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# **BMJ Open**

#### Are people interested in receiving advice from their general practitioner on how to protect their health during heatwaves? A survey of the German population

Journal:	BMJ Open
Manuscript ID	bmjopen-2023-076236
Article Type:	Original research
Date Submitted by the Author:	31-May-2023
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Keywords:	Primary Health Care, EPIDEMIOLOGIC STUDIES, Primary Care < Primary Health Care

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7	3	how to protect their health during heatwaves? A survey of the German
8 9	4	population
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11	6	Short title: Interest in receiving GP advice on health protection during heatwaves
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54 55	40	
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57	42	Number of words: text 4,015, abstract 299
58 59	43	Number of tables: 3
60	44	Number of figures: -

45 Number of supplements: -

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1	1	
2 3	1	ABSIRACI
4 5	2	Objective
6	3	Climate-change induced heatwaves are increasing significantly, putting a strain particularly on the
7	4	health of vulnerable parts of the population. General practitioners (GPs) could reach these people and
8 0	5	provide advice on protective health behaviour against heat. Data is lacking on whether and what topic
10	6	of GP advice people are interested in, and whether specific person characteristics are associated with
11	7	such interests. This study aims to answer these questions.
12 13	8	Design
14 15	9	Cross-sectional, nationwide, face-to-face household survey, conducted during winter 2022/2023.
16 17	10	Setting
18 19	11	Germany.
20 21	12	Participants
22	13	Population-based sample of 4,212 respondents (aged 14-96 years), selected by using multi-stratified
23	14	random sampling (50%) combined with multi-quota sampling (50%).
24 25	15	Main outcome measure
26 27	16	Interest in receiving GP advice on health protection during heatwaves (yes/no), and the topic people
28	17	find most important (advice on drinking behaviour, nutrition, cooling, cooling rooms, physical activity,
29	18	or medication management). Associations between pre-defined person characteristics and the
30 31	19	likelihood of interest were estimated using adjusted logistic regressions.
32 33	20	Results
34	21	A total of 4,020 respondents had GP contact and provided data on the outcome measure. Of these,
35	22	23% (95%CI=22%-25%) expressed interest in GP advice. The likelihood of expressing interest was
30 37	23	positively associated with being female, older age (particularly those aged 75+ years: 38% were
38	24	interested), having a low education, having a migration background, living in a more urban area, and
39 40	25	living in a single-person household. It was negatively associated with increasing income. Advice on
40 41	26	medication management received highest interest (25%).
42 43	27	Conclusions
44	28	During winter season 2022/2023, around one quarter of the German population with GP contact –
45 46	29	and more than one third of those aged 75+ years – was interested in receiving GP advice on
47	30	protective health behaviour during heatwaves, especially on medication management. Climate
48	31	change is creating new demands for healthcare provision in general practice. This study provides
49 50	32	relevant information for research and practice aiming to address these demands.
51	33	
52 53	34	Keywords
54 55	35	primary care, climate change, heatwave, general practitioner, advice, population survey
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### Strengths and limitations of this study

- This study targets an important research gap on population interest for information on preventive measures during heat waves in Germany.
  - The representativeness of the population-based sample, selected by using multi-stratified random probability sampling (50%) combined with multi-quota sampling (50%), is a major strength of this study.
- As the outcome measure was introduced into an existing survey on another health topic, we were not able to collect other variables of interest, such as health status, medication use etc.
- Data were collected during winter season where health effects of heatwaves might be less obvious to individuals compared to the summer season.
- Interest in GP advice can only develop if awareness about adverse effects of heat waves is present. A lack of interest can therefore be the result of lack of awareness about such effects and their potential mitigation measures.

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#### 1 INTRODUCTION

The World Health Organization (WHO, [1]) considers climate change to be the single greatest health threat to humankind. In the future, our society and health care systems will be increasingly confronted with adverse health effects of climate change, such as increased mortality and morbidity during heatwaves [1, 2], resulting in negative impacts on public health.

Heatwaves are hazards that negatively impact various sectors of society such as agriculture, forests, infrastructure, and human health [3, 4]. Although no universally accepted definition exists [5], heatwaves are understood to be prolonged or repeated periods with high or higher-than-normal air temperatures during days and/or nights that exceed a pre-determined temperature threshold over a certain period of time [3, 4]. Such prolonged heatwaves can cause high thermal stress to the body affecting, for example, the cardiovascular system by increasing blood viscosity and impacting the body's capacity to maintain a constant temperature [6, 7]. Numerous studies around the world suggest a systematic association between the occurrence of heatwaves and exacerbated cardiovascular, respiratory, and other forms of morbidity and mortality [8]. 

In Germany, climate change has been causing more frequent, more intense, and prolonged periods of heat in the summer, which has found to be associated with increased mortality rates [9, 10]. In July 2015, for example, a 1.2 increase in hospital admissions and over 3 times higher heat-related morbidity rates were observed for the metropolitan city of Frankfurt am Main [11]. Furthermore, there were 8,700 excess deaths all over Germany attributable to heat in the summer of 2018, which was characterized by an unusually long heat period of up to nine weeks with high weekly mean temperatures [12]. Around 4,500 heat-related excess deaths occurred in the summer of 2022, which is described as the fourth warmest summer since weather records began in Germany in 1881 [13]. Like other countries, Germany implemented a National Adaptation Strategy on Climate Change to address the effects of extreme weather in order to safeguard people's health from the heat [14]. In addition, in 2017, the WHO recommendations for heat health action plans (HHAPs) were adopted by a working group of the national and federal states of Germany to motivate local implementation of action plans [15]. 

Specific groups of society are particularly vulnerable to adverse health effects of heat such as elderly people, people with disabilities or with underlying medical conditions (e.g., people with cardiovascular, respiratory, renal or mental illness, or people suffering from multiple diseases), those working outdoors or in non-cooled environments, those living alone (in isolation) or in urban areas with high population density, as well as people with lower socioeconomic status [2, 8, 16-20]. The relevance of these heat-related health risks is particularly meaningful to Europe, due to its ageing population, urbanisation, and high prevalence of chronic diseases [2]. 

Behavioural measures can effectively help to prevent adverse effects during a heatwave, for instance increasing fluid intake, staying in a cool or air-conditioned environment, wearing loose-fitting clothes, taking showers/footbaths, reducing activity levels, avoiding moderate to high consumption of alcohol, and – in people using medication – monitoring and, if needed, adjusting medication intake [19, 21]. However, while a recent survey in Germany showed that elderly people aim to tackle heat with a number of body-related, home-protective, and activity-related coping strategies, an underuse of water-related heat adaption strategies was observed [18]. 

Substantial public health actions will be needed worldwide to tackle health impacts of climate-change
 induced heatwaves. According to WHO, HHAPs should be designed and implemented together with
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stakeholders at all levels in the health-sector, including general practitioners (GPs), to prevent direct
 effects of heat [22]. The WHO's HHAP of 2011 includes specific recommendations on how GPs should

proactively identify, advise, and monitor patients at risk, and how to educate, counsel, and inform
patients in general regarding individual adjustments of behaviour, medication and fluid intake, as well
as inform them about helplines and medical services [23]. GPs thus have an important role in educating
patients on, and assisting them with, health effects of heat.

In general, GPs are well placed to provide such behavioural advice and information as the majority of
 the population regularly sees a GP, and GPs can particularly reach the most vulnerable groups of
 society (e.g., elderly, multimorbid, and socially isolated people) [24]. Furthermore, patients report that
 they see their GPs as a trusted source of information and advice on health behaviour [25].

However, a survey among GPs in Germany conducted in the year 2022 [26] showed that although around 60% of GPs reported observing heat-induced health effects of heatwaves in their patients, only a minority of GPs actively address this topic with their patients. Around 16% reported that they adjust the medication of their patients during heat periods, while around 10% advise their patients on dealing with heat. Only a few GPs proactively contact patients which are at risk during heat periods [26]. Results from a qualitative study from Germany conducted in 2013 suggest that GPs' knowledge and awareness of heat health impacts and climate change needs to be strengthened – preferably through target-group-specific training - in order to engage them more extensively into preventive actions with their patients [27]. 

To inform the development of effective and tailored prevention measures, it is not only important to
explore the interests and perceptions of GPs, but also of those who will be affected from such
preventive measures – the patients. Are they interested in receiving GP advice on how to protect their
health from heat?

#### 35 24 RESEARCH AIM AND QUESTIONS

Using data from a nationally representative sample of the German population, this study aims to assessthe following research questions:

- What proportion of the German population with GP contact expresses an interest in receiving GP advice on health protection during heatwaves, stratified by socio-demographic characteristics, socio-economic status, and region of residence?
  - 2. Are these person characteristics statistically associated with the likelihood of expressing an interest in receiving GP advice on health protection during heatwaves?
  - 3. Among those expressing an interest in such advice, which topic of advice is preferred most, stratified by age and sex of respondents?

## 5051 36 MATERIALS AND METHODS

#### 53 37 Study design and population

Data was collected using an ongoing, cross-sectional, representative household survey of the German population to which a single question on the interest in receiving GP advice on health protection during heatwaves was added for the period of two survey waves between October/November 2022 and January/February 2023. This study collects data every other month by computer-assisted face-to-face household interviews of participants aged 14+ years (with no upper age limit) living in private households across Germany. Respondents are selected by using a dual frame design: multi-stage, Page 5 of 16

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multi-stratified random probability sampling (50% of the sample) combined with multi-quota sampling (50% of the sample). Details on the sampling design have been described elsewhere (https://osf.io/s2wxc). **Dependent variable** The question on "interest in receiving GP advice on health protection during heatwaves" was introduced using a brief explanation: "Now we would like to ask you a question on a completely different topic. Climate change is causing the earth to warm up. As a result, so-called heatwaves can increasingly be observed in summer, i.e., an unusual number of days with high temperatures. These heatwaves can have a negative impact on health. General practitioners could offer advice on how to protect health during heatwaves". This introduction text was followed by the question and the response options (including topics the GP advice should focus on - if so; single answer only), which were presented in a randomised order to minimise the risk for order bias: "Would you like to receive advice from your general practitioner on how to better protect your health during heatwaves? If so, which of the following topics would be most important to you? 1. Yes, I would like to receive advice, especially on my drinking behaviour (e.g., what, how much or how often I should drink). 2. Yes, I would like to receive advice, especially on my diet (e.g., what or how much I should eat). 3. Yes, I would like to receive advice, especially on how to cool myself down (e.g., arm and foot baths, proper use of fans). 4. Yes, I would like to receive advice, especially on how to keep my living spaces as cool as possible (e.g., darkening rooms, proper ventilation). 5. Yes, I would like to receive advice, especially on my physical activity (e.g., how much, when or where I should exercise). 6. Yes, I would like to receive advice, especially on what to look for regarding medication (e.g., storage, adjusting medication intake or changing medication). 7. No, I do not want any advice from my general practitioner on this. 8. *I do not see a general practitioner.* 9. No answer The question was developed together with two experts, who are medical doctors (one of them being a GP) and researchers in the area of climate change and health (AH, BM). **Independent variables** The following sociodemographic characteristics were measured: age in five categories of 14–24, 25– 39, 40–59, 60–74, 75+ years; sex (female versus male); region of residence (metropolitan area, urban area, versus rural area as reference), migration background (yes versus no), and cohabitation as a potential indicator for social isolation (living in a single-person versus other household). Since effects of climate change, particularly temperature effects [28, 29], as well as accessibility and utilisation of GPs [30], are reported to differ between more rural and more urban areas, we assume interest in GP advice on health protection during heatwaves to also differ between residents of different regions. Area of residence of respondents was therefore assessed by using the variable administrative municipality district size ("politische Gemeindegrößenklasse"). This variable consists of

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seven categories which were summarised into three categories for further analyses comparable to
 other previous studies in the German population [31] (more details have been published elsewhere:
 <u>https://osf.io/zp7c6</u>): rural area (<20,000 residents), urban area (20,000 to 500,000 residents), and</li>
 metropolitan area (>500,000 residents).

Migration background was defined as a positive answer to the question "Was one of your parents born abroad?" The official definition of "migration background" used for administrative purposes includes that at least one parent did not have German nationality by birth. In our study, no information is available for the respondents' country of origin or whether or not they were born in Germany. However, for the purpose of this study we assume that at least part of participants who were classified as having a migration background according to the definition applied in this study have made specific experiences with extreme temperatures (e.g., heat, cold, drought) compared to people without such background [32, 33]. Previous studies have found higher heat vulnerability and exposure among people with migration background compared to those without [34-36]. We therefore assume that people with migration background may also have interests in terms of health protection against heat, and thus included migration background as a dependent variable in the analyses. 

Measured socioeconomic status variables were: educational attainment (low [9 years of education, or no graduation], medium [10 to 11 years], high [>12 years]), and monthly net household income calculated per person in the household. For descriptive purposes, income was categorised using cut-offs that lead to an approximate distribution of: low (~25% of the sample), medium (~60% of the sample), and high (~15% of the sample), approximately reflecting the income distribution in Germany (details on the income calculation can be found here: <u>https://osf.io/387fg/</u>). Income was entered as a continuous variable coded from 0 ( $\leq 0$  income/month) to 7 ( $\geq <7,000$ /month) in the regression models. 

## 33 34 24 Statistical analyses

The study protocol and analysis plan were written prior to analysing the data and pre-registered on
 the Open Science Framework: <u>https://osf.io/ycz7n</u>. Analyses were performed with IBM SPSS Statistics
 for Windows, Version 29.0 (Armonk, NY: IBM Corp).

To address **research question 1**, we report descriptive prevalence data on the number of people expressing an interest in receiving GP advice on how to protect their health against heat effects, stratified by above mentioned person characteristics, and reported as percentages together with 95% confidence intervals (95%CI). For the stratified presentation of results and for logistic regression analyses (research question 2), respondents' answer on the outcome measure was categorised into a binary outcome variable "Yes, I am interested in receiving advice by a GP on how to protect my health during heatwaves" (answers 1-6, coding: 1) versus "No, I am not interested in any advice from my GP on this" (answer 7, coding: 0). 

So 36 Prevalence data were weighted to be representative of the population in Germany accounting for
 personal and household characteristics. Details on the weighting technique have been published in the
 main study protocol [37] and elsewhere (https://osf.io/s2wxc).

