

# Climate Change and Child Health – Importance of Pediatricians for Parents

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## Research Article

**Keywords:** climate change, child health, risk perception, parents, pediatricians, risk communication, education

**Posted Date:** January 13th, 2022

**DOI:** <https://doi.org/10.21203/rs.3.rs-1191923/v1>

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# Abstract

**Background:** Children are among the most vulnerable to suffer from health consequences due to climate change. Parents as caregivers play an important role in protecting them adequately. Pediatricians are regularly seen as highly-trusted health professionals, but it remains unclear whether they are an information source for parents regarding climate change and health. According to the Health Action Process Approach, parents' risk perception is an important pre-intender for intention building.

**Methods:** A sample of parents (N = 243) living in Germany completed an online, cross-sectional survey distributed in summer 2020. Regarding climate change and health, we asked about information sources, relevance estimation, and risk perception of parents. Multiple linear regression with general and individual risk perception as outcomes were used to analyze the effect of knowledge and personal relevance.

**Results:** Parents seek information about climate change and health primarily via internet and social media. Pediatricians are rarely considered as suitable information source. Parents see the highest risk for their child through increasing air pollutants and stronger UV-radiation. Relevance ( $\beta = .52$ ,  $t = 5.79$ ,  $p < .001$ ) and knowledge ( $\beta = .02$ ,  $t = .36$ ,  $p = .72$ ) explain 18.2% of general risk perception ( $F(5, 208) = 9.25$ ,  $p < .001$ ,  $\Delta R^2 = .13$ ). The effect is lower (13%) for individual risk perception ( $F(5, 189) = 5.67$ ,  $p < .001$ ,  $\Delta R^2 = .07$ ).

**Conclusions:** Pediatricians can play a valuable role in informing parents about climate change and health; nevertheless, they are not yet seen as suitable information sources by parents. Results demonstrate that knowledge about climate change and health is not sufficient to increase risk perception of parents, but strengthening risk perception is possible through rising relevance estimation. When informing parents about the expected health impact of climate change, this should be considered.

## Background

Climate change as a serious health threat for children is one of the greatest threats to human health in the 21st century [1]. According to the report of the intergovernmental panel on climate change (IPCC), any increase in global warming will affect human health, with predominantly negative consequences [2]. Health effects of climate change can be both direct (e.g. increase in extreme weather events) and indirect (e.g. increase in allergens) [3]. It is now well established that climate change can impair all population groups; however, children are considered as particularly threatened [4]. As noted by the World Health Organization (WHO) in total 88% of the global burden of disease arising from climate change relates to children younger than five years [5]. They are more likely to suffer from health consequences due to climate change because they prospectively live longer and are more exposed per unit body weight than adults [4].

Children are also dependent on caregivers, especially their parents. Therefore, when thinking about communicating climate change health consequences for children and further behavioral change, it is crucial to first study their parents' attitudes and behaviors. The protection of children against the

expectable health consequences of climate change requires that parents know about the health problems. The study aims to better identify the existing knowledge and the needs of parents as a target group which needs to be informed. It has already been shown that parents rely on child health advice given by pediatricians more than on information provided through media such as the internet, newspaper, and television [6]. Especially young children and their parents have regular contact with their pediatrician. In Germany for example, a minimum of 89% of all children (age  $\leq 6$ ) have annual contact with a pediatrician in an ambulant setting [7]. Therefore, focusing on health consequences due to climate change, we want to clarify which information channels are already used and investigate the role of pediatricians in informing parents.

According to the Health Action Process Approach (HAPA) [8], risk perception can be a key element of risk appraisal to intention generation, action, and thus behavior change. Thus, one way to trigger a behavior change is that parents perceive a risk for their children. The resulting effect on the outcome can be strengthened when also highlighting the seriousness and depicting the expected consequences [9]. However, understanding the factors contributing to risk perception is not trivial. Environmental risks, for example due to climate change, are different from other risks [10]. The effects are accompanied by uncertainty and are difficult to capture due to their complexity [11]. The consequences of climate change are not due to single individual's behavior but to a plethora of behaviors of many. Pro-environmental behavior requires the cooperation of multiple people [11].

Consequently, to learn more about parents as caregivers for children we investigated: Are pediatricians seen as information source for parents regarding climate change and health? Which other channels are already used? Furthermore, we focused on factors predicting risk perception by parents. We wanted to discover to what extent knowledge and personal relevance explain risk perception. We also examined what risks parents perceive for the health of their own child.

