regarding UV-Radiation

The following measures, which reduce the negative effects of UV-Radiation are stated in the Guideline for prevention of skin cancer (Leitlinienprogramm Onkologie 2012).

- Avoidant behaviour (avoid midday sun, seek shade, use awnings in kindergarten)
- Protection by clothing (long-sleeved T-shirts, hat with a wide brim), Sunglasses
- Sunscreen products (protection against sunburn, but not against malignant melanoma)
- Gradual habituation with increasing individual exposure
- No use of perfumes, deodorants and other cosmetics when sunbathing
- Protection by UV opaque glass in the commercial sector

4.1.3 Target groups & Measures – Pollen Count

Depending on the concentration of Pollen in the air, hayfever (rhinitis and conjunctivitis) and / or bronchial asthma may arise at a respective individual disposition. However, the same illnesses may be caused independent of Pollen by other triggers or without external trigger. Therefore, a Pollen allergy must be diagnosed by medical examinations. Seasonality of complaints may indicate a Pollen allergy.

"Desensitisation" may be useful as a long-term therapy which must however be initiated outside the Pollen season.

4.1.3.1 Target group - Pollen Count

Individuals allergic to Pollen are at risk. The Pollen forecast published by the German Pollen Information Service Foundation considers the Pollen of the following plants:

- Hazel
- Alder
- Ash-tree
- Birch
- Grasses
- Rye
- Mugwort
- Ambrosia/Ragweed

4.1.3.2 Measures regarding Pollen Count

The following measures to protect against Pollen and health problems caused by Pollen were researched (Weinert 2013, German Pollen Information Service Foundation):

- Taking medications (antihistamines, eye drops, anti-allergic nasal spray)
- Avoid stays outdoors or reschedule to Pollen reduced hours, step outside preferably after a rain shower
- Pollen protection screen at windows
- Car windows kept closed while driving (air filter in car)
- Hair wash in the evenings to rinse out Pollen
- Not keeping worn street clothes in bedrooms
- Ventilation at times of low Pollen Count (in the city: between 06:00 and 08:00 hrs; in the countryside between 19:00 and 24:00 hrs)

Long-term measures are recommended regardless of a current Pollen Warning:

- Exchange of car ventilation Pollen filters once a year
- Removal of plants from the garden with Pollen that trigger allergic reactions
- Summer vacations should be spent in regions with very little Pollen Count such as the seaside or in the mountains

4.1.4 Target groups & Measures – Ozone

The exposure in the outside air is largely determined by the physical activity: Higher respiratory minute volume increases the proportion of Ozone, which penetrates into the alveoli and is not already decomposed in the bronchi. Thus, the following symptoms occur only after several hours of exposure with simultaneous physical strain:

Respiratory tract irritation, coughing and breathing difficulties may occur from 200 µg/m³.

Changes in lung function parameters may occur from 160 to 300 µg/m³ and an increase in the incidence of asthma attacks may occur from 240-300 µg/m³. A reduction in physical fitness in top-level sport is possible from 240 - 740 µg/m³ (Wagner and Höppe 1998).

No serious health problem or permanent damage is reported. It is just stated that "experience has shown that sensitive individuals", experience some irritation. This affects approximately 10 to 15% of the population across all groups of population (UBA 2005).

4.1.4.1 Target group Ozone

Sensitive groups of population are neither identifiable by age nor by chronic obstructive pulmonary illness (UBA 2005). Effects resulting from an increased Ozone concentration were also found for individuals with pre-existing cardiovascular system conditions (Mücke 2008).

The risk group includes individuals who exercise strenuous physical activities outdoors such as playing, playing sports or frequently performing prolonged strenuous work outdoors. For precautionary reasons, all infants and young children must be classified as a risk group in principle, as they have a relatively increased respiratory volume in relation to their body size (UBA 2005).

4.1.4.2 Measures Ozone

The following preventive measures have been researched:

- Rescheduling of prolonged physical exertion to morning and evening hours
- Reduction or complete avoidance of strenuous work
- Airing of living spaces in the morning and evening hours
- Infants and young children should not be outdoors at noon

The following rule of thumb applies: Rational behaviour with respect to high temperatures is also reasonable with regard to Ozone. The recommendation not to use cars is not intended for individual protection.

4.1.5 Summary of adaptation measures

The table below shows the adaptation measures considered for the Population Survey.

Table 10: Adaptation measures considered

Environmental factor	Measures
Heat	Taking advantage of cooler times of a day for stays in the open air, avoid exhausting physical activities in particular during midday heat
	Consuming plenty of fluids: water, juice, tea, no alcohol
	Airing at night and in the early morning hours
	Deflecting the sun by closing blinds, curtains, shutters
	Using cool rooms for a few hours per day
	Cooling by the use of showers, cold compresses or footbaths
UV-Radiation	Seek shade
	Application of sunscreen products
	Wearing sunglasses
	Avoid midday sun
	Wearing a head covering
	Wearing clothes with long sleeves
	Gradual adapting to sunlight
Pollen Count	Keep car windows closed while driving
	Application of anti-allergic medication (antihistamines)
	Washing hair in the evening
	Avoiding outdoor stays
	Not storing clothing in bedrooms that has been worn outdoors
	Installing Pollen protection screens at windows
	Preferably going outdoors after rain showers
Ozone	Rescheduling of prolonged physical exertion to morning and evening hours
	Reduction or complete avoidance of strenuous work
	Staying in closed rooms

4.2 Survey of DWD and UBA

The DWD has communicated the user numbers shown in the following table. The users include German Federal State ministries, subordinate health authorities and health care facilities, such as retirement homes and nursing homes. For the Heat Warnings, there are different registration procedures for private users and health care facilities. Nevertheless, it cannot be ruled out that amalgamations might occur. Thus, only the total amount of registrations is stated here.

Table 11: Number of DWD Newsletter users Status as of January 2013[17]

Information system	Number of users
Newsletter - UV-Warnings	3,522
Newsletter - Heat Warnings	9,737
Newsletter: Pollen Count Risk-Index	13,830

The DWD provides points of contact for the dissemination of Heat Warnings at the German Federal State ministries.

In addition, administrative agreements, which define the dissemination of Heat Warnings, are in place for each German Federal State.

The German Federal Environment Agency (UBA) offers the “Ozone Forecasts” Newsletter. The UBA has about 80-100 Newsletter subscribers per annum, which include authorities, associations, clubs, science and individuals.[18]

[17] E-mail, Dr. Koppe (DWD) dated 31 January 2013

[18] E-mail, Dr. Mücke (UBA) dated 24. January 2013

4.3 Survey of German Federal State ministries

4.3.1 Procedure

The survey was conducted by means of questionnaires (refer to Capellaro and Sturm, 2015b). This survey was announced in the course of the meeting of the ad hoc working group "Health adaptation to the impacts of climate change" of the standing committee for the "Adaptation to the impacts of climate change" (AFK). The dispatch of the questionnaires by e-mail was performed by the unit IG II 7 of the German Federal Ministry of the Environment on 22 Mai 2013. The completed questionnaires were returned to the sender by the 22 July 2013.

4.3.2 Evaluation

4.3.2.1 Response rate

With the exception of the German Federal State of Saxony, all German Federal State ministries responsible for health or other similar bodies responded to the survey. In addition, the environmental ministries of North Rhine-Westphalia and Rhineland-Palatinate have collaboratively answered the questions regarding Ozone.

4.3.2.2 Receipt of information or Warnings

All 15 German Federal State ministries that responded to the survey receive DWD Heat Warnings. In addition, six of those respondents also subscribe to the Heat Pre-information. Two German Federal States subscribe to UV-Information and two other German Federal States subscribe to Pollen Information or to Severe Weather Warnings, respectively. Only the Environmental Agency of Rhineland-Palatinate subscribes to UBA forecasts; the State of Hessen gets informed by using other sources. 11 health authorities do not receive Ozone Forecasts and another three authorities could not or did not provide an answer.

4.3.2.3 Distribution of information or Warnings to healthcare facilities

Six Federal States distribute information or Heat Warnings to health care facilities under their own responsibility (Bavaria, Berlin, Bremen, Hessen, North Rhine-Westphalia, Saxony-Anhalt).

Only Baden-Wuerttemberg refers to an obligation for health institutions to get themselves informed by the DWD. A further seven Federal States recommend healthcare facilities to get themselves informed by the DWD (Hessen, Mecklenburg-Western Pomerania, Lower Saxony, Rhineland-Palatinate, Saxony-Anhalt, Schleswig-Holstein and Thuringia) and in six Federal States refrain from a systematic requirement or commitment of health care facilities to get themselves informed.

Retirement homes and nursing homes receive Heat Warnings in 10 Federal States (Baden-Wuerttemberg, Bavaria, Bremen, Hessen, Mecklenburg-Western Pomerania, Lower Saxony, Rhineland-Palatinate, Saarland, Saxony-Anhalt, Schleswig-Holstein) in four Federal States, such facilities already receive Heat Pre-information.

In eight Federal States, health authorities receive the Heat Warnings (Baden-Wuerttemberg, Hessen, Mecklenburg-Western Pomerania, Lower Saxony, North Rhine-Westphalia, Rhineland-Palatinate, Saxony-Anhalt, Schleswig-Holstein) of which they also receive Heat Pre-information in three Federal States, Ozone Forecast in two Federal States and in one Federal State they also receive the Pollen-Risk Index and the UV-Warnings.

Table 12: Survey of the German Federal State ministries, distribution of information or Warnings

	Retirement / nursing homes and similar recipients receive information or Warnings (Question 6)	Forwarding in a Federal State's own responsibility (Question 5)	Facilities are obliged (Question 5)	Facilities are recommended to (Question 5)	Facilities are not required to and are not requested to (Question 5)
Baden-Wuerttemberg	x		x		
Bavaria	x	x			
Berlin		x			
Brandenburg					x
Bremen	x	x			x
Hamburg					x
Hessen	x	x		x	
Mecklenburg-Western Pomerania	x			x	
Lower Saxony	x			x	x
North Rhine-Westphalia		x			
Rhineland-Palatinate	x			x	
Saarland	x				x
Saxony					
Saxony-Anhalt	x	x		x	
Schleswig-Holstein	x			x	x
Thuringia				x	

In five Federal States, welfare centres and home care services received Heat Warnings (Hessen, Mecklenburg-Western Pomerania, Lower Saxony, Saarland and Saxony-Anhalt) in addition, one Federal State already receives Heat Pre-information.

In five Federal States, homes for sick and disabled people receive Heat Warnings and in two Federal States they receive Heat Pre-information.

In three Federal States, hospitals receive Heat Warnings, and Heat Pre-information is already subscribed to by one Federal State.

Childcare facilities receive Heat Warnings in two Federal States, and in one Federal State, they also receive the Ozone Forecast.

In one Federal State, child-minders (so-called “foster mothers”) and schools also receive Heat Warnings; however, this does not apply to sports clubs and trade association/unions.

In two Federal States, emergency services receive Heat Warnings and also the Heat Pre-information in one Federal State. In another Federal State, official Weather Warnings are provided to emergency medical services, fire departments and police forces; in another Federal State, fire departments and police forces also receive Heat Warnings.

In one Federal State, Heat Warnings are also passed on to the general public and in one respective Federal State are also passed on to the press, the County Governments and/or the judicial.

The dissemination of information or Warnings is coordinated by a subordinate administration level in six Federal States; five Federal States negate such procedure. The remaining respondents did not provide any information on this topic.

4.3.2.4 Action plans

Three Federal States have Heat Action plans for all stages in place; three other Federal States have no such plans in place. The respondents from two other Federal States have no information on this topic.

Two Federal States are aware of measures in the event of an Ozone Forecast; two other Federal States are aware of measures in the event of upcoming Severe Weather Warnings.

Four German Federal State ministries cannot provide information on possible measures.

4.3.2.5 Distribution of information or Warnings to the population

The German Federal States use different and sometimes multiple ways to advise the population on the information and Warning systems of the DWD and UBA: 10 German Federal States use their website, three use their own brochures and four Federal States use other ways, mostly press releases. In this context, eight Federal States refer to the information systems of the DWD and UBA, three forward such information on their states own responsibility.

4.3.2.6 Evaluation of information or Warnings

14 Federal States consider the receipt of information or Warnings on extreme weather events to be reliable and 12 Federal States consider such information to be received in good time.

The benefits of Warnings of severe or extreme heat was evaluated by participants as follows: nine respondents rated the benefit as “high”, two as “low”, one could not see any benefit or harm, two participants did not provide or did not know the answer. The benefit of Heat Pre-information was evaluated by three participants as “high” and by two participants as “low”.

One Federal State evaluated all Warnings and information as being highly beneficial; two other Federal States see high benefit in Ozone Forecasts or Severe Weather Warnings.

4.3.3 Discussion

The receipt of information or Warnings varies greatly between the Federal States.

All German Federal State ministries subscribe to Heat Warnings. However, only two state ministries subscribe to UV-Information (Lower Saxony, Saxony-Anhalt) and only one State ministry receives Pollen Information (Mecklenburg-Western Pomerania) or Severe Weather Warnings (Berlin) respectively.

The forwarding of the Heat Warnings does however vary. A distribution to retirement and nursing homes is partly performed by the ministries of health. Other Federal States require health care facilities, such as retirement and nursing homes, to use DWD Heat Warnings. Other Federal States leave it

open to institutions to get informed on appropriate extreme weather events with or without explicit requests.

The distribution of Heat Warnings or the recommendation or obligation to obtain such information applies to (multiple answers possible):

- Retirement and nursing homes in two thirds of the Federal States,
- Local health authorities in half the Federal States,
- Social centres and outpatient nursing services and homes for the sick and disabled in one third of the Federal States,
- Hospitals in one fifth of the Federal States.

Table 13: Survey of the German Federal State Ministries: Question 6: Forwarding, recommendation or commitment regarding Heat Warnings

Heat Information	BW	BY	BE	BB	HB	HH	HE	MV	NI	NW	RP	SL	SN	ST	SH	TH
Welfare centres / outpatients' care services								X	X			X			X	
Retirement homes / nursing homes and similar facilities	X	X			X		X	X	X		X	X		X	X	
Hospitals							X					X			X	
Dormitories	X				X		X	X				X				
Child care facilities					X			X								
Local Health Authorities	X						X	X	X	X	X			X	X	X
Other							X			X		X				

Remark: The Federal States of Hamburg and Brandenburg did not answer this detailed question. The State of Berlin only distributes official Severe Weather Warnings, but not Heat Information. The State of Saxony has not responded to the questionnaire.

Out of the 10 countries that have indicated in the survey, that they distribute Heat Warnings to retirement and nursing homes, a legal obligation for distribution only exists in the state of Baden-Wuerttemberg. At least a recommendation to distribute is made in the remaining Federal States of Hessen, Mecklenburg-Western Pomerania, Lower Saxony, Rhineland-Palatinate, Saxony-Anhalt and Schleswig-Holstein.

Action plans are in place in one quarter of the Federal States, (Baden-Wuerttemberg, Bremen, Hessen and, for Ozone, the Rhineland-Palatinate Ministry of Environment) one fifth of the Federal States is aware of such measures (Saarland, North Rhine-Westphalia and Berlin with respect to measures in case of official Weather Warnings).

The population is informed on information and Warning systems for extreme weather events on the websites of the Federal States, and by press releases or brochures provided by the Federal States.

4.4 Survey of participants of the ÖGD-advanced training

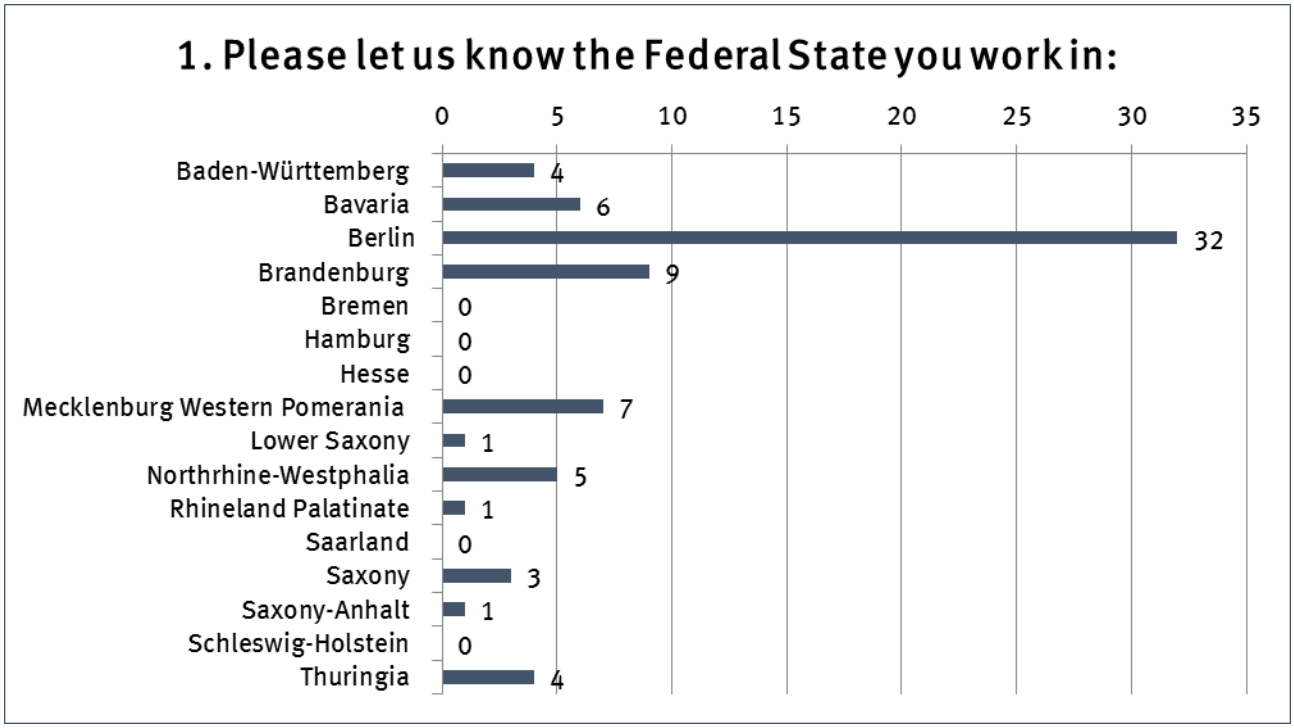
4.4.1 Results

4.4.1.1 Response rate

535 individuals participated in this event. 77 questionnaires (14.4%) have been returned after the event. No participant has made use of the other options (e-mail, fax, mail) provided for submission by the 31 March 2013.

Most participants (32, approx. 42%) were from Berlin (Answer to question 1: "Please let us know the Federal State you work in"). A significantly lower number of only 9 participants indicated the state of Brandenburg.

Figure 10: ÖGD survey, Question 1: German Federal State



The following answering options for Question 2 "In what kind of institution do you work", were available:

- Health Authority
- Superior Federal Authority
- State Authority
- Subordinate health authority / local health authority
- Other public authority; please state:
- Medical, Veterinary or Chemical Investigation Office
- Hospital
- School or children day-care centre
- Nursing and retirement homes
- Other facility; please state:

Several answers were allowed. 14 participants (18%) stated working at a

Health Authority 27 participants (36%) stated working at a subordinate health authority or a local health authority. 7 of the latter participants also stated working for a health authority.

Table 14: German Health Authorities Survey, Question 2: Facilities

Relative (approx.)	Absolute	Facilities
18%	14	Health Authority
17 %	13	Superior Federal Authority
9 %	7	State Authority
36 %	27	Subordinate health authority / local health authority
20 %	15	Other public authority; please state:
9 %	7	Medical, Veterinary or Chemical Investigation Office
1 %	1	Hospital
0 %	0	School or children day-care centre
0 %	0	Nursing and retirement homes
0 %	0	Other facility; please state:

Table 15: German Health Authorities Survey, Question 2: Authorities / facilities, free-text answers

Stating other authorities/facilities (free-text, explanation in brackets, if necessary)
Food Control Office
BfR
German Federal Ministry of Food, Agricultural & Consumer Protection
German Federal Ministry
BZA Reinickendorf, Veterinary Office
LÜVA Northern Saxony (Veterinary and Food Control Office) Ministry
(Health Department)
Public Order Office, Veterinary and Food Control Office
Federal Environmental Agency, AZ/AGD Saxony-Anhalt
Veterinary and Food Control Office
VLA (Veterinary and Food Control Office) Border Control
BfR
German Federal Ministry of Food, Agricultural & Consumer Protection

Based on the objective of the ÖGD-training participants survey, only the responses of subordinate health authorities or local health authorities (n=27) were considered for evaluation.

4.4.1.2 Receipt of information or Warnings

The most frequent answer was that Heat Warnings and Official Warnings (weather/storm Warnings) are received (both: 15, approx. 56% each). According to the responses, other information or Warnings are received more rarely (below 20%). Multiple answers were possible.

Table 16: German Health Authorities Survey, Question 3: Receipt of information or Warnings

Relative (approx.)	Absolute	Information and/or Warnings
19 %	5	Heat Pre-information
56 %	15	Heat Warnings
11 %	3	UV-Warnings
7 %	2	Pollen Count Risk-Index
56 %	15	Official Warnings (Weather / Severe Weather Warnings)
0 %	0	other, please state
19 %	5	none
0 %	0	no answer / do not know

The respondents who stated that they received Heat Warnings (n=15), work in the following Federal States:

Table 17: German Health Authorities Survey, Receipt of information or Warnings by each German Federal State

Absolute	German Federal State
5	Bavaria
2	Berlin
2	Mecklenburg-Western Pomerania
2	North Rhine-Westphalia
2	Thuringia
1	Baden-Wuerttemberg
1	Saxony

DWD (n=9) and Federal State authorities (n=8) were indicated as the sources for the receipt of Heat Warnings, from which three participants stated both, DWD and Federal State authorities as sources of supply. The following sources were indicated as free-text answer: “district office”, “fire brigade, disaster Warnings”, “catastrophe prevention services/Federal State Office”, “district office”, “management of the City Council” and “environmental agency”.

4.4.1.3 Receipt of Ozone Forecasts

Three out of 27 participants working at a subordinate health authority or a local health authority indicated receiving Ozone Forecasts. 23 participants working at a subordinate health authority or a local health authority answered the question “Do you receive Ozone Forecasts?” with “No“; one participant did not answer this question. Federal State authority (as other sender), the DWD and the Environmental Agency were each named once as the source of information.

4.4.1.4 Propagation of information or Warnings

When asked, “The healthcare facilities (such as hospitals, welfare centres and nursing homes) may be informed or warned in different ways. The transmission can be done by the information systems of the DWD and UBA or are in a Federal States own responsibility. Information or Warnings are distributed as follows:” the most common answer was “No answer / do not know” (n=10) and “There is no sub-distribution” (n=8).

Five respondents from a subordinate health authority or a local health authority indicated that they forward the information or Warnings on their own responsibility. Two respondents indicated that the health care institutions would be notified directly by the DWD and/or UBA information systems. One participant stated that health care institutions are requested to register with the DWD / UBA for receiving information or Warnings.

The following table represents the answer distribution to the question "To which facilities do the answer(s) to the previous question apply?". Information is most commonly distributed to retirement/nursing homes and similar institutions. "Public transport" and "Forest management" were stated as free-text answer.

Table 18: German Health Authorities Survey, Question 8: Informed Facilities

Absolute	Bodies
7	Retirement homes/Nursing homes and similar facilities
5	Hospitals
4	Welfare centres/Outpatients' care providers
3	Dormitories (for disabled or sick people)
3	Childcare facilities such as day nurseries, day-care centres and similar facilities
3	Schools
3	Local health authorities
2	Rescue services
2	Fire Department
2	Surgeries
1	Police
1	Other (free-text: public transport, forest administration)
0	Foster mothers
0	Sports clubs
0	Trade association/trade unions

4.4.1.5 Measures

The question "The Warnings can lead to the implementation of concrete protection and adaptation measures in accordance with an action plan. Are you aware of the actions to be taken?" was answered as follows:

Seven of the 27 respondents from subordinate/local health authorities are aware of the to be introduced measures in cases of Heat Warnings (strong or extreme heat exposure).

Table 19: German Health Authorities Survey, Question 9: Awareness of measures

	Yes	No	No measures available	No answer / do not know
Heat Pre-information	4	4	3	2
Heat Warning (strong heat exposure)	6	3	2	1
Heat Warning (extreme heat exposure)	7	3	2	1
UV-Warnings	2	6	1	1
Pollen Count Risk-Index	2	4	1	1
Ozone Warnings	4	3	2	2
Official Warnings (Severe Weather Warnings)	7	5	1	1
Other Information and/or Warnings	2	5	0	3

4.4.1.6 Information to the public

The positive answers of respondents from subordinate/local health authorities to the question "By which means do citizens receive information and Warnings" were limited to the following statements:

- "Information and Warnings are passed on to the media under own responsibility." (n=7)
- "Information and Warnings are directly distributed by the information system of the German Weather Service and the Federal Environment Agency, i.e., a registration with the DWD/UBA is made by the citizens themselves." (n=4)

And two respondents have ticked both answers. Four participants selected "No" and ten participants selected "No answer / Do not know". The following answers were not selected:

"Information and Warnings are passed on to the citizens under own responsibility …

- … by forwarding a Newsletter. "
- … by telephone."
- … by means of SMS."

4.4.1.7 Evaluation of information or Warnings

When asked "We receive the information and Warnings from the DWD / UBA …

- reliably."
- in good time."

frequently neither answer was ticked (n=17). Four respondents indicated both possible answers, whereas four respondents only selected "in good time" and two respondents only selected "reliably".

5 participants did not answer the question "How would you rate the usefulness of the information and Warning systems for the vulnerable populations?". The other respondents from subordi-

nate/local health authorities mostly estimated the benefits as positive, as shown in the following table.

