Acceptability of health-only versus climate-and-health framings in lifestyle-related climate-sensitive health counselling: results of a randomised survey experiment in Germany

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Summary

Background Climate-sensitive health counselling (CSHC) delivered by health professionals could promote individual patients and planetary health, particularly within lifestyle counselling. However, health professionals' uncertainty about the acceptability of CSHC remains a barrier to implementation. This study aimed to establish the effects of different topics and framings on patients' acceptability of lifestyle-related CSHC.

Methods We conducted a randomised survey experiment with a 2×3 mixed factorial design embedded in a larger survey in the Health-Related Beliefs and Health Care Experiences (HeReCa) panel study in Germany, an online panel of the general adult population from five of the 16 federal states across Germany. Participants were randomly assigned in a 1:1 ratio to one of two topics (either diet or physical activity) and were presented with three vignettes in a random order (framing A framed the given advice in health terms only; framing B presented the advice in terms of health and climate co-benefits; and framing C emphasised health, climate co-benefits, and climate risks). Topic served as the between-subject factor, and framing served as the within-subject factor. We hypothesised that the acceptability of CSHC would differ according to framing, but not according to topic. The primary outcome variable was the acceptability of the CSHC vignettes, measured using an acceptability score based on four items (affective attitude, burden, ethicality, and perceived effectiveness), rated on a five-point Likert scale (1–5 score: 1=not acceptable, 5=very acceptable). We refined our hypotheses based on subpopulations generated from a Left–Right Self-Placement for political orientation and climate change attitude test. We applied descriptive statistics, t tests, and a mixed ANOVA to the full and stratified samples.

Findings Of 3346 individuals who signed up for the HeRaCa panel between November, 2019, and June, 2020, 3163 participants of the panel (94·5%) were given the survey and 1516 (47·9%) submitted responses between April and June, 2022. 25 participants with incomplete data were excluded, and 1491 participants were included in the mixed ANOVA primary analysis. 748 participants were allocated to the diet group and 743 to the physical activity group. The mean age of the full sample was 55·6 years (SD 14·2). Excluding 62 participants with missing values, 814 (57·0%) were female and 613 (49·2%) were male; two participants (0·1%) self-identified as a diverse gender. In the whole cohort, the mean acceptability score of framing A was 4·09 (SD 0·71), was 3·67 (0·91) for framing B; and was 3·55 (0·97) for framing C. Mixed ANOVA revealed a significant and large effect of framing (partial η^2=0·18, p<0·001), and a significant but negligible effect of topic (partial η^2=0·004, p=0·021) on CSHC acceptability. Stratified analysis revealed that framing effects were less pronounced among participants alarmed about climate change or positioned politically to the left.

Interpretation Health-only framings of CSHC yield greater acceptability than health-and-climate framings across all subgroups. Differences are most pronounced among participants cautious or doubtful about climate change. These findings highlight tensions between the planetary health aims of CSHC and acceptability to patients, which could be alleviated by applying patient-centred communication techniques.

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Introduction

Humanity is driving the transgression of planetary boundaries, which are critical processes for a stable earth system, including biosphere integrity, freshwater change, and climate change.[1] By risking the stability of the earth system, humanity is endangering its own livelihood and health.[2] Societal transformation is needed to achieve health and wellbeing for all within planetary boundaries.[2,3]

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Research in context

Evidence before this study

A scoping review about climate-sensitive health counselling (CSHC) was published on July 10, 2023, which included 97 published articles retrieved from Web of Science, PubMed, and Google Scholar from database inception until Nov 30, 2022. This Article proposed a framework for CSHC, highlighting the aims, content areas, and communication strategies for CSHC and identifying barriers and facilitators for its implementation. For this Article, we repeated the search strategy of the scoping review to identify further research published in the period after the scoping review. On Nov 8, 2024, we searched PubMed for articles published between Dec 1, 2023, and Oct 31, 2024, without language restrictions. Core concepts covered by the search were "climate change", "health professional", "patient", and "health counselling". Inclusion and exclusion criteria were based on the population (health professionals and patients), concept (CSHC), and context (clinical setting). Of 532 studies identified in the new search, 49 met the inclusion criteria, with the high number of articles being published in the past 2 years indicating an increasing interest in the topic. 27 of the newly identified articles explicitly mentioned lifestyle-related CSHC, which is one of the three content areas identified by the original review. As in the original review, several articles identified uncertainty of health professionals about receptiveness of patients for CSHC as a barrier for its implementation. Studies based on surveys or in-depth interviews with physicians found that some physicians used health framings instead of health-and-climate

framings to mitigate feared negative effects on their patient relationship. However, no study formally tested effects of health versus health-and-climate framings on patients' acceptability of CSHC.

Added value of this study

This study tested the hypothesis that framing advice on eating plant-rich diets and practising active modes of transport in the context of health only would make it more acceptable for patients than framing of the same advice in the context of health and climate change co-benefits and risks in CSHC. We confirmed our hypothesis for the full sample and all investigated subgroups, although the difference in acceptability was smaller in those oriented politically to the left and those alarmed about climate change compared with other political orientations and climate change attitudes. A follow-up question showed that more than half of participants would recommend a physician using health-and-climate framings to a friend.

Implications of all the available evidence

Worries of health professionals about the lower acceptability of health-and-climate framings compared with health-only framings in individual counselling situations seem justified. Yet in the context of physicians' potential role in societal transformation towards sustainability, patient-centred approaches to CSHC which adapt messages to patients' environmental values seem promising and warrant further research.

Two particularly promising areas for societal transformation with co-benefits for human health and a stable climate are the transition towards healthy and sustainable food and transport systems.[4–8] A 2021 modelling study showed a reduction of 5·86 million deaths related to diet and 1·15 million deaths related to physical inactivity annually across nine countries by 2040 if greenhouse gas reduction policies complied with the Paris Agreement.[9]

However, results of the *Lancet* Countdown on health and climate change show that global indicators on healthy and sustainable diets and transport are still performing badly and little progress is being made.[2] Multilevel changes, for instance in individual behaviour, social norms, policies, and infrastructure, are needed to achieve high adherence to plant-based diets and active modes of transport.[10,11] Health-care professionals can serve as essential change agents capable of driving societal transformation due to their trust and status within the community.[12,13] They can support the transition towards healthy and climate-friendly diets and mobility in various ways,[3] one of them being the counselling of patients.[14,15] Concepts such as climate-sensitive health counselling (CSHC) and planetary health co-benefit prescribing have recently emerged to support this transition.[16,17] CSHC describes the integration of

climate change and health topics into the communication between health professionals and patients, with the overarching aim of promoting and protecting individual and planetary health.[16] Planetary health co-benefit prescribing focuses on recommendations and prescriptions for patients which have benefits for both the patient and the planet.[17] Both concepts entail counselling about diet and physical activity,[16,18] which seem to bear the greatest potential for lifestyle-related health improvements and climate change mitigation.[17] Qualitative findings from the USA and Germany suggest that lifestyle-related CSHC is one focus of physicians who communicate about climate change and health with patients.[19,20]