To address research question 2, adjusted logistic regression models were conducted to explore associations between the pre-defined person characteristics of respondents and the likelihood that they are interested in receiving advice from their GP on health protection during heatwaves (yes versus no). Adjustment sets for regression analyses were derived by application of directed acyclic graphs (DAGs). More details – including the graphs – have been published together with the analysis protocol: https://osf.io/ycz7n. Depending on the minimal sufficient adjustment set needed for each model, Page 7 of 16

- simple or multivariable regression models were conducted. Regression analyses were conducted using unweighted data. To address research question 3 among the subgroup of respondents with an interest in receiving GP advice, we present descriptive prevalence data (together with 95%CI) on the topics this advice is preferred to focus on (answer options 1 to 6). This prevalence data is presented descriptively and stratified by age categories and sex of respondents. We had not planned statistical testing of relative differences in the analysis protocol, as the number of cases in the subgroups was expected to be too small. This descriptive analysis was conducted using unweighted data as weights were only available for the total sample and these should not be applied to subsamples that are already selected on the basis of specific person characteristics (e.g., interest in GP advice). Dealing with missing data Overall, missing data in this face-to-face survey occurred only for a small share of the following independent variables: education: 2.3%, income: 0.1%, migration background: 3.9%. Thus, we assumed that excluding cases with missing data would not have relevant effects on our results, and used complete cases for the final analysis. Patient and public involvement statement The study was population-based and did not address a specific patient group. Public was not involved in design, conduct, or dissemination of this study. RESULTS A total of 4,212 respondents aged 14+ years of the general population in Germany participated in the study between October/November 2022 and January/February 2023. Respondents without GP contact (answer 8, n=128, 3% of the total sample) or who preferred not to answer the outcome measure (answer 9, n=64, 1.5% of the total sample) were excluded from the analyses, which leads to a final sample of 4,020 individuals. Person characteristics of this final sample are reported in Table 1. The age range was 14 to 96 years (n=469 aged 75+ years), with a mean age of 51.6 years (standard deviation (SD)=18.5), and 52.8% (n=2,121) of the respondents were female.
  - Research question 1: Proportion of the population with interest in receiving GP advice on health protection during heatwaves, stratified by person characteristics
  - Among the general population, 23.4% (95%CI=22.0%-24.8%, n=892; unweighted data: 26.8%, n=1,079) expressed an interest in receiving GP advice on health protection during heatwaves. Relative differences in this interest stratified by person characteristics are presented in **Table 1.** Highest interest was observed in respondents aged 75+ years (38.2%, 95%CI=33.3%-43.2%).
  - Research question 2: Associations between person characteristics and the likelihood of expressing an interest in GP advice
  - The likelihood of expressing an interest in GP advice was positively associated with being female, increasing age, having a low compared to high educational attainment, having a migration background compared to not having such background, living in an urban or metropolitan area compared to a rural area, and living in a single-household compared to other households, see Table 1. The likelihood was negatively associated with increasing net household income per person.

2 advice on health protection (=yes) relative to the respondents' characteristics; including results of

3 regression models on associations between these characteristics and an interest in receiving GP

4 advice (yes vs. no).

	Total sample, n=4,020	Interested in GP advice on	health protection against	
	unweighted data	heat = yes	s (vs. no)	
	% (n)	weighted data, n=892 % (n, 95%Cl)	unweighted data OR <sup>§</sup> (95%CI)	
Sex <sup>a</sup>				
Male (reference)	47.2 (1899)	19.9 (368, 18.1-21.8)	1	
Female	52.8 (2121)	26.6 (524, 24.7-28.6)	1.39 (1.21-1.60)	
Age in years <sup>a</sup>				
14 – 24	8.4 (337)	14.1 (64, 11.1-17.7)	Continuous, per year	
25 – 39	21.9 (881)	22.0 (183, 19.20-24.9)	1.01 (1.01-1.01)	
40 – 59	32.3 (1300)	20.1 (257, 17.9-22.4)		
60 – 74	25.7 (1033)	28.0 (243, 25.0-31.1)		
75+	11.7 (469)	38.2 (146, 33.3-43.2)		
Educational attainmer	it <sup>b</sup>			
High (ref.)	30.8 (1237)	19.4 (231, 17,2-21,8)	1	
Medium	37.5 (1506)	22.8 (326, 20.7-25.1)	1.07 (0.89-1.28)	
low	29.5 (1185)	30.0 (314, 27, 2-32, 9)	1.26(1.04-1.51)	
Household income/f <sup>c</sup>	20.0 (1100)	30.0 (31 ) 27 2 32.3)	1120 (1101 1101)	
High	26.2 (1056)	21 2 (212 18 8-22 0)	Continuous coo ¥	
Modium	20.3 (1030) 60 8 (2446)	21.3 (213, 10.0 - 23.3)		
wealum	60.8 (2446)	23.0 (550, 21.9-25.4)	0.91 (0.83-0.99)	
	12.8 (513)	27.1 (124, 23.1-31.4)		
Nigration background			4	
No (ref.)	82.0 (3298)	22.1 (663, 20.7-23.7)	1	
Yes	14.2 (570)	25.9 (179, 22.7-29.3)	1.62 (1.34-2.00)	
Region of residence				
Rural area (ref.)	38.2 (1535)	17.7 (279, 15.9-19.7)	1	
Urban area	41.9 (1686)	28.4 (464, 26.2-30.7)	2.17 (1.82-2.59)	
Metropolitan area	19.9 (799)	24.7 (150, 21.3-28.3)	2.07 (1.67-2.57)	
Cohabitation <sup>e</sup>				
Other household (r	ef.) 62.0 (2494)	21.6 (631, 20.1-23.1)	1	
Single-person hous	ehold 38.0 (1526)	29.4 (262, 26.4-23.5)	1.20 (1.02-1.40)	
Data are presented as co	plumn percentages (number), row perc	centages (number, 95% confidenc	e interval (95%CI)), and as	
	er with 95% Ci around OR.		,	
*Entered as continuous	/ariable in regression analyses (range f	rom 0 [€0 income] to 7 [€7,000 o	r morej.	
<sup>3</sup> Adjustment sets for reg	ression analyses were derived by appli	cation of directed acyclic graphs	(DAGS, more details –	
<sup>a</sup> Univariate logistic r	earession model: no adjustment is nec	essary or possible – as it would pr	<u>2711</u> ). roduce a collider hias – to	
estimate the total ef	fect of the independent variable on the	e outcome.		
<sup>b</sup> Multivariable logist	ic regression model adjusted for the va	riable: migration background.		
<sup>c</sup> Multivariable logist	c regression model adjusted for the va	riables: sex, age, educational atto	ainment, migration	
background.				
<sup>d</sup> Multivariable logist	ic regression model for the variables: a	ge, educational attainment, incor	me per person, migration	
background, cohabit	ation.			
<sup>e</sup> Multivariable logist	c regression model for the variables: a	ge, educational attainment, incor	me per person, migration	
background, region (	of residence.			
Research question 3	3: Among those interested in G	P advice, which topic of ad	lvice is preferred most.	
also stratified by se	x and age?	<i>,</i> ,		
Table 2 presents th	ne frequency of each suggeste	d topic the advice should	focus on according to	
respondents with g	eneral interest in receiving such	GP advice. With around 25	5%. the most frequently	
montioned tonic referred to medication intake and handling during besturyues. The least mentioned				
mentioned topic referred to medication intake and nandling during heatwaves. The least mentioned				
topics ( $\sim$ 10%) referred to strategies of cooling oneself and cooling the living spaces.				

2	TABLE 2. Most important topic	the GP advi	ice is preferr	ed to focus	on among r	espondents	with an inte	erest in
3 4	GP advice (n=1,079, unweighted data; single answer only, response options were presented in a randomised order).					omised		
	Yes, I would like to receive advic	ce, most impo	ortantly					% (n)
	on my drinking behaviour (e.g.	, what, how r	nuch or how	often I shoul	d drink)		18	.6 (201)
	on my diet (e.g., what or how i	nuch I should	leat)				19	.9 (215)
	on how to keep my living space	es as cool as r	oossible (e.g	darkening ro	ooms, proper	ventilation)	10	0.3 (110)
	on my physical activity (e.g., ho	ow much, whe	en or where I	should exerc	cise)	,	15	.1 (163)
_	on what to look for regarding r	medication (e	.g., storage, a	djusting the	amount or ch	anging medic	cation) 25	.1 (271)
5	Data are presented as percentages (no	umber).						
-								
/								
8	Table 3 presents these result	s stratified	by two rel	evant perso	on character	ristics which	n could be	
9	recognised by the treating GP v	vithout much	h effort – ag	e and sex. A	mong respo	ndents with	an interest	
10	in receiving GP advice, women	(20.7%) con	npared to m	en (15.7%)	expressed re	elatively mo	re often an	
11	interest in receiving advice on	their drinkin	g behaviour	, while men	i (17.5%) exp	ressed relat	tively more	
12	often than women (13.4%) inte	erest in advic	e on their p	hysical activ	vity during he	eatwaves.		
13	With regard to age the younge	st age grour	) (14-24 veal	s 32 2%) w	vas relativelv	more often	interested	
1J 1/	in receiving GP advice on their	drinking hol	haviour as a	health prot	tection strate	and against	host while	
15	more elderly respondents age		in receiving GP advice on their drinking behaviour as a health protection strategy against heat, while					
тэ	more elderly respondents aged 60 years and over were relatively more often interested in receiving						n rocoiving	
16	advice on medication handling	and intake (	nd over wer ~34%)	e relatively	more often	interested i	n receiving	
16	advice on medication handling	and intake (	nd over wer ~34%).	e relatively	more often	interested i	n receiving	
16 17	advice on medication handling	and intake (	nd over wer ~34%).	e relatively	more often	interested i	n receiving	
16 17 18	advice on medication handling TABLE 3. Most important topic the	and intake ( GP advice is	nd over wer ~34%).	e relatively	more often mong respor	interested i ndents with	n receiving an interest i	n GP advi
16 17 18 19	TABLE 3. Most important topic the stratified by sex and age (n=1,079,	GP advice is single answ	nd over wer ~34%). preferred to rer only, resp	e relatively o focus on a ponse optio	more often mong respor ns were pres	interested i ndents with rented in a r	n receiving an interest i andomised o	n GP advie order).
16 17 18 19	TABLE 3. Most important topic the stratified by sex and age (n=1,079,	GP advice is single answ	nd over wer ~34%). preferred to rer only, resp	e relatively o focus on a ponse option	more often mong respor ns were pres	interested i indents with eented in a r	n receiving an interest i andomised	n GP advie order).
16 17 18 19	TABLE 3. Most important topic the stratified by sex and age (n=1,079, Yes, would like to receive advice, most importantly	GP advice is single answ Sex, Female	nd over wer ~34%). preferred to rer only, resp , % (n) Male	e relatively o focus on a ponse option	more often mong respor ns were pres Age 25–39	interested i indents with ented in a r categories, 40–59	n receiving an interest in andomised % (n) 60–74	n GP advid order). <b>75+</b>
16 17 18 19	TABLE 3. Most important topic the stratified by sex and age (n=1,079, Yes, would like to receive advice, most importantly	GP advice is single answ Sex, Female 20.7 (131)	nd over wer ~34%). preferred to rer only, resp , % (n) Male 15.7 (70)	e relatively o focus on a ponse option <b>14–24</b> 32.2 (21)	more often mong respor ns were pres 25–39 22.6 (53)	interested i indents with ented in a r e categories, 40–59 14.6 (45)	n receiving an interest i andomised % (n) <b>60–74</b> 17.4 (53)	n GP advid order). <b>75+</b> 17.6 (29
16 17 18 19	<ul> <li>TABLE 3. Most important topic the stratified by sex and age (n=1,079,</li> <li>Yes, would like to receive advice, most importantly</li> <li> on my drinking behaviour</li> <li> on my diet</li> </ul>	GP advice is single answ Sex, Female 20.7 (131) 19.9 (126)	nd over wer ~34%). preferred to rer only, resp , % (n) <u>Male</u> 15.7 (70) 20.0 (89)	e relatively o focus on a ponse option <b>14–24</b> 32.2 (21) 10.8 (7)	more often mong respor ns were pres 25–39 22.6 (53) 22.6 (53)	interested i indents with eented in a r categories, 40–59 14.6 (45) 25.2 (78)	n receiving an interest i andomised % (n) <b>60–74</b> 17.4 (53) 16.4 (50)	n GP advid order). <b>75+</b> 17.6 (29 16.4 (27
16 17 18 19	<ul> <li>TABLE 3. Most important topic the stratified by sex and age (n=1,079,</li> <li>Yes, would like to receive advice, most importantly</li> <li> on my drinking behaviour</li> <li> on my diet</li> <li> on how to cool myself</li> </ul>	GP advice is single answ Sex, Female 20.7 (131) 19.9 (126) 11.2 (71)	nd over wer ~34%). preferred to yer only, resp , % (n) <u>Male</u> 15.7 (70) 20.0 (89) 10.6 (47)	e relatively o focus on a ponse option <b>14–24</b> 32.2 (21) 10.8 (7) 15.4 (10)	more often mong respor ns were pres 25–39 22.6 (53) 22.6 (53) 12.3 (29)	interested i indents with cented in a r ccategories, 40–59 14.6 (45) 25.2 (78) 15.9 (49)	n receiving an interest in andomised % (n) <b>60–74</b> 17.4 (53) 16.4 (50) 4.3 (13)	n GP advid order). <b>75+</b> 17.6 (29 16.4 (27 10.3 (17
16 17 18 19	<ul> <li>TABLE 3. Most important topic the stratified by sex and age (n=1,079,</li> <li>Yes, would like to receive advice, most importantly</li> <li> on my drinking behaviour</li> <li> on my diet</li> <li> on how to cool myself</li> <li> on how to keep my living spaces</li> </ul>	GP advice is single answ <b>Sex</b> , <b>Female</b> 20.7 (131) 19.9 (126) 11.2 (71) 9.9 (63)	nd over wer ~34%). preferred to rer only, resp , % (n) <u>Male</u> 15.7 (70) 20.0 (89) 10.6 (47) 10.8 (48)	e relatively o focus on a oonse option <b>14–24</b> 32.2 (21) 10.8 (7) 15.4 (10) 16.9 (11)	more often mong respor ns were pres 25–39 22.6 (53) 22.6 (53) 12.3 (29) 11.5 (27)	interested i indents with eented in a r <b>e categories</b> , <b>40–59</b> 14.6 (45) 25.2 (78) 15.9 (49) 8.7 (27)	n receiving an interest i andomised % (n) <b>60–74</b> 17.4 (53) 16.4 (50) 4.3 (13) 11.1 (34)	n GP advie order). <b>75+</b> 17.6 (29 16.4 (27 10.3 (17 7.3 (12)
16 17 18 19	<ul> <li>TABLE 3. Most important topic the stratified by sex and age (n=1,079,</li> <li>Yes, would like to receive advice, most importantly</li> <li> on my drinking behaviour</li> <li> on my diet</li> <li> on how to cool myself</li> <li> on how to keep my living spaces as cool as possible on my physical activity</li> </ul>	GP advice is single answ Sex, Female 20.7 (131) 19.9 (126) 11.2 (71) 9.9 (63) 13.4 (85)	nd over wer ~34%). preferred to rer only, resp , % (n) <u>Male</u> 15.7 (70) 20.0 (89) 10.6 (47) 10.8 (48) 17 5 (78)	e relatively o focus on a ponse option <b>14–24</b> 32.2 (21) 10.8 (7) 15.4 (10) 16.9 (11) 9 2 (6)	more often mong respor ns were pres 25–39 22.6 (53) 22.6 (53) 12.3 (29) 11.5 (27) 14 0 (33)	interested i indents with sented in a r <b>categories</b> , <b>40–59</b> 14.6 (45) 25.2 (78) 15.9 (49) 8.7 (27) 15 9 (49)	n receiving an interest in andomised % (n) <b>60–74</b> 17.4 (53) 16.4 (50) 4.3 (13) 11.1 (34) 16 7 (51)	n GP advio order). <b>75+</b> 17.6 (29 16.4 (27 10.3 (17 7.3 (12) 14 5 (24
16 17 18 19	<ul> <li>TABLE 3. Most important topic the stratified by sex and age (n=1,079,</li> <li>Yes, would like to receive advice, most importantly</li> <li> on my drinking behaviour</li> <li> on my diet</li> <li> on how to cool myself</li> <li> on how to keep my living spaces as cool as possible</li> <li> on my physical activity</li> <li> on what to look for regarding</li> </ul>	GP advice is single answ Sex, Female 20.7 (131) 19.9 (126) 11.2 (71) 9.9 (63) 13.4 (85) 24.9 (158)	nd over wer ~34%). preferred to rer only, resp , % (n) Male 15.7 (70) 20.0 (89) 10.6 (47) 10.8 (48) 17.5 (78) 25.4 (113)	e relatively o focus on a conse option <b>14–24</b> 32.2 (21) 10.8 (7) 15.4 (10) 16.9 (11) 9.2 (6) 15.4 (10)	more often mong respor ns were pres 25–39 22.6 (53) 22.6 (53) 12.3 (29) 11.5 (27) 14.0 (33) 17.0 (40)	interested i indents with cented in a r <b>categories</b> , <b>40–59</b> 14.6 (45) 25.2 (78) 15.9 (49) 8.7 (27) 15.9 (49) 19.7 (61)	n receiving an interest in andomised % (n) <b>60–74</b> 17.4 (53) 16.4 (50) 4.3 (13) 11.1 (34) 16.7 (51) 34.1 (104)	n GP advie order). 75+ 17.6 (29 16.4 (27 10.3 (17 7.3 (12) 14.5 (24 33.9 (56
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16 17 18 19	<ul> <li>TABLE 3. Most important topic the stratified by sex and age (n=1,079, Yes, would like to receive advice, most importantly</li> <li> on my drinking behaviour</li> <li> on my diet</li> <li> on how to cool myself</li> <li> on how to keep my living spaces as cool as possible</li> <li> on my physical activity</li> <li> on what to look for regarding medication</li> <li>Data are presented as percentages (numb</li> </ul>	GP advice is single answ <b>Sex</b> , <b>Female</b> 20.7 (131) 19.9 (126) 11.2 (71) 9.9 (63) 13.4 (85) 24.9 (158)	nd over wer ~34%). preferred to rer only, resp , % (n) Male 15.7 (70) 20.0 (89) 10.6 (47) 10.8 (48) 17.5 (78) 25.4 (113)	e relatively o focus on a bonse option <b>14–24</b> 32.2 (21) 10.8 (7) 15.4 (10) 16.9 (11) 9.2 (6) 15.4 (10)	more often mong respor ns were pres 25–39 22.6 (53) 22.6 (53) 12.3 (29) 11.5 (27) 14.0 (33) 17.0 (40)	interested i indents with cented in a r <b>categories</b> , <b>40–59</b> 14.6 (45) 25.2 (78) 15.9 (49) 8.7 (27) 15.9 (49) 19.7 (61)	n receiving an interest in andomised % (n) <b>60–74</b> 17.4 (53) 16.4 (50) 4.3 (13) 11.1 (34) 16.7 (51) 34.1 (104)	n GP advi order). 75+ 17.6 (29 16.4 (27 10.3 (17 7.3 (12 14.5 (24 33.9 (56
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<ul> <li>16</li> <li>17</li> <li>18</li> <li>19</li> </ul>	<ul> <li>TABLE 3. Most important topic the stratified by sex and age (n=1,079,</li> <li>Yes, would like to receive advice, most importantly</li> <li> on my drinking behaviour</li> <li> on my diet</li> <li> on how to cool myself</li> <li> on my physical activity</li> <li> on my physical activity</li> <li> on what to look for regarding medication</li> <li>Data are presented as percentages (numb</li> </ul>	GP advice is single answ <b>Sex</b> , <b>Female</b> 20.7 (131) 19.9 (126) 11.2 (71) 9.9 (63) 13.4 (85) 24.9 (158) rer).	nd over wer ~34%). preferred to rer only, resp , % (n) Male 15.7 (70) 20.0 (89) 10.6 (47) 10.8 (48) 17.5 (78) 25.4 (113)	e relatively o focus on a bonse option <b>14–24</b> 32.2 (21) 10.8 (7) 15.4 (10) 16.9 (11) 9.2 (6) 15.4 (10)	more often mong respor ns were pres 22-6 (53) 22.6 (53) 12.3 (29) 11.5 (27) 14.0 (33) 17.0 (40)	interested i indents with cented in a r <b>e categories</b> , <b>40–59</b> 14.6 (45) 25.2 (78) 15.9 (49) 8.7 (27) 15.9 (49) 19.7 (61)	n receiving an interest in andomised % (n) <b>60–74</b> 17.4 (53) 16.4 (50) 4.3 (13) 11.1 (34) 16.7 (51) 34.1 (104)	n GP advi order). <b>75+</b> 17.6 (25 16.4 (27 10.3 (17 7.3 (12 14.5 (24 33.9 (56
<ul> <li>16</li> <li>17</li> <li>18</li> <li>19</li> </ul>	<ul> <li>TABLE 3. Most important topic the stratified by sex and age (n=1,079,</li> <li>Yes, would like to receive advice, most importantly</li> <li> on my drinking behaviour</li> <li> on my diet</li> <li> on how to cool myself</li> <li> on how to keep my living spaces as cool as possible</li> <li> on my physical activity</li> <li> on what to look for regarding medication</li> <li>Data are presented as percentages (numb</li> </ul>	GP advice is single answ <b>Sex</b> , <b>Female</b> 20.7 (131) 19.9 (126) 11.2 (71) 9.9 (63) 13.4 (85) 24.9 (158) eer).	nd over wer ~34%). preferred to rer only, resp , % (n) <u>Male</u> 15.7 (70) 20.0 (89) 10.6 (47) 10.8 (48) 17.5 (78) 25.4 (113)	e relatively o focus on a ponse option <b>14–24</b> 32.2 (21) 10.8 (7) 15.4 (10) 16.9 (11) 9.2 (6) 15.4 (10)	more often mong respor ns were pres 25–39 22.6 (53) 22.6 (53) 12.3 (29) 11.5 (27) 14.0 (33) 17.0 (40)	interested i indents with cented in a r categories, 40–59 14.6 (45) 25.2 (78) 15.9 (49) 8.7 (27) 15.9 (49) 19.7 (61)	n receiving an interest in andomised % (n) <b>60–74</b> 17.4 (53) 16.4 (50) 4.3 (13) 11.1 (34) 16.7 (51) 34.1 (104)	n GP advi order). <b>75+</b> 17.6 (29 16.4 (27 10.3 (17 7.3 (12 14.5 (24 33.9 (56
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metropolitan areas and those living alone, as well as people with a migration background. Respondents