Table 20: German Health Authorities Survey, Question 13: Use of the information and Warning systems

	Great benefits	Lower benefits	Neither nor	Minor damage	Major damage	No answer / do not know
Heat Pre-information	4	7	3	0	0	4
Heat Warning (extreme heat exposure)	10	5	1	0	0	4
Heat Warning (extreme heat exposure)	10	4	1	0	0	4
UV-Warnings	5	7	2	0	0	4
Pollen Count Risk-Index	8	3	4	0	0	3
Ozone Warnings	6	4	5	0	0	3
Official Warnings (Severe Weather Warnings)	9	8	2	0	0	2
Other Information and/or Warnings	4	1	5	0	0	5

4.4.1.8 Limitations

The self-selection of participants represents the biggest limitation of the subordinate/local health authorities survey. In addition, the participants of the event neither constitute a representative nor a randomized sample for the survey target group. Although the respondents work in a health authority (or similar authority), there is no guarantee that they are actually the right interviewees for the topic.

4.4.2 Discussion

Considering the limitations, the survey of subordinate/local health authorities can only provide very limited information about the extent the information or Warnings of the DWD and UBA will be passed on to official recipients and on how many recipients are actually reached via institutional information channels.

Also the heterogeneous composition of the respondents makes any evaluation difficult. Berlin alone represents 42% of respondents. The other eastern Federal States are represented by 32%, and the western Federal States are represented by 23% of respondents and almost a third of the Federal States are not represented at all.

Individual Warnings or information (such as Heat Warnings and Severe Weather Warnings) are only received by a maximum of 50% of the subordinate/local health authorities that responded during the survey (n=15).

Only seven of the 15 respondents can provide further details on the distribution of Heat Warnings to healthcare facilities. The remaining eight respondents deny the existence of a sub-distributor, ten respondents could not or did not provide an answer.

“Retirement/nursing homes and similar facilities” are indicated as the main recipients by the seven subordinate/local health authorities, which can provide details on the forwarding of Heat Warnings. (n=6). Medical surgeries are mentioned here two times.

When taking a detailed look at the answers of those seven respondents in isolation from the other answers, a widespread knowledge of the information or Warnings regarding the following measures can also be noted (five for Heat Warnings, four for Severe Weather Warnings, two for Ozone Warnings, one for UV-Warnings and one for the Pollen-Risk-Index).

Despite the increasingly thinner data basis, it can be noted that the cascading information on Heat Warnings from the DWD to the health ministries of the Federal States and the local health authorities towards the nursing homes, might work. [19]

Consequently, it must be questioned whether and how the agreed cascade of information can be extended to other healthcare facilities (such as doctors) and used for other information systems to the same extent.

A quarter of the responding subordinate/local health authority forward information and Warnings to the media. Again, the question arises whether the working cascade of information can be extended to facilities that are not related to health care but bear social responsibility (such as clubs or unions).

[19] Since these seven respondents originate from different German federal states (Baden-Wuerttemberg, Bavaria, Mecklenburg-Western Pomerania, North Rhine-Westphalia, Saxony and Thuringia), these examples of good practice cannot be attributed to a single federal state.

4.5 Evaluation of Newsletters by the project team

The Newsletter itself can also be analysed according to various criteria. These components can help to ensure that the information provided in the Newsletter are understandable, manageable and of practical use for the subscribers. The analysis is represented in Table 21.

Table 21: Analysis of the Newsletters: Heat, UV, Pollen and Ozone Warning

	Heat	UV	Pollen Count	Ozone
Publisher	DWD	DWD	DWD	UBA
Subscribers (Status as of January 2013)	9,737	3,522	13,830	80-100
Sender e-mail	German Meteorological Service Heat Warning DWDNewsletterAdterAdmin_HZ@newsletter.dwd.de	German Weather Service UV-Warning DWDNewsletterAdterAdmin_UV@listen.dwd.de	German Meteorological Service Pollen Count Risk-Index DWDNewsletterAdmin_PV@newsletter.dwd.de	abo@liwa.de
Subject line e-mail	DWD -› Heat Warning - HZ_DWHH	DWD -› high UV-Warning Index - UV_ESXX	DWD -› Pollen Count Risk-Index Germany -	Graphical version: Ozone Forecast
Point of contact	including point of contact e-mail and telephone number	including point of contact e-mail and telephone number	not explicitly stated	not explicitly stated
Further Information	Reference to www.dwd.de	Reference to www.dwd.de	no link to further information	Reference to the entire forecast with link
Unsubscribe	direct link	direct link	direct link	direct link
Currentness	for the next day	Same day forecast	same day or next day	4-day Forecast, starting on the previous day
Confinement	Area unambiguous (County)	Area unambiguous (County)	Area unambiguous (German Federal States)	Area unambiguous (Postcode areas)
Content e-mail	Letters and combination of numbers, taken up, defined date and region	Letters and combination of numbers, defined date and region brief explanation Warning and behavioural recommendation publishing partner stated	Subject take up defined date and region publishing partner stated (German Pollen Information Service Foundation)	region and period stated Warning/Note on risk in the text is not unambiguous - › concrete Warning is not evident

	Heat	UV	Pollen Count	Ozone
		(German Federal Office for Radiation Protection)		
Thresholds	Note on “strong heat exposure“	Note on “Ozone layer too thin for the season“	Key indicates unusually high values	The colour scheme in the appendix provides references to elevated values
Notification period	May to August	April to August	approximately 1st of January to 31st of October	not specified
Recommendations	No behavioural recommendation with reference to WHO	none	none	Recommendations
Language	Abandonment of technical terms	Abandonment of technical terms	Abandonment of technical terms	Technical terms Special characters and abbreviations
Comprehensibility	not conclusive at first glance › concrete Warning gets slightly lost	not conclusive at first glance › concrete Warning gets slightly lost	Information evident at a glance, clear representation by means of a table	difficult for consumers to translate, unclear attachments (five graphics)
Pictorial clarification	no graphical support	no graphical support	comprehensible key	Key is separated from cards
Emphases	without colour highlighting	without colour highlighting	Colour highlighted Risk-Index	without colour highlighting

When opening the e-mail, the first impression already plays an important role for evaluating the professionalism, credibility and reliability of the information obtained. The sender German Weather Service Newsletters can be clearly identified, while the address of UBA Ozone Forecast appears arbitrarily.

The subject line of Heat and UV-Newsletter summarises the content of the e-mail meaningfully, however, the acronyms in capital letters possibly confuse the reader (Example: Table 1: DWD -> Heat Warning - HZ_DWHH). The Pollen Count Warning is received without such acronyms. The subject line of the Ozone Forecast is also available in English, however, the Newsletter itself is written entirely in German.

As regards the content, the Heat and UV-Newsletters start with a combination of letters and numbers that is of little use for subscribers and rather irritating. Subsequently, information on the region, the period of validity and the editor of the Warning are provided. So far, both Newsletters are very similar. In addition to the Warning itself, the UV-Newsletter also contains a brief explanatory statement and an indication of behaviour of WHO recommendations. As for the Heat Warning, the Pollen Count and Ozone Forecast also do not contain recommendations for possible protective behaviour.

The presentation of reference values or Warning threshold is also helpful for the user.

The risk-index in the Pollen Count Newsletter is presented in a simplified and easy to understand format. Keys quickly and unambiguously convey the message and the coloured highlights.

The Ozone Forecast also utilises colouring; however it is inconvenient to send the key for the graphics as a separate annex.

In addition, the Ozone Forecast includes a not very helpful text with abbreviations, nomenclature and symbols that are confusing for subscribers.

It makes a good impression, that Heat and UV-Warnings include a specific point of contact and a link for more information. The Pollen Count and Ozone-Newsletter state no personal contact nor is a link for further information provided for the Pollen-Risk-Index. All four Newsletters provide highly visible unsubscribing information with a link.

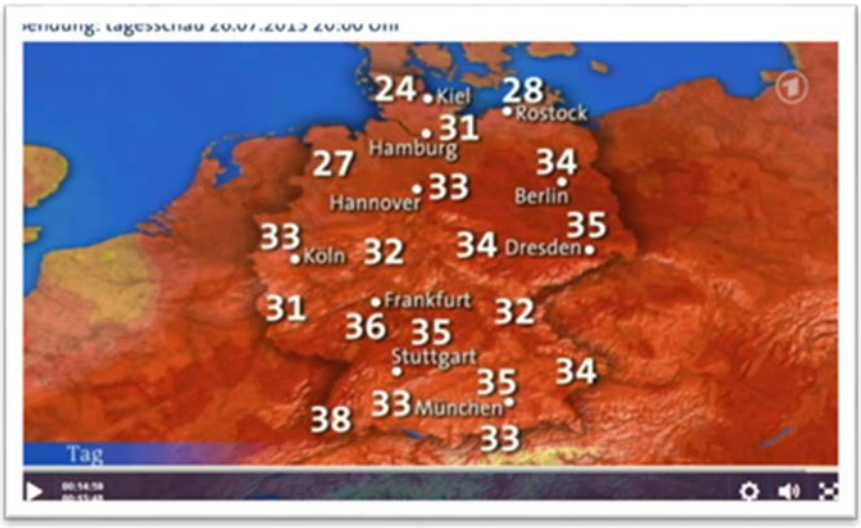
All four Newsletters were promptly sent either on the day before or the day the forecast applies to, and hence provides a sound basis for directly applying the information to everyday life. The regional confinement also increases the individual benefit.

4.6 Research: other multipliers / media monitoring

4.6.1 TV and Radio Research

About 100 television and radio stations are available in Germany respectively. The news programme "Tagesschau" that was broadcasted by the ARD on the 26 July 2013 is evaluated as an example. [20]

Figure 11: Screenshot of the "Tagesschau" evening news broadcasted on 26. July 2013



Source: http://www.tagesschau.de/multimedia/sendung/ts43364.html, 16 August 2013

The "Tagesschau" news on 26 July 2013 indeed mentioned "expected record-breaking highs near 40 degrees", but did not mention the DVD Heat Warning. UV-Radiation, Ozone or Pollen Count were also not mentioned.

In the field of radio, the news from the radio station "NDR Info" was analysed that was broadcasted at 13:00 hrs on the 25th, 26th and 27th of July 2013. No Heat Warning was broadcasted. On Friday, 26th July 2013 a severe local weather risk was indicated for the following Monday. (NDR, 2013)

4.6.2 Daily Newspaper Research

In order to determine which newspapers have passed on the Heat Warning or reported on UV-Radiation, Pollen Count or Ozone, the online archives of the nationwide published newspapers as well as individual regionally published daily newspapers were examined.

In this context, the newspapers shown in the table below were taken into account.

[20] The DWD issued an official Heat Warning inter alia for the German federal state of Hamburg on 26 July 2013. This warning was valid for the period Friday, 07.26.2013 11:00 hrs until Saturday, 27 July 2013 19:00 hrs. Very high temperatures were reported in the whole of Germany (http://www.wetterstatistik.org/wetteraufzeichnungen/wetterdaten-2013/, 01 January 2015). Hence it is assumed that Heat Warnings were issued for several regions.

Table 22: Research multipliers, examined daily newspapers

Daily newspapers examined:
Abendzeitung München
Augsburger
Allgemeine Badische
Newspaper
Berliner Zeitung
Berliner Morgenpost
Bild.de
Die Welt
Frankfurter Allgemeine
Frankfurter Rundschau
Hamburger Abendblatt
Hamburger Morgenpost
Handelsblatt
Neustadter Nachrichten
Potsdamer neueste Nachrichten
Ruhrnachrichten
Segeberger Zeitung
Süddeutsche
taz
Weser-Kurier

One of the following search terms needed to be found in the issues of Friday, 26th July 2013, Saturday, 27th July 2013 and possibly of Sunday, 28th July 2013:

Table 23: Research multipliers, search terms Daily newspapers

Search terms
Heat Warning
Heat wave
Heat
UV-Index
UV-Radiation
Pollen Count
Pollen Count Forecast
Pollen Forecast
Ozone

20 newspapers reported heat. In 17 cases, either a reference mas made to the DWD or the DWD Heat Warning was mentioned in an article. UV-Radiation or UV-Index was mentioned 9 times, Pollen Count was not mentioned at all and Ozone was mentioned in an article 6 times. A detailed description is published elsewhere (Capellaro and Sturm, 2015a).

4.6.3 Research Internet

The Internet provides numerous ways of obtaining the information or Warnings. The search for multipliers in this field was carried out as follows. A Google Alert was set up for the terms “Heat Warning”, “UV-Index”, “Pollen Count Forecast” and “Ozone Forecast”. Google Alerts represent e-mail alerts on the latest relevant Google results.

As part of this research, the notifications on websites were evaluated that contained the search terms during the period 25 July to 27 July.

Table 24: Research multipliers, Evaluation Google Alerts

Search terms	
Heat Warning	69
UV-Index	0
Pollen Count Forecast	0
Ozone Forecast	1

Since Heat Waves are events that are significantly less frequent than Pollen Count or UV-Radiation, this obviously leads to increased reporting.

4.6.4 Research Applications and Software

An Internet search was performed to detect applications and software applications for digital devices. Applications should be found that contain Warnings or information provided by the national information systems. Such applications could be applicable for both stationary stand-alone computers (e.g., PC and Mac) as well as for “Mobile Computing” devices (e.g., smartphones, tablet PCs, notebooks or similar).

The digital distribution platforms of leading companies in this field were searched for this purpose.

- Apple (“AppStore” and/or “iTunes”) for operating system “iOS” [21]
- Google (“Google Play”) for operating system “Android”
- Microsoft (“Windows Phone Store” and/or “Windows Store”) for operating systems “Windows 8” and “Windows RT”

The search terms used are described below.

The search terms for Heat Warning system applications are as follows: “Heat”, “Heat Warning”, “Heat Forecast” and “Heat Alert”.

The search terms used for UV-Index applications are as follows: “UV-Index” and “UV-Radiation”.

The search terms for Pollen Count applications are as follows: “Pollen”, “Pollen Count”, “Pollen Warning”, “Pollen Forecast” and “Pollen Alert”.

[21] The dates for the queries were scheduled for the 07 August 2013 and 22 August 2013.

The search terms for Ozone Forecast applications are as follows: “Ozone” “Ozone Warning”, “Ozone Forecast” and “Ozone Alert”.

For the collection of applications, the following parameters were recorded, if possible:

- Type of Warning and Information (Heat, UV-Radiation, Pollen Count or Ozone)
- Options for receiving more than one type of Warning and information
- Data basis (e.g. DWD data)
- GPS or postcode-based localisation
- Notification or PUSH-function 22 upon exceeding certain thresholds
- Price in Euro
- Frequency of use based on the displayed number of downloads or installations

Products were only recorded, if the description of an application expands on Warnings and information on the UV-Index, Heat Warning systems, Pollen Count and/or Ozone Forecasts. An application was also only recorded once, if it repeatedly occurred in the results of various queries. Applications that only provide general information on weather forecasts or that are not available in German language were not recognized.

112 applications could be identified by this search. Unfortunately, all information was not available in each case. The data source for example could often not be traced and the number of downloads was only provided for the Google App. In addition, it is not always clear from the application descriptions whether Heat Warnings are actually issued or not.

73 of the applications found are free of charge. The other applications cost between 0.50 € and 3.99 €. An overview of the applications found is shown elsewhere (Capellaro and Sturm, 2015a).

In conclusion, it can be stated that numerous applications are available that feature different characteristics and Warning functions. However, it is not always clear whether the information displayed by such application is actually data that is provided by the information systems analysed. The acceptance of these applications is not very pronounced in the population yet (refer to Population Survey).

4.6.5 Discussion

Heat Warnings are very popular with media multiplier by newspapers, the Internet and by developers of applications for digital devices (such as smart phones). This result may have different causes. Firstly, Heat Warnings fall into the so-called “silly season”, i.e. a time when less (political) messages are available to the media. Furthermore, a Heat Warning is a rare event that concerns all readers. 71% of the population has already heard or read about Heat Warnings.

The UV-Index is the least known information system (30 %). The research revealed that nine out of 20 newspapers discuss UV-Radiation or UV-Index during Heat Waves. The Population Survey also reflected these findings. Most people who heard or read about the UV-Index received such information from a newspaper or a magazine (43 %, TV: 29 %, Radio: 13 %).

However, the Pollen Count Forecast is best known. 87% of respondents said that they had heard or read about it. TV, radio and newspaper assume that the Pollen Count Forecast is preferably published in regional media. In addition, the newsworthiness of Pollen Count is not comparable to that of a heat wave. The people, who have already heard of a Pollen Count Forecast, have the stronger affinity for new media, compared to the people who know the other information systems at least by name. As regards the source, 8.6% of respondents with allergies stated the website of the DWD, 21.9% stated

[22] Interactive service that automatically alerts, updates or transfer notifications (message is “pushed").

other websites and 2.5% stated applications for computers or smartphones. Each of these values is higher than for other information systems.

The Ozone Forecast is also better known than the UV-Index. 54.2% of respondents have heard or read of the Ozone Forecast. Only a few relevant multipliers were identified for the Ozone Forecast. Ozone was discussed in five of the 20 newspapers surveyed. The evaluation of the Google Alerts only returned one hit. In retrospect, the search strategy ("Ozone Forecast") must be evaluated as being too narrow. By means of a free Internet search, numerous articles on the subject of Ozone were found for the State of Bavaria that contained e.g., the term Ozone Alert. The wide recognition of the Ozone Forecast is in contrast to the few respondents (28.3%) who chose the correct definition for Ozone ("Ozone is a gas that is contained in our breathing air") in the survey.

4.7 Scientific studies

4.7.1 Literature research: Heat Warning systems

Full-text versions could be found for the following sources:

1. Abrahamson, V., Raine, R., 2009. Health and social care responses to the Department of Health Heatwave Plan. J. Public Health Oxf. Engl. 31, 478–489. doi:10.1093/pubmed/fdp059
2. Abrahamson, V., Wolf, J., Lorenzoni, I., Fenn, B., Kovats, S., Wilkinson, P., Adger, W.N., Raine, R., 2009. Perceptions of heatwave risks to health: interview-based study of older people in London and Norwich, UK. J. Public Health Oxf. Engl. 31, 119–126. doi:10.1093/pubmed/fdn102
3. Alberini, A., Gans, W., Alhassan, M., 2011. Individual and public-program adaptation: coping with heat waves in five cities in Canada. Int. J. Environ. Res. Public. Health 8, 4679–4701. doi:10.3390/ijerph8124679
4. Anderson, M., Carmichael, C., Murray, V., Dengel, A., Swainson, M., 2013. Defining indoor heat thresholds for health in the UK. Perspect. Public Health 133, 158–164. doi:10.1177/1757913912453411
5. Blättner, B., Heckenhahn, M., Georgy, S., Grewe, H.A., Kupski, S., 2010. Identifying residential areas with heat-related health risks. Sociodemographic and climate data mapping as a planning tool for targeted prevention strategies. Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz 53, 75–81. doi:10.1007/s00103-009-0995-1
6. Cusack, L., de Crespigny, C., Athanasos, P., 2011. Heatwaves and their impact on people with alcohol, drug and mental health conditions: a discussion paper on clinical practice considerations. J. Adv. Nurs. 67, 915–922. doi:10.1111/j.1365-2648.2010.05551.x
7. Ferrara, P., Vena, F., Caporale, O., Del Volgo, V., Liberatore, P., Ianniello, F., Chiaretti, A., Riccardi, R., 2013. Children left unattended in parked vehicles: a focus on recent italian cases and a review of literature. Ital. J. Pediatr. 39. doi:10.1186/1824-7288-39-71
8. Forsberg, B., Bråbäck, L., Keune, H., Kobernus, M., Krayer von Krauss, M., Yang, A., Bartonova, A., 2012. An expert assessment on climate change and health - with a European focus on lungs and allergies. Environ. Health Glob. Access Sci. Source 11 Suppl 1. doi:10.1186/1476-069X-11-S1-S4
9. Haque, M.A., Yamamoto, S.S., Malik, A.A., Sauerborn, R., 2012. Households' perception of climate change and human health risks: a community perspective. Environ. Health Glob. Access Sci. Source 11. doi:10.1186/1476-069X-11-1
10. Khalaj, B., Lloyd, G., Sheppeard, V., Dear, K., 2010. The health impacts of heat waves in five regions of New South Wales, Australia: a case-only analysis. Int. Arch. Occup. Environ. Health 83, 833–842. doi:10.1007/s00420-010-0534-2
11. Liu, T., Xu, Y.J., Zhang, Y.H., Yan, Q.H., Song, X.L., Xie, H.Y., Luo, Y., Rutherford, S., Chu, C., Lin, H.L., Ma, W.J., 2013. Associations between risk perception, spontaneous adaptation behavior to heat waves and heatstroke in Guangdong province, China. BMC Public Health 13. doi:10.1186/1471-2458-13-913
12. Morabito, M., Crisci, A., Vallorani, R., Modesti, P.A., Gensini, G.F., Orlandini, S., 2011. Innovative approaches helpful to enhance knowledge on weather-related stroke events over a wide geographical area and a large population. Stroke J. Cereb. Circ. 42, 593–600. doi:10.1161/STROKEAHA.110.602037
13. Nassar, A.A., Childs, R.D., Boyle, M.E., Jameson, K.A., Fowke, M., Waters, K.R., Hovan, M.J., Cook, C.B., 2010. Diabetes in the desert: what do patients know about the heat? J. Diabetes Sci. Technol. 4, 1156–1163.
14. Nogueira, P.J., Machado, A., Rodrigues, E., Nunes, B., Sousa, L., Jacinto, M., Ferreira, A., Falcao, J.M., Ferrinho, P., 2010. The new automated daily mortality surveillance system in Portugal. Euro Surveill. Bull. Eur. Sur Mal. Transm. Eur. Commun. Dis. Bull. 15.
15. Oakman, T., Byles-Drage, H., Pope, R., Pritchard, J., 2010. Beat the Heat: don't forget your drink - a brief public education program. Aust. N. Z. J. Public Health 34, 346–350. doi:10.1111/j.1753-6405.2010.00564.x

16. O'Neill, M.S., Carter, R., Kish, J.K., Gronlund, C.J., White-Newsome, J.L., Manarolla, X., Zanobetti, A., Schwartz, J.D., 2009. Preventing heat-related morbidity and mortality: new approaches in a changing climate. Maturitas 64, 98–103. doi:10.1016/j.maturitas.2009.08.005
17. Reid, C.E., O'Neill, M.S., Gronlund, C.J., Brines, S.J., Brown, D.G., Diez-Roux, A.V., Schwartz, J., 2009. Mapping community determinants of heat vulnerability. Environ. Health Perspect. 117, 1730–1736. doi:10.1289/ehp.0900683
18. Toloo, G., FitzGerald, G., Aitken, P., Verrall, K., Tong, S., 2013. Evaluating the effectiveness of heat warning systems: systematic review of epidemiological evidence. Int. J. Public Health 58, 667–681. doi:10.1007/s00038-013-0465-2
19. Walker, R., Hassall, J., Chaplin, S., Congues, J., Bajayo, R., Mason, W., 2011. Health promotion interventions to address climate change using a primary health care approach: a literature review. Health Promot. J. Aust. Off. J. Aust. Assoc. Health Promot. Prof. 22 Spec No, S6–12.