Health-care professionals currently face several barriers to implementing CSHC. In addition to a paucity of knowledge about the links between climate change and health effects,[21–23] many health-care professionals express uncertainty regarding how to conduct CSHC in a manner that patients find acceptable.[12,22,23] While patients' acceptability of a health intervention is not the main factor in driving clinical recommendations, it is seen as an important component to consider in recommendation development.[24] Currently there is an absence of empirical evidence on patients' perspectives and acceptability regarding CSHC. An online survey in Germany found

that while 46·7% of patients held a rather favourable view of CSHC, 19·3% were indifferent, and 33·9% were rather unfavourable.[25] A qualitative study from Germany indicated that patients who had received lifestyle-related CSHC found it acceptable when delivered in a patient-centred manner, taking the interests, values, and current biopsychosocial context of the patient into account.[19] Standardised climate counselling not directed at lifestyles but at the health effects of climate change was appreciated by most parents in a paediatric outpatient clinic in Wisconsin, USA.[26] However, studies employing robust methodologies to evaluate the acceptability of lifestyle-related CSHC are currently scarce.[12,16]

With regard to communication strategies, opinion papers call on health professionals to mention climate co-benefits when counselling patients on healthy and climate-friendly lifestyles.[27,28] Conversely, studies eliciting physicians' perspectives on CSHC found that they were reluctant to address climate change explicitly with patients, fearing the politicisation of the topic.[22,29] A 2021 qualitative exploration of physicians from the USA found that surveyed clinicians would primarily frame lifestyle-related CSHC around patient health benefits rather than climate benefits.[20] In communication practice and scholarship, framing is an approach that emphasises certain attributes of an issue over others and, as a consequence, shapes how that issue is understood.[30] This technique can significantly change how people react to an issue.[31] The framing of climate and health issues has been explored in public climate communication, where health-focused framings have been shown to enhance behavioural intention,[32] evoke positive emotions regarding climate action within public discourse,[33] and increase support for climate policies.[34] However there is currently not enough research examining the effects of climate-and-health framings within the health-care setting.

Consequently, a research gap exists concerning patients' acceptability of CSHC and the impact of climate-and-health framings in lifestyle-related CSHC. This study aimed to contribute to evidence-based recommendations on how to conduct CSHC through the following three objectives: first, to determine the acceptability of diet-related and physical activity-related CSHC; second, to establish the effects of different climate-and-health framings and different lifestyle topics on the acceptability of CSHC; and third, to identify differences in CSHC acceptability among subgroups with different political orientations and climate change attitudes. Health-care professionals need this practical information to effectively drive societal transformation for healthy people and a healthy planet.

Methods

Survey design and participants
We conducted this study in Germany, where individual members of the local climate change and health
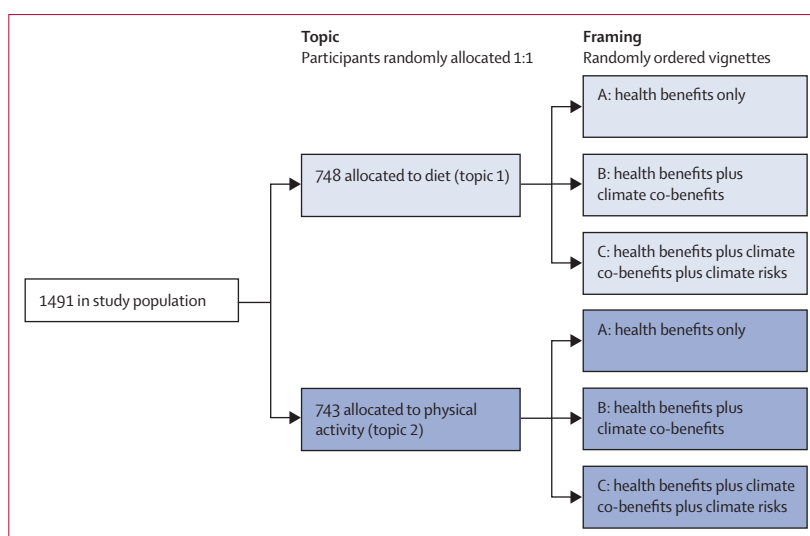

Figure 1: Experimental study design (2 × 3 mixed factorial design)

community have started implementing CSHC in the clinical setting.[19,35] We used the online panel Health-Related Beliefs and Health Care Experiences (HeReCa) in Germany to administer a cross-sectional survey. Recruitment of HeReCa panel members took place from November, 2019 to December, 2020. A random sample of 50 045 individuals was drawn from municipal registries in five of the 16 federal states across Germany: Baden–Württemberg, Berlin, Saxony–Anhalt, Schleswig–Holstein, and North Rhine–Westphalia.

3346 participants (6·7% of the sample) registered online and agreed to participate in short online surveys three to four times a year.[36] No sociodemographic information is available for the 44 747 individuals who did not enrol. Compared with the general German adult population, HeReCa panel members were more highly educated and slightly overrepresent people from the age group of 41–80 years (appendix p 10). We deemed all current panel members as eligible and invited the 3163 panel members enrolled in April, 2022 to participate in our study via email in April, 2022 (appendix p 13). Participants received two email reminders to participate in May and June, 2022. Sample construction is shown in detail in the appendix (p 3).

We conducted a survey experiment with a 2 × 3 mixed factorial design embedded in a larger survey. Topic (either diet or physical activity) served as the between-subject factor, and framing (health-only and health-and-climate framings) served as the within-subject factor (figure 1). Due to the embedded design, we defined the sample size by the number of participants in the full survey.[25] Nonetheless, we determined a minimum sample size for our experiment, including the stratified analysis. The assumed effect size for the within-subject effect was based on previous research on communication framings in the clinical setting (partial $\eta^2=0\cdot15$ or more).[37] We calculated the sample size for

See **Online** for appendix

two groups with three measurements with an α-error probability of 0·05, power of 0·90, and assumed correlation among repeated measurement of 0·5, aided by G*Power version 3.1.[38] This approach resulted in a required sample size of n=74 (appendix p 2), indicating that a minimum of 74 participants in each subgroup of the stratified analysis is sufficient.

We randomly assigned participants to a topic in a 1:1 allocation ratio. Each topic group received three case vignettes of similar CSHC situations with different framings in a random order (see figure 1 and appendix pp 13–20 for the full questionnaire in German and English). Simple randomisations were performed by the survey software. Masking to allocation was not possible due to the nature of the experiment. Framing A framed the given advice in health terms only. Framing B presented the advice in terms of health and climate co-benefits, while framing C emphasised health, climate co-benefits, and climate risks.