were particularly interested to receive advice on medication management during heatwaves, while

they were less interested in advice on cooling strategies.

Regarding these preferred topics, relative differences could be observed with regard to sex and age categories of respondents. Women and adolescents to young adults were relatively more often interested in advice on their drinking behaviour, while men were relatively more often interested in advice on their physical activity. Older respondents (>60 years) were relatively more often interested in advice on medication management. This is probably also due to the greater prevalence of drug intake in the elderly. In a survey conducted among physicians in Germany it was found that 40% of the physicians adapted their patients' medication regularly or occasionally during heat waves, and 41% gave regular or occasional advice on dealing with heat [26]. Thus, there seems to be a substantial potential in implementing pre-summer medication check-ups and giving tailored behavioural advice before and during heat waves [22, 23] among physicians to meet the preferences assessed in this study. 

Interest in receiving advice can only develop if awareness about adverse effects of heat waves is present. A lack of interest can therefore be the result of lack of awareness about adverse effects and their potential mitigation measures, or can result from already acquired knowledge from other sources. In this study advice on how to cool oneself was not identified as a predominant interest. Nevertheless, cooling oneself actively with water-bound measures, such as wet clothes or cool arm and foot baths, has been shown to be an efficient and at the same time underused protective measure for elderly [18, 38]. This example illustrates that preferences assessed in this study should not be the only guidance for GPs, but need to be considered together with other evidence. 

Studies show that public awareness of climate change is related to personal experiences of climate impacts [39]. Interest in GP advice on health protection measures during heatwaves is therefore assumed to be also related to the presence and perception of heat, which is obviously highest in during summer months. Data of the present study was collected during winter season when the effects of heatwaves are less obvious to individuals, so that a considerable seasonality of responses can be assumed. However, we have chosen a time when the population is not particularly aware of heat effects, but rather measure the general interest in GP advice; whereas in summer or during heat waves, greater interest can be expected. 

To our knowledge, this is the first study to provide evidence, that there is an interest in the general public to receive heat health information from their GP. We would have liked to compare our results with other national and international data, but results of other studies on population interest in GP advice on other health behaviour, such as physical activity or diet, are hardly comparable due to different contexts and often different survey methodologies. In general, however, it can be stated that the information needs and system of the GP as a reliable partner can be considered comparable worldwide. Our study provides practical orientation for GPs on what topic of advice people are interested in, and whether specific person characteristics are associated with such interests. It is known that specific groups of society are particularly vulnerable to adverse health effects of prolonged or repeated periods of heat such as elderly people, people with chronic conditions or lower socioeconomic status, those living alone or in areas with high population density [2, 8, 16-20], and people with migration background [34-36]. This fits well to our results, in which these groups are expressing a higher interest in GP advice on health protective behaviours. 

GPs are already, and will increasingly be, on the frontline dealing with health impacts of the climate change. It is therefore necessary to develop, evaluate, and implement target-group adapted Page **11** of **16** 

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- interventions aiming to adjust general practice to these new challenges in order to maintain population
   health in the best possible way. The present study provides initial data on the current interest of the
- a population for advice from GPs on protective measures against heat and on the specific target groups
   a for such advice. For the future, it will be important to evaluate alignets abages related best because and an another second secon
- for such advice. For the future, it will be important to explore climate change-related healthcare needs
   and target groups more in-depth, also with a focus on other impacts of climate change such health
- 6 effects from air pollution, allergies, extreme weather events, and food and water insecurity.
- Furthermore, it will be essential to explore GPs' current views, knowledge and practice, as well as
   potential barriers and facilitators in this regard.

## 1213 9 Strengths and limitations

A major strength of this study is the representative sample including respondents of high age groups, and the broad range of relevant person characteristics that were collected among the general population of Germany. Our study also has limitations. As described above, data was collected during winter season and might be confounded by awareness of climate change, health effects of heat and their potential mitigation measures. Both might have influenced the response behaviour, and we could not take this into account in the present study. The same might be true for respondents who don't feel that their GP is adequately competent in terms of advising in general. 

- Another limitation is that no information was available on health status and associated needs, or on the use of medication among respondents. The latter becomes relevant particularly with regard to GP advice on medication management during heat. In addition, no detailed information about the migration background of respondents was available. Therefore no differences according to place of birth and region of origin could be taken into account in the analyses, which would have been relevant with regard to potential previous experiences with extreme temperatures.
- Furthermore, the six different topics GP advice could focus on were selected by the study team. Respondents could have other interests that were not suggested and thus not taken into account in the present analysis. One has also to consider, that the survey design only allowed participants to pick their most preferred advice topic, so that we might have missed secondary preferences. Finally, social desirability bias may have occurred in face-to-face interviews that may have affected the prevalence estimates, most likely resulting in an overestimate.

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### 29 Conclusion

Our findings show that in winter 2022/2023, around one quarter of the population in Germany with GP contact was interested in receiving advice on protective health behaviour during heatwaves from their GP; especially on medication management. Specific - rather more vulnerable - groups of the population were even more interested in receiving such advice. Climate change is creating new demands for healthcare provision in general practice. This study provides important information for research and practice aiming to address these demands in the future. 

#### 1 Statements

 

#### 2 Acknowledgements

The authors thank Constanze Cholmakow-Bodechtel and Franziska Wenng from the market research
institute "Cerner Enviza" for the collection of the data.

#### 6 Competing Interests

BM receives an honorarium as a scientific advisor to the insurance company "Die Techniker". AH is
member of the German Climate Change and Health Alliance (KLUG e.V.) and speaker of the section
climate change and health of the German College of General Practitioners and Family Physicians
(DEGAM). She does not receive payments from any of those organizations. The other authors have no
competing interests to declare.

#### 13 Funding

From 2016 to 2019 (waves 1-18), the population study (DEBRA study) was supported by the Ministry of Innovation, Science and Research of the German State of North Rhine-Westphalia (MIWF) in the context of the "NRW Rückkehrprogramm" (the North Rhine–Westphalian postdoc return program). Since 2019 (wave 19 onwards), the study has been supported by the German Federal Ministry of Health (BMG). 

#### 19 Statement of Ethics

The study protocol has been peer-reviewed and approved by the ethics committee of Heinrich-Heine University Duesseldorf, Germany (HHU 5386/R). Since 2021, the fieldwork is conducted by the market
 research institute Cerner Enviza (former Kantar), Germany. Interviewers make sure that all participants
 give oral informed consent. This method of consent has been approved by the ethics committee.

#### 24 Author Contributions

SKa coordinated the study, conceptualised and drafted the analysis protocol, drafted the manuscript, analysed and interpreted the data. AH and BM: provided expert advice on the development of the main outcome question and, together with BH, SKI, and SW critically revised the analysis protocol and the manuscript. DK conceived the study, provided expert advice on analyses, and critically revised the analysis protocol and the manuscript. All named authors contributed substantially to the manuscript and agreed on its final version. 

#### 44 31 Data Availability Statement

The data underlying this study are third-party data and are available to researchers on reasonable request from the corresponding author (<u>sabrina.kastaun@med.uni-duesseldorf.de</u>). All proposals requesting data access will need to specify how it is planned to use the data, and all proposals will need approval of the study team (DK, SKI, SKa) before data release.