These two studies could not be evaluated, because they were not accessible in full-text:

1. Krau, S.D., 2013. The impact of heat on morbidity and mortality. Crit. Care Nurs. Clin. North Am. 25, 243–250. doi:10.1016/j.ccell.2013.02.009
2. Rosenfeld, L.A., Fox, C.E., Kerr, D., Marziale, E., Cullum, A., Lota, K., Stewart, J., Thompson, M.Z., 2009. Use of computer modeling for emergency preparedness functions by local and state health officials: a needs assessment. J. Public Health Manag. Pract. JPHMP 15, 96–104. doi:10.1097/01.PHH.0000346004.21157.ef

4.7.2 Literature research: UV-Warning systems

These are the 13 articles used in the full-text search:

1. Bandi, P., Cokkinides, V.E., Weinstock, M.A., Ward, E.M., 2010. Physician sun protection counseling: prevalence, correlates, and association with sun protection practices among US adolescents and their parents, 2004. Prev. Med. 51, 172–177. doi:10.1016/j.ypmed.2010.05.003
2. Cokkinides, V., Kirkland, D., Andrews, K., Sullivan, K., Lichtenfeld, J.L., 2012. A profile of skin cancer prevention media coverage in 2009. J. Am. Acad. Dermatol. 67, 570–575. doi:10.1016/j.jaad.2011.11.920
3. Goldenberg, A., Nguyen, B.T., Brian Jiang, S.I., 2014. Knowledge, Understanding, and Use of Preventive Strategies against Nonmelanoma Skin Cancer in Healthy and Immunosuppressed Individuals Undergoing Mohs Surgery. Dermatol. Surg. Off. Publ. Am. Soc. Dermatol. Surg. Al 40, 93–100. doi:10.1111/dsu.12399
4. Grether-Beck, S., Marini, A., Jaenicke, T., Krutmann, J., 2014. Photoprotection of human skin beyond ultraviolet radiation. Photodermatol. Photoimmunol. Photomed. doi:10.1111/phpp.12111
5. Haluza, D., Cervinka, R., 2013. Perceived relevance of educative information on public (skin) health: a cross-sectional questionnaire survey. J. Prev. Med. Public Health Yebang Ŭihakhoe Chi 46, 82–88. doi:10.3961/jpmph.2013.46.2.82
6. Li, J., Uter, W., Pfahlberg, A., Gefeller, O., 2012. A comparison of patterns of sun protection during beach holidays and everyday outdoor activities in a population sample of young German children. Br. J. Dermatol. 166, 803–810. doi:10.1111/j.1365-2133.2012.10805.x
7. Markovitsi, D., Gustavsson, T., Banyasz, A., 2010. Absorption of UV radiation by DNA: spatial and temporal features. Mutat. Res. 704, 21–28. doi:10.1016/j.mrrev.2009.11.003
8. Marrett, L.D., Northrup, D.A., Pichora, E.C., Spinks, M.T., Rosen, C.F., 2010. The Second National Sun Survey: overview and methods. Can. J. Public Health Rev. Can. Santé Publique 101, I10–13.
9. Morris, J., Laing-Morton, T., Marno, P., Curnow, A., 2011. An investigation into the awareness and understanding of the ultraviolet index forecasts in the South West of England. Photochem. Photobiol. Sci. Off. J. Eur. Photochem. Assoc. Eur. Soc. Photobiol. 10, 103–108. doi:10.1039/c0pp00232a
10. Reeder, A.I., Jopson, J.A., Gray, A.R., 2012. "Prescribing sunshine": a national, cross-sectional survey of 1,089 New Zealand general practitioners regarding their sun exposure and vitamin D perceptions, and advice provided to patients. BMC Fam. Pract. 13. doi:10.1186/1471-2296-13-85

11. Surber, C., Ulrich, C., Hinrichs, B., Stockfleth, E., 2012. Photoprotection in immunocompetent and immunocompromised people. Br. J. Dermatol. 167 Suppl 2, 85–93. doi:10.1111/j.1365-2133.2012.11093.x
12. Wang, Y., Yu, J., Gao, Q., Hu, L., Gao, N., Gong, H., Liu, Y., 2012. The relationship between the disability prevalence of cataracts and ambient erythemal ultraviolet radiation in China. PloS One 7. doi:10.1371/journal.pone.0051137
13. Williams, A.L., Grogan, S., Clark-Carter, D., Buckley, E., 2013. Appearance-based interventions to reduce ultraviolet exposure and/or increase sun protection intentions and behaviours: a systematic review and meta-analyses. Br. J. Health Psychol. 18, 182–217. doi:10.1111/j.2044-8287.2012.02089.x

This article was not available as full-text version:

Buendía-Eisman, A., Conejo-Mir, J., Prieto, L., Castillejo, I., Moreno-Gimenez, J.C., Arias-Santiago, S., 2013. "Buen Rayito Study": awareness, attitudes and behavior of teenagers to sunlight through a web based system in Spain. Eur. J. Dermatol. EJD 23, 505–509. doi:10.1684/ejd.2013.2075

4.7.3 Literature research: Pollen Count Warning Systems

The full-text search for Pollen Count Warning systems resulted in these 12 articles:

1. Castellano-Méndez, M., Aira, M.J., Iglesias, I., Jato, V., González-Manteiga, W., 2005. Artificial neural networks as a useful tool to predict the risk level of Betula pollen in the air. Int. J. Biometeorol. 49, 310–316. doi:10.1007/s00484-004-0247-x
2. Forsberg, B., Bråbäck, L., Keune, H., Kobernus, M., Krayer von Krauss, M., Yang, A., Bartonova, A., 2012. An expert assessment on climate change and health - with a European focus on lungs and allergies. Environ. Health Glob. Access Sci. Source 11 Suppl 1. doi:10.1186/1476-069X-11-S1-S4
3. Frenguelli, G., Passalacqua, G., Bonini, S., Fiocchi, A., Incorvaia, C., Marcucci, F., Tedeschini, E., Canonica, G.W., Frati, F., 2010. Bridging allergologic and botanical knowledge in seasonal allergy: a role for phenology. Ann. Allergy Asthma Immunol. Off. Publ. Am. Coll. Allergy Asthma Immunol. 105, 223–227. doi:10.1016/j.anai.2010.06.016
4. García-Mozo, H., Yaezel, L., Oteros, J., Galán, C., 2014. Statistical approach to the analysis of olive long-term pollen season trends in southern Spain. Sci. Total Environ. 473-474, 103–109. doi:10.1016/j.scitotenv.2013.11.142
5. Gonzalo-Garjo, M.A., Tormo-Molina, R., Muñoz-Rodríguez, A.F., Silva-Palacios, I., 2006. Differences in the spatial distribution of airborne pollen concentrations at different urban locations within a city. J. Investig. Allergol. Clin. Immunol. 16, 37–43.
6. Justin-Temu, M., Risha, P., Abla, O., Massawe, A., 2008. Incidence, knowledge and health seeking behaviour for perceived allergies at household level: a case study in Ilala district Dar es Salaam Tanzania. East Afr. J. Public Health 5, 90–93.
7. Kasprzyk, I., Walanus, A., 2010. Description of the main Poaceae pollen season using bi-Gaussian curves, and forecasting methods for the start and peak dates for this type of season in Rzeszów and Ostrowiec Sw. (SE Poland). J. Environ. Monit. JEM 12, 906–916. doi:10.1039/b912256g
8. O'Leary, R., Wallace, J., BREATH Study Research Group, 2012. Asthma triggers on the Cheyenne River Indian Reservation in western South Dakota: the Breathing Relief Education and Tribal Health Empowerment (BREATHE) Study. S. D. Med. J. S. D. State Med. Assoc. 65, 57,–59, 61 passim.
9. Proulx, R., Massicotte, P., Pépino, M., 2014. Googling trends in conservation biology. Conserv. Biol. J. Soc. Conserv. Biol. 28, 44–51. doi:10.1111/cobi.12131
10. Rodríguez-Rajo, F.J., Valencia-Barrera, R.M., Vega-Maray, A.M., Suárez, F.J., Fernández-González, D., Jato, V., 2006. Prediction of airborne Alnus pollen concentration by using ARIMA models. Ann. Agric. Environ. Med. AAEM 13, 25–32.
11. Rosenlund, H., Kull, I., Pershagen, G., Wolk, A., Wickman, M., Bergström, A., 2011. Fruit and vegetable consumption in relation to allergy: disease-related modification of consumption? J. Allergy Clin. Immunol. 127, 1219–1225. doi:10.1016/j.jaci.2010.11.019

12. Sánchez Mesa, J.A., Galán, C., Hervás, C., 2005. The use of discriminant analysis and neural networks to forecast the severity of the Poaceae pollen season in a region with a typical Mediterranean climate. Int. J. Biometeorol. 49, 355–362. doi:10.1007/s00484-005-0260-8

These two articles could not be found:

1. Rodríguez, R., Villalba, M., Batanero, E., Palomares, O., Salamanca, G., 2007. Emerging pollen allergens. Biomed. Pharmacother. Biométd. Pharmacothérapie 61, 1–7. doi:10.1016/j.biopha.2006.09.014
2. Smith, M., Cecchi, L., Skjøth, C.A., Karrer, G., Šikoparija, B., 2013. Common ragweed: a threat to environmental health in Europe. Environ. Int. 61, 115–126. doi:10.1016/j.envint.2013.08.005

4.7.4 Literature research: Ozone Warning Systems

Full-text versions could be found for the following sources:

1. Kelly, F.J., Fuller, G.W., Walton, H.A., Fussell, J.C., 2012. Monitoring air pollution: Use of early warning systems for public health: Monitoring and communicating air quality. Respirology 17, 7–19. doi:10.1111/j.1440-1843.2011.02065.x
2. Semenza, J.C., Wilson, D.J., Parra, J., Bontempo, B.D., Hart, M., Sailor, D.J., George, L.A., 2008. Public perception and behavior change in relationship to hot weather and air pollution. Environ. Res. 107, 401–411. doi:10.1016/j.envres.2008.03.005

4.7.5 Summary

4.7.5.1 Heat

The following risk factors reported in the literature for mortality associated with Heat were identified:

- Age (O'Neill et al., 2009a; Reid et al., 2009)
- Poverty (Reid et al., 2009), live in cities (O'Neill et al., 2009)
- Bedridden individuals (Bouchama et al., 2007)
- Not leaving the house on a daily basis (Bouchama et al., 2007)
- Need of nursing care (Bouchama et al., 2007)
- Mental illnesses (Bouchama et al., 2007)
- Cardiovascular diseases (Bouchama et al., 2007)
- Lung diseases (Bouchama et al., 2007)
- Social isolation (Reid et al. 2009)
- Living without air conditioning (O'Neill et al., 2009a; Reid et al., 2009)

However, staying in cooler environments (Bouchama et al., 2007) and intensified social contacts (Bouchama et al., 2007) have a protective effect. Additional showers or baths (Bouchama et al., 2007) and the use of ventilators also demonstrate a trend towards better survival. (Bouchama et al., 2007).

Heat Warning systems are recommended by European experts in addition to measures of educational work and other monitoring systems (Forsberg et al., 2012).

For the evaluation of Heat Warning systems, unavoidable methodological difficulties must be considered. The comparability of different Heat Waves cannot be assured. They vary in duration and maximum temperature and are accompanied by several, also health affecting events such as particulate matter. Furthermore, different populations differ, for example in the prevalence of chronic diseases, age structure and other risk factors. It is also for this reason that a comparable control region is hard to find (Toloo et al., 2013).

Whether Heat Warning systems can save lives, has been researched by Toloo (Toloo et al., 2013). [15]

Studies have been considered. Six studies concluded that Heat Warning systems can save lives, i.e., reduce mortality. Two of these studies were also identified by the research conducted during this project (Chau et al., 2009; Fouillet et al., 2008). Toloo et al. could not identify a study that investigated to what extent Heat Warnings could prevent other, non-fatal adverse health effects (morbidity).

An Australian study showed that the risk of emergency admission to hospital due to heat-related illnesses increased more on days with extreme heat stress than for any other reason (Khalaj et al., 2010).

Some studies however show, that Heat Warnings have no influence on protective behaviour (Kalkstein and Sheridan, 2007; Sheridan, 2007).

In numerous studies, the perceived vulnerability has a positive impact on the implementation of protection measures (Abrahamson et al., 2009; Alberini et al., 2011; Kalkstein and Sheridan, 2007; Liu et al., 2013; Semenza et al., 2008; Sheridan, 2007).

A frequently mentioned problem is that older or other vulnerable people do not perceive themselves as vulnerable (Abrahamson et al., 2009; Alberini et al., 2011b; Sheridan, 2007; Toloo et al., 2013).

The publicity of heat wave Warnings or forecasts was widespread in most studies (Alberini et al., 2011; Bassil and Cole, 2010; Kalkstein and Sheridan, 2007; Semenza et al., 2008; Sheridan, 2007).

The contradiction between the effectiveness of Heat Warnings on the one hand and the low impact on the behaviour on the other hand, cannot currently be conclusively explained.

4.7.5.2 UV-Radiation

One study describes the results of a survey conducted in England in 2008. 67% of respondents reported to know the UV-Index, whereas only 40% were able to answer a comprehension question correctly and 60% reported that the UV-Index does not affect their protective behaviour.

The other publications each refer to the following items below without relating to the UV-Index: UV-protective behaviour (Li et al., 2012), the media coverage of skin cancer prevention (Cokkinides et al., 2012), the impact of campaigns with cosmetic arguments on the UV protection (Williams et al., 2013), the approach taken by physicians in cases of vitamin D deficiency (Reeder et al., 2012) or the conduct of physicians with regards to advise on sunscreen measures (Bandi et al., 2010).

Further publications only describe the methodology of a survey (Marrett et al., 2010), chemical UV protection (Grether-Beck et al., 2014) or the absorption of UV-Radiation by the DNA (Markovitsi et al., 2010).

Publications that solely relate to immunosuppressed individuals were also identified (Goldenberg et al., 2014; Surber et al., 2012).

One study collected the sources of information for skin health and found that print media, television and the family are the most relevant sources. Doctors only came fourth.

However, information from doctors, achieved a better growth of knowledge, a higher risk perception and more intense protection behaviour than the other sources of information (Haluza and Cervinka, 2013).

In addition to the systematically researched literature (refer to Chapter 3.7.2) the study of Börner et al. on the influence of the UV-Index was also taken into account. 27% of respondents stated that they know the UV-Index, 17% stated that they consider it, but only less than 10% were able to correctly interpret the UV-Index (Börner et al., 2010).

4.7.5.3 Pollen Count

None of the reviewed studies includes an evaluation of Pollen Count Forecast in terms of effects on knowledge or behaviour of the population.

One article examined the Pollen concentration at three different locations within the same town (Gonzalo-Garjo et al., 2006). One study analysed patterns of Pollen concentration in the time course of a season (Kasprzyk and Walanus, 2010). Other studies described a detailed analysis of the heyday of various grasses (Frenguelli et al., 2010) or a long-term statistical analysis of olive Pollen in Southern Europe (García-Mozo et al., 2014). Several articles examined the frequency of search terms (Pollen, mosquitoes, biodiversity, climate change, etc.) as a function of latitude and calendar week (Proulx et al., 2014). Other publications recognized e.g. a protective role of fruits and vegetables against hayfever (Rosenlund et al., 2011), analysed the prevalence and knowledge of allergies in Tanzania (Justin-Temu et al., 2008), evaluated the forecasts for alder, birch or grass Pollen based on actually measured values (Castellano-Méndez et al., 2005; Rodríguez-Rajo et al., 2006; Sánchez Mesa et al., 2005) or verified the factors triggering asthma for people living in Indian reservations (O'Leary et al., 2012).

Another recent study, which was not covered by the systematic research (refer to Chapter 3.7.3), examines the Pollen and particulate concentrations at three different sites in Berlin (Mücke et al., 2014).

4.7.5.4 Ozone

The article "Monitoring Air Pollution: Use of early Warning system for public health" by Kelly et al. discussed the relationship between information systems and human health. Early Warning systems aim to enable the population to carry out protective measures. [23] The presence of mixed results regarding the effectiveness of early Warning systems is mentioned. In addition, factors are cited that are conducive to change in behaviour. This includes in particular the personal experience of poor air quality. The social and geographical environment, as well as confidence, also appear to be relevant factors. Confidence is rather caused by personal experience or personal concern than by true forecasting values. The possibility of disseminating forecasts and Warnings on air quality via smartphone is described (Kelly et al., 2012).

The study by Semenza et al. concludes that the Warning system for air quality does not sufficiently reach the population (Semenza et al., 2008).

[23] "The ultimate aim should be to empower people to modify behaviour—for example, when to increase medication, the route/mode of transport taken to school or work or the appropriate time to pursue outdoor activities—in a way that protects their health as well as the quality of the air they breathe." (Kelly et al., 2012)

4.8 Representative Population Survey

In summer 2013, a representative telephone survey of the population was performed.

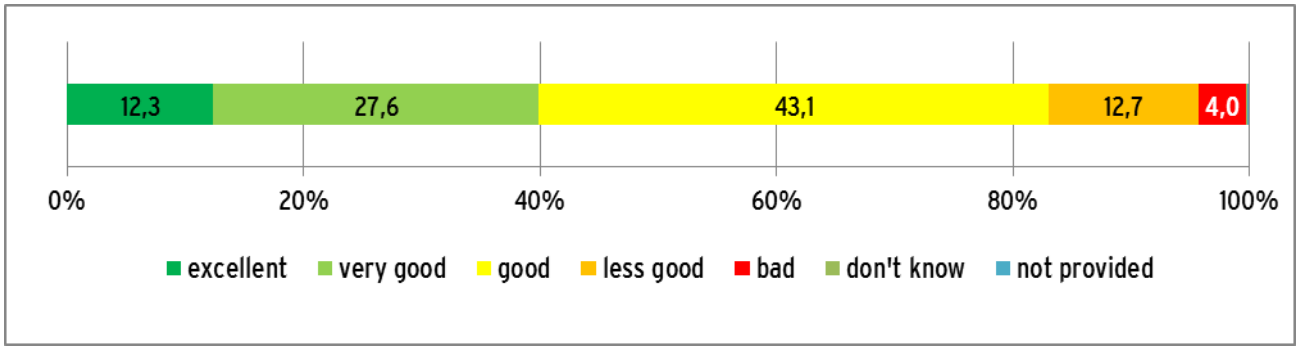
4,000 people answered the questions in the main questionnaire about their health, their information behaviour, risk perception and knowledge of the Warning systems.

A maximum of 400 people also answered one of the four additional questionnaires, which included questions about one of the four information and early Warning systems and their related protection measures.

4.8.1 General findings

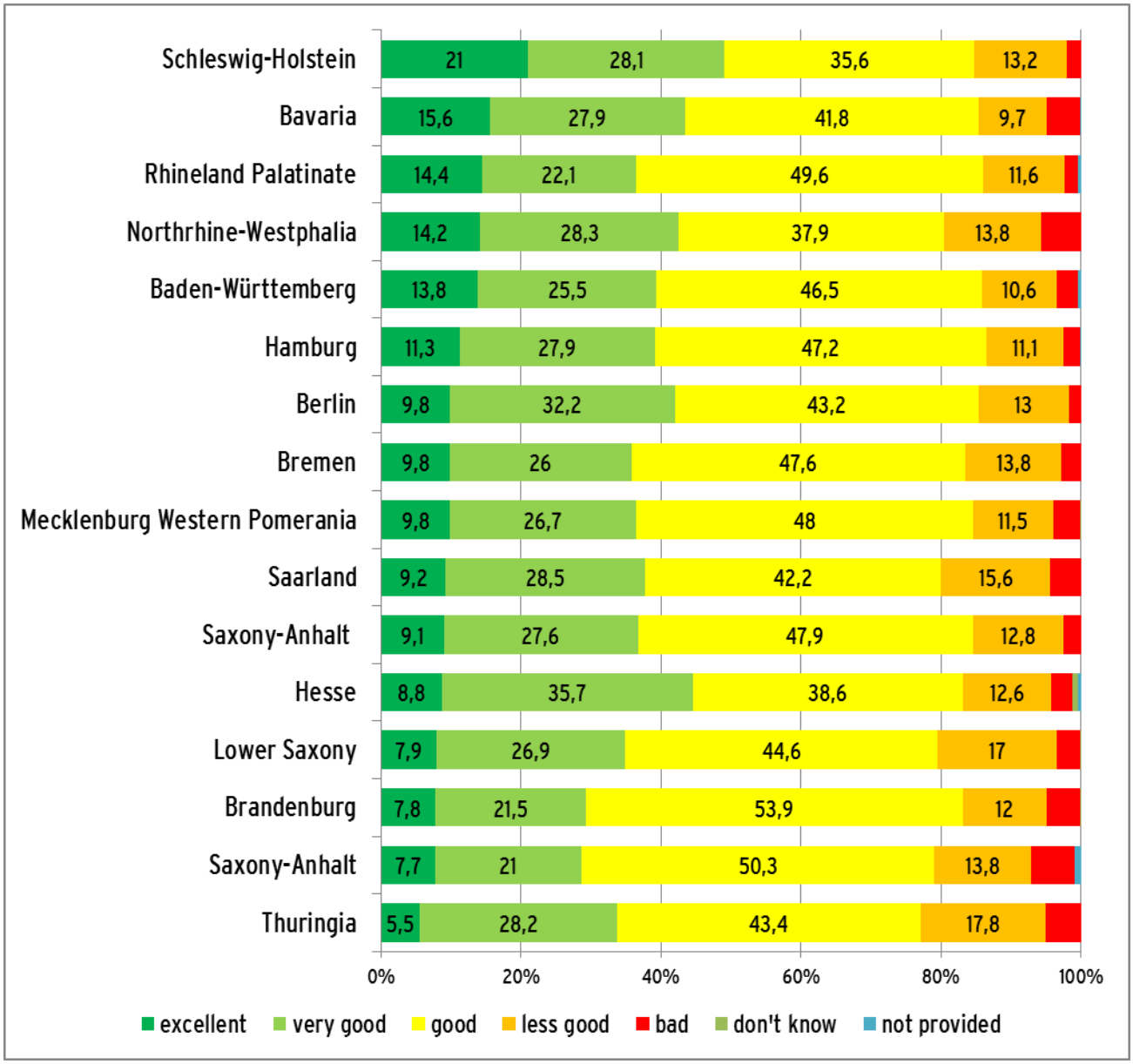
4.8.1.1 Subjective state of health

Figure 12: *"How would you genereally describe your state of health?"*



To the question "How would you describe your state of health in general?" most respondents (43%) stated good. 40% stated excellent or very good state of health. 13% describe their health as less good, and 4% as bad.

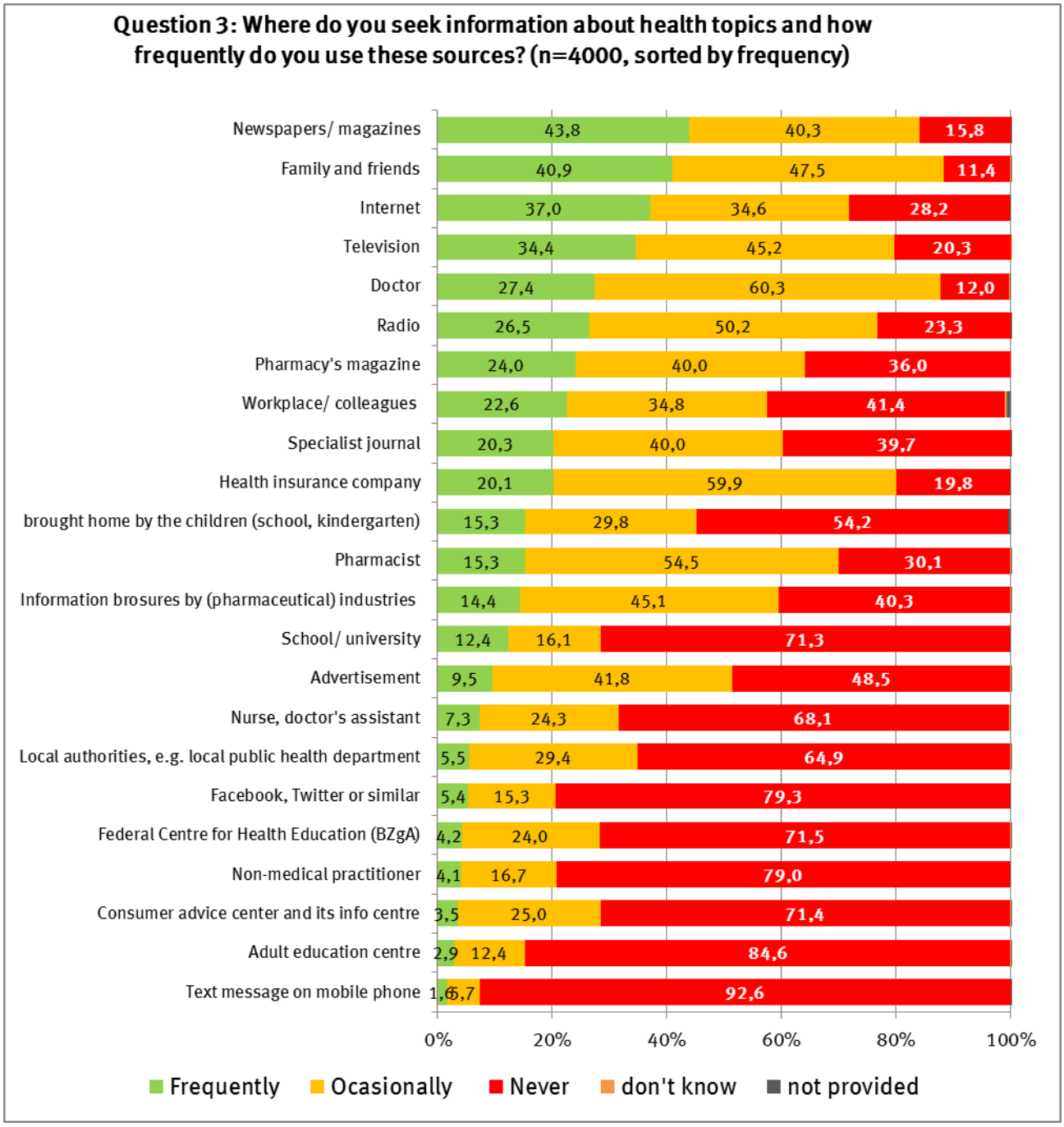
Figure 13: *"How would you generally describe your state of health?"* (by German Federal States)



If the Federal States are considered individually, significant differences can be noted with respect to the perceived state of health. In Schleswig-Holstein 21% of respondents refer to their status of health as excellent, however, this was only stated by 6% in Thuringia.