## Methods

### Study procedure

With a cross-sectional study design we used an online questionnaire in German lasting around 10 minutes which was configured by using the open-source software tool Lime Survey [12]. It was first applied in a pretest version. The distribution started in March and ended in summer 2020. To reach especially parents with different socioeconomic backgrounds, the link was posted multiple times in social network- and messenger groups regarding parent- and child-specific topics. The total number of asked participants is therefore unknown. All participants could take part anonymously on a voluntary basis and were informed about the purpose of the study. Participation was possible for parents living according to their postal code in Germany with at least one child aged 0 to 18 years.

### Study population

Of 243 respondents in total, 187 (77.6%) were female and the average age was 42 years (SD 7.73) (see Table 1). Most participants (42%) had two children and their youngest child was on average around 6.5 years old (SD 4.86).

Table 1  
Baseline characteristics of study sample

Characteristics	Sample (n=243)
Sex	
Male (%)	54 (22.4)
Female (%)	187 (77.6)
Age of participants (years), mean (SD)	42.00 (7.73)
Born in Germany (%)	205 (85.8)
Number of children, med (IQR)	2 (1-2)
Age of youngest child (years), mean (SD)	6.53 (4.86)
Educational background	
University degree (%)	175 (72.5)
High school diploma (%)	32 (13.3)
Other degree (%)	33 (13.8)
Professional field	
Medicine and health (%)	58 (26.1)
Other field (%)	164 (73.9)

Due to the very open distribution form, the sample is self-selective and only representative of a certain group of parents. The majority had either a university degree (72.5%) or a high school diploma (A-level) (13.3%) and is therefore highly educated. About one quarter of all participants worked in a health or medicine related professional field.

## Measures and scales

Our outcome variable was risk perception since it is an important pre-intender for intention building [13]. In Table 2 it can be seen that risk perception was measured in two different ways according to the HAPA-model, namely as the general perception (Outcome 1) and as the personal perception of risk (Outcome 2) using the concept of Weinstein [14][15].

Table 2  
Item overview of used constructs

Construct	Items	Cronbach's $\alpha$
Knowledge	● I know exactly where I can find information about the consequences of climate change on health. <sup>1</sup>	.71
	● I feel sufficiently well informed about the consequences of climate change on health. <sup>1</sup>	
Relevance	● I see a risk to my child's health from [given effects of climate change on health]. <sup>1</sup> (see Table 3)	.77
Risk perception	● Outcome 1: Climate change and its consequences on health worry me. <sup>1</sup>	-
	● Outcome 2: How likely do you think your child is to experience negative health effects from climate change compared to other children of the same age? <sup>2</sup>	-
Notes: Cronbach's $\alpha$ computed for reliability analysis. Answer possibilities for items were		
<sup>1</sup> (1) totally disagree; (2) disagree; (3) agree; (4) totally agree		
<sup>2</sup> (1) much less than average; (2) fairly less than average; (3) slightly less than average; (4) average; (5) slightly more than average; (6) fairly more than average; (7) much more than average.		

We operationalized knowledge as potential predictor for risk perception with two items (see Table 2). To investigate whether relevance estimation has a mediating effect for knowledge on risk perception we constructed a scale consisting of the expected health consequences due to climate change in Germany [3].

## Statistical methods

Descriptive analyses were performed to investigate the sociodemographic background and distributions of key survey items. Already used information sources and knowledge about climate change and health were descriptively analyzed. Cronbach's  $\alpha$  was computed for reliability analysis. Possible correlations were computed using Pearson's correlation coefficient. Through multiple linear regression analyses we examined any statistical effect of relevance estimation for knowledge on risk perception. Data management and analysis were carried out using RStudio (Version 4.1.1) [16]. Significance levels were set at the 5% level [17].

## Results

### Knowledge and information sources

Most participants (83.3%) knew where to find information about climate change and health (see Table 3). When asked about already used information sources, two thirds of all parents chose “internet/ social media” and half of them “newspaper”. Fewer parents used pediatricians (16.5%) and general practitioners (11.1%) to gather information about climate change and health consequences.