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	ST	ROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cress-criticity and studies	
Section/Topic	ltem #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,2
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Objectives	3	State specific objectives, including any prespecified hypotheses	5
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Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, and data collection	5-7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers diagnostic criteria, if	6-7, Table 1
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe	6-7, Table 1
Bias	9	Describe any efforts to address potential sources of bias	7-8
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which good may be were chosen and why	7-8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7-8
		(b) Describe any methods used to examine subgroups and interactions	7-8
		(c) Explain how missing data were addressed	8
		(d) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(e) Describe any sensitivity analyses	n/a
Results		a A	

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, exanyine of or eligibility,	8, Table 1
		confirmed eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on a social and potential confounders	8, Table 1
		(b) Indicate number of participants with missing data for each variable of interest	8
Outcome data	15*	Report numbers of outcome events or summary measures	8
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision degree, 95% confidence	Table 1
		interval). Make clear which confounders were adjusted for and why they were included 🕺 호 호	
		(b) Report category boundaries when continuous variables were categorized	Table 1
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful and the second	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses $\overline{\mathbf{a}}, \overline{\mathbf{m}}, \overline{\mathbf{c}}$	Table 2-3, n/a
Discussion		ning shitt	
Key results	18	Summarise key results with reference to study objectives	10-11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and	12
		magnitude of any potential bias	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of argives, results from	10-12
		similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information		arte	
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, original study on	13
		which the present article is based $\sqrt{2}$	

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cator and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicinearg/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.secobe-statement.org.

# **BMJ Open**

#### Are people interested in receiving advice from their general practitioner on how to protect their health during heatwaves? A survey of the German population

lournal	RM1 Open
Journal:	Dien Chen
Manuscript ID	bmjopen-2023-076236.R1
Article Type:	Original research
Date Submitted by the Author:	01-Aug-2023
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<b>Primary Subject Heading</b> :	General practice / Family practice
Secondary Subject Heading:	General practice / Family practice, Public health
Keywords:	Primary Health Care, EPIDEMIOLOGIC STUDIES, Primary Care < Primary Health Care

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1 2 3	1	Research Article
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5 6	2	Are people interested in receiving advice from their general practitioner o
7	3	how to protect their health during heatwaves? A survey of the German
8	4	population
9 10	5	
11	6	Short title: Interest in receiving GP advice on health protection during heatwaves
12	7	
13	8	2023-07-30
15	9	
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54 55	40	
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57	42	Number of words: text 4,015, abstract 297
58	43	Number of tables: 3
59 60	44	Number of figures: -

#### Number of figures: -45 Number of supplements: -

#### Page 1 of 17

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1 2	1	ABSTRACT
2 3	T	ADSTRACT
4 5	2	Objective
6	3	Climate change increases frequency, intensity and length of heatwaves, which puts a particular strain
7	4	on the health of vulnerable population groups. General practitioners (GPs) could reach these people
8 9	5	and provide advice on protective health behaviour against heat. Data is lacking on whether and what
10	6	topic of GP advice people are interested in, and whether specific person characteristics are associated
11 12	7	with such interests.
12	8	Design
14	9	Cross-sectional, nationwide, face-to-face household survey, conducted during winter 2022/2023.
16 17	10	Setting
18 19	11	Germany.
20 21	12	Participants
22	13	Population-based sample of 4,212 respondents (aged 14-96 years), selected by using multi-stratified
23	14	random sampling (50%) combined with multi-quota sampling (50%).
24 25	15	Main outcome measure
26	16	Interact in receiving CD advice on balth protection during bootypyon (yes (no)) and the tonic people
27 29	10 17	find most important (advice on drinking behaviour, putrition, cooling, cooling rooms, physical activity
28 29	18	or medication management). Associations between pre-defined person characteristics and the
30	19	likelihood of interest were estimated using adjusted logistic regressions
31 32		
33	20	Results
34 25	21	A total of 4,020 respondents had GP contact and provided data on the outcome measure. Of these,
35 36	22	23% (95%CI=22%-25%) expressed interest in GP advice. The likelihood of expressing interest was
37	23	positively associated with being female, older age (particularly those aged 75+ years: 38% were
38	24	interested), having a low education, having a migration background, living in a more urban area, and
40	25	living in a single-person household. It was negatively associated with increasing income. Advice on
41	26	medication management received highest interest (25%).
42 43	27	Conclusions
44	28	During winter season 2022/2023, around one quarter of the German population with GP contact –
45 46	29	and around 40% of those aged 75+ years – was estimated to have a stated interest in receiving GP
47	30	advice on protective health behaviour during heatwaves, especially on medication management.
48	31	Climate change is creating new demands for healthcare provision in general practice. This study
49 50	32	provides initial relevant information for research and practice aiming to address these demands.
51	33	
52 53	34	Keywords
54 55	35	primary care, climate change, heatwaye, general practitioner, advice, population survey
56		p - /
57 58	36	
59	37	Strengths and limitations of this study
60	38	

Page **2** of **17** 

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- A major strength is the use of a sample of the German population, selected by using multistratified random probability sampling (50%) combined with multi-quota sampling (50%).
  - As the outcome measure was introduced into an existing omnibus survey, however, we did not have room to collect other variables of interest, such as health status and medication use.
    - Data were collected during winter season where health effects of heatwaves might be less • apparent to individuals compared to the summer season.
  - No data were collected on risk awareness regarding heatwaves and its adverse effects, which might be a prerequisite for the interest in GP advice on preventive measures against heat.

#### 1 INTRODUCTION

The World Health Organization (WHO, [1]) considers climate change to be the single greatest health threat to humankind. In the future, our society and health care systems will be increasingly confronted with adverse health effects of climate change, such as increased mortality and morbidity during heatwaves [1, 2], resulting in negative impacts on public health.

Heatwaves are hazards that negatively impact various sectors of society such as agriculture, forests, infrastructure, and human health [3, 4]. Although no universally accepted definition exists [5], heatwaves are understood to be prolonged or repeated periods with high or higher-than-normal air temperatures during days and/or nights that exceed a pre-determined temperature threshold over a certain period of time [3, 4]. Such prolonged heatwaves can cause high thermal stress to the body affecting, for example, the cardiovascular system by increasing blood viscosity and impacting the body's capacity to maintain a constant temperature [6, 7]. Numerous studies around the world suggest a systematic association between the occurrence of heatwaves and exacerbated cardiovascular, respiratory, and other forms of morbidity and mortality [8]. 

In Germany, climate change has been causing more frequent, more intense, and prolonged periods of heat in the summer, which has found to be associated with increased mortality rates [9, 10]. In July 2015, for example, a 1.2 increase in hospital admissions and over 3 times higher heat-related morbidity rates were observed for the metropolitan city of Frankfurt am Main [11]. Around 4,500 heat-related excess deaths occurred in the summer of 2022, which is described as the fourth warmest summer since weather records began in Germany in 1881 [12]. Like other countries, Germany implemented a National Adaptation Strategy on Climate Change to address the effects of extreme weather in order to safeguard people's health from the heat [13]. In addition, in 2017, the WHO recommendations for heat health action plans (HHAPs) were adopted by a working group of the national and federal states of Germany to motivate local implementation of action plans [14]. However, as implementation of HHAPs is not an obligation by law yet and responsibilities on community and federal state level remain unclear, only few communities have HHAP in place [15], mainly in larger cities, such as Cologne and Mannheim [16, 17]. In those cities institute of general medicine and Associations of Statutory Health Insurance Physicians (Kassenärztliche Vereinigung, KV) are involved to ensure engagement of GPs and other physicians [16]. In June 2023, a new national heat protection plan was published by the Federal Ministry of Health. The new concept includes various measures in cooperation with the public health service, general practitioners, hospitals, and the health care sector together with municipalities and federal states. GPs are to play a central role, especially in protecting vulnerable patients. The focus is on creating awareness that heat can pose a threat to health and on approaches to reach out to patients at risk [18]. 

Specific groups of society are particularly vulnerable to adverse health effects of heat such as elderly people, people with disabilities or with underlying medical conditions (e.g., people with cardiovascular, respiratory, renal or mental illness, or people suffering from multiple diseases), those working outdoors or in non-cooled environments, those living alone (in isolation) or in urban areas with high population density, as well as people with lower socioeconomic status [2, 8, 19-23]. These risks will increase further due to the wider trends in Europe of an aging population, with greater levels of chronic disease and increasing levels of urbanisation [2]. 

58
 59 42 Behavioural measures can effectively help to prevent adverse effects during a heatwave, for instance
 60 43 increasing fluid intake, staying in a cool or air-conditioned environment, wearing loose-fitting clothes,

taking showers/footbaths, reducing activity levels, avoiding moderate to high consumption of alcohol,

- and – in people using medication – monitoring and, if needed, adjusting medication intake [22, 24].
- However, while a recent survey in Germany showed that elderly people aim to tackle heat with a number of body-related, home-protective, and activity-related coping strategies, an underuse of
  - water-related heat adaption strategies was observed [21].

Substantial public health actions will be needed worldwide to tackle health impacts of climate-change induced heatwaves. According to WHO, HHAPs should be designed and implemented together with stakeholders at all levels in the health-sector, including general practitioners (GPs), to prevent direct effects of heat [25]. The WHO's HHAP of 2011 includes specific recommendations on how GPs should proactively identify, advise, and monitor patients at risk, and how to educate, counsel, and inform patients in general regarding individual adjustments of behaviour, medication and fluid intake, as well as inform them about helplines and medical services [26]. GPs thus have an important role in educating patients on, and assisting them with, health effects of heat. 

In general, GPs are well placed to provide such behavioural advice and information as the majority of the population regularly sees a GP, and GPs can particularly reach the most vulnerable groups of society (e.g., elderly, multimorbid, and socially isolated people) [27]. Furthermore, patients report that they see their GPs as a trusted source of information and advice on health behaviour [28]. 

However, a survey among GPs in Germany conducted in the year 2022 [29] showed that although around 60% of GPs reported observing heat-induced health effects in their patients, only a minority of GPs actively address this topic regularly with their patients. Around 16% reported that they regularly adjust the medication of their patients during heat periods, while around 10% regularly advise their patients on dealing with heat. Only a few GPs proactively contact patients which are at risk during heat periods [29]. Around 40% of GPs report a need in continuing and further training for themselves and for team members on topics and consulting opportunities regarding climate-change related health effects. These recent results are in line with data from a previous qualitative study conducted in 2013 suggesting that GPs' knowledge and awareness of heat health impacts and climate change needs to be strengthened – preferably through target-group-specific training – in order to engage them more extensively into preventive actions with their patients [30]. 

To inform the development of effective and tailored prevention measures, it is not only important to explore the interests and perceptions of GPs, but also of those who will be affected by such preventive measures - the patients. Are they interested in receiving GP advice on how to protect their health from heat? 

#### **RESEARCH AIM AND QUESTIONS**

Using data from a nationally representative sample of the German population, this study aims to assess the following research questions: 

- What proportion of the German population with GP contact expresses an interest in receiving GP advice on health protection during heatwaves, stratified by socio-demographic characteristics, socio-economic status, and region of residence?
- 2. Are these person characteristics statistically associated with the likelihood of expressing an interest in receiving GP advice on health protection during heatwaves?
- 3. Among those expressing an interest in such advice, which topic of advice is preferred most, stratified by age and sex of respondents?

#### Page 5 of 17

1 2	1	
3 4	2	MATERIALS AND METHODS
5 6	3	Study design and population
7 8	4	Data was collected using an ongoing, cross-sectional, representative household survey of the German
9	5	population to which a single question on the interest in receiving GP advice on health protection during
10	6	heatwaves was added for the period of two survey waves between October/November 2022 and
11	7	lanuary/February 2023 This study collects data every other month by computer-assisted face-to-face
12	, 8	bousehold interviews of participants aged 14+ years (with no upper age limit) living in private
13	0	households (rented or owned) across Cormany, Bosnondents are selected by using a dual frame
15	9	design multi store multi stratified readers probability serepling (FO)( of the sereple) combined with
16	10	design: multi-strage, multi-stratified random probability sampling (50% of the sample) combined with
17	11	multi-quota sampling (50% of the sample). Details on the sampling design have been described
18	12	elsewhere ( <u>https://ost.io/s2wxc</u> ).
20	12	
21	14	Dependent variable
22	14	The question on "interest in requiring CD advice on health protection during heatwoyce" was
23	15	The question on interest in receiving GP advice on health protection during healtwaves was
24 25	16	introduced using a brief explanation: "Now we would like to ask you a question on a completely
26	17	different topic. Climate change is causing the earth to warm up. As a result, so-called heatwaves can
27	18	increasingly be observed in summer, i.e., an unusual number of days with high temperatures. These
28	19	heatwaves can have a negative impact on health. General practitioners could offer advice on how to
29	20	protect health during heatwaves".
30 31	21	
32	22	This introduction text was followed by the question below. Response options (including topics the GP
33	23	advice should focus on – if so) were presented to respondents as a nominal scale and in a randomised
34	24	order to minimise the risk for order bias. Respondents were allowed to choose a single answer that
35	25	best applied to them.
30 37	26	"Would you like to receive advice from your general practitioner on how to better protect your health
38	27	during heatwayes? If so, which of the following tonics would be most important to you?
39	28	
40	20	1 Ves I would like to receive advice, especially on my drinking behaviour (e.g. what how much
41 42	30	or how often I should drink)
42 43	31	<ol> <li>Yes, I would like to receive advice, especially on my diet (e.g., what or how much I should eat).</li> </ol>
44	32	3. Yes, I would like to receive advice, especially on how to cool myself down (e.g., arm and foot
45	33	baths, proper use of fans).
46	34	4. Yes, I would like to receive advice, especially on how to keep my living spaces as cool as possible
4/ 19	35	(e.g., darkening rooms, proper ventilation).
40 49	36	5. Yes, I would like to receive advice, especially on my physical activity (e.g., how much, when or
50	37	where I should exercise).
51	38	6. Yes, I would like to receive advice, especially on what to look for regarding medication (e.g.,
52	39	storage, adjusting medication intake or changing medication).
53 54	40	7. No, I do not want any davice from my general practitioner on this.
55	41	8. Tab not see a general practitioner.
56	4∠ ∆२	J. IND ULISWEI
57	رب ۸۸	The question was developed together with two experts, who are modical dectors (one of them being
58 50	44 15	a GD) and researchers in the area of climate change and health (ALL DA)
59 60	45	a Gry and researchers in the area of climate change and health (AH, BIVI).
50	46	

#### 1 Independent variables

The following sociodemographic characteristics were measured: age in five categories of 14–24, 25– 39, 40–59, 60–74, 75+ years; sex (female versus male); region of residence (metropolitan area, urban area, versus rural area as reference), migration background (yes versus no), and cohabitation as a potential indicator for social isolation (living in a single-person versus other household).