4.8.1.2 Sources of information

Figure 14: *"Where do you seek information about health topics and how frequently do you use these sources?"*

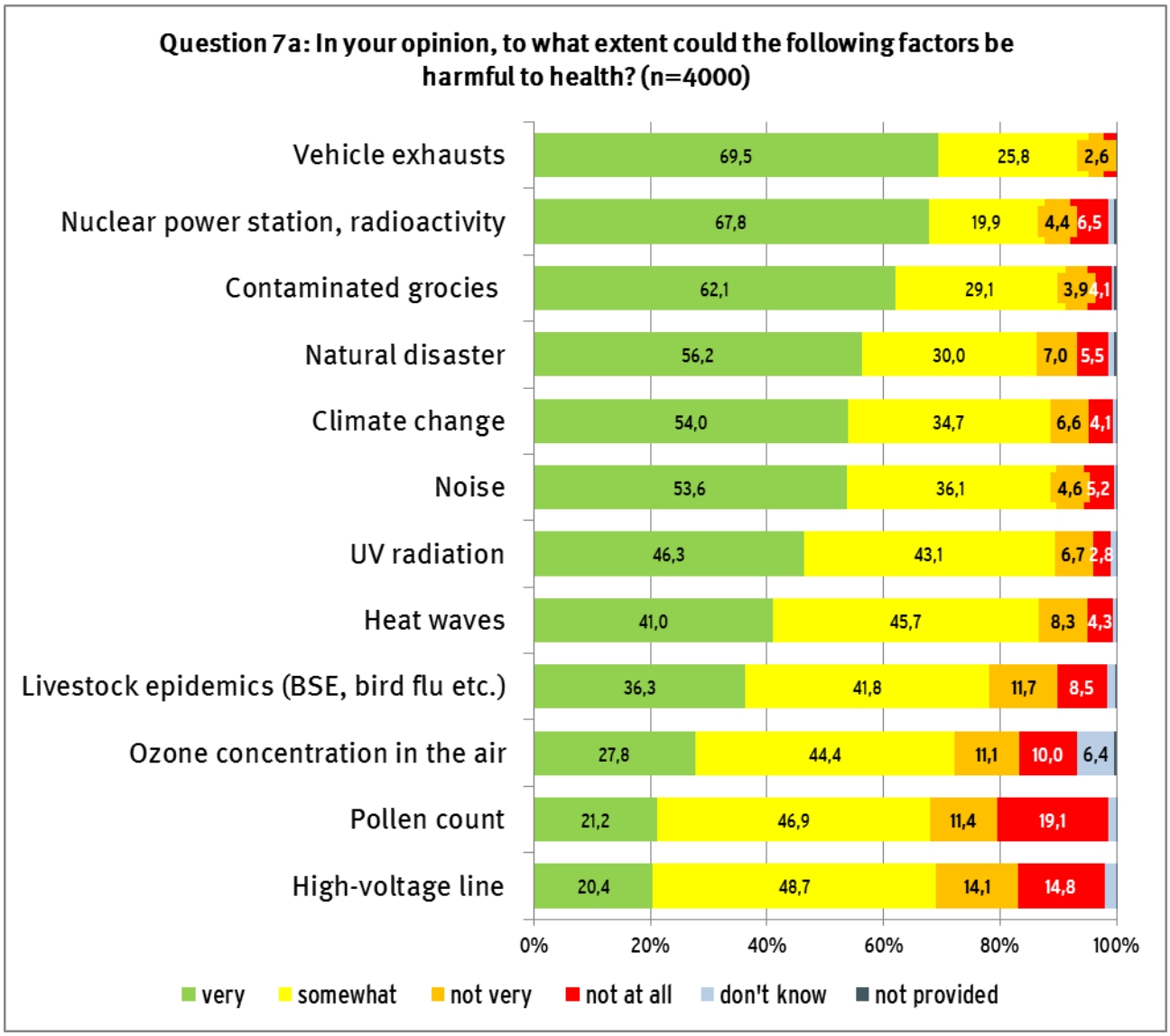


The most used sources of health information are Newspapers/Magazines (43.8 %), Family and friends (40.9%), as well as Internet (37%) and television (34.4 %).

87.7% of respondents frequently or occasionally use a doctor as a source of health information. 31.6% of respondents still frequently or occasionally derive health information from nurses or medical assistants.

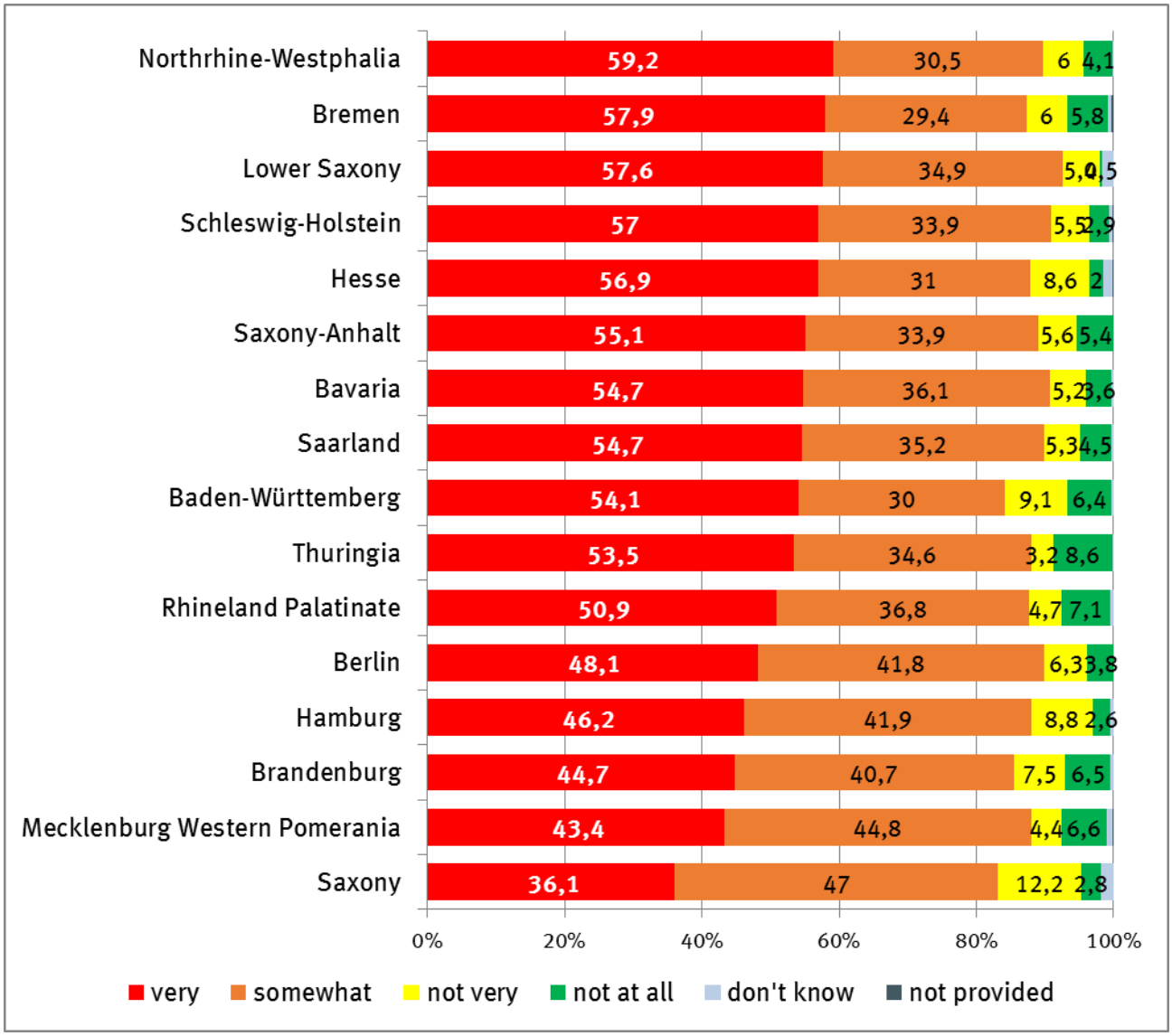
4.8.1.3 Risk perception

Figure 15: Question 7a: "*In your opinion, to what extent could the following factors be harmful to health?*"



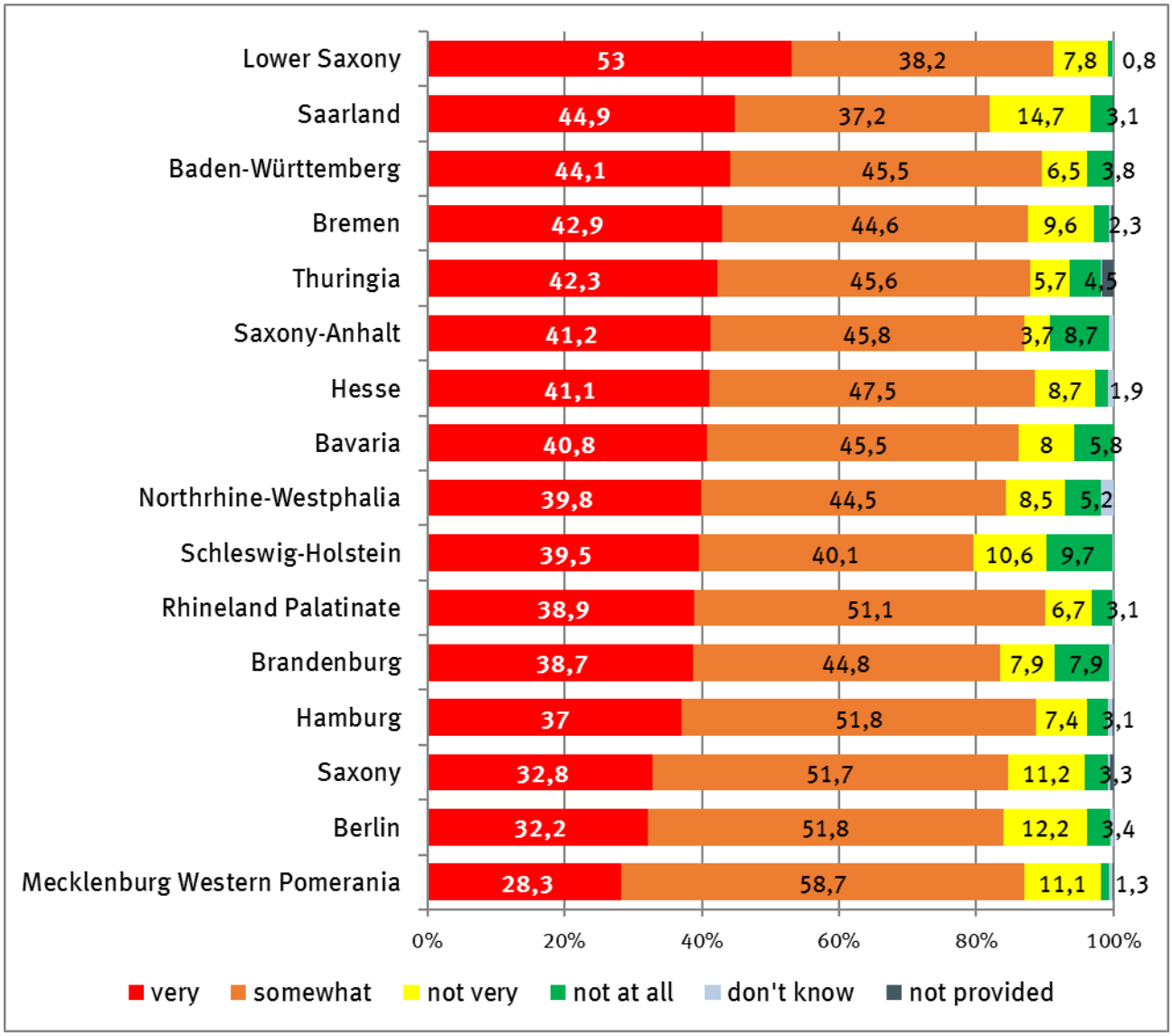
The perception with regard to the seriousness of the risk posed by different threats varies greatly. The respondents feel that UV-Radiation, Heat Waves, Ozone and Pollen Count are less harmful to health than other questioned environmental influences.

Figure 16: Question 7a: Health impairment by climate change (by German Federal States)



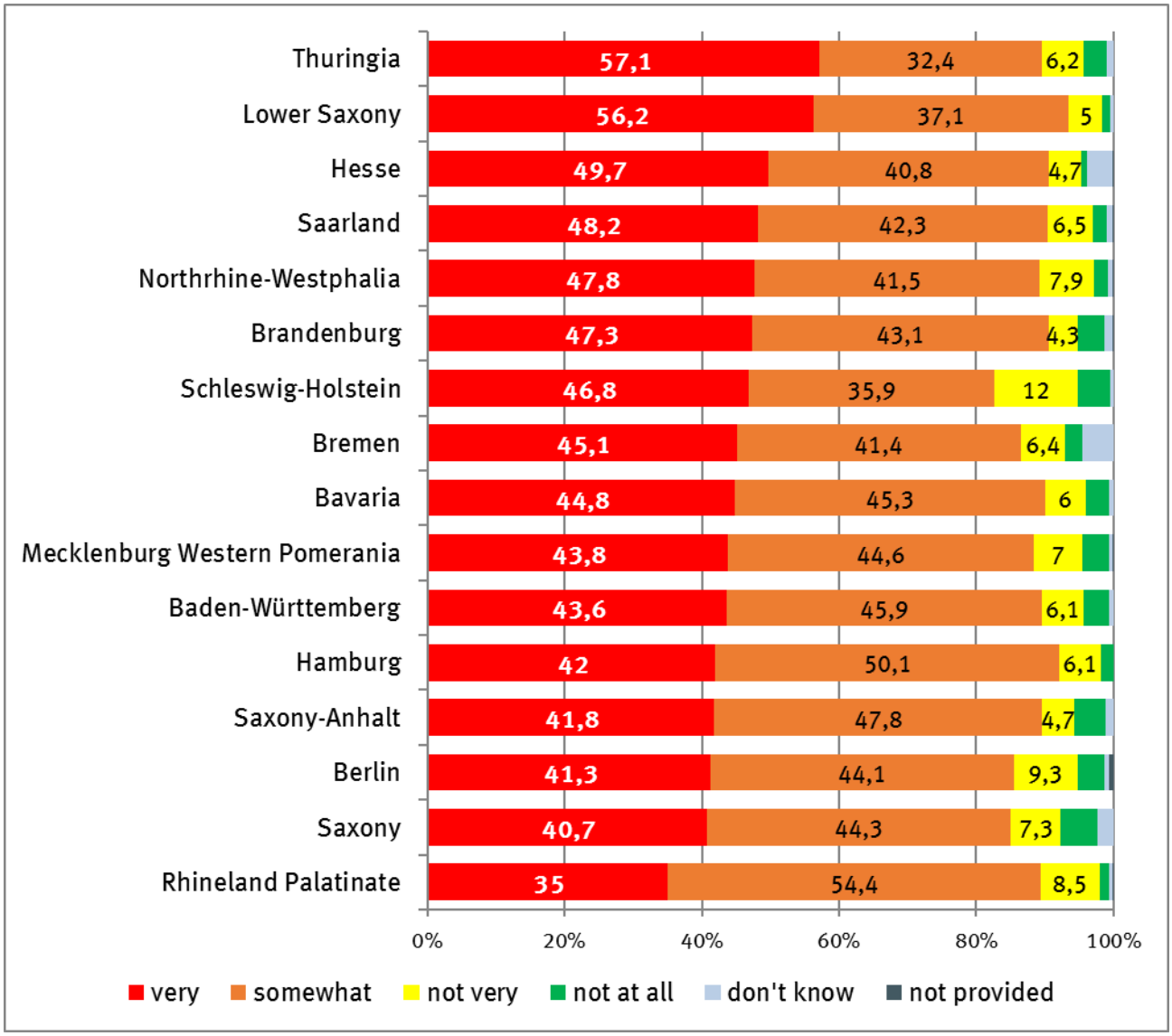
The perception of climate change as a health hazard is most common in North Rhine-Westphalia (59%). Only 36% of the surveyed inhabitants of the State of Saxony expect a considerable impairment.

Figure 17: Question 7a: Health impairment by heat waves (by German Federal States)



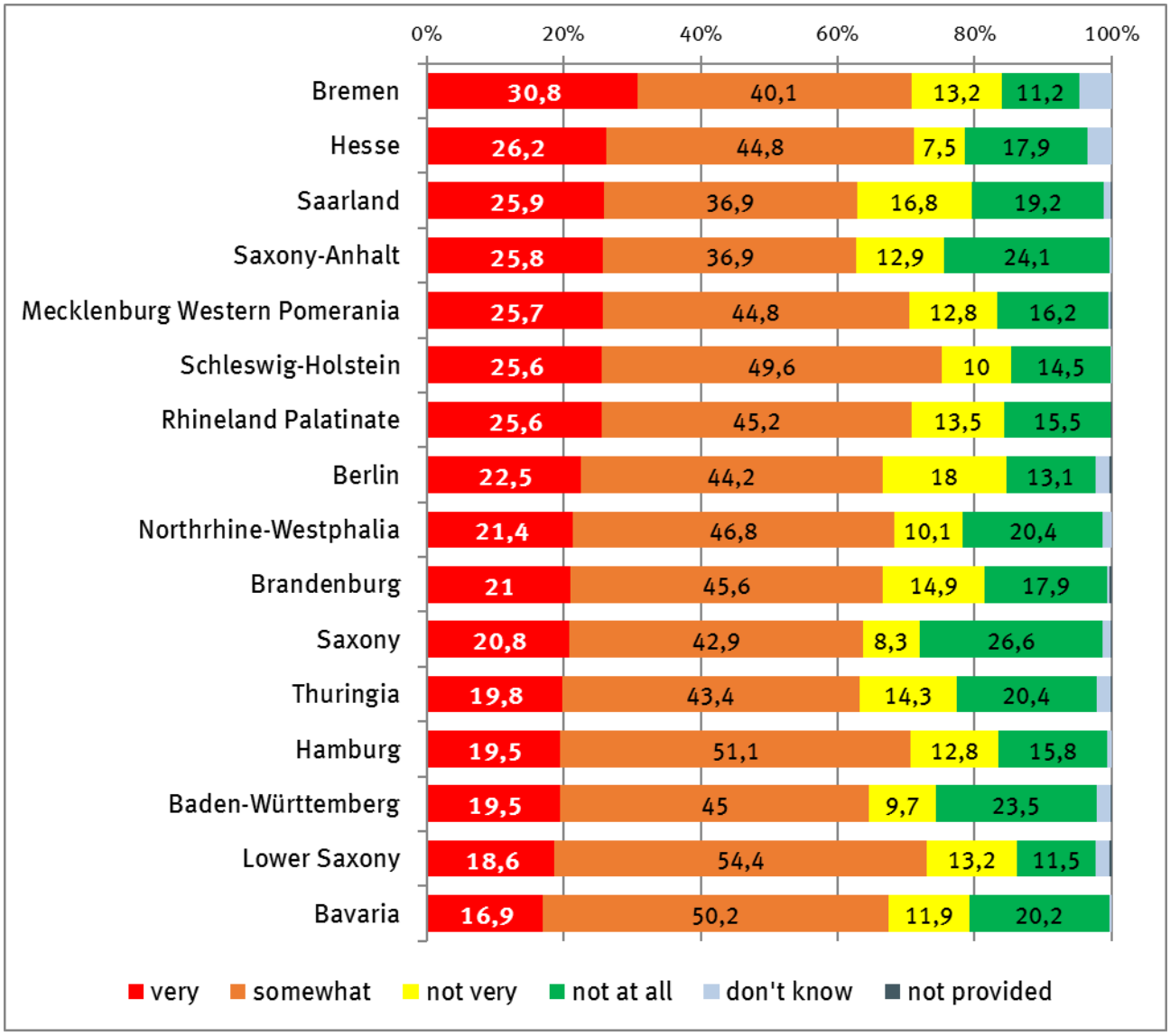
The risk imposed by Heat Waves is perceived most strongly in the State of Lower Saxony (53 %). The significant difference to the State of Saarland is particularly notable. Here 45% state that Heat Waves may damage ones health to a large extent.

Figure 18: Question 7a: Health impairment by UV-Radiation (by Germany Federal States)



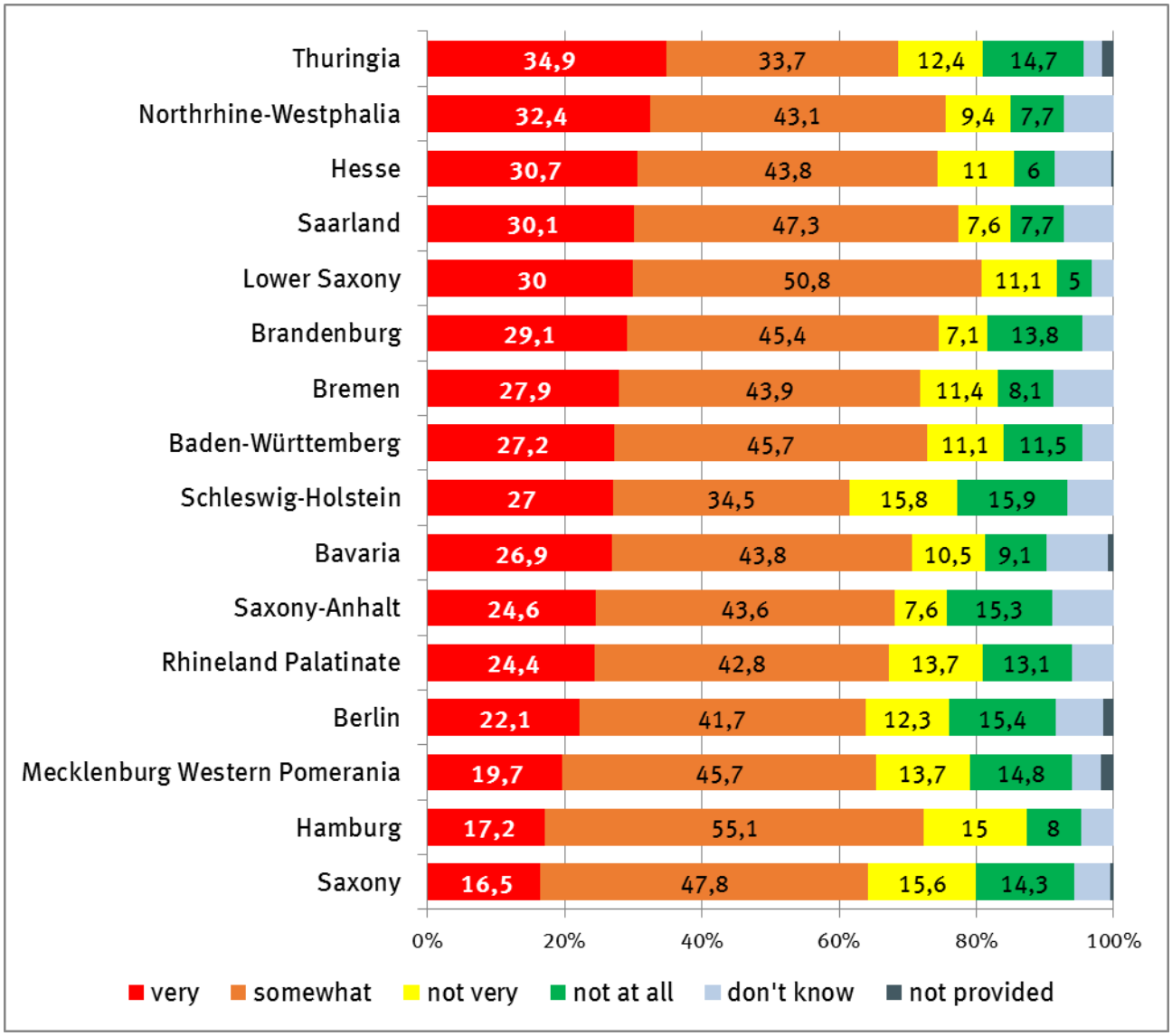
UV-Radiation is considered highly hazardous to health by many respondents from Thuringia (57%) and Lower Saxony (56%). Only 35% of respondents from Rhineland-Palatinate shared this view.

Figure 19: Question 7a: Health impairmen due to Pollen Count (by German Federal States)



The health risk posed by Pollen Count is considered to be high by 31% of respondents from the State of Bremen. In Bavaria however, only 17% assume a strong impairment caused by Pollen Count.

Figure 20: Question 7a: Health impairment by the ozone concentration in the air to breathe (by German Federal States)



35% of respondents from Thuringia attribute a strong health hazard to Ozone. In the State of Saxony however, only 17% share this view.

4.8.1.4 Awareness of information systems

The publicity of the information systems varies greatly. 86.8% know the Pollen Count Forecast and 29.5% know the UV-Index. The publicity of Heat Warnings (71.0%) and Ozone Forecasts/Warnings (54.2%) lie in between.