Table 3  
Descriptive summary of key survey items

Item	Mean (SD)
Knowledge	
I know exactly where I can find information about the consequences of climate change on health. <sup>1</sup>	3.00 (.94)
I feel sufficiently well informed about the consequences of climate change on health. <sup>1</sup>	2.48 (.89)
Relevance	
I see a risk to my child's health from:	
Increase of air pollutants. <sup>1</sup>	3.52 (.73)
Increase of UV-radiation. <sup>1</sup>	3.34 (.77)
Increased contamination of waters with pathogens (e. g. cyanobacteria). <sup>1</sup>	3.03 (.90)
Infectious diseases caused by ticks. <sup>1</sup>	2.91 (.90)
Heat and warmth. <sup>1</sup>	2.90 (.94)
Extended and intensified pollen season. <sup>1</sup>	2.62 (.97)
Physical consequences because of extreme weather events. <sup>1</sup>	2.55 (.92)
Mental consequences because of extreme weather events. <sup>1</sup>	2.39 (.94)
Risk perception	
How likely do you think your child is to experience negative health effects from climate change compared to other children of the same age? <sup>2</sup>	3.55 (1.10)
Climate change and its consequences on health worry me. <sup>1</sup>	3.50 (.78)
Note: Answer possibilities for items were	
<sup>1</sup> (1) totally disagree; (2) disagree; (3) agree; (4) totally agree	
<sup>2</sup> (1) much less than average; (2) fairly less than average; (3) slightly less than average; (4) average; (5) slightly more than average; (6) fairly more than average; (7) much more than average.	

Parents were asked whether they feel sufficiently well informed about the health consequences through climate change. It was shown that more than half of the parents (51.9%) do not feel well informed ((1) = 12.8%; (2) = 39.1%<sup>[1]</sup>).

## Relevance estimation for own child

When measuring relevance, we focused on the individual expected negative health consequences for the own child in Germany due to climate change [3]. As seen in Table 3, parents see the highest risk for the health of their children through the increase of air pollutants. Almost 90% of all participants totally agreed (62.7%) or agreed (26.7%) that climate change leads to increasing air pollutants and therefore threaten the health of their children. Increased and stronger UV-radiation is also seen as highly relevant for the health of the participants' children since almost 85% (totally) agreed. Focusing on the health consequences with the lowest mean values (see Table 3), it is clear that parents consider mental and physical consequences because of extreme weather events to be least relevant. Less than 40% see a risk through mental consequences ((3) = 22.6%; (4) = 16%) and less than 50% through physical consequences ((3) = 28.8%; (4) = 18.1%). The mean score estimating the risk for all consequences was 2.91 (SD = .55). In addition, it was asked in which period the participants consider the topic of climate change and health to be important. For 89.3% the topic is already relevant. Only small proportions say that it will be important for them in five years (5.4%), ten years (2.5%), or never, because it would not concern them (1.6%).

## Risk perception for own child

To establish the general risk perception, all participants were asked whether climate change and its consequences worry them. The results show that most participants (84.8%) feel worried ((3) = 20.2%; (4) = 64.6%). We also compared the individual perceived risk for the own child in comparison to other children of the same age. The analysis showed that almost half of all parents (49.4%) perceive an average risk. Around one third (32.9%) estimates the risk lower than the average, and only 8.6% higher than average.

## Relatedness within the constructs of knowledge, relevance, and risk perception

The following set of analyses examined whether any correlations exist within the constructs of knowledge, relevance, and risk perception. Table 4 provides the summary statistics for the intercorrelations among the three constructs. A medium positive correlation was found between relevance estimation and general risk perception ( $r = .40$ ;  $p < .001$ ). Respondents with a high general relevance estimation therefore perceive a higher risk. The same effect, but to a lesser extent, appears for relevance and individual risk perception ( $r = .25$ ;  $p < .001$ ).



Table 4  
Descriptive statistics and correlations for main variables

Variable	1	2	3	4
1. Knowledge	-	.11	-.03	.10
2. Relevance		-	<b>.40***</b>	<b>.25***</b>
3. General risk perception			-	.07
4. Individual risk perception				-
Mean	2.74	2.91	3.50	3.55
SD	.80	.55	.78	1.10

Note: Pearson correlation coefficient; \*\*\*p < .001 (bold).

Regression analyses were used to investigate if knowledge and relevance estimations predict risk perception. Gender, occupation, and education were considered as control variables.