Since effects of climate change, particularly temperature effects [31, 32], as well as accessibility and utilisation of GPs [33], are reported to differ between more rural and more urban areas, we assume interest in GP advice on health protection during heatwaves to also differ between residents of different regions. Area of residence of respondents was therefore assessed by using the variable administrative municipality district size ("politische Gemeindegrößenklasse"). This variable consists of seven categories which were summarised into three categories for further analyses comparable to other previous studies in the German population [34] (more details have been published elsewhere: https://osf.io/zp7c6): rural area (<20,000 residents), urban area (20,000 to 500,000 residents), and metropolitan area (>500,000 residents).

Migration background was defined as a positive answer to the question "Was one of your parents born abroad?" The official definition of "migration background" used for administrative purposes includes that at least one parent did not have German nationality by birth. In our study, no information is available for the respondents' country of origin or whether or not they were born in Germany. However, for the purpose of this study we assume that at least part of participants who were classified as having a migration background according to the definition applied in this study have made specific experiences with extreme temperatures (e.g., heat, cold, drought) compared to people without such background [35, 36]. Previous studies have found higher heat vulnerability and exposure among people with migration background compared to those without [37-39]. We therefore assume that people with migration background may also have interests in terms of health protection against heat, and thus included migration background as a dependent variable in the analyses. 

Measured socioeconomic status variables were: educational attainment (low [9 years of education, or no graduation], medium [10 to 11 years], high [>12 years]), and monthly net household income calculated per person in the household. For descriptive purposes, income was categorised using cut-offs that lead to an approximate distribution of: low (~25% of the sample), medium (~60% of the sample), and high (~15% of the sample), approximately reflecting the income distribution in Germany (details on the income calculation can be found here: <u>https://osf.io/387fg/</u>). Income was entered as a continuous variable coded from 0 ( $\notin$ 0 income/month) to 7 ( $\geq$  $\notin$ 7,000/month) in the regression models. 

## 47<br/>4834Statistical analyses

The study protocol and analysis plan were written prior to analysing the data and pre-registered on
the Open Science Framework: <u>https://osf.io/ycz7n</u>. Analyses were performed with IBM SPSS Statistics
for Windows, Version 29.0 (Armonk, NY: IBM Corp).

To address research question 1, we report descriptive prevalence data on the number of people expressing an interest in receiving GP advice on how to protect their health against heat effects, stratified by above mentioned person characteristics, and reported as percentages together with 95% confidence intervals (95%CI). For the stratified presentation of results and for logistic regression analyses (research question 2), respondents' answer on the outcome measure was categorised into a binary outcome variable "Yes, I am interested in receiving advice by a GP on how to protect my health

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during heatwaves" (answers 1-6, coding: 1) versus "No, I am not interested in any advice from my GP
on this" (answer 7, coding: 0).

- Prevalence data were weighted to be representative of the population in Germany accounting for
   personal and household characteristics. Details on the weighting technique have been published in the
   main study protocol [40] and elsewhere (https://osf.io/s2wxc).
- To address research question 2, adjusted logistic regression models were conducted to explore associations between the pre-defined person characteristics of respondents and the likelihood that they are interested in receiving advice from their GP on health protection during heatwaves (yes versus no). Adjustment sets for regression analyses were derived by application of directed acyclic graphs (DAGs). More details – including the graphs – have been published together with the analysis protocol: https://osf.io/ycz7n. Depending on the minimal sufficient adjustment set needed for each model, simple or multivariable regression models were conducted. Regression analyses were conducted using unweighted data.
- To address research question 3 among the subgroup of respondents with an interest in receiving GP advice, we present descriptive prevalence data (together with 95%CI) on the topics this advice is preferred to focus on (answer options 1 to 6). This prevalence data is presented descriptively and stratified by age categories and sex of respondents. We had not planned statistical testing of relative differences in the analysis protocol, as the number of cases in the subgroups was expected to be too small. This descriptive analysis was conducted using unweighted data as weights were only available for the total sample and these should not be applied to subsamples that are already selected on the basis of specific person characteristics (e.g., interest in GP advice).
- 31 22 Dealing with missing data
- Overall, missing data in this face-to-face survey occurred only for a small share of the following
   independent variables: education: 2.3%, income: 0.1%, migration background: 3.9%. Thus, we
   assumed that excluding cases with missing data would not have relevant effects on our results, and
   used complete cases for the final analysis.
- Patient and public involvement statement
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#### 30 RESULTS

- A total of 4,212 respondents aged 14+ years of the general population in Germany participated in the study between October/November 2022 and January/February 2023. Respondents without GP contact (answer 8, n=128, 3% of the total sample) were on average 8 years younger, more often men, and were more often from the lowest income group compared to those with GP contact. Those without GP contact or who preferred not to answer the outcome measure (answer 9, n=64, 1.5% of the total sample) were excluded from the analyses, which leads to a final sample of 4,020 individuals. Person characteristics of this final sample are reported in **Table 1**. The age range was 14 to 96 years (n=469 aged 75+ years), with a mean age of 51.6 years (standard deviation (SD)=18.5), and 52.8% (n=2,121) of the respondents were female.
- Research question 1: Proportion of the population with interest in receiving GP advice on health
   protection during heatwaves, stratified by person characteristics

#### Page **8** of **17**

1 Among the general population, 23.4% (95%CI=22.0%-24.8%, n=892; unweighted data: 26.8%, n=1,079)

2 expressed an interest in receiving GP advice on health protection during heatwaves. Relative

3 differences in this interest stratified by person characteristics are presented in **Table 1.** Highest interest

4 was observed in respondents aged 75+ years (38.2%, 95%CI=33.3%-43.2%).

5 Research question 2: Associations between person characteristics and the likelihood of expressing
 6 an interest in GP advice

The likelihood of expressing an interest in GP advice was positively associated with being female,
increasing age, having a low compared to high educational attainment, having a migration background
compared to not having such background, living in an urban or metropolitan area compared to a rural
area, and living in a single-household compared to other households, see **Table 1**. The likelihood was
negatively associated with increasing net household income per person.

**TABLE 1.** Characteristics of all respondents (n=4,020), and prevalence estimates on the interest in GP advice on health protection (=yes) relative to the respondents' characteristics; including results of regression models on associations between these characteristics and an interest in receiving GP advice (yes vs. no).

Total sample, n=4,020 unweighted data		Interested in GP advice on health protection against heat = yes (vs. no)			
	% (n)	weighted data, n=892	unweighted data		
		% (n, 95%Cl)	OR§ (95%CI)		
Sexª					
Male (reference)	47.2 (1899)	19.9 (368, 18.1-21.8)	1		
Female	52.8 (2121)	26.6 (524, 24.7-28.6)	1.39 (1.21-1.60)		
Age in years <sup>a</sup>					
14 – 24	8.4 (337)	14.1 (64, 11.1-17.7)	Continuous, per year		
25 – 39	21.9 (881)	22.0 (183, 19.20-24.9)	1.01 (1.01-1.01)		
40 – 59	32.3 (1300)	20.1 (257, 17.9-22.4)			
60 – 74	25.7 (1033)	28.0 (243, 25.0-31.1)			
75+	11.7 (469)	38.2 (146, 33.3-43.2)			
Educational attainment <sup>b</sup>					
High (ref.)	30.8 (1237)	19.4 (231, 17. <mark>2</mark> -21.8)	1		
Medium	37.5 (1506)	22.8 (326, 20.7-25.1)	1.07 (0.89-1.28)		
Low	29.5 (1185)	30.0 (314, 27.2-32.9)	1.26 (1.04-1.51)		
Household income/€ <sup>c</sup>					
High	26.3 (1056)	21.3 (213, 18.8-23.9)	Continuous, see <sup>¥</sup>		
Medium	60.8 (2446)	23.6 (556, 21.9-25.4)	0.91 (0.83-0.99)		
Low	12.8 (513)	27.1 (124, 23.1-31.4)			
Migration background <sup>a</sup>					
No (ref.)	82.0 (3298)	22.1 (663, 20.7-23.7)	1		
Yes	14.2 (570)	25.9 (179, 22.7-29.3)	1.62 (1.34-2.00)		
Region of residence <sup>d</sup>					
Rural area (ref.)	38.2 (1535)	17.7 (279, 15.9-19.7)	1		
Urban area	41.9 (1686)	28.4 (464, 26.2-30.7)	2.17 (1.82-2.59)		
Metropolitan area	19.9 (799)	24.7 (150, 21.3-28.3)	2.07 (1.67-2.57)		
Cohabitation <sup>e</sup>		,	. ,		
Other household (ref.)	62.0 (2494)	21.6 (631, 20.1-23.1)	1		
Single-person household	38.0 (1526)	29.4 (262, 26.4-23.5)	1.20 (1.02-1.40)		

18 Odds Ratios (OR) together with 95% CI around OR, statically significant results are highlighted in bold.

<sup>59</sup> 19
 <sup>4</sup>Entered as continuous variable in regression analyses (range from 0 [€0 income] to 7 [€7,000 or more].

16       re         17       m         18       to         19       20         20       T/         21       GI         22       Da         23       24         25       Ta         26       re         27       in         28       in         29       of         30       W         31       in         33       ac         34       35         35       TABL         36       strati         Yes,       mos	ABLE 2. Most important topic the GP advice is preferred to focus on among respondents with an P advice (n=1,079; single answer only, response options were presented in a randomised order).   (es, I would like to receive advice, most importantly   a. on my drinking behaviour (e.g., what, how much or how often I should drink) on my diet (e.g., what or how much I should eat) on how to cool myself (e.g., arm and foot baths, proper use of fans) on how to keep my living spaces as cool as possible (e.g., darkening rooms, proper ventilation) on who to keep my living spaces as cool as possible (e.g., darkening rooms, proper ventilation) on what to look for regarding medication (e.g., storage, adjusting the amount or changing medication) .ta are presented as percentages (number). able 3 presents these results stratified by two relevant person characteristics which could coognised by the treating GP without much effort – age and sex. Among respondents with an interreceiving GP advice, women (20.7%) compared to men (15.7%) expressed relatively more often terest in receiving advice on their drinking behaviour, while men (17.5%) expressed relatively more often interest receiving GP advice on their drinking behaviour as a health protection strategy against heat, whore elderly respondents aged 60 years and over were relatively more often interest in receiving GP advice on their drinking behaviour as a health protection strategy against heat, whore elderly respondents aged 60 years and over were relatively more often interest in receiving GP advice on their drinking behaviour as a health protection strategy against heat, whore elderly respondents aged 60 years and over were relatively more often interested in receiving in a context of the gravite is preferred to focus on among respondents with an interest fied by sex and age (n=1,079; single answer only, response options were presented in a randomis w	interest in % (n), unweighted data 18.6 (201) 19.9 (215) 10.9 (118) 10.3 (111) 15.1 (163) 25.1 (271) be est an ore ted hile ing est in GP adv sed order). I data				
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16 re 17 m 18 to 19	spics (~10%) referred to strategies of cooling oneself and cooling the living spaces.					
16 re 17 m 18 to	pics (~10%) referred to strategies of cooling oneself and cooling the living spaces.					
16 re 17 m 18 to	pics (~10%) referred to strategies of cooling oneself and cooling the living spaces.					
16 re 17 m		icu				
16 re	entioned topic referred to medication intake and handling during heatwaves. The least mentior	Ned				
10	spondents with general interest in receiving such GP advice. With around 25%, the most frequer	ntly				
15 <b>T</b> a	able 2 presents the frequency of each suggested topic the advice should focus on according	to				
14 <b>al</b> :	so stratified by sex and age?					
13 <b>Re</b>	esearch question 3: Among those interested in GP advice, which topic of advice is preferred mo	ost,				
14						
11 12	background, region of residence.					
10	<sup>e</sup> Multivariable logistic regression model for the variables: age, educational attainment, income per person, migration					
8 9	"Multivariable logistic regression model for the variables: age, educational attainment, income per person, migration backaround, cohabitation.					
7	background.					
6	<sup>c</sup> Multivariable logistic regression model adjusted for the variables: sex, age, educational attainment, migration					
4 5	estimate the total effect of the independent variable on the outcome. <sup>b</sup> Multivariable loaistic regression model adjusted for the variable: migration background.					
3	<sup>a</sup> Univariate logistic regression model: no adjustment is necessary or possible – as it would produce a collider bias – to					
2 inc	cluding the graphs – have been published together with the analysis protocol https://osf.io/ycz7n):					

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

on my drinking behaviour	20.7 (131)	15.7 (70)	32.2 (21)	22.6 (53)	14.6 (45)	17.4 (53)	17.6 (29)
on my diet	19.9 (126)	20.0 (89)	10.8 (7)	22.6 (53)	25.2 (78)	16.4 (50)	16.4 (27)
on how to cool myself	11.2 (71)	10.6 (47)	15.4 (10)	12.3 (29)	15.9 (49)	4.3 (13)	10.3 (17)
on how to keep my living spaces as cool as possible	9.9 (63)	10.8 (48)	16.9 (11)	11.5 (27)	8.7 (27)	11.1 (34)	7.3 (12)
on my physical activity	13.4 (85)	17.5 (78)	9.2 (6)	14.0 (33)	15.9 (49)	16.7 (51)	14.5 (24)
on what to look for regarding medication	24.9 (158)	25.4 (113)	15.4 (10)	17.0 (40)	19.7 (61)	34.1 (104)	33.9 (56)

1 Data are presented as percentages (number).

#### 

 

#### 3 DISCUSSION

Among a representative sample of the general population in Germany, aged 14 to 96 years and with GP contact, which was collected during winter season 2022/2023, the proportion of people who expressed an interest in receiving advice from their GP on how to protect their health during heatwaves was 23%. Interest in receiving such advice was higher in specific subgroups such as women, elderly people, people with lower education level and lower incomes, people from urban or metropolitan areas and those living alone, as well as people with a migration background. Respondents were particularly interested to receive advice on medication management during heatwaves, while they were less interested in advice on cooling strategies.

Regarding these preferred topics, relative differences could be observed with regard to sex and age categories of respondents. Women and adolescents to young adults were relatively more often interested in advice on their drinking behaviour, while men were relatively more often interested in advice on their physical activity. Older respondents (>60 years) were relatively more often interested in advice on medication management. This is probably also due to the greater prevalence of drug intake in the elderly. In a survey conducted among physicians in Germany it was found that 40% of the physicians adapted their patients' medication at least occasionally during heatwaves, and 41% gave at least occasional advice on dealing with heat [29]. Thus, there seems to be substantial potential in implementing pre-summer medication check-ups and giving behavioural advice before and during heatwaves [25, 26]. Findings of this study on priorities on which GP advice is wished to focus on could guide future studies exploring these preferences in more detail. 

Interest in receiving advice can only develop if awareness about adverse effects of heatwaves is present. A lack of interest can therefore be the result of lack of awareness about adverse effects and their potential mitigation measures, or can result from already acquired knowledge from other sources. In this study advice on how to cool oneself was not identified as a predominant interest. Nevertheless, cooling oneself actively with water-bound measures, such as wet clothes or cool arm and foot baths, has been shown to be an efficient and at the same time underused protective measure for elderly [21, 41]. This example illustrates that preferences assessed in this study should not be the only guidance for GPs, but need to be considered together with other evidence. 