Figure 21: Question 10d: "*Have you ever heard of or read about a Heat Warning in any form?*"

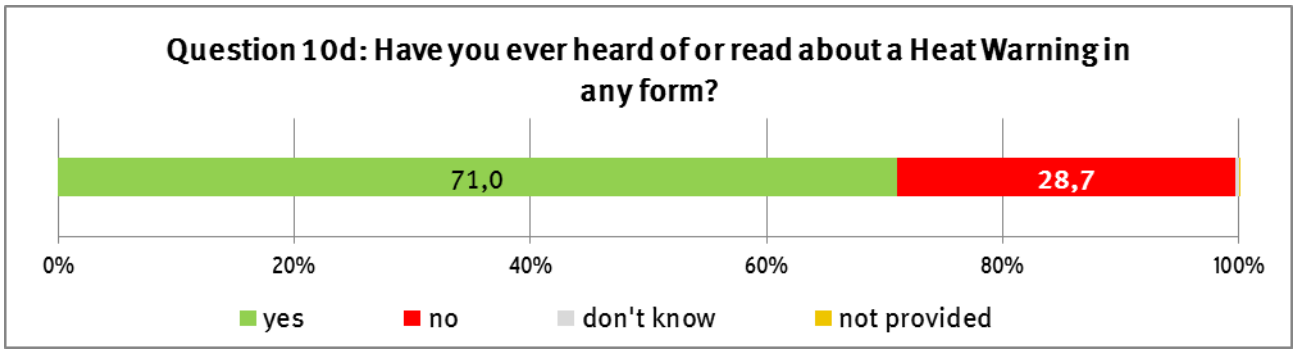


Figure 22: Question 10d: "*Have you ever heard of or read about a Heat Warning in any form?*" (by German Federal States)

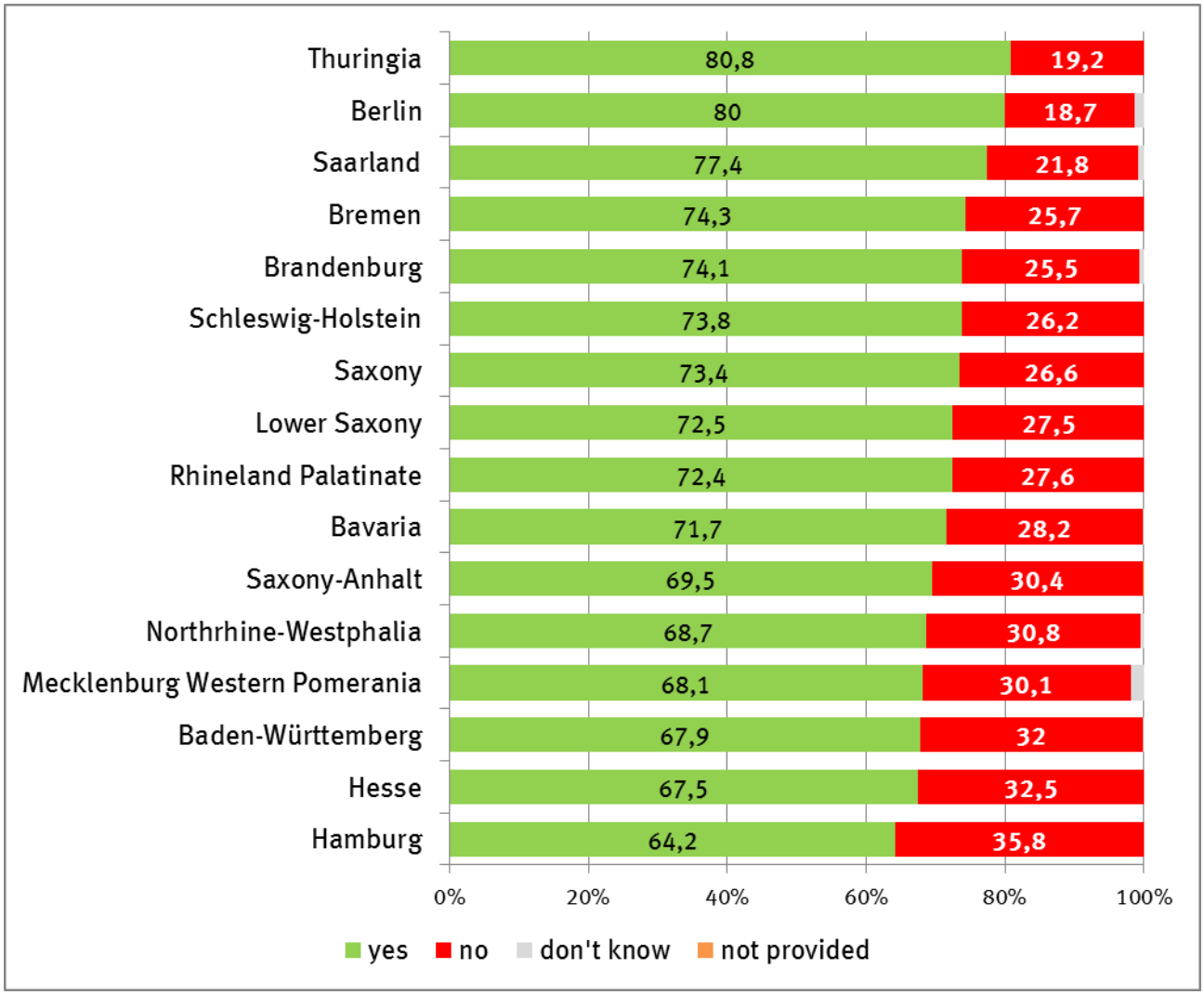


Figure 23: Question 11c: "*Have you ever heard of or read about an UV-Index in any form?*"

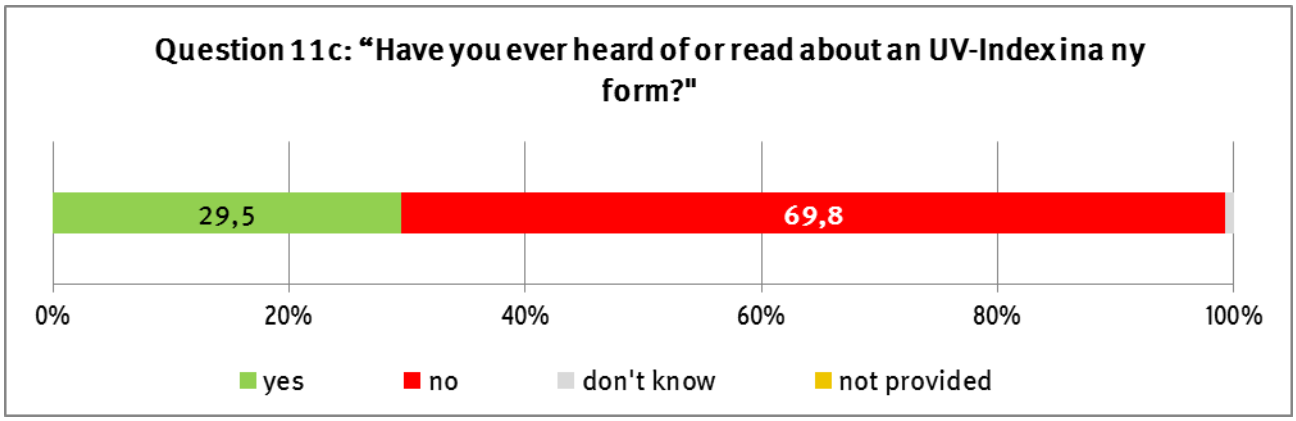


Figure 24: Question 11c: "Have you ever heard of or read about an UV-Index in any form?" (by German Federal States)

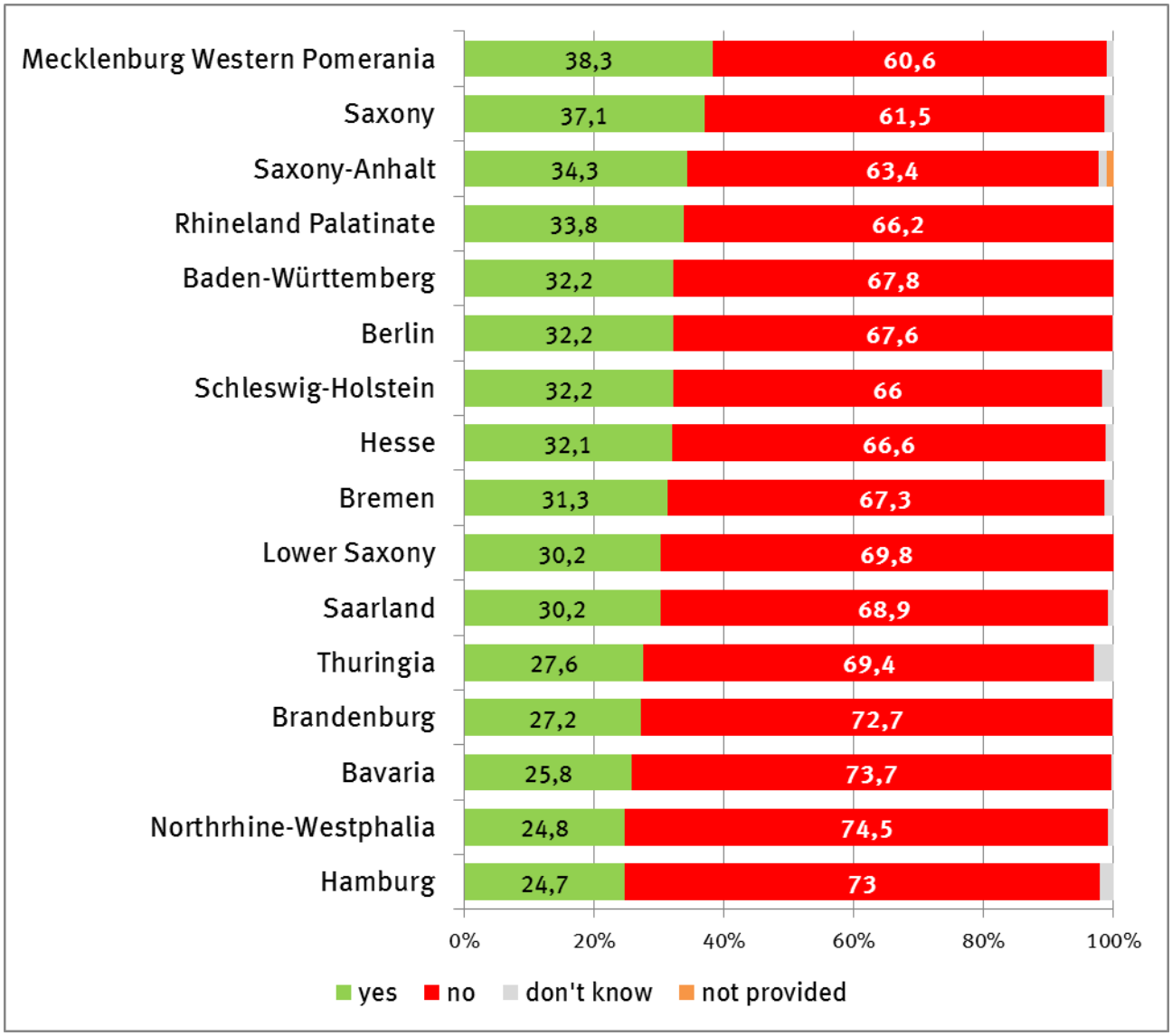


Figure 25: Question 12b: "*Have you ever heard of or read about a pollen forecast or a pollen warning in any form?*"

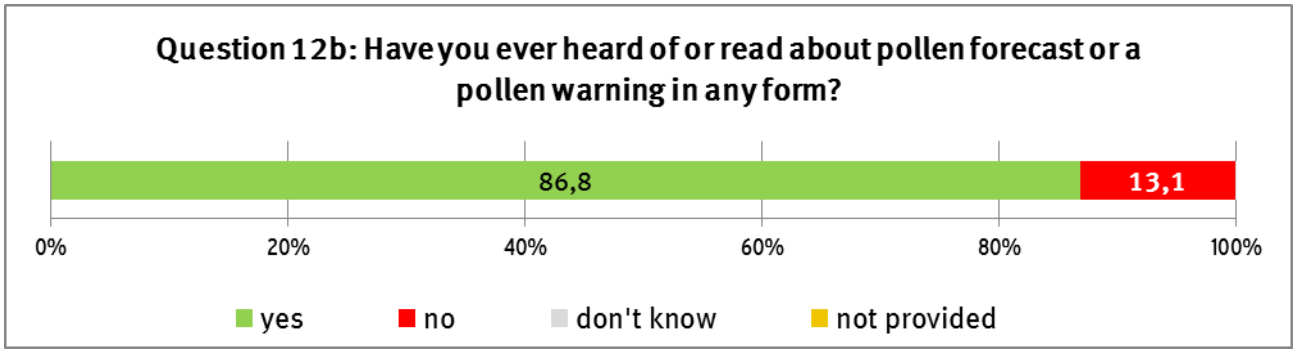


Figure 26: Question 12b: "*Have you ever heard of or read about a pollen forecast or a pollen warning in any way?*" (by German Federal States)

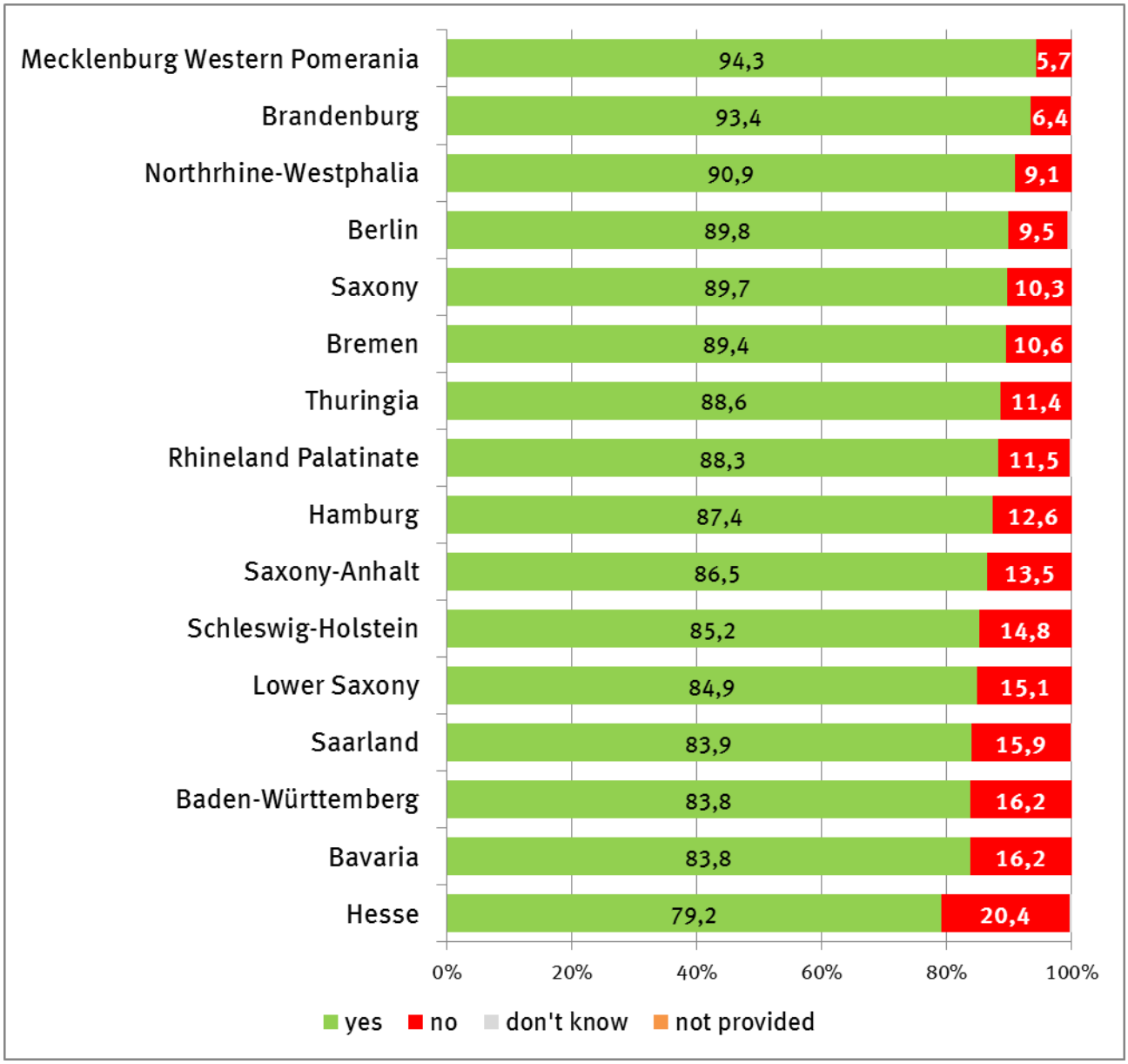


Figure 27: Question 13c: "*Have you ever heard of or read about an ozone forecast or an ozone warning in any way?*"

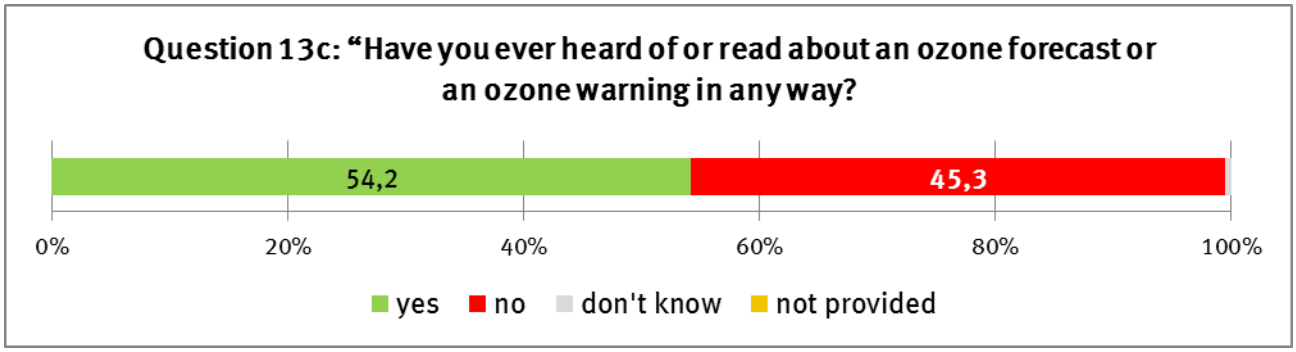
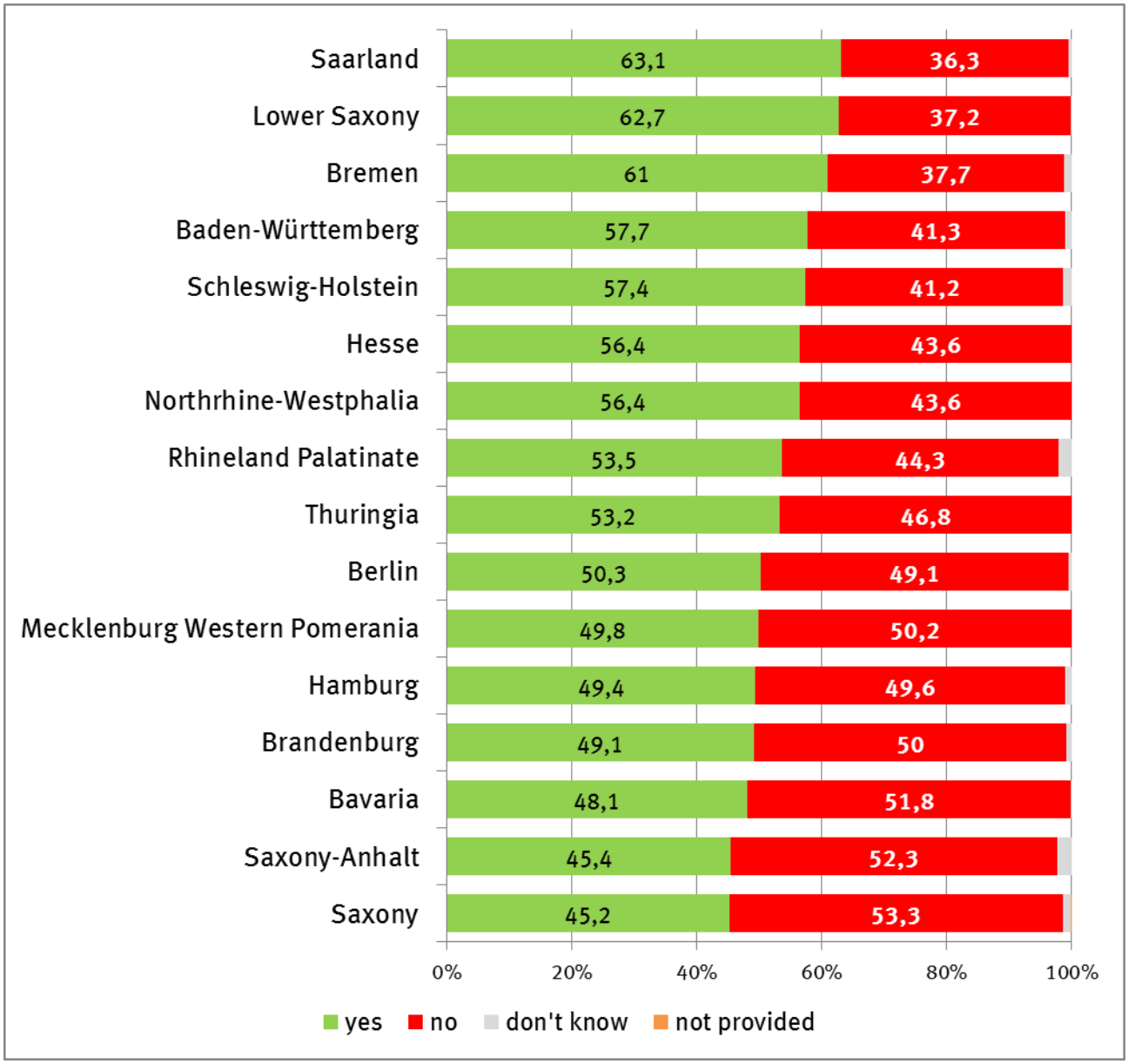


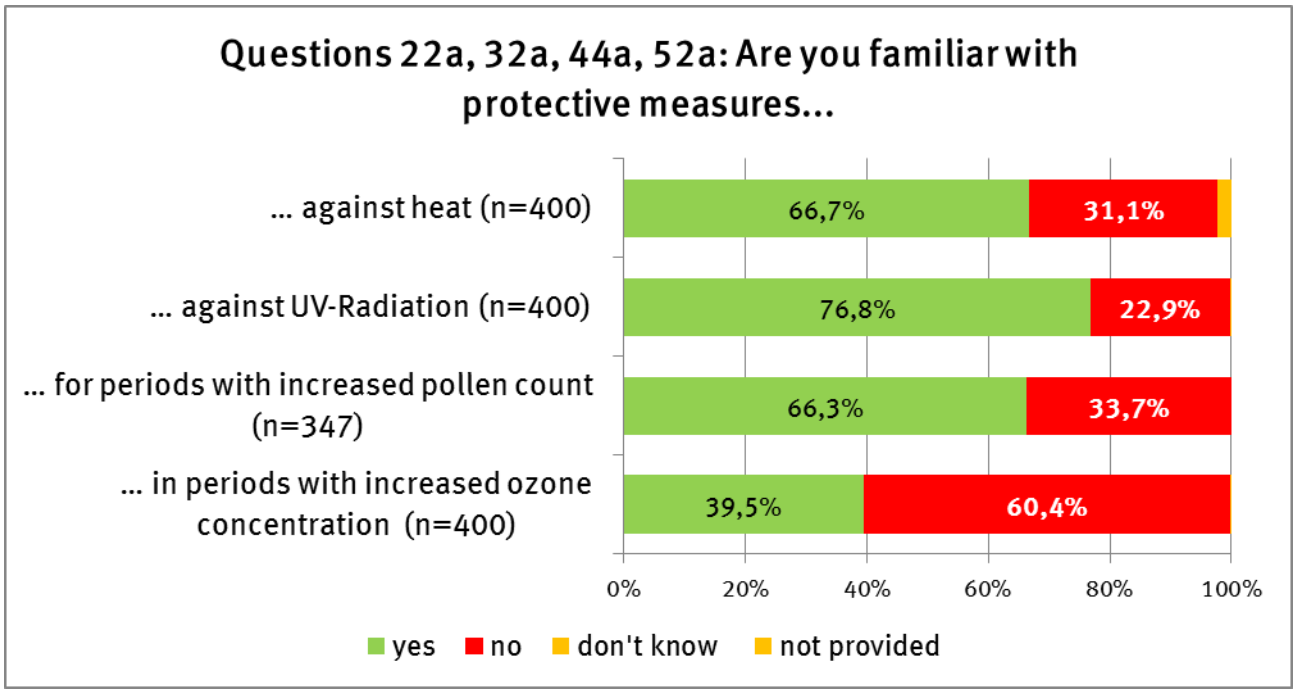
Figure 28: Question 13c: "*Have you ever heard of or read about an ozone forecast or an ozone warning in any way?*" (by German Federal States)



4.8.2 Conclusion of health-related adaptation measures

4.8.2.1 Awareness of adaptation measures

Figure 29: Questions 22a, 32a, 44a, 52a: "*Are you familiar with protective measures…?*"



The publicity of safeguards varies with regard to environmental factors (Heat, UV-Radiation, Pollen Count and Ozone). Without having previously heard concrete measures in the interview, respondents of the representative Population Survey (n=4,000) stated knowing measures against the exposure to the respective environmental factors. The respective vulnerable individuals were interviewed.

Knowledge of protective measures against UV-Radiation is the most widespread (76.8 %). The publicity of measures against heat (66.7%) and Pollen Count (66.3%) is similarly widespread.

Protective measures against Ozone (39.5%) are only known by a smaller proportion of vulnerable respondents.

If the awareness of individual measures is polled in a supported way, i.e., if measures are indicated to the respondents, a different result is observed. It turns out that the knowledge of heat protection measures is more widespread than the knowledge of protection measures against UV-Radiation.

The polled protection measures against Ozone and Pollen Count are less known to the interviewees.

The following simplified table in which each relative frequency of a response is presented illustrates this. Furthermore, means and standard deviations are mentioned.

An analysis of statistical correlations provides sporadic evidence on causal relations between knowledge, fitness, effects and use of the measures, however, due to the small number of cases, the result is not statistically sound.