## General Risk perception

With general risk perception as the outcome, the overall model including the mentioned control variables and knowledge was significant ( $F(4, 209) = 2.96, p < .05, R^2 = .05$ ). Knowledge was not associated with general risk perception ( $\beta = .02, t = .36, p = .72$ ). There was only a significant gender effect ( $\beta = -.37, t = -2.98, p < .01$ ) showing a lower risk perception for men compared to women. When including relevance in the model, 18.2% of the variance can be explained ( $F(5, 208) = 9.25, p < .001, \Delta R^2 = .13$ ). Relevance was positively associated with risk perception for health consequences due to climate change ( $\beta = .52, t = 5.79, p < .001$ ).

## Individual risk perception

Analyzing the effects of knowledge and relevance on individual risk perception, the overall model including knowledge is significant ( $F(4, 190) = 2.99, p < .05, R^2 = .06$ ). Apart from a negative effect regarding occupation ( $\beta = -.44, t = -2.35, p < .05$ ), indicating a lower risk perception for health professions compared to other professions, there is no association between the main variables including knowledge with individual risk perception. When extending the model by relevance, there is also a positive association between relevance estimation and individual risk perception ( $\beta = .55, t = 3.80, p < .001, F(5, 189) = 5.67, p < .001, \Delta R^2 = .07$ ).

### Footnote:

<sup>[1]</sup> See Table 2 for detailed answer possibilities.

## Discussion

In the context of climate change and child health, the present study was designed to determine the current information status and suitable information channels for parents. The majority of respondents

say they know where to find information about climate change and health, while it was also shown that half of the participants do not feel well informed. Currently, parents from our sample primarily seek information via the internet and social media, newspapers, and books or magazines. It was not evaluated in detail which webpages they use. Parents' sense of uninformedness raises the question of whether the information sources already being used are actually appropriate, or whether there are other mediators that would be more suitable for educating parents. Health care professionals are highly trusted by the German population and can therefore play a valuable role in combating the challenges of climate change for society [18]. Nevertheless, our results show that only a small portion of our studied sample of parents considers pediatricians or general practitioners as suitable sources of information. As stated in a policy statement by the American Academy of Pediatrics (AAP) [19], it is possible to identify pediatricians as an important and underutilized resource for providing climate change and health education. Pediatricians should broaden and strengthen their knowledge about the health consequences of climate change to realize and oppose them. By understanding the threats of climate change on child health, pediatricians can engage in informing parents and seek their awareness to become a suitable and trustworthy information source for parents [19]. Although our study results address only a very specific subset of parents and are therefore difficult to generalize, it is undisputed that failure to act will lead to major injustices for the next generations [20]. Parents of all sociodemographic groups have regular contact with their pediatricians in Germany. We assume that this is precisely why they are a suitable source to address the groups unable to be reached by the survey, due to differing interest in the topic. Therefore, we recommend that pediatricians engage more in proactively communicating and mitigating the health impacts of climate change. One approach would be to reinforce their education through training modules, such as those drafted and offered by the LMU Munich [21][22].

Furthermore, we wanted to investigate how parents perceive the relevance of health risks posed to their children through climate change. The consequences of climate change were seen as having varying extents of relevance to child health, but for almost all participants, climate change and health is already a relevant topic. The most relevant health risk for their children was seen in increasing air pollutants, followed by changes of UV-radiation. Mental and physical consequences because of extreme weather events were seen less frequent as a risk. The assessment could be different due to the flood events in Rhineland-Palatinate (Germany), which occurred after the survey was conducted. This is somewhat different to results of a representative German population survey [23] which showed that participants were especially worried about more frequent occurrence of heat waves, drought, and forest fires. Equally worrying were more frequent storms and floods [23]. The results could differ because of the restriction of our study to analyze parents mainly from cities, where air pollution is more present. We could show that participants feel worried by climate change and its consequences. When asked about risks due to climate change, only 14.1% of all German participants named health consequences [23]. For over a half (51.7%), natural disasters and weather problems were perceived as risks. When asked about the specific health consequences due to climate change, on average participants felt worried [23]. A study conducted in the United States [24] came up with similar results compared to the one just introduced [23]; open questions in particular showed missing associations about climate change and consequences for human health

[24]. This result may be explained by the fact that media articles only seldom cover the topic of climate change and human health [1]. Over a ten-year period (2008-2018), the newspaper the People's Daily published, on average, about 2500 articles each year addressing climate change, from which only 14 articles a year also focused on human health [1]. Mass media might in some cases have an impact on a person's risk perception, whereas interpersonal communication channels may be effective as well [25].