Studies show that public awareness of climate change is related to personal experiences of climate impacts [42]. Interest in GP advice on health protection measures during heatwaves is therefore assumed to be also related to the presence and perception of heat, which is obviously highest in during summer months. Data of the present study was collected during winter season when the effects of heatwaves are less apparent to individuals, so that a considerable seasonality of responses can be assumed. However, we have chosen a time when the population is not particularly aware of heat effects, but rather measure the general interest in GP advice; whereas in summer or during heatwaves, 

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greater interest can be expected. Our results show that on average about one in four people with GP contact express interest in receiving GP advice on health protection measures during heatwaves. The data thus also point out a substantial potential of raising awareness among the population on heatinduced health effects. In this context, it is known that individuals often underestimate their own level of risk which poses a barrier to taking action (e.g., seeking advice) [43, 44]. GPs can thus play an

6 important role to strengthen individual awareness among their patients.

To our knowledge, this is the first study to provide evidence, that there is an interest in the general public to receive heat health information from their GP. We would have liked to compare our results with other national and international data, but results of other studies on population interest in GP advice on other health behaviour, such as physical activity or diet, are hardly comparable due to different contexts and often different survey methodologies. In general, however, it can be stated that the information needs and system of the GP as a reliable partner can be considered comparable worldwide. Our study provides practical orientation for GPs on what topic of advice people are interested in, and whether specific person characteristics are associated with such interests. It is known that specific groups of society are particularly vulnerable to adverse health effects of prolonged or repeated periods of heat such as elderly people, people with chronic conditions or lower socioeconomic status, those living alone or in areas with high population density [2, 8, 19-23], and people with migration background [37-39]. This fits well to our results, in which these groups are expressing a higher interest in GP advice on health protective behaviours. 

GPs are already, and will increasingly be, on the frontline dealing with health impacts of climate change. It is therefore necessary to develop, evaluate, and implement targeted interventions aiming to adjust general practice to these new challenges in order to maintain population health in the best possible way. The present study provides initial data on the current interest of the population for advice from GPs on protective measures against heat and on the specific target groups for such advice. For the future, it will be important to explore climate change-related healthcare needs, risk perception, and target groups more in-depth, also with a focus on other impacts of climate change such health effects from air pollution, allergies, extreme weather events, and food and water insecurity. Furthermore, it will be essential to explore GPs' current views, knowledge and practice, as well as potential barriers and facilitators in this regard. 

#### 30 Strengths and limitations

A major strength of this study is the representative sample including respondents of older age groups, and the broad range of relevant person characteristics that were collected among the general population of Germany. Our study also has limitations. As described above, data was collected during winter season which means that awareness of the topic may differ from those that might have been expressed if data was collected during the summer months. . Both might have influenced the response behaviour, and we could not take this into account in the present study. In addition, some respondents who had negative experiences with the counselling behaviour or competence of their GP in the past, may be more likely to refuse any advice on health behaviour in general. 

Another limitation is that no information was available on health status and associated needs, or on the use of medication among respondents. The latter becomes relevant particularly with regard to GP advice on medication management during heat. In addition, no detailed information about the migration background of respondents was available. Therefore no differences according to place of birth and region of origin could be taken into account in the analyses, which would have been relevant with regard to potential previous experiences with extreme temperatures. 

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Furthermore, the six different topics GP advice could focus on were selected by the study team.

- Respondents could have other interests that were not suggested and thus not taken into account in
- the present analysis. One has also to consider, that the survey design only allowed participants to pick
- their most preferred advice topic, so that we might have missed secondary preferences. Finally, social
- desirability bias may have occurred in face-to-face interviews that may have affected the prevalence
  - estimates, most likely resulting in an overestimate.
- Our study was conducted in people with GP contact. There is also a small proportion of people who don't see a GP, but these have not been included here.

#### Conclusion

- Our findings show that in winter 2022/2023, an estimated one guarter of the population in Germany .ce, nore interes. articularly vulner. with GP contact was interested in receiving advice on protective health behaviour during heatwaves from their GP; especially on medication management. Specific groups of the population – particularly highest age groups – were even more interested in receiving such advice. This suggests an important
- opportunity for a group that is particularly vulnerable to adverse health effects of heatwaves.

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1 2	1	Statements
3	T	Statements
4	2	Acknowledgements
5	3	The authors thank Constanze Cholmakow-Bodechtel and Franziska Wenng from the market research
7	4	institute "Cerner Enviza" for the collection of the data.
8	5	
9	6	Competing Interests
10	7	BM receives an honorarium as a scientific advisor to the insurance company "Die Techniker". AH is
12	8	member of the German Climate Change and Health Alliance (KLUG e.V.) and speaker of the section
13	9	climate change and health of the German College of General Practitioners and Family Physicians
14 15	10	(DEGAM). She does not receive payments from any of those organizations. The other authors have no
15 16	11	competing interests to declare.
17	12	
18	13	Funding
19 20 21	14	German Federal Ministry of Health (BMG), grant number: ZMI1-2521DSM209.
21	15	Statement of Ethics
23	16	This study involves human participants and was approved by the Ethics Committee of the Heinrich-
24	17	Heine-University Duesseldorf, Germany (HHU 5386/R).
25 26	18	
20	19	Author Contributions
28	20	SKa coordinated the study, conceptualised and drafted the analysis protocol, drafted the manuscript,
29	21	analysed and interpreted the data. AH and BM: provided expert advice on the development of the
30 31	22	main outcome question and, together with BH, SKI, and SW critically revised the analysis protocol and
32	23	the manuscript. DK conceived the study, provided expert advice on analyses, and critically revised the
33	24	analysis protocol and the manuscript. All named authors contributed substantially to the manuscript
34 25	25	and agreed on its final version.
36		
37	26	Data Availability Statement
38	27	The data underlying this study are third-party data and are available to researchers on reasonable
39 40	28	request from the corresponding author (sabrina.kastaun@med.uni-duesseldorf.de). All proposals
41	29	requesting data access will need to specify how it is planned to use the data, and all proposals will
42	30	need approval of the study team (DK, SKI, SKa) before data release.
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	ST	ROBE 2007 (v4) Statement—Checklist of items that should be included in reports of crease-용ctional studies	
Section/Topic	ltem #	Recommendation	Reported on page
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		៉េ ឆ្នាំ ភ្លុ (b) Provide in the abstract an informative and balanced summary of what was done and what væggfgund	2
Introduction	·	an a	
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported <b>6</b>	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods	1	a erie and erie and erie	
Study design	4	Present key elements of study design early in the paper	5-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, by or up, and data collection	5-7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers Give diagnostic criteria, if applicable	6-7, Table 1
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7, Table 1
Bias	9	Describe any efforts to address potential sources of bias	7-8
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which gou high go were chosen and why	7-8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7-8
		(b) Describe any methods used to examine subgroups and interactions	7-8
		(c) Explain how missing data were addressed	8
		(d) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(e) Describe any sensitivity analyses	n/a
Results		ар р	

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		BMJ Open by open open opy 202	Page
Participants	13* (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, exangine of or eligibility,		8, Table 1
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information of the social of	8, Table 1
		(b) Indicate number of participants with missing data for each variable of interest	8
Outcome data	15*	Report numbers of outcome events or summary measures	8
Main results	16	( <i>a</i> ) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision being the structure of	Table 1
		(b) Report category boundaries when continuous variables were categorized	Table 1
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful and the period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses $\overline{\mathbf{A}}, \overline{\mathbf{R}}, \overline{\mathbf{C}}$	Table 2-3, n/a
Discussion		ning S htt	
Key results	18	Summarise key results with reference to study objectives	10-11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Dia both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information		ar t	
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, by the original study on which the present article is based	13

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in controls in case-control studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine article of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.secobe-statement.org.

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# **BMJ Open**

#### Are people interested in receiving advice from their general practitioner on how to protect their health during heatwaves? A survey of the German population

Journal:	BMJ Open
Manuscript ID	bmjopen-2023-076236.R2
Article Type:	Original research
Date Submitted by the Author:	31-Aug-2023
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<b>Primary Subject Heading</b> :	General practice / Family practice
Secondary Subject Heading:	General practice / Family practice, Public health
Keywords:	Primary Health Care, EPIDEMIOLOGIC STUDIES, Primary Care < Primary Health Care
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1 2 3	1	Research Article
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5 6	2	Are people interested in receiving advice from their general practitioner o
7	3	how to protect their health during heatwaves? A survey of the German
8	4	population
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11	6	Short title: Interest in receiving GP advice on health protection during heatwaves
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13	8	2023-07-30
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57	42	Number of words: text 4,015, abstract 297
58	43	Number of tables: 3
59 60	44	Number of figures: -

#### Number of figures: -45 Number of supplements: -

#### Page 1 of 17

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1 2	1	ΔΒςτραστ
3	1	
4 5	2	Objective
6	3	Climate change increases the frequency, intensity and length of heatwaves, which puts a particular
7	4	strain on the health of vulnerable population groups. General practitioners (GPs) could reach these
8 9	5	people and provide advice on protective health behaviour against heat. Data is lacking on whether and
10	6	what topic of GP advice people are interested in, and whether specific person characteristics are
11	7	associated with such interests.
12 13	8	Design
14	9	Cross-sectional, nationwide, face-to-face household survey, conducted during winter 2022/2023.
16 17	10	Setting
18	11	Germany.
20 21	12	Participants O
21	13	Population-based sample of 4,212 respondents (aged 14-96 years), selected by using multi-stratified
23	14	random sampling (50%) combined with multi-quota sampling (50%).
24 25	15	Main outcome measure
26 27	16	Interest in receiving GP advice on health protection during heatwaves (yes/no), and the topic people
28	17	find most important (advice on drinking behaviour, nutrition, cooling, cooling rooms, physical activity,
29	18	or medication management). Associations between pre-defined person characteristics and the
30 31	19	likelihood of interest were estimated using adjusted logistic regressions.
32 33	20	Results
34	21	A total of 4,020 respondents had GP contact and provided data on the outcome measure. Of these,
35	22	23% (95%CI=22%-25%) expressed interest in GP advice. The likelihood of expressing interest was
30 37	23	positively associated with being female, older age (particularly those aged 75+ years: 38% were
38	24	interested), having a lower level of educational attainment, having a migration background, living in a
39	25	more urban area, and living in a single-person household. It was negatively associated with increasing
40 41	26	income. Advice on medication management received highest interest (25%).
42	27	Conclusions
43	20	
44 45	28	During winter season 2022/2023, around one quarter of the German population with GP contact –
46	29	and around 40% of those aged 75+ years – was estimated to have a stated interest in receiving GP
47 49	30 21	Climate change is creating new demands for healthcare provision in general practice. This study
40 49	21 22	childre change is creating new demands for nearchard provision in general practice. This study
50	22 22	provides initial relevant information for research and practice aiming to address these demands.
51 52	55	
52 53	34	Keywords
54 55	35	primary care, climate change, heatwave, general practitioner, advice, population survey
56 57	36	
58	27	Church and limitations of this study
59 60	3/ 20	Strengths and limitations of this study
	38	

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- A major strength is the use of a sample of the German population, selected by using multistratified random probability sampling (50%) combined with multi-quota sampling (50%).
  - As the outcome measure was introduced into an existing omnibus survey, however, we did not have flexibility to collect other variables of interest, such as health status and medication use.
  - Data were collected during winter season where health effects of heatwaves might be less apparent to individuals compared to the summer season.
  - No data were collected on risk awareness regarding heatwaves and its adverse effects, which may be a prerequisite for the interest in GP advice on preventive measures against heat.

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#### INTRODUCTION

The World Health Organization (WHO, [1]) considers climate change to be the single greatest health threat to humankind. In the future, our society and health care systems will be increasingly confronted with adverse health effects of climate change, such as increased mortality and morbidity during heatwaves [1, 2], resulting in negative impacts on public health.

Heatwaves are hazards that negatively impact various sectors of society such as agriculture, forests, infrastructure, and human health [3, 4]. Although no universally accepted definition exists [5], heatwaves are understood to be prolonged or repeated periods with high or higher-than-normal air temperatures during days and/or nights that exceed a pre-determined temperature threshold over a certain period of time [3, 4]. Such prolonged heatwaves can cause high thermal stress to the body affecting, for example, the cardiovascular system by increasing blood viscosity and impacting the body's capacity to maintain a constant temperature [6, 7]. Numerous studies around the world suggest a systematic association between the occurrence of heatwaves and exacerbated cardiovascular, respiratory, and other forms of morbidity and mortality [8]. 

In Germany, climate change has been causing more frequent, more intense, and prolonged periods of heat in the summer, which has found to be associated with increased mortality rates [9, 10]. In July 2015, for example, a 1.2 fold increase in hospital admissions and over 3 times higher heat-related morbidity rates were observed for the metropolitan city of Frankfurt am Main [11]. Around 4,500 heat-related excess deaths occurred in the summer of 2022, which is described as the fourth warmest summer since weather records began in Germany in 1881 [12]. Like other countries, Germany implemented a National Adaptation Strategy on Climate Change to address the effects of extreme weather in order to safeguard people's health from the heat [13]. In addition, in 2017, the WHO recommendations for heat health action plans (HHAPs) were adopted by a working group of the national and federal states of Germany to motivate local implementation of action plans [14]. However, as implementation of HHAPs is not an obligation by law yet and responsibilities on community and federal state level remain unclear, only few communities have HHAP in place [15], mainly in larger cities, such as Cologne and Mannheim [16, 17]. In those cities Institute of General Medicine and Associations of Statutory Health Insurance Physicians (Kassenärztliche Vereinigung, KV) are involved to ensure engagement of General Practitioners (GPs) and other physicians [16]. In June 2023, a new national heat protection plan was published by the Federal Ministry of Health. The new concept includes various measures in cooperation with the public health service, general practitioners, hospitals, and the health care sector together with municipalities and federal states. GPs are to play a central role, especially in protecting vulnerable patients. The focus is on creating awareness that heat can pose a threat to health and on approaches to reach out to patients at risk [18]. 

Specific groups of society are particularly vulnerable to adverse health effects of heat such as elderly people, people with disabilities or with underlying medical conditions (e.g., people with cardiovascular, respiratory, renal or mental illness, or people suffering from multiple diseases), those working outdoors or in non-cooled environments, those living alone (in isolation) or in urban areas with high population density, as well as people with lower socioeconomic status [2, 8, 19-23]. These risks will increase further due to the wider trends in Europe of an aging population, with greater levels of chronic disease and increasing levels of urbanisation [2]. 