Table 25: Awareness, aptitude, effectiveness and use of health-related adaptation measures

Measure	Awareness (yes)[24]	Suitability (very)[25]	Effectiveness (high)[26]	Usage (always)[27]	"never" in connection with Forecast[28]
Taking advantage of cooler times of a day for stays in the open air, Avoiding exhausting activities in particular during midday heat	98 % (n=400)	87 % (n=400)	85 % (n=400)	91 % (n=400)	48 % (n=265)
Consuming plenty of fluids: water, juice, tea, no alcohol	99 % (n=400)	84 % (n=400)	88 % (n=400)	81 % (n=400)	39 % (n=263)
Airing at night and in the early morning hours	97 % (n=400)	67 % (n=400)	80 % (n=400)	67 % (n=400)	36 % (n=247)
Deflecting the sun by closing blinds, curtains, shutters	97 % (n=400)	83 % (n=400)	83 % (n=400)	62 % (n=400)	34 % (n=236)
Using cool rooms for a few hours per day	78 % (n=400)	49 % (n=400)	64 % (n=400)	41 % (n=400)	35 % (n=246)
Cooling by the use of showers, cold compresses or footbaths	93 % (n=400)	41 % (n=400)	47 % (n=400)	31 % (n=400)	41 % (n=260)
Midpoint (Heat)	**94 %**	**69 %**	**74 %**	**62 %**	**39 %**
Standard deviation +/- (Heat)	**8 %**	**20 %**	**16 %**	**23 %**	**5 %**
Seek shade	97 % (n=400)	68 % (n=400)	73 % (n=400)	58 % (n=400)	6 % (n=136)
Application of sunscreen products	98 % (n=400)	69 % (n=400)	74 % (n=400)	47 % (n=400)	13 % (n=142)
Wearing sunglasses	97 % (n=400)	64 % (n=400)	70 % (n=400)	46 % (n=400)	14 % (n=89)
Avoiding midday sun	94 % (n=400)	54 % (n=400)	72 % (n=400)	44 % (n=400)	5 % (n=107)
Wearing a head covering	98 % (n=400)	46 % (n=400)	73 % (n=400)	34 % (n=400)	16 % (n=130)

[24] Question: "Have you ever heard of this?" Answering options: Yes/No / Do not know/No answer

[25] Question: "Would these measures be personally appropriate for you?" Answering options: Very / Somewhat / Not Very / Not at all / Do not know / No answer

[26] Question: "Do you consider these measures to be effective?" Answering options: Very / Somewhat / Not Very / Not at all / Do not know / No answer

[27] Question: "Do you personally use this protective measure?" Answering options: Yes, always / Yes, sometimes / Rarely / Never / Do not know / No answer

[28] (Only asked, when the warning was known) Question: "Do you personally use this protective measure due to a warning?" Answering options: Yes, always / Yes, sometimes / Rarely / Never / Do not know / No answer

Measure	Awareness (yes)[24]	Suitability (very)[25]	Effectiveness (high)[26]	Usage (always)[27]	"never" in connection with Forecast[28]
Wearing clothes with long sleeves	94 % (n=400)	25 % (n=400)	57 % (n=400)	6 % (n=400)	11 % (n=131)
Gradual adapting to sunlight	69 % (n=400)	37 % (n=400)	44 % (n=400)		
Midpoint (UV-Radiation)	92 %	52 %	66 %	39 %	11 %
Standard deviation +/- (UV-Radiation)	10 %	17 %	12 %	18 %	5 %
Car windows kept closed while driving	79 % (n=347)	47 % (n=347)	54 % (n=347)	55 % (n=347)	27 % (n=264)
Application of anti-allergic medication (antihistamines)	79 % (n=347)	48 % (n=347)	52 % (n=347)	43 % (n=347)	48 % (n=240)
Washing hair in the evening	69 % (n=347)	46 % (n=347)	45 % (n=347)	38 % (n=347)	28 % (n=232)
Avoiding outdoor stays	80 % (n=347)	21 % (n=347)	35 % (n=347)	20 % (n=347)	26 % (n=286)
Not storing clothing in bedrooms that has been worn outdoors	68 % (n=347)	45 % (n=347)	44 % (n=347)	18 % (n=347)	45 % (n=234)
Installing Pollen protection screens at windows	66 % (n=347)	29 % (n=347)	26 % (n=347)	18 % (n=347)	76 % (n=156)
Preferably going outdoors after rain showers	71 % (n=347)	37 % (n=347)	38 % (n=347)	12 % (n=347)	15 % (n=282)
Midpoint (Pollen Count)	73 %	39 %	42 %	29 %	38 %
Standard deviation +/- (Pollen Count)	6 %	11 %	10 %	16 %	20 %
Rescheduling of prolonged physical exertion to morning and evening hours	76 % (n=400)	28 % (n=400)	34 % (n=400)	30 % (n=400)	11 % (n=237)
Reduction or complete avoidance of strenuous work	77 % (n=400)	28 % (n=400)	43 % (n=400)	30 % (n=400)	11 % (n=238)
Staying in closed rooms	72 % (n=400)	24 % (n=400)	34 % (n=400)	13 % (n=400)	14 % (n=236)
Midpoint (Ozone)	75 %	27 %	37 %	24 %	12 %
Standard deviation +/- (Ozone)	3 %	2 %	5 %	10 %	2 %
Midpoint of all measures	85 %	49 %	57 %	40 %	27 %
Standard deviation of all measures	12 %	20 %	19 %	22 %	18 %

4.8.2.2 Differentiation of adaptation measures

The measures differ in several dimensions, which have not been operationalized for the survey. These characteristics of the measures are partly polled in combination by asking the question “Would that measure be appropriate for you personally?” Nevertheless, the differences described in this Chapter may be relevant for implementing the adaptation measures.

Thus, the point in time for implementing a measure or for expecting the effect of a measure is different. As an example, drinking is an acute help on hot days. Deflecting the sun also helps acutely, but the application of such measure is already helpful some days before an extreme heat exposure in order to reduce the heating of the premises by direct sunlight.

The direct effects of the measures on the well-being is also different. As an example anti-allergic medication is only fully effective in some cases if it was taken for several days. In contrast, a walk after rainfall results in an immediate improved well-being due to the relief of symptoms for some effected individuals.

In turn, some UV-Radiation protection measures have immediate pleasurable effects. However such effects are not related to the health problems caused by UV-Radiation. For example, shade and avoiding high summer midday sun immediately acts as a form of relief due to a lower heat exposure. The reduced UV-Radiation itself does not affect the well-being that directly.

For some cases, a comprehensive planning may be more necessary than for others. The measure “Consuming plenty of fluids: water, juice, tea, no alcohol” does not require extensive planning since drinking water should be fully available indoors (but not necessarily when traveling or when working outdoors). The measure “Taking advantage of cooler times of a day for stays in the open air, avoid exhausting activities especially in the midday heat”, however, require a change of the daily routine that may need to be discussed with other people.

The effort to darken rooms may be smaller than using cooler rooms.

Restrictions for example may be related to medication (e.g., by fatigue) or a change of the daily routine. In contrast and independent of environmental influences, morning airing is widespread and thus does not constitute any restriction.

In summary, protective measures can be implemented acute and/or in good time before an upcoming strain, i.e., preventive, and show different degrees of indirect or direct impact on the well-being. Furthermore, they also differ in the extent of the necessary planning or preparation and they vary with respect to their accessibility or concerning the burdens and restrictions that may be associated with their implementation.

4.8.2.3 Use, suitability and effectiveness of the measures

The use of health-related precautions against heat is the most widespread.

This may be due to the high degree of publicity of protective measures and their good evaluation regarding suitability and effectiveness. Likewise, the following aspects of the environmental factor “Heat” may be relevant in this context: Heat is immediately noticed by those affected and some measures achieve quick relief. The more complex measures such as “Using cool rooms for a few hours per day” and “Cooling by the use of showers, cold compresses or footbaths” are implemented less consistently.

The measures against UV-Radiation are used less constantly. On average they receive a somewhat lower rating in terms of their suitability and effectiveness. In particular, many respondents (34.4%) consider the wearing of clothes with long sleeves as not being suitable. Nevertheless, the average lower rating for protection against UV-Radiation is also to be observed if such measure is disregarded.

The measures against Pollen Count and Ozone are considered less suitable and less effective with respect to all areas. This also corresponds to a lower use of the relevant measures.

4.8.2.4 Consideration of forecasts for the use of measures

There are significant differences to what extent the Warnings or forecasts are taken into account for the use of measures. It turns out that for more respondents, the Warnings and forecasts for immediate noticeable environmental factors such as heat and Pollen are deemed irrelevant for their protective behaviour. Thus, more respondents state that the use of a protective measure was never related to a Warning or forecasting. For example, using cooler times of the day for outdoor activities was not complied with by 48% of the users of this protective measure in conjunction with a Warning or forecasting.

As concerns UV-Radiation and Ozone, which are not as immediately perceptible,[29] the forecasts and Warnings are relevant for more respondents. [30] For example, the limitation of exhaustive works was not implemented in conjunction with a Warning or forecasting by only 11 % of the users of this protective measure.

For measures against Pollen Count, the respective forecasts are considered at highly varying degrees.

For example, the adaptation measure “preferably going outdoors after rain showers” is in a narrower context with the Warning. Only 11% of users of this adaptation measure are not using this measure in conjunction with a Pollen Count Forecast. In the context of taking anti-allergic medication, the forecast is not relevant for 48%.

The independence from a forecast is higher for measures such as “Not storing clothing in bedrooms that has been worn outdoors”, “Application of anti-allergic medication (antihistamines)” and “Installing Pollen protection screens at windows”. One possible explanation for this effect is, that such measures are continuously implemented throughout the Pollen Count season. Hence, no daily adjustment of behaviour takes place based on a forecast.

This heterogeneity does not occur to the same extent for measures against other environmental factors.

4.8.2.5 Regression model for the use of measures

A statistical regression model is used to identify the factors influencing the use of protective measures against the health effects of environmental influences.

Out of the factors under consideration, the suitability of a measure (“Would that measure be appropriate for you personally?”) and the type of a measure [31] show the greatest effect on the likelihood to use a measure of protection against the heat. The likelihood to use a measure increases, if such measure is assumed to be appropriate. This co-relation applies to all stages of an individual’s per-

[29] There are neither sense organs nor direct symptoms for noticing UV-Radiation and Ozone. In contrast, heat is easily noticeable and allergic sufferers respond quickly to relevant exposure. Affected individuals notice these environmental factors.

[30] As part of the 3rd project meeting it was decided that the negative answers to questions polling the protection relevance of warnings or predictions must also be included in the evaluation.

[31] The type of measure (action_id) is a so-called dummy variable, which also controls the use of a measure in addition to the impact of the measure itself (as described in Chapter “Differentiation of adaptation measures”, the measure “consuming fluids” can be easily implemented without much effort - the variable “type of measure” thus explains the variance of use that arises from the specific characteristics of each measure and prevents that such effects happen to be reflected in other factors).

sonal appropriateness and amplifies towards the category “very appropriate measure” in an approximately linear way.

The perceived effectiveness of the measure (“Do you consider these measures to be effective?”) is also an important predictor - measures perceived as “very effective” are used more frequently.

The intention to change a behaviour (“Do you use the service for adjusting your behaviour respectively?”) has a moderate and a significant impact on the use of protective measures.

Also the risk perception (“How high would you assess the risk for your own health by [Heat, UV-Radiation, Pollen Count, Ozone]?”) has a moderate and a significant impact on the use of protective measures.

Furthermore and even after inspecting all other factors, the effect clearly shows that measures against Heat (group=1) and Pollen Count are used much more frequently than measures against UV and Ozone.

The following factors have no significant influence on the use of measures:

- Interest in health topics (Question 2: “How strongly are you interested in health issues?”)
- Perceived self-efficacy (“Do you think that the receipt of forecasts and Warnings would help you to implement protective measures?”)
- Knowledge of protective measures only (“Have you ever heard of this?”; e.g., staying in closed rooms)
- Knowledge of information or Warnings (“Have you ever heard or read of any form of [a Heat Warning, the UV-Index, Pollen Count Forecast or Warning, an Ozone Forecast or Warning]?”)
- Knowledge (an index that was created from a variety of knowledge based questions regarding the respective environmental risk)

Only the gender is decisive for control variables. For men, the use of protective measures is considerably less likely than for women. In addition, this model includes the variables education (not significant) and the type of measure, which has a significant impact regardless of the answer to all questions.

Table 26: Findings resulting from the regression model for the benefit of all measures

Terms in the model [32]	Question	Answers	Coefficient	Level of significance
Threshold value for q3d=1_nutzung	Do you use this measure?	Never	-3,377	0,000
Threshold value for q3d=2_nutzung		Rarely	-2,482	0,000
Threshold value for q3d=3_nutzung		Yes, sometimes	-0,618	0,001
Threshold value for q3d=4_nutzung		Yes, always	0,000	*[33]
q3a_kenntnis	Have you ever heard of (this measure)?	No	-0,058	0,465
q3a_kenntnis		Yes	0,000	
q3b_eignung	Would this measure be suitable for you personally?	Not at all	-2,649	0,000
q3b_eignung		Little/somewhat	-1,394	0,000
q3b_eignung		Very	0,000	*
q3c_wirksam	Do you consider this measure to be effective?	Not at all	-0,544	0,000
q3c_wirksam		Little/somewhat	-0,434	0,000
q3c_wirksam		Very	0,000	*
02	How strongly are you interested in health issues?	Not at all	-0,264	0,153
02		Not particularly	0,014	0,888
02		To some extent	-0,062	0,222
02		Very	0,000	*
q5a_selbst	Do you think that the receipt of forecasts and Warnings would help you to implement protective measures?	No	-0,076	0,131
q5a_selbst		Yes		0,000
q0c_risk	How high do you rate the risk of your own health resulting from [Heat, UV-Radiation, Pollen Count, Ozone]?	Low	-0,230	0,004
q0c_risk		Rather low	-0,138	0,040
q0c_risk		Rather high	-0,163	0,017
q0c_risk		High	0,000	*
q0g_intent	Question 10g: Do you use	No	-0,156	0,012

[32] In addition, this model controls the variables Education (Q16A – 6 Weightings - all not significant) and type of measure (q3_action – 22 Weightings - partly significant). Due to lack of space, the individual coefficients of these two variables are not presented here.

[33] This coefficient represents the reference category and therefore equals zero.

Terms in the model [32]	Question	Answers	Coeffi-cient	Level of sig-nificance
	the Service to adapt your behaviour accordingly?	Yes	0,000	*
q0d_kenntwarn	("Have you ever heard or read of any form of [a Heat Warning, the UV-Index, Pollen Count Forecast or Warning, an Ozone Forecast or Warning]?")	No	0,032	0,597
q0d_kenntwarn		Yes	0,000	*
q1a_sum	Index created from different knowledge-related ques-tions		0,070	0,502
group=1	Sub-groups	Heat	1,146	0,000
group=2		UV	-0,190	0,200
group=3		Pollen Count	0,623	0,000
group=4		Ozone	0,000	*
Q12	Gender	Male	-0,159	0,001
Q12		Female	0,000	*
Q11	Age (in years)		0,005	0,002

In summary, the use of a measure essentially depends on its suitability, its perceived efficiency and the perception of the underlying risk. This will be taken into account when developing the communication concept.

Further regression models for the use of protective measures against each of the individual environmental factors, are listed elsewhere (Capellaro and Sturm, 2015b).

4.8.3 Conclusion on risk perception

4.8.3.1 Description of the risk perception

When comparing the risk perception of various environmental factors based on the question "How high do you assess the risk for your own health?", which expressly refers to the health of the person interviewed, shows a few clear differences. Ozone is assumed as an environmental factor with a high health risk by the fewest people (14 %). The proportion is even lower amongst the respondents who are regarded as vulnerable to Ozone.

17% of respondents rated the risk to health due to heat as high. 21% of respondents indicate that UV-Radiation presents a high-risk. The assessment of risk for Heat and UV-Radiation by the vulnerable groups is not more common (measured by this question) than with the general population.

30% of the respondents from the group of people vulnerable to Pollen Count assume the health risk associated with Pollen to be high.

The following table provides a simplified summary of the results for the health risk assessments discussed in this Chapter. Only the relative frequency of responses is stated for each question. The analysis of the distribution of additional answers will not lead to additional findings.

The question "In your opinion, to what extent could the following factors be harmful to health?" is more general and without explicit reference to the health of the person interviewed. In this context, the proportion of respondents who assume a very large damage to health rises significantly compared to the questions addressed above.

Table 27: Simplified representation of the risk perception regarding various environmental influences

	"How high do you assess the risk for your own health?" (high)	To what extent can the risk damage health? (very)	Thought about it at least once during the last two weeks	Future health risk (very)	Awareness (very good and good)
Heat (n=4000)	17 %	41 %	39 %	33 %	34 %
Vulnerable to Heat (n=1549)	17 %	43 %	51 %	36 %	31 %
UV-Radiation (n=4000)	21 %	46 %	37 %	43 %	30 %
Vulnerable to UV-Radiation (n=3247)	21 %	46 %	36 %	43 %	31 %
Pollen Count (n=4000)	--	21 %	22 %	33 %	--
Vulnerable to Pollen Count (n=819)	30 %	38 %	17 %	44 %	--
Ozone (n=4000)	14 %	28 %	21 %	28 %	15 %
Vulnerable to Ozone (n=2769)	10 %	27 %	23 %	28 %	15 %

A very high damage potential is attributed to UV-Radiation by 46% of respondents.

For Heat Waves, this applies to 41% of the general population whereas this assumption is slightly more (43%) frequent with vulnerable respondents. A very high damage potential is attributed to Ozone by 28 % of respondents. With respect to Pollen Count, the perception of risk differs most clearly between the general population (21%) and vulnerable persons (38%).

The presence of risk in everyday life is measured by the following question: "Please convey, if you have thought about this issue in the last two weeks and if so, how many times. Please answer with 'No', '1 to 2 times', '3 to 5 times' or 'more' !"

The presence of risk, which can also be interpreted as a psychologically stressful concern, is most widespread for the factor of Heat. 51% of the vulnerable persons and 39% of all respondents have at least once thought about Heat in the two weeks preceding the survey. UV-Radiation occupies the 2nd rank with 37% of the respondents (36% of vulnerable respondents). Pollen Count (22%) and Ozone (21%) are less significant as a risk for the respondents. However, the low risk perception with regards to Pollen Count can be due to the survey period (from 26 August 2013 until 08 October 2013), since the Pollen Count season was already over at this time.

Against the backdrop of climate change, the future importance of environmental factors was also polled ("If the climate was to change in the future, to which extent would the occurrence of the following factors possibly impair your health?").

Within the factors considered, the general population assumes UV-Radiation to be the most threatening (43%) health risk. Heat and Pollen Count are each considered by 33% as very negative factors and Ozone is considered as such by 28%.

The analogy to the current health risk perception with regards to Pollen Count is distinctive. 44% of vulnerable people attribute very negative impact to Pollen Count for the future. This assessment is probably also related to the differences of environmental factors, which are described in the next Chapter in more detail.

4.8.3.2 Differentiation of environmental influences

Heat, UV-Radiation, Ozone and Pollen Count as well as illnesses and health symptoms associated with those environmental factors differ in several areas. These include in particular the following:

- Subjective burdening
- Time gap between exposure and burdening
- Presence of “immune” groups of population
- Effectiveness of protection measures

Subjective burdening by Heat is acute and pronounced. It also affects non-vulnerable individuals. The protection options are very influenced, inter alia by the individual circumstances of life. In addition, the vulnerable population group is partly already in need of help.

However, UV-Radiation itself does cause immediate burdening. Sunburns occur as a result of exposure with a delay of hours and the serious long-term damage such as skin aging or cancer occurs only after decades. The vulnerability depends on the exposure and the skin type. Thus, the separation of vulnerable people from not vulnerable people is more gradual in this context. Very good options for protection measures exist.

Pollen Count only causes acute symptoms for sensitized individuals. The clear separation between vulnerable and not vulnerable individuals is also reflected by the risk perception. Protection measure options are limited. Pollen Count also differs from other environmental factors in another aspect: There is a probability verging on certainty that seasonal complaints occur on a yearly basis.

Ozone pollution may lead to acute symptoms. The identification of vulnerable individuals on the basis of socio-demographic and epidemiological data is difficult. The vulnerability is caused by behaviour “physical stress outside of rooms” and is individually very differently pronounced. The feasibility of the protective measures is highly dependent on the circumstances of life such as the ability to avoid the triggering behaviour (physical work or athletic stress during Ozone pollution).

4.8.3.3 Regression models for risk perception

Risk perception depends on additional factors. An assumed correlation is represented in effect model (refer to Chapter 2.2). A statistical regression model is used to identify the factors influencing the risk perception with regards to health effects of the four environmental influences.

In summary and based on the factors under consideration, it was concluded, that the presence of risk in everyday life and the personal involvement has the greatest effect on the probability that one’s risk is assumed to be high. With regard to UV-Radiation the knowledge of the diseases caused by UV-Radiation, increases the risk perception. The control variables age (older) and gender (female) significantly reinforce the perception of risks. Family members or acquaintances affected, in this case, from case skin cancer or cataracts, do not represent a significant variable in the context of UV-Radiation.

The risk perception with regards to Pollen Count is largely influenced by the respondents own health complaints. Also the control variable “school-leaving qualification” plays a role in this context. The

knowledge about Ozone [34] influences not only the presence of the risk but also the perception of Ozone as a health risk. Women also assume the risk posed by Ozone to be high. The regression models for risk perception that are differentiated according to environmental factors are described in more detail elsewhere (refer to Capellaro and Sturm, 2015b).

4.8.4 Conclusion on information systems (Warnings and forecasts)

4.8.4.1 Awareness of the Warnings

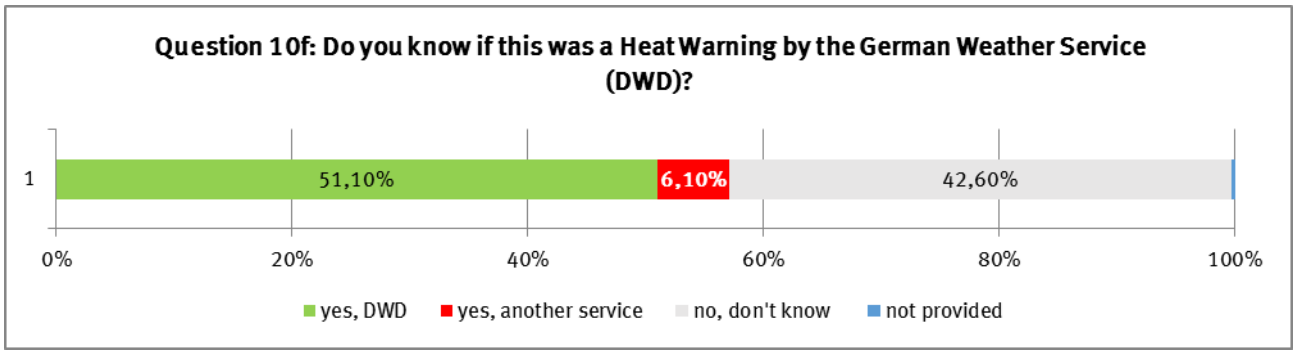
The information systems should support the population during the adaptation measures. It is required for this purpose, that the information systems actually reach the population. The existing information systems have different levels of awareness.

The Pollen Count Forecast is best known (86.6%), followed by Heat Warnings (71.0%).

Confusion with the weather forecast cannot be excluded for hot days.

However 51.1% of those who already heard of a Heat Warning state, that Heat Warnings are actually published by the German Weather Service.

Figure 30: Question 10f: "*Do you know if this was a Heat Warning by the German Weather Service (DWD)?*" (n=2919)



54.2 % know the Ozone Forecast and 29.5% know the UV-Index. The difference between the total population and the vulnerable groups with respect to all information systems is low.

[34] For this purpose an index was created from the questions: "Are you familiar with the term Ozone?", "In your opinion, which of the following descriptions applies best to Ozone? (Ozone is a gas, which emerges from old refrigerators. - Ozone, is an alternative term for particulate matter. - Ozone is a gas that is contained in our breathing air. - Ozone is not relevant for breathing since it occurs solely in the very high ozone layer.)" and the open question: "What medical conditions might be caused by ozone?" (Respiratory complaints).

Table 28: Awareness of information systems

	Have you ever heard or read of any form of a Heat Warning, the UV-Index, Pollen Count Forecast or Warning, an Ozone Forecast or Warning? (Yes)
Heat (n=4000)	71,0 %
Heat vulnerable (n=1549)	65,5 %
UV-Radiation (n=4000)	29,5 %
UV-Radiation vulnerable (n=2953)	32,8 %
Pollen Count (n=4000)	86,6 %
Pollen Count vulnerable (n=380)	88,0 %
Ozone (n=4000)	54,2 %
Ozone vulnerable (n=2790)	57,5 %

4.8.4.2 Sources of information

Most commonly, respondents heard or read of the information systems by means of websites, newspapers / magazines, radio, television or in the context of conversations. These statements correspond to the sources of health issues in general (refer to Figure 14). The order of these five main sources of information varies slightly from the relevant information systems.

The Newsletters and websites of the issuing institutions play a minor role. Among the Newsletters offered, the Heat-related Newsletter is the best known (8%) and is also used the most (1.3%). This figure recorded by the survey appears too high in comparison with the actual number of recipients[35].

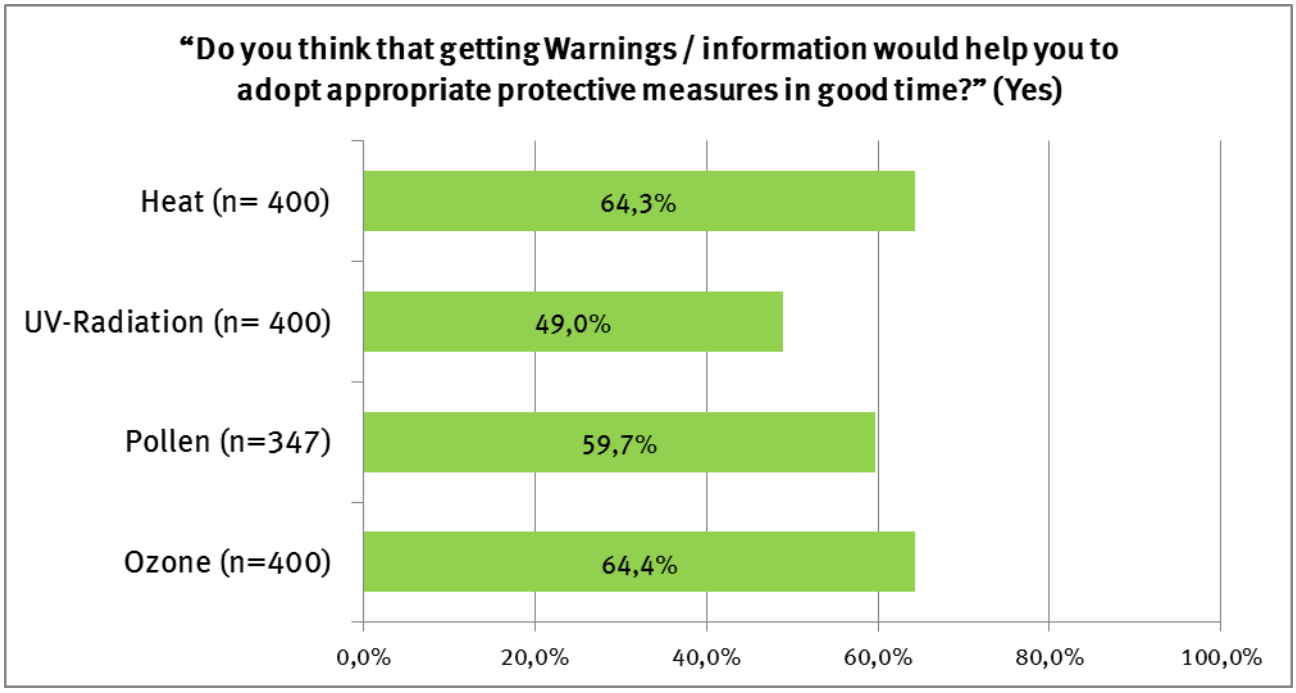
4.8.4.3 Impact of information systems on the use of measures

As already described by the regression model for the use of protective measures, there is no significant relationship between the knowledge of Heat Warnings and the use of measures.

