



The ethics and moral psychology of HPV vaccination: Evidence from a cross-cultural study

M. Alejandra Petino Zappala^{a,d}, Andrea Quint^a, T.N. Phuc Nguyen^{a,b},
Julia V. Schulz^a, Johannes T. Doerflinger^c, Nora C. Heinzelmann^{d,*}

^a German Cancer Research Center, Im Neuenheimer Feld 280, Heidelberg, 69120, Germany

^b Friedrich-Alexander University of Erlangen-Nuremberg, Hindenburgstraße 34, Erlangen, 91054, Germany

^c University of Freiburg, Friedrichstraße 39, Freiburg, 79098, Germany

^d Heidelberg University, Grabengasse 1, Heidelberg, 69117, Germany

ARTICLE INFO

Keywords:

Empirical ethics
Moral psychology
Vaccination
Vaccine ethics
Vaccine hesitancy
HPV
Trust

ABSTRACT

Vaccine hesitancy is a major threat to public health worldwide. Debates about vaccines are often moralized; however, how ethics and ethical judgments relate to vaccination intention remains underexplored. Here, we identify ethically relevant concerns from the academic literature that we operationalize for a pre-registered survey to study how ethical judgments relate to parents' intentions to vaccinate their children against HPV. We also investigate potential sociocultural influences on ethical judgments: we compare parents from the US, the UK, and Germany. We find that parents' ethical judgments in all countries are strongly associated with vaccination intention. We also find cross-cultural differences in how their trust in science, physicians, and institutions relates to perceived sociomoral pressure. Still, in the three countries trust moderates the negative correlation between perceived health risks and vaccination intention. These results suggest that campaigns highlighting ethical aspects of vaccination and targeting relevant moral concerns could be effective against hesitancy.

1. Introduction

Vaccine hesitancy has been named as one of the top ten threats to global health even before the COVID-19 pandemic (WHO, 2019). In many countries, vaccination rates for preventable diseases are currently far below those needed for herd immunity (WHO, 2023).

While the pandemic has undoubtedly propelled the ethics of vaccination to the forefront of public discussion, debates around this topic long predate this event. Advocates of vaccination have argued that not getting vaccinated is unethical because it imposes risks on others; from this perspective, unvaccinated individuals are free-riders who benefit from the public good of herd immunity without contributing to it (van den Hoven, 2012; Giubilini, 2019). Critics of vaccination mandates have objected that this decision is personal and prudential; therefore, penalties against the unvaccinated violate individual liberty and autonomy (Blunden, 2019). These and further moral concerns sometimes do and sometimes do not align with ethical theory.

This moralization of the public debate about vaccination may contribute to vaccine hesitancy, i.e., reluctance or refusal to have oneself

or one's children vaccinated (Rosenfeld & Tomiyamam 2022; Amin et al., 2017). Therefore, investigating the role of ethical concerns about vaccination may contribute to a better understanding of vaccine hesitancy (Datar et al., 2023; Kwok et al., 2021; Luthy et al., 2013). This is what our work aspires to. We draw on ethical theory, a set of approaches within ethics or moral philosophy (henceforth, we shall not distinguish the two), to research to what extent ethical concerns affect beliefs and vaccination intentions. For this, we operationalized possible ethically salient aspects of the decision about Human Papilloma Viruses (HPV) vaccination for empirical research. For example, since according to utilitarianism one ought to promote goodness or wellbeing, we researched whether parents believed that they were ethically required to vaccinate their children for others' benefit. We also investigated the role of personal moral values, for example worries about sexual activity, which could be relevant given the nature of HPV transmission (see below).

Our study is, to our knowledge, the first to focus on the ethics and moral psychology of hesitancy toward HPV vaccination. Coverage for this vaccine lies well below the target, even in wealthy countries: for

* Corresponding author.

E-mail addresses: petino.zappala@alumni.uni-heidelberg.de (M.A. Petino Zappala), nora.heinzelmann@uni-heidelberg.de (N.C. Heinzelmann).