The HeReCa panel was approved by the Ethics Committee of the Medical Faculty of the Martin Luther University Halle–Wittenberg (application number 2019–044). The approval for the specific amendment for this survey was given on April 4, 2022. All participants gave written informed consent to participate in the study.

Survey hypotheses

Our study hypotheses were developed in a workshop by the research team. The scope on lifestyle-related CSHC had been chosen, because it was one of the most prevalent topics in CSHC in qualitative research on CSHC from the research team and beyond.[16,19,20] Preliminary findings from qualitative research from the research team did not indicate a preference of patients for diet-related or physical activity-related CSHC.[19] Furthermore, physicians had repeatedly stated uncertainty about the question of whether they should mention climate change explicitly or not (Herrmann A; unpublished). We preregistered the following hypotheses and the study design at AsPredicted.org (reference number 95403; appendix p 2).

Our first hypothesis was that the level of acceptability for CSHC differs according to framing, with the order of acceptability predicted as framing A (health only) being more acceptable than framing B (health and climate as co-benefits), and both being more acceptable than framing C (a combination of health, climate co-benefits, and climate risks). If supported, this would indicate that framing affects acceptability.

Our second hypothesis was that the level of acceptability for CSHC does not differ by topic, positing that diet and physical activity would be equally acceptable. If supported, this would indicate that topic does not affect acceptability.

To refine our first hypothesis we formulated two sub-hypotheses. Sub-hypothesis 1.1 posits that the acceptability of CSHC framings would be reversed (ie, A<B<C) for participants who expressed alarm and concerned attitudes towards climate change. Similarly, sub-hypothesis 1.2 suggests that this reversal applies to participants who identify as politically left or moderately left. We based these sub-hypotheses on the assumption that individuals with different political orientations and attitudes towards climate change exhibit varying climate-related behaviours.[39,40]

We developed six text-based vignettes illustrating three different framings of CSHC related to diet and physical activity conducted by a physician. We introduced the participant to each vignette as follows: "You have been diagnosed with high blood pressure and elevated blood lipid levels…As you also want to work proactively for your health, you ask if you could work on your lifestyle". The full text of all six CSHC vignettes and details on their development are shown in the appendix (pp 4, 13–20). Table 1 provides an overview of the important sections of the vignettes to clarify the differences between them. After rating each of the three vignettes from one topic individually regarding their acceptability, participants indicated which physician they would recommend to a friend facing the same health issues as a follow-up question. To minimise bias we used the same pronouns for all physician vignettes and chose names that were typical for the region.

	Topic 1: diet	Topic 2: physical activity
Framing A with Dr Müller		
Health benefits only	To prevent high blood pressure and associated diseases, it is particularly important to eat plenty of vegetables, fruit, and wholegrain products…*	To prevent high blood pressure and associated diseases, it is particularly important to be physically active regularly…*
Framing B with Dr Schmidt		
Health benefits plus climate co-benefits	Conversation is framed as for topic 1, framing A plus: In the course of the conversation, Dr Schmidt mentions, among other things, that eating less meat also contributes to climate change mitigation because livestock farming produces a lot of greenhouse gases. She says: "So eating less meat is first and foremost good for your health, and also good for the climate."	Conversation is framed as for topic 2, framing A plus: In the course of the conversation, Dr Schmidt mentions that driving also contributes to air pollution and climate change. She says: "So leaving the car at home more often is first and foremost good for your health, and also good for the climate."
Framing C with Dr Keller		
Health benefits plus climate co-benefits plus climate risks	Conversation is framed as for topic 1, framing A and B, plus: She also adds: "Unfortunately, climate change is also bad for our health. In my practice, I see older people suffering more and more from heatwaves. Many of my patients with allergies often still have symptoms in the autumn and winter. For me, protecting the climate means protecting health."	Conversation is framed as for topic 2, framing A and B, plus: She also adds: "Unfortunately, climate change is also bad for our health. In my practice, I see older people suffering more and more from heatwaves. Many of my patients with allergies often still have symptoms in the autumn and winter. For me, protecting the climate means protecting health."

*The vignettes contained more detailed information on how and why to change this behaviour in terms of health benefits (see appendix p 4).

Table 1: Content of the six case vignettes, ordered by topic and framing

Outcomes

The primary outcome variable was the acceptability of the CSHC vignettes, measured using an acceptability score. We built this score based on the acceptability framework for health-care interventions proposed by Sekhon and colleagues, including four items (affective attitude, burden, ethicality, and perceived effectiveness) rated on a five-point Likert scale.[41] The construction of the score is covered in detail in the appendix (p 5). A score of 1 indicates low acceptability, while a score of 5 indicates high acceptability. We pre-tested the survey in a paper format with five participants to ensure understandability then conducted an online pilot test with 19 participants to assess understandability, technical feasibility, and variation in the outcomes.

We used sociodemographic variables (age, sex, income, and education) that were included in the HeReCa baseline characteristics. Additionally, we assessed political orientation using the ALLBUS Left–Right Self-Placement scale, which ranges from 1 (left) to 10 (right).[42] We measured climate change attitudes with the Six Americas Short Survey (SASSY).[43] This four-item tool separates the population into six categories of climate change attitudes: alarmed, concerned, cautious, disengaged, doubtful, and dismissive. While SASSY has been validated for the US population, no comparable short version exists for Germany. Therefore, we translated the original tool into German and calculated SASSY types using the online tool provided by Chryst and colleagues.[44]

Statistical analysis

For data analysis, we calculated descriptive statistics for the Likert-scale ratings for each item. We built the acceptability score by determining the mean rating across four acceptability component constructs for each of the six case vignettes. To measure internal consistency of the scores, we calculated Cronbach's α for the acceptability scores across all six vignettes. We then tested the effects of framing and topic on acceptability using a mixed ANOVA, stratifying effect size using Cohen's d.[45] We assessed the necessary assumption of normality by visually inspecting quantile–quantile (Q-Q) plots of all six acceptability scores (appendix pp 19–22). To test for the homogeneity of covariances among the between-subject factors we performed Box's test of equality of covariance matrices. We applied Mauchly's test of sphericity and applied Huynh–Feldt correction if the Greenhouse–Geisser ε was over 0·75 and Greenhouse–Geisser-correction if ε was under 0·75. To test whether the acceptability of framing A was greater than framing B, and framing B greater than framing C, as preregistered, we performed a pairwise comparison with Bonferroni adjustment for multiple comparison. To further analyse the differences between framings, we conducted a mixed ANOVA with a planned orthogonal contrast comparing framing A versus the mean effect of framings B and C (contrast 1) and framing B versus framing C (contrast 2). Effect size was interpreted as partial $\eta^2 < 0·01$ being negligible; η^2 from 0·01 to under 0·06 as small, η^2 from 0·06 to under 0·14 as medium; and η^2 of 0·14 or greater as large.