Nevertheless, the majority of the population indicates that the receipt of Warnings or information would help to take appropriate protective measures, and this does not only apply to heat.

[35] 9,737 “Heat Warnings” Newsletter users, Status as of January 2013:

Figure 31: "Do you think that getting Warnings / information would help you to adopt appropriate protective measures in good time?" (Yes)



4.8.4.4 Desired channels of information

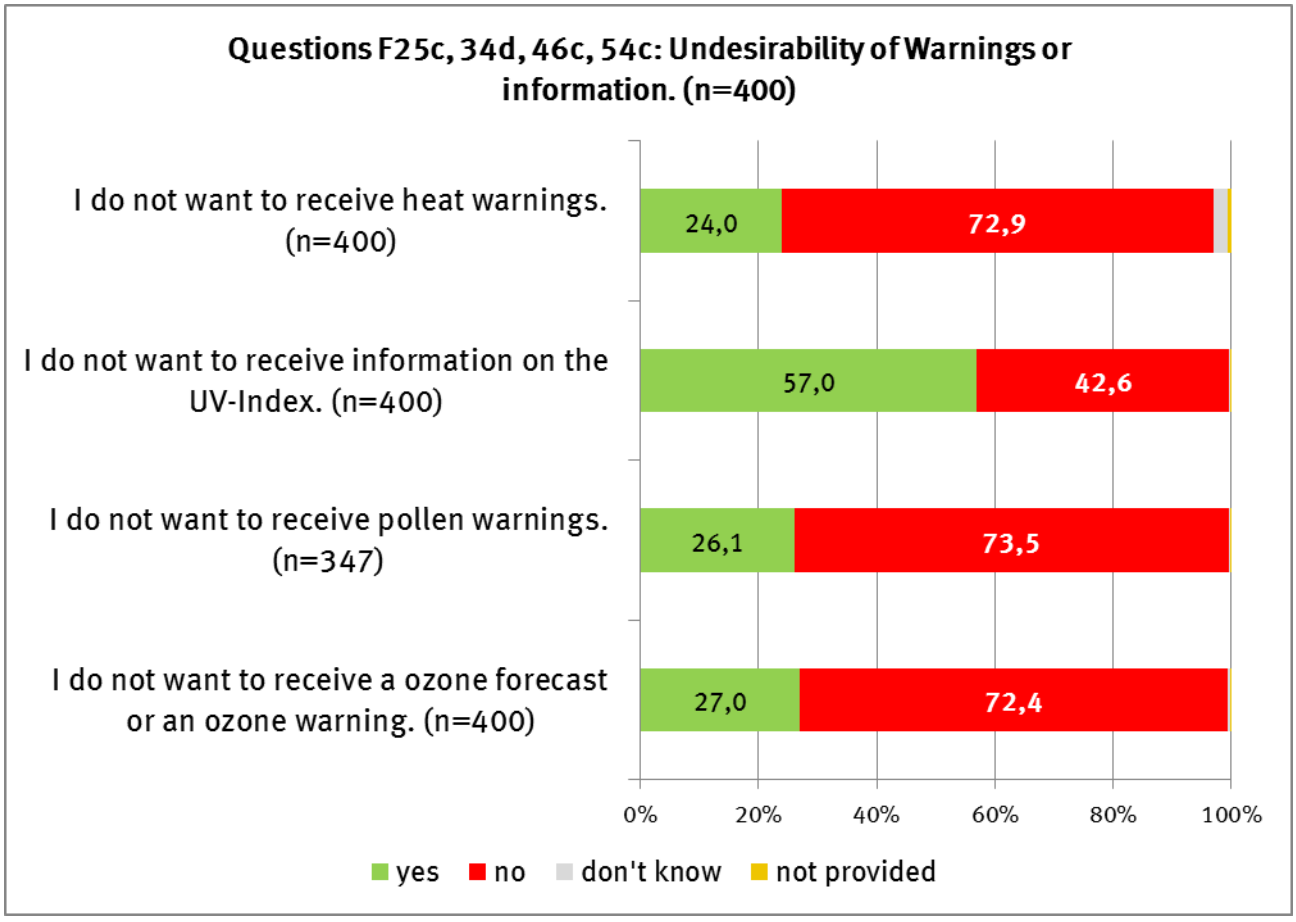
The preferred ways, in which the vulnerable population groups would like to receive alerts and information, slightly differ between the information systems. Radio, television, newspaper / magazine and Internet are mostly among the 5 most popular information channels, a conversation with a doctor is also frequently amongst the top 5 information channels. A more detailed description of the preferred information channels that is differentiated by environmental factor is provided elsewhere (Capellaro and Sturm, 2015b).

4.8.4.5 Unintended effects

Information systems can also cause unintended effects. Such unintended effects may include concern, worry or anxiety. Such effects affect the health since, according to the definition of WHO[36], mental well-being is explicitly part of health. In connection with the question on the way the information or Warnings should be provided, the vulnerable individuals surveyed could also answer that they are not interested in Warnings or information. Approximately every fourth respondent preferred not to receive Warnings on extreme Heat, Pollen Count or Ozone. More than every second respondent does not want information on the UV-Index.

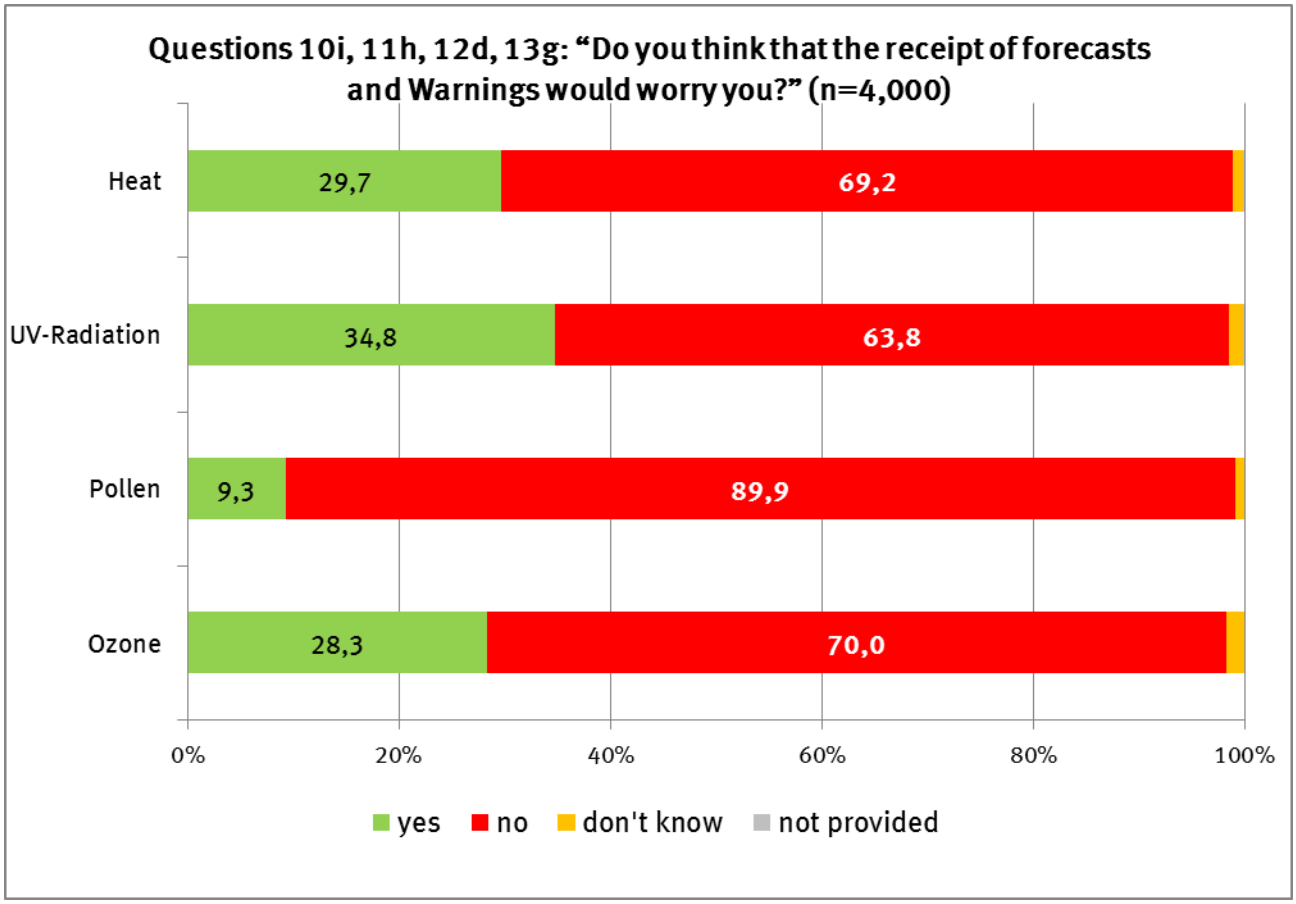
[36] Preamble to the 1948 Constitution of the World Health Organization: "Health is the state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." Cited by (Blümel and Franzkowiak, 2011)

Figure 32: Questions F25c, 34d, 46c, 54c: Questions F25c, 34d, 46c, 54c: Undesirability of Warnings or information. (n=400)



The concern associated to a forecast is most widespread for the UV-Index (34.8 %). Information on Heat (29.7%) and Ozone (28.3%) are less worrying for a slightly lower share of the population. By contrast, Pollen Count forecasts only worry 9.3%, which is probably due to the large proportion of the population who does not suffer discomfort from Pollen Count.

Figure 33: Questions 10i, 11h, 12d, 13g: “Do you think that the receipt of forecasts and Warnings would worry you?” (n=4,000)



5 Communication concept

5.1 Cornerstones of the communication concept

In this Chapter, recommendations are derived from the collected data, which act as the cornerstones for the to be developed communication concept, where the results presented in Chapter 4, are essentially used as foundation. However, results from volume 2 of the survey may also be considered sporadically (Capellaro and Sturm, 2015c).

5.1.1 Results from the evaluation of the measures

The implementation of measures inter alia depends on whether they are perceived as being useful. The suitability or unsuitability does not only depend on personal preferences, but also on the real life situation that may hinder or promote (contextual factors) the implementation of measures. During the course of this survey, it was not possible to identify the reasons for respondents not to implement measures.

The communication process must meet two conditions in order to improve the perceived suitability of measures:

1. Individual communication is meaningful, since individual circumstances of life are concerned. In this context, a conversation can also be regarded as support for the implementation of measures. The information systems should support the population during the adaptation measures.

2. In order to identify the perceived/actual barriers and the conducive circumstances, the design of the communication concept must be of participatory nature. This applies to conversations and should also be taken into account for media communication.

The perceived effectiveness of health-related measures is also helpful for the implementation of measures. Information systems should also consider the explicit mentioning of the effectiveness of measures. However, there is need for further research in this regard. The evaluation of the measures is not in scope for the project. Nevertheless, there is the impression that not all measures are based on evidence in a narrower sense. The indication of effectiveness and the degree, to which such efficacy is proven, is also part of the requirements for evidence-based patient information [37] that can also be applied to health information for healthy citizens.

5.1.2 Results from the evaluation of the risk perception

In the context of prevention and health promotion, risk perception is ambivalent. On the one hand the regression model “use of protective measures” (refer to Chapter 4.8.2.5) shows that risk perception has a beneficial influence on the implementation of measures. On the other hand, unintended effects, such as anxiety or concern are also related to the perception of risk.

The salutogenetic perspective is one way to overcome this dilemma. In contrast to the pathogenesis, the salutogenesis is characterised by promoting and preserving health, instead of avoiding diseases. Thus the aspects of a measure that increase well-being should be more emphasized than the health risks resulting from environmental influences. Immediate positive effects are more motivating than long-term positive effects. This must be considered for the further research required for safeguard measures, if applicable.

Continuous enlightenment is required, as shown by the presence of risks that impacts the implementation of safeguard measures. This can be achieved by continuous reporting, continuous advertising

[37] In this context, reference must also be made to the principles of “knowledge based” and “openness” as incorporated in the German Strategy for Adaptation to Climate Change (DAS).

or by regular use of ones own media. The knowledge about the health risks, as part of Health Literacy, has no significant effect on the use of measures or the perception of risks. As part of the Population Survey, the operationalization of this field was performed only by a few and inconsistent indicators. Thus, it is recommended to promote Health Literacy due to the obvious context even without a significant regression. Knowledge about the environmental factors, the risks and the protective measures should be part of media work and other communicative activities.

5.1.3 Results from the evaluation of the information systems

Knowing the health-related measures and the knowledge of information systems have no statistically significant impact on the implementation of adaptation measures by the respondents. This may be due to the small sample size in the sub-groups. On the other hand, institutional recipients such as nursing homes are not included in the survey, (refer to Chapter 5.1.4).

However, the regression model for the use of protective measures against Heat and Pollen Count, i.e. question 10d/41d ("Do you use this service in order to take protective measures?") and the knowledge of information systems, shows a moderate and a significant effect on the implementation of applicable solutions. Generally, the information systems are known (refer to Chapter 4.8.4.1), however, the DWD and UBA Newsletters are much less known and their use is quasi irrelevant with regards to the population.

It is therefore recommended to increase the distribution of Warnings and forecasts. This can be achieved e.g., by using additional digital distribution channels or by a stronger media presence and a better integration of multipliers,

e.g., smartphone Apps issued by the German Pollen Information Service Foundation (PID) and the DWD. In addition to receiving Warnings by the smartphone user, the Heat Warning App (Google Play, 2014) also offers the option to inform others via SMS, which can be received by all mobile phones.

The dissemination of Warning via social media also offers the possibility to further distribute information or Warnings by the recipients. The use of social media for the distribution of Warnings should also include the possibility to publish location-based, i.e., regionally selective information. Regarding the current dissemination of Warnings and information via e-mail, the following points must be noted:

- No measures are recommended.
- The relevance for action is not clear. Appeals are missing.
- Options to get additional information are not available (e.g., via a link).
- The presentation is not very appealing.

For the further development not only Warnings or predictions should be provided, but also measures and background information should at least be available. For this purpose, attention must be paid to accessibility and intelligibility of language. Suggestions for the content design of background information could be derived from the criteria of the evidence-based patient information (Klemperer and Sänger, 2006).

5.1.4 Results from the analysis of institutionalised information channels

The analysis of the institutionalised channels has shown that the cascading information on Heat Warnings from the DWD via the health ministries of the Federal States and the local health authorities towards the nursing homes, can work.

Consequently, it is recommended to extend the agreed information cascade to other healthcare facilities (such as physicians) (Haluza and Cervinka, 2013) and to also use this information cascade for the other information systems to the same extent.

Based on the second volume (Capellaro and Sturm, 2015c) it is to be examined to which extent the obligation of preliminary planning by the recipient and the binding force of acute measures can be increased (Cusack et al., 2011). For this purpose, the competence and risk perception of recipients should also be strengthened e.g., by means of further education. Examples of such training include the "Climate Change Adaptation School" project of the German Federal Ministry of the Environment, which was conducted by the Charité in Berlin (Klimawandel und Gesundheit, Climate Change and Health, 2014) and the "Climate-Adapted Care" project[38] of the climate adaptation network of the Hessen model region, which awards a quality seal to care service providers (KLIMZUG direkt, 2015).

The assessment and evaluation tools of the German Network for Quality Development in Nursing (DNQP) and possibly the "Regulation on structural minimum requirements for nursing homes, old people's homes and nursing homes for adults" could also be considered, if necessary. However, these tools do not include requirements for technical or structural heat prevention (sun protection devices such as awnings or air conditioners).[39] The consideration of e.g. Heat Waves in these documents can improve or facilitate their obligation to adaptation measures in nursing and their implementation by technical and/or physical infrastructure.

5.1.5 Results from the analysis of multipliers

The information channels that are wanted most by the public are the traditional media as well as conversation with doctors. Heat Waves are considered the strongest in the media.

The desire of the population, for the distribution of information and Warnings via the media is a costly and result open effort. For this purpose, on the one hand the media needs to be constantly addressed and on the other hand the demand for these partially unspectacular forecasts must be stimulated in population.

Regardless of the dissemination of forecasts and Warnings via the media, the structured media work accompanying the forecasts and Warnings of the operators of information systems (DWD, UBA, BfS and PID) is recommended as a contribution to the Health Literacy of the population and in order to intensify the reporting.

5.1.6 Improved implementation of the "integrated approach" (DAS)

An offer that puts together various health-related information would also be possible. The integration of additional information, in addition to connecting the four information systems, would also be possible. The DWD Weather Warnings, and the information about activity and infectivity resulting from animal disease vectors, are mentioned as examples (e.g. http://www.zeckenwetter.de). In this context, the European Commission has proposed to extend an early Warning system for infectious diseases to all cross-border health threats (European Commission, 2013a). The EU strategy on adaptation to climate change (European Commission, 2013B) also indicates early Warning systems as a way to act against the backdrop of uncertainty. This recommendation, however, is only indirectly based on the results of the evaluation.

[38] The project is part of the Initiative "Make Climate Change future-proof - Northern Hessen", abbreviated "KLIMZUG Nordhessen".

[39] http://www.klimawandelundgesundheit.de/wissensdatenbank/downloads.html?tx_kgdownloads_pi1%5BdownloadsID%5D=18, 10. May2014

5.2 Communication concept

The communication concept aims at a better implementation of health-related adaptation measures for the protection against the four environmental factors considered.

5.2.1 Objectives of the communication concept

Citizens shall be enabled to carry out adaptation measures in order to protect public health. The information systems shall trigger actions. Such actions shall relate specifically to a Warning situation.

Health Literacy [40] refers to skills required for this purpose. Besides practical everyday knowledge and skills, the knowledge of risks and measures are also part of Health Competence. However, this term also includes the ability to find and to take advantage of health information. A person with a strong Health Literacy has great control over health-influencing factors in different fields of action (e.g., family, working life, health system) and therefore also has more control over his health.

The main goal of the communication concept, i.e., the protection of public health, should be achieved through

- Implementing adaptation measures by vulnerable or care giving people for managing acute situations and Warning and
- Sustainable education for achieving the required Health Literacy.

Moreover, it is important for achieving the main objective and the two sub-goals, that the framework conditions for the protagonists and the context of the protection measures are designed by the protagonists in such a way that adaptation measures can be implemented more easily. Due to the evaluation results of the project and due to the Adaptation Action Plan of the DAS, dialogue and participation are part of the communication concept at hand. Thus, the exchange, the feedback from the general public and from other protagonists or multipliers and the possibility of two-way communication represent a further objective of the concept.

5.2.2 Target group

The target audience for the communication concept is inhomogeneous. The general population must be considered in addition to the respective vulnerable individuals (Chapter 4.1) since all citizens belong to the social environment of vulnerable individuals and as such carry out or support protective measures and/or themselves may be vulnerable in the future.

In addition, the professional medical and nursing care must be considered.

5.2.3 Overview / Summary

“Pillar 1: ’Provision of knowledge, inform, empower and participate’, represent the initiatives of the German Federal Government to expand the knowledge base, to provide and transfer information, to expand the information infrastructure and to support dialogue, participation and to build networks of protagonists” (DAS-APA, page 15).

[40] The definition of the European Health Literacy Consortium is as follows: “Health Literacy is linked to literacy and entails people’s knowledge, motivation and competences to access, understand, appraise and apply health information in order to make judgements and take decisions in everyday life concerning health care, disease prevention and health promotion to maintain or improve quality of life during the life course.” (Kickbusch et al., 2013)

In order to expand the knowledge base, a systematic search, evaluation and maintenance of relevant information that is deemed necessary for the prevention of health problems caused by Heat, UV-Radiation, Ozone and Pollen Count. The creation of a 'Body of Knowledge' is one option.

Involvement and participation should also be realized in the concept. Thus, representatives of the target groups are already integrated in the development and maintenance of the 'Body of Knowledge'. In addition, the setting-based approachrepresents participatory-based approach. It should be reviewed for all communication activities, whether the salutogenetic perspective is useful. In contrast to the pathogenesis, the salutogenesis is characterised by promoting and preserving health, instead of avoiding diseases. (Shome et al., 2009). In addition to the stronger motivation also the avoidance of the negative effects of Warnings and information can be achieved by using the salutogenic perspective. Hence, concerns that are triggered by alerts and information at about one in three recipients may be counteracted.

5.2.3.1 Levels of protagonists

In addition to the target group, which consists of the total population, the concept also provides for the involvement of other protagonists.

The individual level refers to people who carry out adaptation measures for protection purposes.

These may be vulnerable individuals, care giving relatives or other acquaintances. Excluded are individuals allocated to the next level.

The professional level is composed of doctors, specialised medical staff and professional caregivers. They professionally perform protective measures for third parties or shall instruct patients or clients on performing protective measures. The level of the multipliers refers to individuals who are responsible for other people professionally or in their spare time. Such professional multipliers include, for example teachers or supervisors. The private multipliers include e.g., trainers or people who perform a corresponding activity e.g., in a club.

Above that is the level of politics, where the subordinate health authorities may have a special role. The subordinate health authorities represent the interface between politics and the other levels. They can identify and inform local protagonists, but can also introduce the results of the regional participation to the political level.

5.2.3.2 Communicative measures

Further paths and channels of communication are recommended by the communication concept, which complement the Newsletters that dispatch Warnings and information to interested parties. Newsletters continue to be a key element for informing protagonists on acute Warnings. In addition to the Newsletters, the original information systems provider can use the following forms of communication:

- Newsletter
- SMS
- Apps
- Social Media (Twitter, Facebook etc.)
- Media Relations
- Websites (Warning/Forecast)
- Websites (Background)
- Brochures etc. (own media)
- Conversations
- Further education

A strict allocation of communication activities to individual objectives of the concept is difficult to achieve. Nevertheless, this allocation is made in the following tables.

Table 29: Mapping of the media of providers to the objectives of the communication concept

Medium	Warning / triggering actions	Health Literacy / Enlightenment	Change of framework conditions /practical help
Newsletter	+++	+	0
SMS	+++		0
Apps	+++	+	0
Social Media (Twitter, Facebook etc.)	+++	+	0
Media Relations	++	++	motivates the use of other media
Websites (Warning/Forecast)	+++	+	0
Websites (Background)	0	+++	0
Brochures etc. (own media)	0	+++	0
Conversations	+++	+++	+++
Further education	0	+++	+++

+++ Primary goal, ++ Aim is also pursued, + Secondary objective, 0 Not an objective of this medium

Table 30: Mapping of the media of providers to the levels of protagonist

Medium	Individual level	Professional level	Multiplier level	Politics level
Newsletter	+	+	+	+
SMS	+	+	+	
Apps	+	+	+	
Social Media (Twit-	+		+	

Medium	Individual level	Professional level	Multiplier level	Politics level
ter, Facebook etc.)				
Media Relations	+		+	
Websites (Warning/Forecast)	+			
Websites (Background)	+	+	+	+
Brochures etc. (own media)	+	+	+	
Conversations	+			
Further education		+	+	+

+ Level is target group of this medium

5.2.4 Components of the communication concept

The following components represent essential elements of the concept:

- Knowledge based approach
- Optimisation of Warnings
- Improving the populations Health Literacy
- Expansion of institutionalised channels of communication
- Development of a setting-based approach

The Warnings and/or Forecasts could be improved for acute Warning situations. This concerns the design, the content, as well as a more widespread distribution.

In Warning situations, the target group should already have a sufficient level of protection competence itself. Thus, preparatory measures can be implemented, and the risk perception of vulnerable individuals can be improved. For this purpose, the continuous improvement of the Health Literacy of the population is recommended. In order to ensure correctness and consistency of the messages, the "knowledge base" principle of the German Strategy for Adaptation to Climate Change (DAS) must be considered for the implementation of the two mentioned points. The institutionalised channels of communication can work. However, there are regional differences. An extension of this approach to other multipliers and further Warnings must be reviewed and appears selectively necessary. However, the consequences resulting from a Warning should be specified and the subsequent compliance should be promoted.

Numerous reasons lead to an approach that is oriented at the setting-based approach [41]. Such a program is also orientated at the first strategic pillar of the Adaptation Action Plan 'Provision of knowledge, inform, empower and participate' of the German Strategy for Adaptation to Climate Change (DAS-APA). In addition, people can be reached in difficult social situations and a great deal of participation can be implemented.

From a citizen's perspective it may be desirable to have a communication partner for health hazards. Health-related information can be coordinated and forwarded by a single body. Thus, similar simple precautions may be expected for example when Heat, intensive UV-Radiation and high Ozone concentration occur at the same time. Conversely, if different bodies independently recommend different protective and otherwise justified measures, their credibility, acceptance as well as the implementation by the vulnerable individuals will be less likely.

5.2.5 Knowledge based approach

Some limitations must be considered as shown in the limitations of the project (Chapter 2.3). Firstly, the health damage by the four environmental factors is not quantified and therefore not comparable. Secondly, the recommended health protection or adaptation measures are not evidence-based. This means that their effectiveness is not sufficiently scientifically proven or it is not indicated to what extent such measures are actually scientifically examined. In the context of communication, this presents an issue, especially when different communicative protagonists communicate different messages independently of each other. This can result in a substantial loss of trust.