Behavioural measures can effectively help to prevent adverse effects during a heatwave, for instance increasing fluid intake, staying in a cool or air-conditioned environment, wearing loose-fitting clothes,

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taking showers/footbaths, reducing activity levels, avoiding moderate to high consumption of alcohol,

- and – in people using medication – monitoring and, if needed, adjusting medication intake [22, 24].
- However, while a recent survey in Germany showed that elderly people aim to tackle heat with a number of body-related, home-protective, and activity-related coping strategies, an underuse of
  - water-related heat adaption strategies was observed [21].

Substantial public health actions will be needed worldwide to tackle health impacts of climate-change induced heatwaves. According to WHO, HHAPs should be designed and implemented together with stakeholders at all levels in the health-sector, including GPs, to prevent direct effects of heat [25]. The WHO's HHAP of 2011 includes specific recommendations on how GPs should proactively identify, advise, and monitor patients at risk, and how to educate, counsel, and inform patients in general regarding individual adjustments of behaviour, medication and fluid intake, as well as inform them about helplines and medical services [26]. GPs thus have an important role in educating patients on, and assisting them with, health effects of heat. 

In general, GPs are well placed to provide such behavioural advice and information as the majority of the population regularly sees a GP, and GPs can particularly reach the most vulnerable groups of society (e.g., elderly, multimorbid, and socially isolated people) [27]. Furthermore, patients report that they see their GPs as a trusted source of information and advice on health behaviour [28]. 

However, a survey among GPs in Germany conducted in the year 2022 [29] showed that although around 60% of GPs reported observing heat-induced health effects in their patients, only a minority of GPs actively address this topic regularly with their patients. Around 16% reported that they regularly adjust the medication of their patients during heat periods, while around 10% regularly advise their patients on dealing with heat. Only a few GPs proactively contact patients which are at risk during heat periods [29]. Around 40% of GPs report a need for continuing and further training for themselves and for team members on topics and consulting opportunities regarding climate-change related health effects. These recent results are in line with data from a previous qualitative study conducted in 2013 suggesting that GPs' knowledge and awareness of heat health impacts and climate change needs to be strengthened – preferably through target-group-specific training – in order to engage them more extensively into preventive actions with their patients [30]. 

To inform the development of effective and tailored prevention measures, it is not only important to explore the interests and perceptions of GPs, but also of those who will be affected by such preventive measures - the patients. Are they interested in receiving GP advice on how to protect their health from heat? 

#### **RESEARCH AIM AND QUESTIONS**

Using data from a nationally representative sample of the German population, this study aims to assess the following research questions: 

- What proportion of the German population with GP contact expresses an interest in receiving GP advice on health protection during heatwaves, stratified by socio-demographic characteristics, socio-economic status, and region of residence?
- 2. Are these person characteristics statistically associated with the likelihood of expressing an interest in receiving GP advice on health protection during heatwaves?
- 3. Among those expressing an interest in such advice, which topic of advice is preferred most, stratified by age and sex of respondents?

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1 2	1	
3 4 5	2	MATERIALS AND METHODS
5 6	3	Study design and population
7 8	4	Data was collected using an ongoing, cross-sectional, representative household survey of the German
9	5	population to which a single question on the interest in receiving GP advice on health protection during
10	6	heatwaves was added for the period of two survey waves between October/November 2022 and
11	7	lanuary/February 2023 This study collects data every other month by computer-assisted face-to-face
12	, 8	bousehold interviews of participants aged 14+ years (with no upper age limit) living in private
13	0	households (rented or owned) across Cormany, Bosnondents are selected by using a dual frame
15	9	design multi-steep multi-stratified and dem much shilts are shell by using a dual frame
16	10	design: multi-strage, multi-stratified random probability sampling (50% of the sample) combined with
17	11	multi-quota sampling (50% of the sample). Details on the sampling design have been described
18	12	elsewhere ( <u>https://ost.io/s2wxc</u> ).
20	12	
21	14	Dependent variable
22	14	The question on "interest in requiring CD advice on health protection during heatwoyce" was
23	15	The question on interest in receiving of advice on health protection during heatwaves was
24 25	16	introduced using a brief explanation: Now we would like to ask you a question on a completely
26	1/	different topic. Climate change is causing the earth to warm up. As a result, so-called heatwaves can
27	18	increasingly be observed in summer, i.e., an unusual number of days with high temperatures. These
28	19	heatwaves can have a negative impact on health. General practitioners could offer advice on how to
29	20	protect health during heatwaves".
30 31	21	
32	22	This introduction text was followed by the question below. Response options (including topics the GP
33	23	advice should focus on - if so) were presented to respondents as a nominal scale and in a randomised
34	24	order to minimise the risk for order bias. Respondents were allowed to choose a single answer that
35	25	best applied to them.
37	26	"Would you like to receive advice from your general practitioner on how to better protect your health
38	27	during heatwayes? If so, which of the following topics would be most important to you?
39	28	
40	29	1 Yes I would like to receive advice especially on my drinking behaviour (e.g. what how much
41 42	30	or how often I should drink).
43	31	2. Yes, I would like to receive advice, especially on my diet (e.g., what or how much I should eat).
44	32	3. Yes, I would like to receive advice, especially on how to cool myself down (e.g., arm and foot
45	33	baths, proper use of fans).
46 47	34	4. Yes, I would like to receive advice, especially on how to keep my living spaces as cool as possible
47 48	35	(e.g., darkening rooms, proper ventilation).
49	36	5. Yes, I would like to receive advice, especially on my physical activity (e.g., how much, when or
50	37	where I should exercise).
51	38	6. Yes, I would like to receive advice, especially on what to look for regarding medication (e.g.,
52	39	storage, adjusting medication intake or changing medication).
54	40 //1	<ol> <li>No, 1 do not want any davice from my general practitioner on tins.</li> <li>8 I do not see a general practitioner</li> </ol>
55	42	9. No answer
56	43	
57	44	The question was developed together with two experts, who are medical doctors (one of them being
28 59	45	a GP) and researchers in the area of climate change and health (AH, BM)
60	46	

### 1 Independent variables

The following sociodemographic characteristics were measured: age in five categories of 14–24, 25– 39, 40–59, 60–74, 75+ years; sex (female versus male); region of residence (metropolitan area, urban area, versus rural area as reference), migration background (yes versus no), and cohabitation as a potential indicator for social isolation (living in a single-person versus other household).

Since effects of climate change, particularly temperature effects [31, 32], as well as accessibility and utilisation of GPs [33], are reported to differ between more rural and more urban areas, we assume interest in GP advice on health protection during heatwaves to also differ between residents of different regions. Area of residence of respondents was therefore assessed by using the variable administrative municipality district size ("politische Gemeindegrößenklasse"). This variable consists of seven categories which were summarised into three categories for further analyses comparable to other previous studies in the German population [34] (more details have been published elsewhere: https://osf.io/zp7c6): rural area (<20,000 residents), urban area (20,000 to 500,000 residents), and metropolitan area (>500,000 residents).

Migration background was defined as a positive answer to the question "Was one of your parents born abroad?" The official definition of "migration background" used for administrative purposes includes that at least one parent did not have German nationality by birth. In our study, no information is available for the respondents' country of origin or whether or not they were born in Germany. However, for the purpose of this study we assume that at least part of participants who were classified as having a migration background according to the definition applied in this study have personal experiences with extreme temperatures (e.g., heat, cold, drought) compared to people without such background [35, 36]. Previous studies have found higher heat vulnerability and exposure among people with migration background compared to those without [37-39]. We therefore assume that people with migration background may differ from those without such background regarding their interests in terms of health protection against heat, and thus included migration background as a dependent variable in the analyses. 

Measured socioeconomic status variables were: educational attainment (low [9 years of education, or no graduation], medium [10 to 11 years], high [>12 years]), and monthly net household income calculated per person in the household. For descriptive purposes, income was categorised using cut-offs that lead to an approximate distribution of: low (~25% of the sample), medium (~60% of the sample), and high (~15% of the sample), approximately reflecting the income distribution in Germany (details on the income calculation can be found here: https://osf.io/387fg/). Income was entered as a continuous variable coded from 0 ( $\leq 0$  income/month) to 7 ( $\geq \epsilon$ 7,000/month) in the regression models. 

#### 49 35 Statistical analyses

The study protocol and analysis plan were written prior to analysing the data and pre-registered on
the Open Science Framework: <u>https://osf.io/ycz7n</u>. Analyses were performed with IBM SPSS Statistics
for Windows, Version 29.0 (Armonk, NY: IBM Corp).

To address **research question 1**, we report descriptive prevalence data on the number of people expressing an interest in receiving GP advice on how to protect their health against heat effects, stratified by above mentioned person characteristics, and reported as percentages together with 95% confidence intervals (95%CI). For the stratified presentation of results and for logistic regression analyses (research question 2), respondents' answer on the outcome measure was categorised into a

#### Page **7** of **17**

- binary outcome variable "Yes, I am interested in receiving advice by a GP on how to protect my health
   during heatwaves" (answers 1-6, coding: 1) versus "No, I am not interested in any advice from my GP
- 3 on this" (answer 7, coding: 0).
- Prevalence data were weighted to be representative of the population in Germany accounting for
  personal and household characteristics. Details on the weighting technique have been published in the
  main study protocol [40] and elsewhere (<u>https://osf.io/s2wxc</u>).
- To address research question 2, adjusted logistic regression models were used to explore associations between the pre-defined person characteristics of respondents and the likelihood that they are interested in receiving advice from their GP on health protection during heatwaves (yes versus no). Adjustment sets for regression analyses were derived by application of directed acyclic graphs (DAGs). More details – including the graphs – have been published together with the analysis protocol: https://osf.io/ycz7n. Depending on the minimal sufficient adjustment set needed for each model, simple or multivariable regression models were applied. Regression analyses were conducted using unweighted data.
- To address research question 3 among the subgroup of respondents with an interest in receiving GP advice, we present descriptive prevalence data (together with 95%CI) on the topics this advice is preferred to focus on (answer options 1 to 6). This prevalence data is presented descriptively and stratified by age categories and sex of respondents. We had not planned statistical testing of relative differences in the analysis protocol, as the number of cases in the subgroups was expected to be too small. This descriptive analysis was conducted using unweighted data as weights were only available for the total sample and these should not be applied to subsamples that are already selected on the basis of specific person characteristics (e.g., interest in GP advice).
- 32
  33
  23 Dealing with missing data
- Overall, missing data in this face-to-face survey occurred only for a small share of the following
   independent variables: education: 2.3%, income: 0.1%, migration background: 3.9%. Thus, we
   assumed that excluding cases with missing data would not have relevant effects on our results, and
   used complete cases for the final analysis.
- 28 Patient and public involvement statement
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#### 31 RESULTS

- A total of 4,212 respondents aged 14+ years of the general population in Germany participated in the study between October/November 2022 and January/February 2023. Respondents without GP contact (answer 8, n=128, 3% of the total sample) were on average 8 years younger, more often men, and were more often from the lowest income group compared to those with GP contact. Those without GP contact or who preferred not to answer the outcome measure (answer 9, n=64, 1.5% of the total sample) were excluded from the analyses, which leads to a final sample of 4,020 individuals. Person characteristics of this final sample are reported in Table 1. The age range was 14 to 96 years (n=469 aged 75+ years), with a mean age of 51.6 years (standard deviation (SD)=18.5), and 52.8% (n=2,121) of the respondents were female.

# Research question 1: Proportion of the sample with interest in receiving GP advice on health protection during heatwaves, stratified by person characteristics

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1 Among the general population, 23.4% (95%CI=22.0%-24.8%, n=892; unweighted data: 26.8%, n=1,079)

2 expressed an interest in receiving GP advice on health protection during heatwaves. Relative

3 differences in this interest stratified by person characteristics are presented in **Table 1.** Highest interest

4 was observed in respondents aged 75+ years (38.2%, 95%CI=33.3%-43.2%).

5 Research question 2: Associations between person characteristics and the likelihood of expressing
 6 an interest in GP advice

The likelihood of expressing an interest in GP advice was positively associated with being female,
increasing age, having a low compared to high educational attainment, having a migration background
compared to not having such background, living in an urban or metropolitan area compared to a rural
area, and living in a single-household compared to other households, see **Table 1**. The likelihood was
negatively associated with increasing net household income per person.

**TABLE 1.** Characteristics of all respondents (n=4,020), and prevalence estimates on the interest in GP advice on health protection (=yes) relative to the respondents' characteristics; including results of regression models on associations between these characteristics and an interest in receiving GP advice (yes vs. no).

	Total sample, n=4,020 unweighted data	Interested in GP advice on he heat = ves (	ealth protection against vs. no)
	% (n)	weighted data, n=892	unweighted data
		% (n, 95%Cl)	OR§ (95%CI)
Sexª			
Male (reference)	47.2 (1899)	19.9 (368, 18.1-21.8)	1
Female	52.8 (2121)	26.6 (524, 24.7-28.6)	1.39 (1.21-1.60)
Age in years <sup>a</sup>			
14 – 24	8.4 (337)	14.1 (64, 11.1-17.7)	Continuous, per year
25 – 39	21.9 (881)	22.0 (183, 19.20-24.9)	1.01 (1.01-1.01)
40 – 59	32.3 (1300)	20.1 (257, 17.9-22.4)	
60 – 74	25.7 (1033)	28.0 (243, 25.0-31.1)	
75+	11.7 (469)	38.2 (146, 33.3-43.2)	
Educational attainment <sup>b</sup>			
High (ref.)	30.8 (1237)	19.4 (231, 17. <mark>2</mark> -21.8)	1
Medium	37.5 (1506)	22.8 (326, 20.7-25.1)	1.07 (0.89-1.28)
Low	29.5 (1185)	30.0 (314, 27.2-32.9)	1.26 (1.04-1.51)
Household income/€ <sup>c</sup>			
High	26.3 (1056)	21.3 (213, 18.8-23.9)	Continuous, see <sup>¥</sup>
Medium	60.8 (2446)	23.6 (556, 21.9-25.4)	0.91 (0.83-0.99)
Low	12.8 (513)	27.1 (124, 23.1-31.4)	
Migration background <sup>a</sup>		, , , , , , , , , , , , , , , , , , ,	
No (ref.)	82.0 (3298)	22.1 (663, 20.7-23.7)	1
Yes	14.2 (570)	25.9 (179, 22.7-29.3)	1.62 (1.34-2.00)
Region of residence <sup>d</sup>			
Rural area (ref.)	38.2 (1535)	17.7 (279, 15.9-19.7)	1
Urban area	41.9 (1686)	28.4 (464, 26.2-30.7)	2.17 (1.82-2.59)
Metropolitan area	19.9 (799)	24.7 (150, 21.3-28.3)	2.07 (1.67-2.57)
Cohabitation <sup>e</sup>			. ,
Other household (ref.)	62.0 (2494)	21.6 (631, 20.1-23.1)	1
Single-person household	38.0 (1526)	29.4 (262, 26.4-23.5)	1.20 (1.02-1.40)

18 Odds Ratios (OR) together with 95% CI around OR, statically significant results are highlighted in bold.

<sup>59</sup> 19
 <sup>4</sup>Entered as continuous variable in regression analyses (range from 0 [€0 income] to 7 [€7,000 or more].