To test hypothesis 1.1 and 1.2, we performed a stratified analysis for political orientation and climate change attitudes, running descriptive statistics and mixed ANOVA with orthogonal contrasts as described for the full sample. For political orientation, we combined the 1–10 scale levels as follows: left (scores of 1 or 2), moderately left (3 or 4), centre (5 or 6), moderately right (7 or 8), and right (9 or 10). For climate change attitudes, after collating our data we combined the three smallest groups, disengaged (n=17), doubtful (n=31), and dismissive (n=17), into one group referred to as doubtful, to meet the threshold for sample size in subgroup analysis. Lastly, to explore potential confounding by sociodemographic variables, we fitted a multilinear regression model. We conducted all analyses in SPSS version 29. This study is reported according to the CONSORT statement (appendix pp 11–12).

Role of the funding source

The participating institutes of the Martin Luther University Halle-Wittenberg fund the HeReCa panel. The funder had no role in conducting this study nor in analysing the results.

Results

Of 3346 individuals who signed up for the HeRaCa panel between November, 2019, and June, 2020, 3163 participants of the panel (94·5%) were given the survey and 1516 (47·9%) submitted responses between April and June, 2022. Those who responded were slightly older and more often female than non-responders, but no clear patterns for differences in education and income were discernible (appendix p 10). We excluded 25 participants due to missing values in relevant outcome variables, leaving a final sample of 1491 participants for the ANOVA: 748 in the diet group and 743 in the physical activity group. The mean age of the total cohort was 55·6 years (SD 14·2). Excluding 62 participants with missing values, 814 (57·0%) were female and 613 (49·2%) were male; two participants (0·1%) self-identified as a diverse gender (table 2). Each of the five federal states contributed approximately one-fifth of the sample by design (18·1%–22·1%). Excluding participants with missing data, 730 (49·0%) of 1489 identified as left or moderately left, 791 (53·1%) of 1491 were alarmed about climate change, and 1379 (93·3%) of 1478 had visited a physician at least once in the past 12 months.

Internal consistency of the acceptability score according to Cronbach's α ranged from 0·88 to 0·92 for the six vignettes (appendix p 5). The Q-Q plots showed that the acceptability scores were sufficiently close to normal distribution, and thus suitable for ANOVA (appendix pp 19–22).

	Total (n=1491)	Group 1: diet (n=748)	Group 2: physical activity (n=743)
Age, years			
21–30	86/1432 (6·0%)	42/716 (6%)	44/716 (6%)
31–40	178/1432 (12·4%)	83/716 (12%)	95/716 (13%)
41–50	190/1432 (13·3%)	94/716 (13%)	96/716 (13%)
51–60	386/1432 (27·0%)	200/716 (28%)	186/716 (26%)
61–70	380/1432 (26·5%)	195/716 (27%)	185/716 (26%)
71–80	186/1432 (13·0%)	89/716 (12%)	97/716 (14%)
81–90	26/1432 (1·8%)	13/716 (2%)	13/716 (2%)
Missing values	59 (4·0%)	32 (4%)	27 (4%)
Sex			
Female	814/1429 (57·0%)	405/713 (57%)	409/716 (7%)
Male	613/1429 (42·9%)	306/713 (43%)	307/716 (43%)
Diverse*	2/1429 (0·1%)	2/713 (<1%)	0
Missing values	62 (4·2%)	35 (5%)	27 (4%)
Federal state			
Baden–Württemberg	308 (20·7%)	168 (22%)	140 (19%)
Berlin	277 (18·6%)	131 (18%)	146 (20%)
North Rhine–Westphalia	270 (18·1%)	131 (18%)	139 (19%)
Saxony–Anhalt	306 (20·5%)	160 (21%)	146 (20%)
Schleswig–Holstein	330 (22·1%)	158 (21%)	172 (23%)
Missing values	0	0	0
Educational level, based on educational degree or degrees†			
High	937/1431 (65·5%)	472/717 (66%)	465/714 (65%)
Middle	401/1431 (28·0%)	198/717 (28%)	203/714 (28%)
Low	73/1431 (5·1%)	35/717 (5%)	38/714 (5%)
Currently a student	4/1431 (0·3%)	4/717 (1%)	0
Other	16/1431 (1·1%)	8/717 (1%)	8/714 (1%)
Missing values	60 (4·0%)	31 (4%)	29 (4%)
Monthly net household income, €			
<€3000	566/1302 (43·5%)	287/651 (44%)	279/651 (43%)
€3000 to €5000	498/1302 (38·2%)	256/651 (39%)	242/651 (37%)
>€5000	238/1302 (18·3%)	108/651 (17%)	130/651 (20%)
Missing values	189 (12·7%)	97 (12%)	92 (12%)

(Table 2 continues on next page)

The mean acceptability score across all topics and framings was 3·77 (SD 0·72). Mean scores for each of the six vignettes across topics and framings are summarised in table 3, and they ranged from 4·13 (0·69) for diet presented with framing A to 3·52 (0·96) for physical activity with framing C.

Bonferroni-adjusted t tests showed the rank order of framings was A greater than B greater than C. The health-only framing A showed a higher acceptability score than health and climate co-benefit framing B (mean acceptability score 4·09 [SD 0·71] for framing A vs 3·67 [0·91] for framing B; mean difference 0·42 [SE 0·02]; p<0·001; table 3). Framing B showed a higher acceptability score than framing C, when climate risk was added (mean acceptability score 3·55 [SD 0·97] for framing C; mean difference to framing B 0·12 [SE 0·02]; p<0·001). Acceptability of diet as a topic (mean 3·81 [SD 0·72]) was higher than for physical activity as a

topic (mean 3·73 [0·73]), with a very small statistically significant mean difference of 0·09 (Bonferroni adjusted, p=0·021; appendix p 7).

The mixed ANOVA showed a large effect of framing on acceptability (F_{HF} [2,2709] 335·03, p<0·001, partial η^2=0·18), and a negligible effect of topic on acceptability (F_{HF} [1,1489] 5·32, p=0·021, partial η^2=0·004). No statistically significant interaction between topic and framing was observed (F_{HF} [2,2709] 0·58; p=0·54). There was a large difference between framing A versus the mean of framings B and C (F_{HF} [1,1489] 501·47; p<0·001; partial η^2=0·25). Also, there was a small difference between framing B and framing C (F_{HF} [1,1489] 42·02; p<0·001, partial η^2=0·03). All reported effects were statistically significant.

In the final question about which physician participants would recommend to a friend depending on the physician's framing, most participants recommended either the physician using the health-only framing A (303 [41%] of 748 for diet and 317 [43%] of 743 for physical activity) or the health, climate co-benefit, and climate risk framing C (301 [40%] of 748 for diet and 279 [38%] of 743 for physical activity). Physicians using the health and climate co-benefit framing B were recommended less often (127 [17%] of 743 for diet and 128 [17%] of 748 for physical activity). 17 (2%) of 748 and 19 (3%) of 743 participants would recommend none of the physicians for diet and physical activity, respectively (appendix p 4).