Thus it is recommended to investigate and evaluate the available scientific information systematically. Such knowledge can be managed, compiled and made available by a 'Body of Knowledge'.

Establishing and maintaining a 'Body of Knowledge' incurs the following tasks:

- Collect evidence-based, scientific information
- Systematically represent and continuously adjust the state of science
- Evaluate information
- Make quality of the information transparent
- Provide knowledge for all different target groups

Possible contents of such 'Body of Knowledge' includes e.g.:

- Relevant diagnoses
- Root causes
- Measures
- Target group specific recommendations
- Epidemiological data
- Risk factors
- Vulnerable individuals
- Sources of relevant, reliable information
- Secondary preventive measures

The 'Body of Knowledge' should be considered for all components of the communication concept and should be accessed by all protagonists for the communication activities they perform.

[41] A Setting is a social context that is relatively permanent and that is subjectively known by its members. This relation is expressed by formal organization (e.g., company, school) regional situation (e.g., municipality, part of town, neighbourhood) same situation of life (e.g., retirees / pensioners) shared values and/or preferences (e.g., religion, sexual orientation) or by a combination of these characteristics. (Rosenbrock et al., 2010)

This procedure also helps to identify specific research needs. Furthermore, this approach complies with the “knowledge base” principle of the German Strategy for Adaptation to Climate Change (DAS).

The first pillar of the APA (Adaptation Action Plan of the German Strategy for Adaptation to Climate Change) is also instrumental for the creation of the ’Body of Knowledge’: “Provision of knowledge, inform, empower and participate”. Involving the future communication protagonists and the vulnerable population is already essential during the systematic research of the available knowledge. Such participation enhances acceptance and usefulness of the ’Body of Knowledge’. In a further step, the following aspects can expand the content design of the ’Body of Knowledge’:

- Imparting communication skills to multipliers
- Assisting informed decision of citizens.

5.2.6 Optimisation of Warnings

The dissemination of Warnings and predictions via e-mail and the web pages of the DWD and UBA is the core element of the national information systems.

5.2.6.1 Goal

Essentially, the particular purpose of such Warnings is to trigger concrete actions. Hence, Warnings predominantly serve a protective action triggering purpose. The explanatory (or enlightening) function of improving the Health Literacy, is explained in Chapter 5.2.7. The following recommendations are given with respect to individual Warnings.

5.2.6.2 Recommendations for Heat Warnings

The DWD Heat Warning Newsletter has obvious strengths in terms of user-friendliness. E.g., the sender and subject line of the e-mail is clearly presented. The validity period for the Warning and the affected area as well as references to further information, contact persons and the unsubscribe function of the Newsletter are self-evident.

The content and layout offer possible areas of improvement for further exploiting the potential of the Newsletter.

It is recommended to omit the combination of letters and numbers at the beginning of the text, since there is no recognizable benefit for the layman. The same applies to the subject line. Furthermore, the Warning should also clearly point out health risks. A template for this element can be found on the website of the German Weather Service. A clear allocation of temperatures to health risks can be found by following the path “Heat Risk-Index” / “Explanations”. [42]

[42] http://www.dwd.de/bvbw/appmanager/bvbw/dwdwwwDesktop?_nfpb=true&_pageLabel=_dwdwww_wetter_warnungen_warnungen&T169600781711254206874155gsbDocumentPath=Navigation%2FOeffentlichkeit%2FWetterWarnungen%2FBiowetter%2FGefahrenindices%2Fgt%2Fgt__erklaer node.html%3F__nnn%3Dtrue (06.11.2014)

Table 31: Relation between the perceived temperature, the thermal sense and the risks posed to human health [43]

Apparent temperature [°C]	Thermal sensation	Health risk
Above 38	very hot	very high
32 to 38	hot	high
26 to 32	warm	medium
20 to 26	slightly warm	low
0 to 20	comfortable	none
-13 to 0	slightly cool	low
-26 to -13	cool	medium
-39 to -26	cold	high
Below - 39	very cold	very high

In addition to the temperature, it should also be specified in the Newsletter, whether the associated health risk is “high” / “very high”. Also, specific recommendations for to be implemented protective measures should be added. The Newsletter should not only inform on potential health risks, but also enable the reader to act appropriately. Three basic rules for Heat Waves are provided on the website under the heading “Heat Warning System”. [44]

The following three basic rules should be complied with during a heat wave:

1. Avoid the heat!
   - Do not stay in the direct sun!
   - Do not go outdoors during the hottest time (afternoon) of the day!
   - Reschedule outdoor physical activity to the early morning hours!
2. Keep your home cool!
   - Only ventilate when it is cooler outdoors than indoors!
   - Avoid direct sunlight during the day!
3. Keep your body cool and ensure sufficient consumption of fluids and electrolyte!
   - Wear airy, light-coloured clothing and head covering! Take a cool shower or a cool bath!
   - Drink sufficiently and regularly!

[43] http://www.dwd.de/bvbw/appmanager/bvbw/dwdwwwDesktop?_nfpb=true&_pageLabel=_dwdwww_wetter_warnungen_warnungen&T169600781711254206874155gsbDocumentPath=Navigation%2FOeffentlichkeit%2FWetter Warnungen%2FBiowetter%2FGefahrenindices%2Fgt%2Fgt__erklaer node.html%3F__nnn%3Dtrue (06.11.2014)

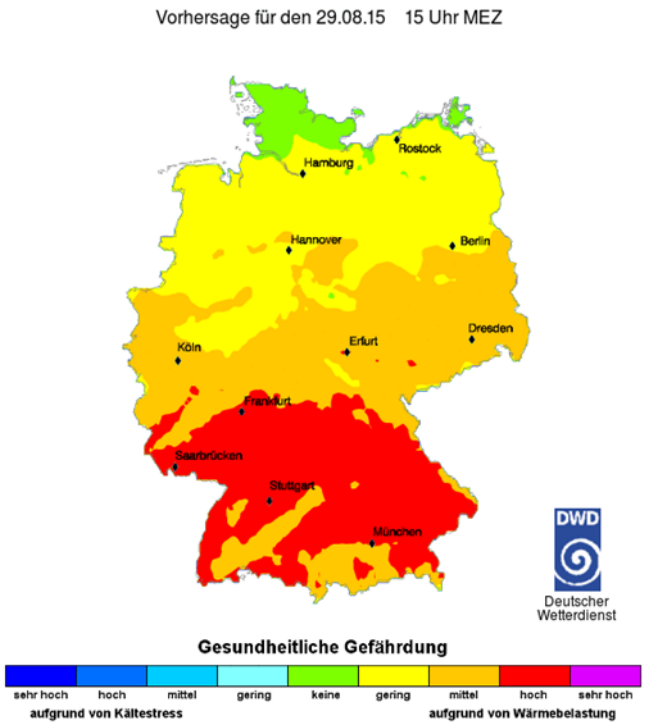
[44] http://www.dwd.de/bvbw/appmanager/bvbw/dwdwwwDesktop?_nfpb=true&_pageLabel=_dwdwww_wetter_warnungen_biowetter&T146028492511448395453905gsbDocumentPath=Navigation%2FOeffentlichkeit%2FWetter Warnungen%2FBiowetter%2FGef__Temp%2Fhitzewarnsystem__node.html%3F nnn%3Dtrue (06.11.2014)

However, these recommendations do not satisfy the requirements for evidence-based patient information (Chapter 2.3.2), since no information on scientific foundations is provided.

The reference to the date of issue of the Newsletter is subordinate in his priority and hence should be placed at the end of the e-mail, e.g., closer to the remark on possible issues on the timely delivery that may result from technical problems.

The renewed reference to affected regions at the end of the text body appears to be slightly irritating since the concerned Federal State was already mentioned at the beginning. Instead, a map with colour coded risk intensity could be inserted at this position. Thus, the county and the associated risk levels individually selected by the subscribers could be visualized and hence increase user-friendliness. Input for this purpose can also be found on the website of the German Weather Service. (Figure 34).

Figure 34: Thermal Risk Index – Forecast



http://www.dwd.de/bvbw/appmanager/bvbw/dwdwwwDesktop?_nfpb=true&_windowLabel=T16960078171254206874155&_urlType=action&_pageLabel=_dwdwww_wetter_warnungen_warnungen, 28 August 2014

5.2.6.3 Recommendations for UV-Warnings

The DWD UV-Warning Newsletter also features a good structure with clearly stated publisher, point of contact, links for further information and for unsubscribing. Content wise, it was successfully

achieved to include a brief justification for the Warning and to propose protective measures, which can also be found on the website of the German Weather Service. [45]

Example 25 April 2013

The Ozone layer is too thin for the season. Thus, the UV-Index shows an unusually high value of 7, high [sic!] for the time. Protective measures are required. The World Health Organization (WHO) urgently recommends seeking the shade at noon. Shirt, sunscreen, sunglasses and head covering are required in the sun.

This e-mail also begins with a combination of letters and numbers, which is unsuitable and should be omitted, as should the abbreviations in the subject line and the coded indication of the monitoring stations at the end.

It would also be advantageous to move the information on the issuing institutions and publication date to the end of the e-mail. This would help to more clearly present the content of the message, which is practically relevant for the reader to initiate action.

5.2.6.4 Recommendations Pollen Count Risk-Index

The DWD Pollen Count Risk-Index Newsletter is characterised by clarity of the sender and the subject. The forecast provides all important information (publisher, validity period and the territory covered). The selected formatting directs the reader to the relevant elements. Users are presented a meaningful table for the selected region. The uncomplicated key is easy to understand due to its colour design.

However, this Newsletter lacks references to preventive and protective measures. Also indications on where to find additional information or points of contact could be supplemented.

5.2.6.5 Recommendations Ozone Forecast

In a holistic view, the UBA Ozone Forecast Newsletter appears unstructured.

The sender must be clearly stated and requires a reputable designation, e.g., similar to the style of the German Weather Service Newsletters.

The subject line is in German and English. This seems obsolete, since the entire e-mail is otherwise kept entirely in German.

For the content design of the Newsletter, it is advisable to apply a user-friendly presentation with complete sentences and without abbreviations and jargon. The interpretation and evaluation of Ozone units requires technical knowledge, which one cannot expect the subscribers to have.

Example 31 July 2013

"O3 Forecast Region 2: Yesterday / today / tomorrow / day after tomorrow
Number of morning stations: 16/22/22/22
1 hour maximums: 92/88/114/152 Micrograms/Cubic meter
1 hour minimums: 64/66/73/99 Micrograms/Cubic meter
Number of morning stations with values › 150: 0/0/0/1

[45] http://www.dwd.de/bvbw/appmanager/bvbw/dwdwwwDesktop?_nfpb=true&_pageLabel=_dwdwww_wetter_warnungen_warnungen&T169600781711254206874155gsbDocumentPath=Navigation%2FOeffentlichkeit%2FWetterWarnungen%2FBiowetter%2FGefahrenindices%2Fuvi%2Fuvi erklaer__node.html%3F nnn%3Dtrue

Example 31 July 2013

Number of morning stations with values › 180: 0/0/0/0."

Instead of the above, a continuous text with the following content is advisable:

Essential components

- To which area and for how long does the forecast apply
- Which threshold is exceeded
- Which health risk will arise there from
- What protective measures can be applied by the user

The graphics, which can be found in the annexes, can be integrated into the text of the e-mail and hence support the message visually. The current supply of five graphics for a four-day forecast can limit the direct applicability and the immediate benefits.

5.2.6.6 Distribution

The information systems are generally known however, the DWD and UBA Newsletters are much less known and their use is quasi irrelevant with regards to the population.

The Warnings can be disseminated, by

- Using social media
- Applications for mobile devices
- Intensification of media relations
- Placement of advertising and
- Strengthened references in the media to the relevant authorities and institutions.

However, the media distribution in combination with improved content of the Newsletter may not necessarily lead to an improvement in the behaviour. Also the participation and the direct communication are not considered in this context. These aspects, however, seem necessary for changing behaviours.

The Heat Phone initiative in the State of Hessen represents a good example of outreach Warnings for specific Warning situations. The Heat Phone is a "joint project" of the health authority for the Kassel region, the Seniors Advisory Council for the city of Kassel and the House of Deaconess Kassel.

Deaconesses and members of the Seniors Advisory Council personally call the Heat Phone participants upon each Heat Warning published by German Weather Service for the City and the County of Kassel. The personal conversation and the caring for one's own health are very much appreciated by the participants. The evaluation shows that the Heat Phone results in an improved health behaviour during Heat events. (Heckenhahn et al., 2013)

The dissemination of Warnings via SMS can also attain additional recipients.

5.2.7 Improving the populations Health Literacy

Accompanying enlightenment that improves the Health Literacy of the population should complement the information systems. In addition to the acute Warnings, the population shall also be advised on reasons for the Warnings being important and how they can protect themselves.

5.2.7.1 Goal

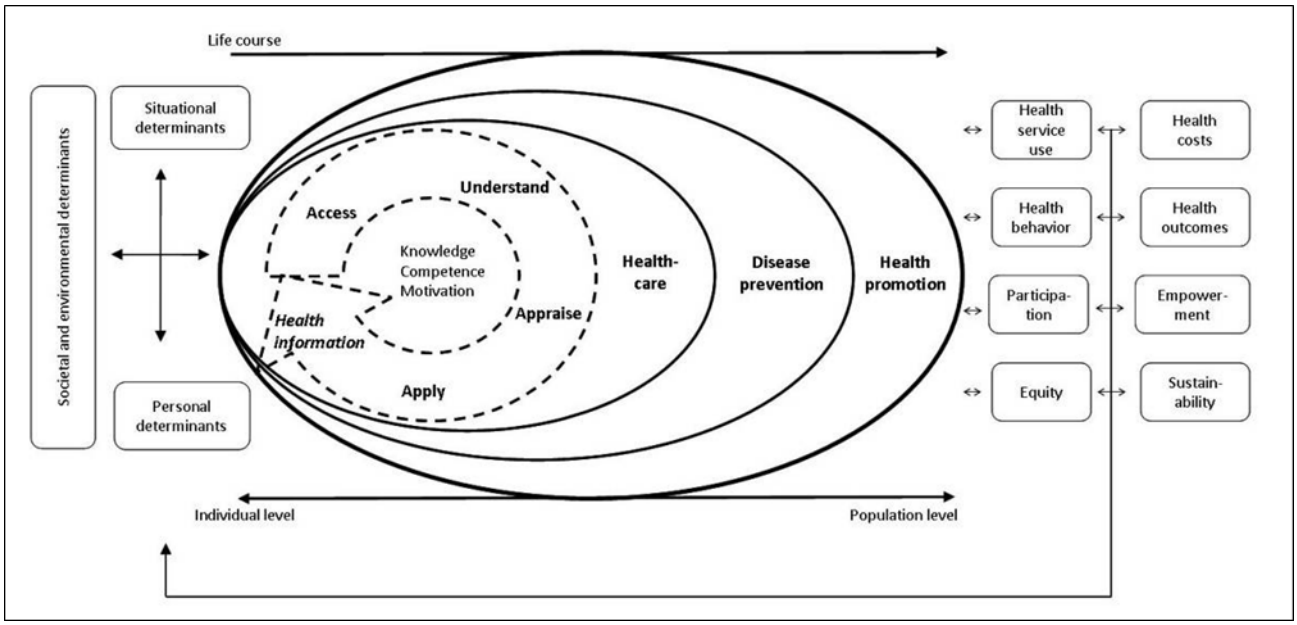
The accompanying enlightenment aims to improve the Health Literacy of the population and shall achieve the population's ability to carry out protective measures.

5.2.7.2 Contents

Health Literacy refers to the ability of individuals to find, understand, evaluate and apply health information (please also refer to the figure below). In the context of the environmental factors examined, this means

- Identify how to know and use the information systems
- Possess adequate risk perception
- Be aware of protective measures and
- Be able to apply protective measures.

Figure 35: Integrated model of Health Literacy by Sörensen et al., 2012



5.2.7.3 Distribution

Using 'own media', which include the websites and brochures of the authorities and institutions involved, can perform the distribution of such content. However, other communication options including social media channels, Apps and multimedia formats such as videos or animations are also suitable to disseminate such information. Media work is an important complementary measure for increasing the use of explanatory media. Dialogue and participation are also possible and desirable in the context of explanatory communication.

Thus, direct communication should also be considered for this purpose and can be utilised for events such as seminars or workshops. The different target groups must be considered. In addition to doctors and physicians, the possible target audience could also include specialised medical staff, caregivers, teachers, trainers to name just a few.

5.2.8 Expansion of institutionalised channels of communication

The forwarding of Heat Warnings to healthcare facilities can work (Chapters 4.4.2 and 5.1.4). In this case, facilities that can carry out health protection measures for particularly vulnerable individuals are reliably informed. It is recommended to further develop and promote the communication channels and the implementation of the following protective measures.

5.2.8.1 Institutionalised recipients

The institutionalised information channels are best developed for Heat Warnings and residential care facilities, although regional differences are apparent. Heat poses a health risk in combination with taking medication. Firstly, medication can have a different effect under the influence of higher temperatures (ABDA - German Associations of Pharmacists). Secondly, taking certain medication without sufficient drinking represents a risk for health damage caused by heat. Therefore, it is pointed at numerous places to consult a doctor.

“The decision to take medication, which may alter the body’s ability to adapt to the heat must be made by the attending physician.” (Niedersächsisches Landesgesundheitsamt, Lower Saxony State health authority, 2006)

Hence doctors are regarded particularly relevant recipients of Heat Warnings, since this professional group may only take the decision on the use of medication.

Even home care services, pharmacies, self-help groups and other existing groups, such as certain associations and clubs, are powerful multipliers. Important recipients for UV-Warnings must also be identified for UV-Radiation. Children and young persons as well as individuals that spend a lot of time outdoors for business or/and recreational purposes, are particularly vulnerable.

Consequently, childcare institutions (e.g. day-care centres for children, kindergartens, nurseries or afternoon clubs) should be aware of UV-Warnings. Also outdoor workers (such as farmers, builders, roofers, skippers and postman) are potential recipients, which should receive implementation-oriented UV-Warnings. This recommendation is also supported by the recognition of certain types of skin cancer as an occupational disease that is planned for 2015 (Bundesministerium für Arbeit und Soziales, German Federal Ministry of Labour and Social Affairs, 2014).

The population vulnerable to Ozone is difficult to identify. Therefore, no concrete extension of institutionalised information channels is recommended. In Warning situations, the previously mentioned information channels should also be used for Ozone Warnings. Please also refer to Chapter 5.1.6.

5.2.8.2 Promote implementation of measures by institutionalised recipients

It is not comprehensively clarified, whether health care facilities actually implement adaptation measures subsequent to the receipt of Warnings. Action plans for Heat partially exist, however data with regard to their implementation and supervision does not exist.

It is recommended to promote the implementation of measures subsequent to the receipt of Warnings (Cusack et al., 2011). In this context, hurdles of implementation (e.g. limited resource) should also be identified.

The duties of the subordinate health authorities in conjunction with Warnings should be reviewed. Such assignment must be substantiated, if required.

At the same time politicians can adjust the framework conditions of professional care providers. For this purpose, the influencing options regarding e.g., the political agenda or promoting relevant research projects, should be capitalized on. The assessment and evaluation tools of the German Network for Quality Development in Nursing (DNQP) and the catalogue of services of the statutory health insurance should be considered in this context.

To this end, also opinion-making measures such as stakeholder dialogues and/or trainings with consideration of the 'Body of Knowledge' should be offered.

In view of the results that are presented in the second volume (Capellaro and Sturm, 2015c), the consideration of the topic education, training and further education for the relevant professional groups also seems to be required.

5.2.9 Development of a setting-based approach

"Conversation" as a means of communication was established as a cornerstone of the communication concept on the basis of the results described in Chapters 4.4.2 and 5.1.4, since individual hurdles for the implementation of measures can apparently not be reduced by the mass media.

The expansion of institutionalised channels of communication already considers recipients who not (only) perform protective measures for others, but (also) educate vulnerable individuals. To a certain extent, this already corresponds to the core of a setting-based approach. Context-sensitive measures are also demanded by the World Health Organization (WHO).

In addition to companies, schools and homes, also leisure facilities, such as sports clubs, or neighbourhoods or communities can be considered as "Settings". One characteristic of the setting-based approachis that different audiences or actors can be simultaneously addressed in a given social context (in the Setting "school" e.g.: students, teachers, parents, staff) and in addition that contextual and individual-based measures can be combined mutually supportive. For the future, the council of experts recommends to increasingly focus on interventions that are based on the setting-based approach (especially companies, schools)" (Sachverständigenrat für die Konzertierte Aktion im Gesundheitswesen, Council of Experts for Concerted Action in Health Care, 2002).

The central element of the setting-based approachis the training of multipliers, which educate and enable vulnerable people with the help of the other means, such as the media offerings of the communication concept. Multipliers can answer questions and receive information on individual hurdles during the implementation of measures and possibly eliminate such hurdles, if necessary.

Existing structures will be used for the implementation. The following groups of persons or institutions may be suitable as multipliers:

- Teachers
- Countrywomen
- Company doctors/occupational physicians/employee health departments
- Trade unions
- Pharmacies
- Evening schools
- Specialised medical staff
- Church (Caritas, Diakonie, ...)
- Children day-care centres
- Health insurance companies
- Clubs
- And many more.

The training of multipliers is based on the 'Body of Knowledge' and should be performed with the involvement of multipliers and vulnerable people.

In order to ensure continuity and timeliness, coordinating bodies must be set up, which on the one hand inform the multipliers on e.g., new developments and on the other hand, collect feedback from the multipliers. Thus, the needs of the population are determined in a structured way and can be taken into account for the further development of the concept.

This approach is best suited for the implementation of the integral approach (see above). A thematic extension of the setting-based approach, e.g., towards extreme weather events or climate change, is possible.

5.2.9.1 Goal

The use of multipliers that are in direct contact with vulnerable individuals also aims to achieve the two objectives Action triggering and improving Health Literacy.

However, it is also worth mentioning at this point that this can also improve the context and the frame work conditions on an individual level. Conversations help to find solutions for smaller implementation hurdles.

In addition, the continuous participation of vulnerable individuals shall be ensured through direct contact with and structured feedback to the coordinating bodies.

5.2.9.2 State of research

Several difficulties become obvious when considering the evidence base for the setting-based approach.

Evidence base instruments for scientific research in scientific fields are mostly less suitable for the evaluation (Elkeles, 2006). Setting related interventions must be designed highly individually. They must be coordinated with the audience in a participatory manner and fitted into the existing organisational and social structures.

The generalizability and applicability of the evaluation is limited. Thus, notes on good practice can be made available, but no instructions that could be transferred to other contexts in a standardised manner.

“Methodological key elements may include the imparting of life skills, empowerment, participation and structure development. However, such elements may be partly difficult to operationalize.” (Engelmann, 2008). Therefore projects in Settings are “often developed insufficiently and are not interlinked with evaluations, objectives are only defined generally (for example, well-being) and the relationship between the intervention and the intended target (chain of effects) is unclear” (Waldherr et al., 2014).

Therefore “a pragmatic application of the categories ’analogy’ and ’reasonableness’ has established itself in the scientific discourse. Evidence-based practice and Quality Assurance is based on the idea that the same or similar activities under the same or similar conditions will lead to the same or similar (health) effects” (Rosenbrock, 2003).

For this purpose, the Federal Centre for Health Education (BZgA) has to create a practice database, in which the projects are evaluated according to so-called “good practice criteria”. The twelve criteria shown in Figure 36 are used for this evaluation and can be grouped into three blocks. Good practice projects must help to reduce social discrimination.

For this purpose, the setting-based approach is particularly suitable. Social and economically underdeveloped neighbourhoods/parts of town, etc. can be identified and can be involved by target groups in the further course of the project. These include inter alia an outreach, low-threshold working method, and participation or multiplier concepts. “Sustainability and Quality development” are mentioned as a third category. In order to systematically build an evidence base, this should in particular encourage the evaluation and cost-benefit orientation.

In particular, the cost-benefit calculation is often neglected, because “economic considerations in projects that are led by the principles of charity and non-profit, are discussed critically” (Meier-Gräwe, 2011). However, the economic evaluation of return on investment or Health Impact Assess-

ments can also impressively demonstrate, the financial benefits. No comprehensive data on this topic is available in Germany, but pilot projects have been carried out sporadically. For instance, different mathematical scenarios showed that more than one million Euros per case could be saved through the project "Frühe Hilfen" (Early Help). Without the intervention, these costs would be incurred for the social security systems during the course of life (Meier-Gräwe, 2011). "Frühe Hilfen" relies on the use of existing structures for distribution of information and dialogues, particularly for the vulnerable groups of population such as families in problematic situations.

Figure 36: Good Practice criteria for health promotion

Adapted from http://www.gesundheitliche-chancengleichheit.de/good-practice/good-practice-kriterien/

793 projects regarding the Part of town/Neighbourhood Living Environment are previously documented in the database of the Cooperation Network Equal Health Opportunities, 66 of which were classified by the criteria as Good Practice Projects (Status as of 03 November 2014). These projects include the core modules:

- Incorporation of health promotion in the everyday world
- Promotion of participation
- Raising competences
- Facilitating accessibility to offers
- Structural transparency
- Coordinating offers by building a network of protagonists
- Helping people to help themselves and

- Health-promoting design of framework conditions.

“Methods of health education and information [are not excluded by any means], but [...] are integrated into the Settings everyday life.” (Engelmann, 2008).

5.2.10 Regional trial of a setting-based approach

It is recommended to test the implementation of the setting-based approachin a model region. To this end, existing structures of a region are cross-linked for a limited period and modified framework conditions will possibly be tested.

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