In our study we asked about the risk for the own child compared to other children at the same age and found that parents generally perceived a risk for their child that was as high as that for other children the same age. Since risk perception is a relevant predictor for changing or adapting behavior [13], we wanted to examine the antecedence for risk perception of parents and analyzed the effect of knowledge and relevance estimation. We differentiated between general and individual risk perception and gained similar results for both types. It has been suggested that knowledge has an impact on risk perception, but this does not appear to be the case. The results presented in the conducted study show that knowledge alone does not seem to predict risk perception. On the other hand, relevance estimation has a statistically significant effect on risk perception. It can therefore be assumed that a person will rather bring up intentions for individual behavioral- and preventive actions in the context of climate change and health when relevance for the own child's health is recognized. The results suggest that it is not sufficient to only provide information or knowledge about climate change and health consequences; the relevance for the own child should also be demonstrated and linked with experiences of the parents that already happen or could happen in future. Risk perception and—in a second step—intentions towards preventive actions could in that way be supported.

## Limitations and further research

The results of the conducted study reflect only a small number of well-educated parents from a convenience sample. Therefore, many demographic groups are left out and generalizability is difficult. Assuming a lower level of information and awareness in other demographic parent groups, our study aims to overcome this gap by involving pediatricians more often and effectively.

Further research should be undertaken to identify possibilities for pediatricians to implement formats for informing parents about the expectable consequences, since it is a problem that is not going to disappear or become weaker. It should be discovered if more parents can be reached through pediatricians, and in what way their knowledge, relevance estimation, and risk perception changes when using a medical and trustworthy source rather than the internet as primary source.

## Conclusions

The aim of this study was to discover the role of pediatricians in informing parents about the expected health consequences due to climate change. Parents currently seek information mainly through the internet but feel overall that they are not informed enough. They see a risk for their children primarily from an increase in air pollutants and UV-radiation. Overall, the study reinforces the idea that parents are

willing to inform themselves about the health consequences of climate change (for their children). We recommend further engagement of pediatricians to educate families, drawing attention to the appearance and prevention of those health consequences. It seems important to not only provide knowledge, but also strengthen the personal relevance for the health for the own individual child to also ensure behavior change.

## List Of Abbreviations

American Academy of Pediatrics (AAP)

Health Action Process Approach (HAPA)

Intergovernmental Panel on Climate Change (IPCC)

World Health Organization (WHO)

## Declarations

### Ethics approval and consent to participate

The research has received permission of the Institutional Review Board of the University Hospital in Munich (# 20-034). The study was orientated on the Declaration of Helsinki<sup>15</sup>.

Participants were informed about the purpose of the study and had to give informed consent by agreeing a data protection- and usage declaration. The data usage note indicates that “no personal data will be requested from you, please do not provide any personal or personally identifiable information. With the settings made, an anonymous survey was configured. This means that there is no entry in the survey database in the data table as by whom, when, and from where the survey was called up and sent in entries. Should you nevertheless enter personal or personally identifiable data, we will treat your personal data confidentially. The provision of your personal data is voluntary. Your personal data will not be passed on or transferred to third parties. Your data will be deleted immediately after we become aware of it.”

### Consent for publication

Not applicable.

### Availability of data and materials

The dataset generated and analyzed during the current study are available in the “LRZ Sync+Share” repository. <https://syncandshare.lrz.de/getlink/fiXhzwMbMrMqGu7z8eWSbNRV/>

### Conflict of interest statement for all authors

The authors declare that there is no conflict of interest regarding the publication of this paper.

## Funding sources

Funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) on the basis of a resolution of the German Bundestag (project number: 67DAS213)

## Authors' contributions

LL wrote the first draft and revision, performed the statistical analyses and interpreted the results. SB and JSchoi designed and coordinated the project, participated in interpreting the results and revised the study. JSchor supported during the statistical analysis, interpretation of the results and revision of the draft. ME helped with designing and conducting the study. All authors read and approved the final manuscript.

## Acknowledgements

The authors want to thank Nicole O'Reilly and Antonia Bartz for editing the text and cross checking our English language.

## Additional information

The study has been published on a preprint server (before revision). See Lagally L, Schorlemmer J, Schoierer J, Edlinger M, Boese-O'Reilly S. Climate Change and Child Health-Assessment of Parents' Perspective and Relevance. Doi:10.1101/2021.02.15.21251730.

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