<https://doi.org/10.1016/j.socscimed.2026.119374>

Received 8 July 2025; Received in revised form 30 March 2026; Accepted 4 May 2026

Available online 8 May 2026

0277-9536/© 2026 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC license (<http://creativecommons.org/licenses/by-nc/4.0/>).

example, while the WHO aims for at least 90% of 15-year-old girls to be vaccinated against HPV, rates are 62% of adolescents between 13 and 17 years old in the US (Pingali et al., 2022), 67% of 13–14 year-old girls in the UK (UK Health Security Agency, 2022), and 43% of 15 year-old girls in Germany (RKI, 2020). Furthermore, HPV vaccination is especially well suited for research into ethical concerns for at least three reasons. First, we expect that self-interest plays a subordinate role in HPV vaccination intention, as those benefiting from vaccination (children and their future sexual partners) are usually not identical to the persons deciding about it (parents, at least for regular vaccination schemes). As in these cases HPV vaccination is in others' best interests (Bayefsky, 2018), ethical reasons may be crucial for decision-making. The more prominently ethical considerations feature in parents' decision about vaccination, the stronger their intention to vaccinate is expected to be. Furthermore, those with more extreme ethical evaluations are likely more confident in their own assessments (Heinzelmann and Tran, 2022).

Second, the HPV vaccine has an unusually clear cost-benefit profile: it effectively reduces the risks of infection, precancerous lesions, and cervical and other cancers (Kombe et al., 2021), and is considered very safe, because it has no known long-term side-effects (Phillips et al., 2017). Overall, potential benefits clearly outweigh potential harms. Given any ethical theory according to which consequences matter morally—notably but not only consequentialist views—parents ethically ought to have their children vaccinated and may even be coerced to do so (Kraaijeveld et al., 2024; Field and Caplan, 2008). The more parents' views align with this outlook, the more likely they should be to intend to vaccinate. Relatedly, some ethicists have argued that an HPV vaccine mandate should be based on considerations of solidarity and health equity (Gostin, 2018; Navarro-Illana et al., 2014), which probably also applies to decisions about vaccination. If parents adopt a similar perspective, we should find that their ethical judgments about the benefits of their own and other children are positively associated with the intention to vaccinate them (Li et al., 2020).

Third, HPV vaccination may raise concerns of sexual morality, as HPV is mostly transmitted sexually. Vaccination is therefore recommended for children before they become sexually active. Conservatives may reject the vaccination for several reasons. For one thing, they may regard the vaccine as irrelevant to their own (abstinent) offspring. For another, they may view it as unethical because they might think that it encourages early sexual activity or sexual risk-taking (Casper and Carpenter, 2008; Holman et al., 2014). Assessing how worries about sexual morality affect parents' intentions to vaccinate, and how these relate to other factors, is crucial to counteract HPV vaccine hesitancy.

We conducted a pre-registered study to gain insights into how ethical judgments may affect decision-making about HPV vaccination, which can in turn inform suggestions into how to increase vaccination intention. In addition to ethical concerns, which have not yet been systematically studied, we investigated possible influences of cultural and societal norms. Ethical judgments may vary with an individual's culture and social environment. Previous work has found differences between attitudes in the US and Germany towards vaccine mandates (Sprengholz et al., 2021). Healthcare systems and how the public relate to them vary between countries; e.g., the National Health Service in the UK has historically been highly regarded (Robertson et al., 2019). Concerns that vaccination may encourage early sexual activity have been reported in parents in the US and UK (Hendry et al., 2013; Holman et al., 2014), but in Germany they have been found to be minor (Deleré et al., 2013). To assess possible influences of such sociocultural aspects on vaccination intention, we sampled in the US, the UK, and Germany (DE).

Lastly, according to the literature, vaccination intention partially depends on factors such as trust in healthcare institutions, physicians, or science (Eitze et al., 2021a,b) and knowledge about diseases and vaccination (Capasso et al., 2022). Therefore, we also investigated parents' trust in doctors, science, and national health institutions, and their (self-ascribed and actual) knowledge about HPV and HPV vaccination.

1.1. Hypotheses

All pre-registered hypotheses and materials are available on the Open Science Framework (OSF) at https://osf.io/j6vgh?view_only=df27cea8735147c5b6061bba49e70d80 (pre-registration) and https://osf.io/x6vw8/?view_only=b87219cc903149bbbc36a8c6fbaee222 (data and analysis scripts). The study was approved by the Ethics Committee of the University of Konstanz (approval 33/2018).