Figure 2 depicts the median and the range of acceptability scores for the three framings A, B, and C for the topics of diet (panels to the left) and physical activity (panels to the right), stratified for climate change attitude (upper panels) and political orientation (lower panels).

Descriptive statistics of the mean acceptability scores show that mean acceptability score across topics was highest for framing A and lowest for framing C across all subgroups (appendix p 6). Effects of framing on acceptability were statistically significant across all but the politically right-wing oriented subgroup and are varying in size (appendix p 7). The framing effect was small (partial η^2=0·05; p<0·001) for those politically oriented to the left and large across all other political orientations (partial η^2 ranging from 0·17 and 0·24; appendix p 7). Furthermore, the framing effect was medium for those alarmed about climate change (partial η^2=0·09; p<0·001), large for those concerned about climate change (partial η^2=0·26; p<0·001), and even larger for those cautious or doubtful about climate change (partial η^2=0·39 and η^2=0·47, respectively; p<0·001 for both). Orthogonal within-subject contrasts showed that the observed effects were bigger for contrast 1 (A vs B + C) than for contrast 2 (B vs C; appendix p 8) for all subgroups. A multilinear regression model with stepwise inclusion of experimental, attitudinal, and sociodemographic variables, regressed on acceptability, did not reveal confounding of our tested effects (appendix p 9).

Discussion

This study demonstrates that the health-only framing of CSHC focused on diet and physical activity resulted in greater acceptability than the health-and-climate framings, both in the overall sample and the stratified analysis. Our findings support hypothesis 1, where acceptability differs according to framing with the rank order being A greater than B greater than C. The rank order did not reverse in subgroups politically oriented to the moderate left or left, or for those alarmed or concerned about climate change, as suggested by hypotheses 1.1. and 1.2. However, the framing effect was small in those politically oriented to the left, medium in those alarmed about climate change, and large in all other subgroups. Hypothesis 2, saying that CSHC on diet would be as acceptable as CSHC on physical activity, needs to be formally rejected. However, the significant effect of $\eta^2 = 0.004$ could be argued to be so small as to be seen as negligible.[45]

The results of this study support the concerns raised previously by physicians that explicitly mentioning climate change in patient health counselling might reduce patients' receptiveness to the information provided.[16,20,22] This finding might suggest that health-care professionals should focus solely on health-oriented framings rather than combined climate-and-health framings when delivering lifestyle-related CSHC. Using a health-only framing can address two of the three proposed aims of CSHC, "to protect and promote individual and public health" and to "encourage climate action and lifestyle change".[16] This is because eating a balanced, predominantly plant-based diet or engaging in active transport may contribute to both aims,[46,47] even if the lifestyle change is being pursued for health purposes only. Thus, a health-only framing can be an option to maximise acceptability of CSHC and avoid feared damage to the physician–patient relationship.[48] However, the clinical relevance of these findings need to be interpreted with caution, as the absolute difference in acceptability was rather small overall. Relevance seems to be higher for subgroups in which framing effects were large and acceptability scores of health-and-climate framings tended towards unacceptable, such as participants who were politically self-positioned to the right and those identifying as cautious or doubtful about climate change.

Overall, patients' acceptability is only one component to consider in the development of clinical recommendations.[24] There are other reasons that speak in favour of explicitly mentioning climate aspects in CSHC. First, addressing climate change explicitly could avoid the perception of a hidden agenda in CSHC which has the potential to breed mistrust in an era marked by disinformation and a diminishing trust in public institutions.[49] For instance, a 2024 USA-based focus group study on climate-informed health decision making by Hantel and colleagues found that patients

	Total n=1491	Group 1: diet (n=748)	Group 2: physical activity (n=743)
(Continued from previous page)			
Political orientation‡, ten-point scale			
Left (1–2)	183/1489 (12·3%)	91/747 (12%)	92/742 (12%)
Moderately left (3–4)	547/1489 (36·7%)	277/747 (37%)	270/742 (36%)
Centre (5–6)	636/1489 (42·7%)	317/747 (42%)	319/742 (43%)
Moderately right (7–8)	109/1489 (7·3%)	56/747 (7%)	53/742 (7%)
Right (9–10)	14/1489 (0·9%)	6/747 (1%)	8/742 (1%)
Missing values	2 (0·1%)	1 (<1%)	1 (<1%)
SASSY attitudes towards climate change			
Alarmed	791 (53·1%)	394 (53%)	397 (53%)
Concerned	457 (30·7%)	234 (31%)	223 (30%)
Cautious	178 (11·9%)	91 (12%)	87 (12%)
Doubtful§	65 (4·4%)	29 (4%)	36 (5%)
Missing values	0	0	0
Physician visits during the last 12 months			
None	109/1478 (7·4%)	55/740 (7%)	54/738 (7%)
1–5	1066/1478 (72·1%)	530/740 (72%)	536/738 (73%)
>5	303/1478 (20·5%)	155/740 (21%)	148/738 (20%)
Missing values	13 (0·9 %)	8 (1%)	5 (1%)

Data are n (%) or n/N (%). Percentages might not exactly add up to 100% due to rounding. SASSY=Six Americas Short Survey.[43] *Optional question, with the options male, female, and diverse. The option of prefer not to say was classified as missing. †High=higher secondary education, including vocational or technical schools, middle=intermediate secondary education, low=general secondary education, and currently a student=attending a secondary educational institution. ‡Measured by the ALLBUS Left–Right Self-Placement scale. §Doubtful was a combination category of three score categories (disengaged, doubtful, and dismissive) as the three categories were too small for separate analysis.

Table 2: General characteristics of the full sample and randomly allocated groups

	Framing A	Framing B	Framing C	Mean across topics
Topic 1: diet (n=748)	4·13 (0·69)	3·73 (0·92)	3·58 (0·98)	3·81 (0·72)
Topic 2: physical activity (n=743)	4·04 (0·72)	3·62 (0·90)	3·52 (0·96)	3·73 (0·73)
Total mean across framings (n=1491)	4·09 (0·71)	3·67 (0·91)	3·55 (0·97)	3·77 (0·72)

Data are mean (SD). Framing A mentioned health only; framing B mentioned both health and climate co-benefits; and framing C included health, climate co-benefits, and climate risks. Mean acceptability scores were built from four variables measured on a five-point Likert scale, with a score of 1 (minimum) indicating little acceptability and 5 (maximum) indicating high acceptability. Exact labelling of the Likert scales for the individual items can be found in the appendix (p 5) and pairwise comparisons in the appendix (p 7).