32 33 34 35 <b>T</b> . 36 st	ABLE 3. Most important topic the GP advice is preferred to focus on among respondents with an intereratified by sex and age (n=1,079; single answer only, response options were presented in a randomis         (res, would like to receive advice, nost importantly       Sex, % (n), unweighted data	est in GP adv sed order). I data
32 33 34 35 <b>T</b> 36 st	<b>ABLE 3.</b> Most important topic the GP advice is preferred to focus on among respondents with an intereratified by sex and age (n=1,079; single answer only, response options were presented in a randomis	est in GP adv sed order).
32 33 34 35 <b>-</b>	<b>NRIF 3</b> Most important tonic the GD advice is preferred to focus on among respondents with an inter-	act in CD adv
32 33 34		
32 33	$a a a b c = 0$ in the formula in the formula $( - 3\pi/0)$ .	
32	advice on medication handling and intake (~34%).	0
	more elderly respondents aged 60 years and over were relatively more often interested in receiv	ing
31	in receiving GP advice on their drinking behaviour as a health protection strategy against heat, wh	nile
30	With regard to age, the youngest age group (14-24 years, 32.2%) was relatively more often interest	ted
29	often than women (13.4%) interest in advice on their physical activity during heatwaves.	
28	interest in receiving advice on their drinking behaviour, while men (17.5%) expressed relatively me	ore
27	in receiving GP advice, women (20.7%) compared to men (15.7%) expressed relatively more often	an
26	recognised by the treating GP without much effort – age and sex. Among respondents with an inter	est
25	Table 3 presents these results stratified by two relevant person characteristics which could	be
24		
23		
22	on what to look for regarding medication (e.g., storage, adjusting the amount or changing medication)	25.1 (271)
	on my physical activity (e.g., how much, when or where I should exercise)	15.1 (163)
	on how to keep my living spaces as cool as possible (e.g., darkening rooms, proper ventilation)	10.3 (111)
	on how to cool myself (e.g., arm and foot baths, proper use of fans)	10.9 (118)
	on my diet (e.g., what or how much I should eat)	19.9 (215)
	on my drinking behaviour (e.g., what, how much or how often I should drink)	data
		unweighted
	Yes, I would like to receive advice, most importantly	% (n),
21	GP advice (n=1,079; single answer only, response options were presented in a randomised order).	
20 21	<b>TABLE 2.</b> Most important topic the GP advice is preferred to focus on among respondents with an GP advice (n=1.070; single answer only response antions were presented in a rendemined order)	interest in
1.7		
19		
18	topics (~10%) referred to strategies of cooling oneself and cooling the living spaces.	
17	mentioned topic referred to medication intake and handling during heatwaves. The least mentior	ned
16	respondents with general interest in receiving such GP advice. With around 25%, the most frequer	ntly
15	Table 2 presents the frequency of each suggested topic the advice should focus on according	to
14	also stratified by sex and age?	
13	Research question 3: Among those interested in GP advice, which topic of advice is preferred mo	ost,
14		
11 12	background, region of residence.	
10	<sup>e</sup> Multivariable logistic regression model for the variables: age, educational attainment, income per person, migration	
8 9	"iviuitivariable logistic regression model for the variables: age, educational attainment, income per person, migration backaround, cohabitation.	
7	background.	
6	<sup>c</sup> Multivariable logistic regression model adjusted for the variables: sex, age, educational attainment, migration	
4 5	estimate the total effect of the independent variable on the outcome. <sup>b</sup> Multivariable logistic regression model adiusted for the variable: miaration backaround.	
3	<sup>a</sup> Univariate logistic regression model: no adjustment is necessary or possible – as it would produce a collider bias – to	
2	including the graphs – have been published together with the analysis protocol <u>https://osf.io/ycz7n</u> ):	
- 3	<sup>§</sup> Adjustment sets for regression analyses were derived by application of directed acyclic graphs (DAGs, more details – including the graphs – have been published together with the analysis protocol <u>https://osf.io/ycz7n</u> ): <sup>a</sup> Univariate logistic regression model: no adjustment is necessary or possible – as it would produce a collider bias – to	

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on my drinking behaviour	20.7 (131)	15.7 (70)	32.2 (21)	22.6 (53)	14.6 (45)	17.4 (53)	17.6 (29)
on my diet	19.9 (126)	20.0 (89)	10.8 (7)	22.6 (53)	25.2 (78)	16.4 (50)	16.4 (27)
on how to cool myself	11.2 (71)	10.6 (47)	15.4 (10)	12.3 (29)	15.9 (49)	4.3 (13)	10.3 (17)
on how to keep my living spaces as cool as possible	9.9 (63)	10.8 (48)	16.9 (11)	11.5 (27)	8.7 (27)	11.1 (34)	7.3 (12)
on my physical activity	13.4 (85)	17.5 (78)	9.2 (6)	14.0 (33)	15.9 (49)	16.7 (51)	14.5 (24)
on what to look for regarding medication	24.9 (158)	25.4 (113)	15.4 (10)	17.0 (40)	19.7 (61)	34.1 (104)	33.9 (56)

1 Data are presented as percentages (number).

#### 

 

#### 3 DISCUSSION

Among a representative sample of the general population in Germany, aged 14 to 96 years and with GP contact, which was surveyed during winter season 2022/2023, the proportion of people who expressed an interest in receiving advice from their GP on how to protect their health during heatwaves was 23%. Interest in receiving such advice was higher in specific subgroups such as women, elderly people, people with lower education level and lower incomes, people from urban or metropolitan areas and those living alone, as well as people with a migration background. Respondents were particularly interested to receive advice on medication management during heatwaves, while they were less interested in advice on cooling strategies.

Regarding these preferred topics, relative differences could be observed with regard to sex and age categories of respondents. Women and adolescents to young adults were relatively more often interested in advice on their drinking behaviour, while men were relatively more often interested in advice on their physical activity. Older respondents (>60 years) were relatively more often interested in advice on medication management. This is probably also due to the greater prevalence of drug intake in the elderly. In a survey conducted among physicians in Germany it was found that 40% of the physicians adapted their patients' medication at least occasionally during heatwaves, and 41% gave at least occasional advice on dealing with heat [29]. Thus, there seems to be substantial potential in implementing pre-summer medication check-ups and giving behavioural advice before and during heatwaves [25, 26]. Findings of this study on priorities on which GP advice is wished to focus on could guide future studies exploring these preferences in more detail. 

Interest in receiving advice can only develop if awareness about adverse effects of heatwaves is present. A lack of interest can therefore be the result of lack of awareness about adverse effects and their potential mitigation measures, or can result from already acquired knowledge from other sources. In this study advice on how to cool oneself was not identified as a predominant interest. Nevertheless, cooling oneself actively with water-related measures, such as wet clothes or cool arm and foot baths, has been shown to be an efficient and at the same time underused protective measure for elderly [21, 41]. This example illustrates that preferences assessed in this study should not be the only guidance for GPs, but need to be considered together with other evidence. 

Studies show that public awareness of climate change is related to personal experiences of climate impacts [42]. Interest in GP advice on health protection measures during heatwaves is therefore assumed to also be related to the presence and perception of heat, which is obviously highestduring summer months. Data of the present study was collected during winter season when the effects of heatwaves are less apparent to individuals, so that a considerable seasonality of responses can be assumed. However, we have chosen a time when the population is not particularly aware of heat effects, but rather measure the general interest in GP advice; whereas in summer or during heatwaves, 

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greater interest can be expected. Our results show that on average about one in four people with GP contact express interest in receiving GP advice on health protection measures during heatwaves. The data thus also point out a substantial opportunity of raising awareness among the population on heatinduced health effects. In this context, it is known that individuals often underestimate their own level of risk which poses a barrier to taking action (e.g., seeking advice) [43, 44]. GPs can thus play an

6 important role to strengthen individual awareness among their patients.

To our knowledge, this is the first study to provide evidence, that there is an interest in the general public to receive heat health information from their GP. We would have liked to compare our results with other national and international data, but results of other studies on population interest in GP advice on other health behaviour, such as physical activity or diet, are not readily comparable due to different contexts and often different survey methodologies. In general, however, it can be stated that the information needs and system of the GP as a reliable partner can be considered comparable worldwide. Our study provides practical orientation for GPs on what topic of advice people are interested in, and whether specific person characteristics are associated with such interests. It is known that specific groups of society are particularly vulnerable to adverse health effects of prolonged or repeated periods of heat such as elderly people, people with chronic conditions or lower socioeconomic status, those living alone or in areas with high population density [2, 8, 19-23], and people with migration background [37-39]. This fits well to our results, in which these groups are expressing a higher interest in GP advice on health protective behaviours. 

GPs are already, and will increasingly be, on the frontline dealing with health impacts of climate change. It is therefore necessary to develop, evaluate, and implement targeted interventions aiming to prepare general practice for these new challenges in order to maintain population health in the best possible way. The present study provides initial data on the current interest of the population for advice from GPs on protective measures against heat and on the specific target groups for such advice. For the future, it will be important to explore climate change-related healthcare needs, risk perception, and target groups more in-depth, also with a focus on other impacts of climate change such health effects from air pollution, allergies, extreme weather events, and food and water insecurity. Furthermore, it will be essential to explore GPs' current views, knowledge and practice, as well as potential barriers and facilitators in this regard. 

#### 30 Strengths and limitations

A major strength of this study is the representative sample including respondents of older age groups, and the broad range of relevant person characteristics that were collected among the general population of Germany. Our study also has limitations. As described above, data was collected during winter season which means that awareness of the topic may differ from those that might have been expressed if data was collected during the summer months. . Both might have influenced the response behaviour, and we could not take this into account in the present study. In addition, some respondents who had negative experiences with the counselling behaviour or competence of their GP in the past, may be more likely to refuse any advice on health behaviour in general. 

Another limitation is that no information was available on health status and associated needs, or on the use of medication among respondents. The latter becomes relevant particularly with regard to GP advice on medication management during heat. In addition, no detailed information about the migration background of respondents was available. Therefore no differences according to place of birth and region of origin could be taken into account in the analyses, which would have been relevant with regard to potential previous experiences with extreme temperatures. 

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Furthermore, the six different topics GP advice could focus on were selected by the study team.

Respondents could have other interests that were not suggested and thus not taken into account in

the present analysis. One has also to consider, that the survey design only allowed participants to pick 

their most preferred advice topic, so that we might have missed secondary preferences. Finally, social desirability bias may have occurred in face-to-face interviews that may have affected the prevalence

estimates, most likely resulting in an overestimate. 

Our study was conducted in people with GP contact. There is also a small proportion of people who

don't see a GP and whose risk during a heatwave may be lower or higher than the surveyed population, 

but these have not been included here. 

#### Conclusion

/2. .ceiving ution manag .ore interested . .articularly vulnerabi. Our findings show that in winter 2022/2023, an estimated one quarter of the population in Germany with GP contact was interested in receiving advice on protective health behaviour during heatwaves from their GP; especially on medication management. Specific groups of the population – particularly

highest age groups - were even more interested in receiving such advice. This suggests an important

opportunity for a group that is particularly vulnerable to adverse health effects of heatwaves.

1 2	1	Statements
3	T	Statements
4	2	Acknowledgements
5	3	The authors thank Constanze Cholmakow-Bodechtel and Franziska Wenng from the market research
7	4	institute "Cerner Enviza" for the collection of the data.
8	5	
9	6	Competing Interests
10	7	BM receives an honorarium as a scientific advisor to the insurance company "Die Techniker". AH is
12	8	member of the German Climate Change and Health Alliance (KLUG e.V.) and speaker of the section
13	9	climate change and health of the German College of General Practitioners and Family Physicians
14	10	(DEGAM). She does not receive payments from any of those organizations. The other authors have no
15	11	competing interests to declare.
17	12	
18	13	Funding
19 20 21	14	German Federal Ministry of Health (BMG), grant number: ZMI1-2521DSM209.
21	15	Statement of Ethics
23	16	This study involves human participants and was approved by the Ethics Committee of the Heinrich-
24	17	Heine-University Duesseldorf, Germany (HHU 5386/R).
25 26	18	
20	19	Author Contributions
28	20	SKa coordinated the study, conceptualised and drafted the analysis protocol, drafted the manuscript,
29	21	analysed and interpreted the data. AH and BM: provided expert advice on the development of the
30 31	22	main outcome question and, together with BH, SKI, and SW critically revised the analysis protocol and
32	23	the manuscript. DK conceived the study, provided expert advice on analyses, and critically revised the
33	24	analysis protocol and the manuscript. All named authors contributed substantially to the manuscript
34 25	25	and agreed on its final version.
36		
37	26	Data Availability Statement
38	27	The data underlying this study are third-party data and are available to researchers on reasonable
39 40	28	request from the corresponding author ( <u>sabrina.kastaun@med.uni-duesseldorf.de</u> ). All proposals
41	29	requesting data access will need to specify how it is planned to use the data, and all proposals will
42	30	need approval of the study team (DK, SKI, SKa) before data release.
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	ST	ROBE 2007 (v4) Statement—Checklist of items that should be included in reports of crease-용ctional studies	
Section/Topic	ltem #	Recommendation	Reported on page
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		៉េ ឆ្នាំ ភ្លុ (b) Provide in the abstract an informative and balanced summary of what was done and what væggfgund	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
9     BMJ Open     Provide statement-Checklist of items that should be included in reports of creational studies       Section/Topic     Image: Comparation of the study's design with a commonly used term in the title or the abstract in the abstract in informative and balanced summary of what was done and what was done reup was done done was done done was done done was done do			
Study design	4	Present key elements of study design early in the paper	5-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, by or up, and data collection	5-7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers Give diagnostic criteria, if applicable	6-7, Table 1
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7, Table 1
Bias	9	Describe any efforts to address potential sources of bias	7-8
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which gou may be were chosen and why	7-8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7-8
		(b) Describe any methods used to examine subgroups and interactions	7-8
		(c) Explain how missing data were addressed	8
		(d) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(e) Describe any sensitivity analyses	n/a
Results		ар	

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, exangine of or eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8, Table 1
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information of the social of	8, Table 1
		(b) Indicate number of participants with missing data for each variable of interest	8
Outcome data	15*	Report numbers of outcome events or summary measures	8
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precipion being the structure of th	Table 1
		(b) Report category boundaries when continuous variables were categorized $\overline{a}$	Table 1
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful and the period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Table 2-3, n/a
Discussion		ning S htt	
Key results	18	Summarise key results with reference to study objectives	10-11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Dia both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information		art	
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, original study on which the present article is based	13

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in controls in case-control studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine article of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.secobe-statement.org.

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