Table 3: Mean acceptability scores for the six case vignettes across topics and framings

did not want their physicians to gatekeep to whom climate and health information is given or not,[22] indicating that actively addressing climate change in CSHC could mitigate patients' concerns about gate-keeping. Furthermore, climate-and-health framings are regarded as an instrument to support building public consensus around climate action.[50,51] Social norms have a considerable effect on individual behaviour.[52] Thus, by
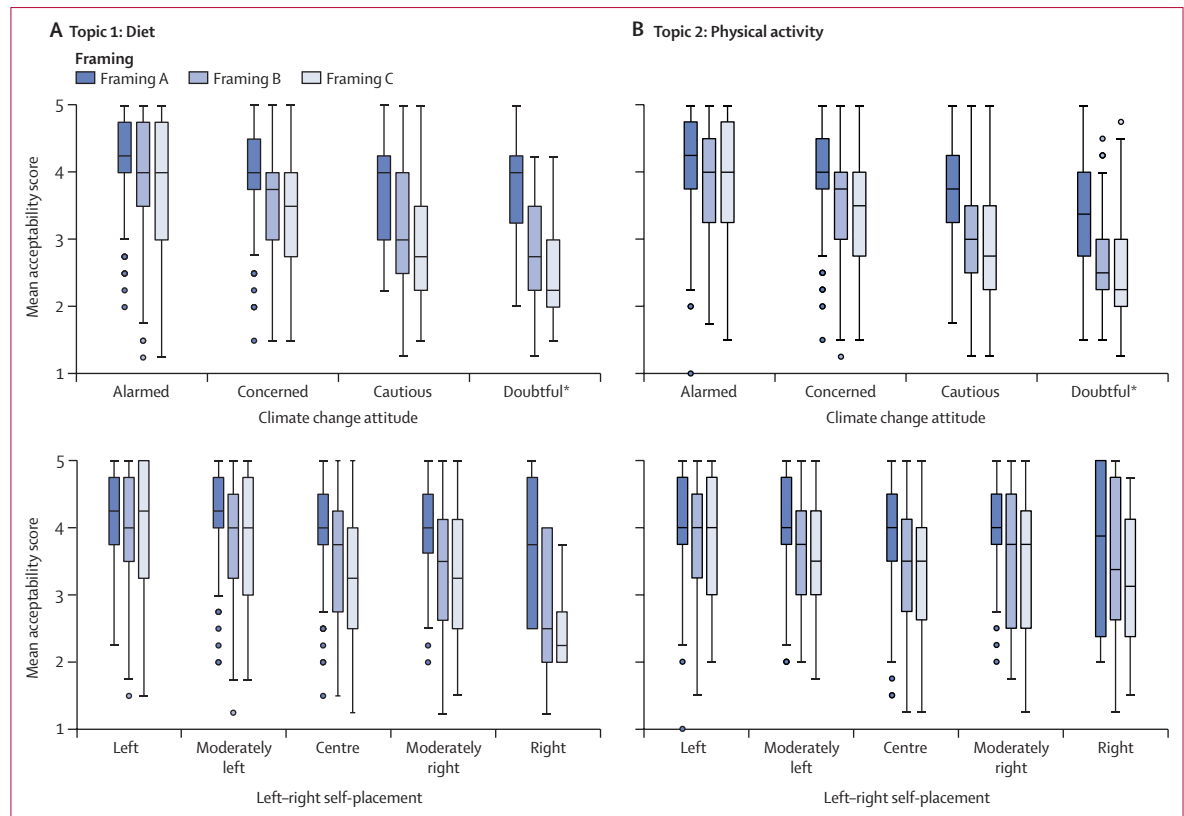
Figure 2: **Box plots displaying the range of acceptability scores by framing for diet (A) and physical activity (B), stratified by climate change attitude and political orientation**

Framing A names health only. Framing B names health and climate co-benefits. Framing C names health, climate co-benefits, and climate risks. The acceptability score is measured on a scale where 1 represents minimum acceptability and 5 represents maximum acceptability. *Category was combined from participants who reported their attitude as disengaged, doubtful, or dismissive.

using climate-and-health framings, health professionals could contribute to shifting social norms towards an increasing acceptance of sustainable behaviour.[12,53] For public climate change communication, Kotcher and colleagues showed that combined information on the health impacts of climate change, health co-benefit solutions, and positive descriptive norms were most likely to motivate people for political climate action in their USA-based study.[54] Health framings were identified to work particularly well for people unconcerned about climate change.[34] Reismann and colleagues found that patients who were exposed to climate-specific medical advice by doctors in Germany had higher knowledge and awareness on climate-related health effects.[55] However, future research is needed to assess whether health and climate framings in CSHC provided in the clinical setting can actually support shifts of social norms and increase support for climate action.

Patient-centred communication techniques[56] could offer a way to alleviate the tensions between increasing individual acceptability of CSHC and maximising the benefit for planetary health. Techniques such as motivational interviewing allow practitioners to modulate counselling to patients' values—eg, actively asking whether patients would like to hear more about the climate aspects of health recommendations or not.[56,57] A 2024 German study showed that of 1275 participants, the majority (74·4%) found that displaying climate and health information material in waiting rooms was seen as an appropriate way of informing about climate change and health issues, compared with 55·8% who thought personal counselling with a physician was appropriate, and 16·9% who thought no avenues were suitable.[25] Informational material might be an option to make the planetary health values of physicians and health institutions transparent, even if health-only framings are used in counselling situations.

This study can also contribute to the discussion on how to best deliver health and climate framings in CSHC. While there was a small (but significant) difference between the acceptability scores of framings B and C, both of which included health and climate advice, the clinical relevance of this difference could be interpreted as low. This interpretation is supported by the results of the follow-up question, showing that patients would more often refer a friend to a physician using framing C, with health, climate co-benefits, and climate risks, than

framing B, which just mentioned health and climate co-benefits (38·9% *vs* 17·1%, respectively). While simply naming health co-benefits is a commonly mentioned strategy of CSHC (framing B),[16,20] expanding on the topic of climate change and health as suggested in framing C seems to be worthwhile, as it does not markedly decrease CSHC acceptability and might hold greater potential for increasing patients' knowledge and awareness, and possibly encourage climate action.[3]

To our knowledge, this is the first study to experimentally test the effects of different framings and topics in lifestyle-related CSHC on its acceptability. Our experimental design, which randomly assigned participants to topics and varied the order of framings in three different case vignettes, provides a robust method for identifying the effects of framing and topic on acceptability. Using the framing as a within-subject factor cannot fully exclude order effects on the individual level, such as mere-exposure effect, where repeated exposure to a stimulus increases liking the stimulus.[58] However, randomising the order of framings between participants fully controls for order effects such as mere exposure, learning, familiarity, or cognitive overload on the group level (the level of analysis of results reported here). Most importantly, using framing as a within-subject factor offers robust control for confounding, as each participant served as their own control, thereby eliminating individual differences (eg, baseline attitudes, cognitive biases, or previous knowledge). This allowed us to reduce error variance and increase statistical power, and allowed for more precise estimation of the framing effects. Another strength of the study is the large sample size, which enabled us to conduct a stratified analysis with sufficient power for all but two subgroups: those with doubtful attitudes toward climate change (n=65) and those with a right-leaning political orientation (n=14). The large sample size overall might have led to overpowering the full sample, meaning that significant but small effects in the full sample should be interpreted with caution.

One potential limitation of our study is that we did not collect the data in a health-care setting. However, 92·6% of participants reported having seen a physician at least once in the last 12 months, suggesting our sample represents an eligible target population. Selection bias is another relevant limitation of this study. First, because participants in the HeReCa study voluntarily signed up to receive health surveys without incentives, participants are not fully representative of the German population (appendix p 10) and might have a heightened interest in health-related topics or be more receptive to new health interventions compared with the general population. Second, the 47·9% of respondents to this survey were more likely to be female and older than non-respondents, a pattern also observed in other HeReCa studies.[59] However, sociodemographic characteristics were not strong

predictors for the acceptability of lifestyle-related CSHC in this study. This aligns with findings about environmental attitudes and behaviours, which are usually more strongly related with other attitudinal characteristics than with sociodemographic characteristics.[39,40] While we do not have information about political self-positioning or climate change attitudes in our non-responders, comparison with the general population shows that our sample is slightly more oriented to the left and more alarmed about climate change (appendix p 10). Therefore it is probable that average acceptability of lifestyle-related CSH is lower in the general population than in this sample. The direction of the framing effect towards greater acceptability of health-only framings was the same across all political and attitudinal subgroups in this study and therefore should not be affected by selection bias. Conversely, the size of the framing effect is probably larger in the general population due to underrepresentation of groups sceptical about climate change in this sample. Further studies are needed to corroborate framing effects in CSHC in Germany and other target populations. Establishing the effects of climate-and-health framings in CSHC on climate change-related knowledge, attitudes, and health behaviours in intervention studies could help to quantify hypothesised benefits of climate-and-health framings and help to balance them against reductions in acceptability.

Health-only framings might yield greater acceptability than health-and-climate framings in lifestyle-related CSHC. In combination with knowledge from literature, patient-centred approaches to CSHC may help to maximise both individual acceptability and planetary health benefits. Future research should investigate the effect of patient-centred CSHC on climate-related attitudes and behaviours to provide evidence on whether CSHC can contribute to societal transformation for health within planetary boundaries.

References

1 Richardson K, Steffen W, Lucht W, et al. Earth beyond six of nine planetary boundaries. *Sci Adv* 2023; **9:** eadh2458.

2 Romanello M, Walawander M, Hsu SC, et al. The 2024 report of the *Lancet* Countdown on health and climate change: facing record-breaking threats from delayed action. *Lancet* 2024; **404:** 1847–96.

3 Howard C, MacNeill AJ, Hughes F, et al. Learning to treat the climate emergency together: social tipping interventions by the health community. *Lancet Planet Health* 2023; **7:** e251–64.

4 Milner J, Green R, Dangour AD, et al. Health effects of adopting low greenhouse gas emission diets in the UK. *BMJ Open* 2015; **5:** e007364.

5 Jarrett J, Woodcock J, Griffiths UK, et al. Effect of increasing active travel in urban England and Wales on costs to the National Health Service. *Lancet* 2012; **379:** 2198–205.

6 Laine JE, Huybrechts I, Gunter MJ, et al. Co-benefits from sustainable dietary shifts for population and environmental health: an assessment from a large European cohort study. *Lancet Planet Health* 2021; **5:** e786–96.

7 Markandya A, Sampedro J, Smith SJ, et al. Health co-benefits from air pollution and mitigation costs of the Paris Agreement: a modelling study. *Lancet Planet Health* 2018; **2:** e126–33.

8 Liu Y, Tong D, Cheng J, et al. Role of climate goals and clean-air policies on reducing future air pollution deaths in China: a modelling study. *Lancet Planet Health* 2022; **6:** e92–99.

9 Hamilton I, Kennard H, McGushin A, et al. The public health implications of the Paris Agreement: a modelling study. *Lancet Planet Health* 2021; **5:** e74–83.

10 Creutzig F, Fernandez B, Haberl H, Khosla R, Mulugetta Y, Seto KC. Beyond technology: demand-side solutions for climate change mitigation. *Annu Rev Environ Resour* 2016; **41:** 173–98.

11 Dubois G, Sovacool B, Aall C, et al. It starts at home? Climate policies targeting household consumption and behavioral decisions are key to low-carbon futures. *Energy Res Soc Sci* 2019; **52:** 144–58.

12 Campbell E, Uppalapati S, Kotcher JE, et al. Activating health professionals as climate change and health communicators and advocates: a review. *Environ Res Health* 2025; **3:** 012002.

13 Kotcher J, Patel L, Wheat S, Philipsborn R, Maibach E. How to communicate about climate change with patients. *BMJ* 2024; **385:** e079831.

14 Lehrer L, Hellmann L, Temme H, et al. Kommunikation zu Klimawandel und Gesundheit für spezifische Zielgruppen. *J Health Monit* 2023; **8:** 39–60.

15 Crowley RA. Climate change and health: a position paper of the American College of Physicians. *Ann Intern Med* 2016; **164:** 608–10.

16 Quitmann C, Griesel S, Nayna Schwerdtle P, Danquah I, Herrmann A. Climate-sensitive health counselling: a scoping review and conceptual framework. *Lancet Planet Health* 2023; **7:** e600–10.

17 Redvers N. Patient-planetary health co-benefit prescribing: emerging considerations for health policy and health professional practice. *Front Public Health* 2021; **9:** 678545.

18 Redvers N, Wright K, Hartmann-Boyce J, Tonkin-Crine S. Physicians' views of patient-planetary health co-benefit prescribing: a mixed methods systematic review. *Lancet Planet Health* 2023; **7:** e407–17.

19 Griesel S, Schwerdtle PN, Quitmann C, Danquah I, Herrmann A. Patients' perceptions of climate-sensitive health counselling in primary care: qualitative results from Germany. *Eur J Gen Pract* 2023; **29:** 2284261.

20 den Boer ACL, Teherani A, de Hoop E. Discussing climate change and other forms of global environmental change during the clinical encounter: exploring US physicians' perspectives. *J Clim Change Health* 2021; **4:** 100058.

21 Kotcher J, Maibach E, Miller J, et al. Views of health professionals on climate change and health: a multinational survey study. *Lancet Planet Health* 2021; **5:** e316–23.

22 Hantel A, Senay E, Richie C, et al. A focus group study of ethical issues during climate-informed health decision-making. *Nat Clim Chang* 2024; **14:** 1040–46.

23 André H, Gonzalez Holguera J, Depoux A, et al. Talking about climate change and environmental degradation with patients in primary care: a cross-sectional survey on knowledge, potential domains of action and points of view of general practitioners. *Int J Environ Res Public Health* 2022; **19:** 4901.

24 Alonso-Coello P, Oxman AD, Moberg J, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 2: Clinical practice guidelines. *BMJ* 2016; **353:** i2089.

25 Krippl N, Mezger NCS, Danquah I, et al. Climate-sensitive health counselling in Germany: a cross-sectional study about previous participation and preferences in the general public. *BMC Public Health* 2024; **24:** 1519.

26 Lewandowski AA, Sheffield PE, Ahdoot S, Maibach EW. Patients value climate change counseling provided by their pediatrician: the experience in one Wisconsin pediatric clinic. *J Clim Change Health* 2021; **4:** 100053.

27 Horton G, Magin P. Healthy patients, healthy planet–green recommendations for GP health promotion. *Aust Fam Physician* 2007; **36:** 1006–08.

28 Maibach E, Frumkin H, Ahdoot S. Health professionals and the climate crisis: trusted voices, essential roles. *World Med Health Policy* 2021; **13:** 137–45.

29 Müller F, Skok JI, Arnetz JE, Bouthillier MJ, Holman HT. Primary care clinicians' attitude, knowledge, and willingness to address climate change in shared decision-making. *J Am Board Fam Med* 2023.

30 Badullovich N, Grant WJ, Colvin RM. Framing climate change for effective communication: a systematic map. *Environ Res Lett* 2020; **15:** 123002.

31 Chong D, Druckman JN. Framing theory. *Annu Rev Polit Sci* 2007; **10:** 103–26.

32 Amelung D, Fischer H, Herrmann A, et al. Human health as a motivator for climate change mitigation: results from four European high-income countries. *Glob Environ Change* 2019; **57:** 101918.

33 Myers TA, Nisbet MC, Maibach EW, Leiserowitz AA. A public health frame arouses hopeful emotions about climate change. *Clim Change* 2012; **113:** 1105–12.

34   Dasandi N, Graham H, Hudson D, Jankin S, vanHeerde-Hudson J, Watts N. Positive, global, and health or environment framing bolsters public support for climate policies. *Commun Earth Environ* 2022; **3:** 239.

35   Krolewski R. Climate change mitigation and health: informing patients. *Dtsch Arztebl* 2022; **119** (in German).

36   Klee B, Costa D, Frese T, et al. To remind or not to remind during recruitment? An analysis of an online panel in Germany. *Int J Public Health* 2024; **69:** 1606770.

37   Perrault EK, Newlon JL. The effect of pharmacy setting and pharmacist communication style on patient perceptions and selection of pharmacists. *J Am Pharm Assoc (2003)* 2018; **58**(4): 404–11.

38   Faul F, Erdfelder E, Lang A-G, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods* 2007; **39:** 175–91.

39   Hornsey MJ, Harris EA, Bain PG, Fielding KS. Meta-analyses of the determinants and outcomes of belief in climate change. *Nat Clim Chang* 2016; **6:** 622–26.

40   Poortinga W, Whitmarsh L, Steg L, Böhm G, Fisher S. Climate change perceptions and their individual-level determinants: a cross-European analysis. *Glob Environ Change* 2019; **55:** 25–35.

41   Sekhon M, Cartwright M, Francis JJ. Acceptability of healthcare interventions: an overview of reviews and development of a theoretical framework. *BMC Health Serv Res* 2017; **17:** 88.

42   GESIS. ALLBUS/GGSS 2012 (Allgemeine Bevölkerungsumfrage der Sozialwissenschaften/German General Social Survey 2012). 2013. https://search.gesis.org/research_data/ZA4614 (accessed April 20, 2023).

43   Maibach EW, Leiserowitz A, Roser-Renouf C, Mertz CK, Akerlof K. Global Warming's Six Americas screening tools: survey instruments; instructions for coding and data treatment; and statistical program scripts. 2011. https://climatecommunication.yale.edu/wp-content/uploads/2016/02/2012_03_Global-Warming%E2%80%99s-Six-Americas-Screener-Manual.pdf (accessed May 23, 2023).

44   Chryst B, Marlon J, Van Der Linden S, Leiserowitz A, Maibach E, Roser-Renouf C. Global Warming's "Six Americas Short Survey": audience segmentation of climate change views using a four question instrument. *Environ Commun* 2018; **12:** 1109–22.

45   Cohen J. Statistical power analysis for the behavioral sciences, 2nd edn. New York Academic Press, 1988.

46   Willett W, Rockström J, Loken B, et al. Food in the Anthropocene: the EAT-*Lancet* Commission on healthy diets from sustainable food systems. *Lancet* 2019; **393:** 447–92.

47   Woodcock J, Edwards P, Tonne C, et al. Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. *Lancet* 2009; **374:** 1930–43.

48   Lindemer A. The costs of climate activism for medical professionals: a case study of the USA, the UK, and Germany. *Lancet Planet Health* 2023; **7:** e770–76.

49   Stevenson B, Wolfers J. Trust in public institutions over the business cycle. *Am Econ Rev* 2011; **101:** 281–87.

50   Senay E, Sarfaty M, Rice MB. Strategies for clinical discussions about climate change. *Ann Intern Med* 2021; **174:** 417–18.

51   Sarfaty M, Abouzaid S. The physician's response to climate change. *Fam Med* 2009; **41:** 358–63.

52   Schultz PW, Nolan JM, Cialdini RB, Goldstein NJ, Griskevicius V. The constructive, destructive, and reconstructive power of social norms. *Psychol Sci* 2007; **18:** 429–34.

53   Peters E, Boyd P, Cameron LD, et al. Evidence-based recommendations for communicating the impacts of climate change on health. *Transl Behav Med* 2022; **12:** 543–53.

54   Kotcher J, Feldman L, Luong KT, Wyatt J, Maibach E. Advocacy messages about climate and health are more effective when they include information about risks, solutions, and a normative appeal: evidence from a conjoint experiment. *J Clim Change Health* 2021; **3:** 3.

55   Reismann L, Weber A, Leitzmann M, Jochem C. Climate-specific health literacy and medical advice: the potential for health co-benefits and climate change mitigation. An exploratory study. *J Clim Change Health* 2021; **4:** 100072.

56   Römer J, Herrmann A, Molkentin K, Müller BS. Application of motivational interviewing in climate-sensitive health counselling–a workshop report. *Z Evid Fortbild Qual Gesundhwes* 2024; **189:** 50–54.

57   Alame D, Truog RD. How should clinicians weigh the benefits and harms of discussing politicized topics that influence their individual patients' health? *AMA J Ethics* 2017; **19:** 1174–82.

58   Zajonc RB. Attitudinal effects of mere exposure. *J Pers Soc Psychol* 1968; **9:** 1–27.

59   Lühnen J, Frese T, Mau W, et al. Public information needs and preferences on COVID-19: a cross-sectional study. *BMC Public Health* 2023; **23:** 394.