Ethical judgments. Our main goal was to probe whether a person's ethical judgments are associated with their vaccination intention. Using HPV vaccination as a case study, we expected that, against the claim that vaccination is entirely a personal and not an ethical choice, participants would recognize the ethical dimension of vaccination and even appreciate that ethical concerns support vaccination. As people generally tend to view their own decisions as morally good (Tappin and McKay, 2017), we hypothesized that the ethically better parents rate HPV vaccination, the greater their willingness to have their own child vaccinated (H1). We further pre-registered three hypotheses predicting that ethical judgments would align with ethical theories according to which consequences matter morally, notably consequentialism. This view takes into account the possible benefits and harms of vaccination of all parties. Particularly, moral concerns about one's own and other children's benefits would positively relate to vaccination intention. Thus, the stronger the belief that vaccinating one's own child protects others, the higher the willingness to have one's child vaccinated against HPV (H2). Similarly, the more strongly participants agree that parents are ethically required to have their children vaccinated against HPV for the children's benefit, the higher their willingness to have their own child vaccinated against HPV should be (H3). The more strongly participants believe that parents are ethically required to have their children vaccinated against HPV for others' benefit, the higher their willingness to have their own child vaccinated against HPV (H4). The more participants regard vaccination as in-line with their conscience, the higher is their willingness to have their own child vaccinated against HPV (H5). Based on previous work (AUTHORS, DATE), we hypothesized that the extremity of ethical judgments is positively associated with participants' confidence about those judgments (H6). Because some parents may be hesitant to vaccinate their child against a sexually transmitted disease due to sexual morality concerns (Bednarczyk, 2015), we expected that beliefs that HPV vaccination could prompt early sexual activity would negatively correlate with vaccination intention (H7). Furthermore, given possible moral objections to the presumed effects of the vaccination on sexual activity, we expected a negative correlation between the strength of these concerns and the ethical rating of vaccination (not pre-registered).

Trust and knowledge. We explored the role of socio-cultural factors, notably trust and knowledge, and their relation to ethical judgments. Trust has been found to positively affect vaccination intention (Capasso et al., 2022; Reinhart et al., 2022; Reuben et al., 2020); however, the mechanism for this relationship remains underexplored. Here, we hypothesized that trust is negatively correlated with perceived pressure to get vaccinated (H8) and mitigates the negative influence of perceived health risk of vaccination on the intention to vaccinate (H9).

Evidence suggests a positive relationship between knowledge about vaccination or the disease it prevents and vaccination intention (Ashkenazi et al., 2020; Eitze et al., 2021a,b). However, other studies have found that overestimation of one's knowledge of scientific matters is not uncommon (Ladwig et al., 2012) and can be associated with people's stances on these matters, possibly affecting their behaviors or opinions on policy (e.g. Motta et al., 2018; Trémoilière and Djeriouat, 2021; Canady and Larzo, 2023). Such 'illusion of knowledge' has been found to be associated with anti-vaccination attitudes and with belief in vaccination harms or conspiracy theories (Motta et al., 2018; Vranic et al., 2022). Whether this 'illusion of knowledge' is common for HPV vaccination and whether it impacts vaccination intention has not yet been evaluated. We investigated this by distinguishing between parents' actual and presumed HPV-related knowledge, i.e., how much they

believe to know, regardless of whether they actually do.

While we expected that the two were positively correlated (H10), we anticipated that they may play different roles: We hypothesized that actual rather than presumed informedness is positively related to ethical judgment (H11) and, ultimately, to vaccination intention (not pre-registered). Because a substantial amount of misinformation about vaccination is shared in social media, which may contribute to vaccine hesitancy (Kornides et al., 2023), we also tested the hypothesis that an illusion of knowledge is negatively related to intention to vaccinate in parents who have made their decision or are close to making it (H12).

Lastly, although we did not pre-register hypotheses regarding comparisons between countries, we explored whether these correlations hold in heterogeneous cultural contexts. We expected to find differences between countries for parents' perception of moral pressure and intention to vaccinate.

2. Methods

2.1. Design and participants

Our study was conducted as a cross-sectional correlation survey in Germany, the US, and the UK in English (US, UK) or German (Germany) as part of a larger study that also investigated psychological aspects of health behavior.

We recruited participants between February 7, 2023 and March 8, 2023, in the US and UK through Prolific and in Germany through Qualtrics. We opted for standard sampling, since the demographics of the particular population analyzed are unknown. However, for the US and the UK, we selected a gender-balanced sample; this was not possible for Germany. We pre-screened by two conditions: Participants were at least 18 years old, and resided in the corresponding country. The study description and the informed consent called for parents with at least one unvaccinated child between 9 and 14 years (11–14 in the UK), the age range for HPV vaccination according to national recommendations. Respondents were newly asked in the survey whether they had a child meeting these conditions. Those who did not satisfy the criteria were excluded. Other criteria of exclusion were failing two attention checks, and choosing the same value on the scales for all items, on top of quality checks implemented by the platforms.

The survey was conducted online. Respondents were reminded that answers were completely anonymous, as survey platforms assign a numeric ID to participants. Both answering privately and anonymously are thought to reduce desirability bias (Burruss and Johnson, 2021; Kreuter et al., 2008; Rickwood and Coleman-Rose, 2023), i.e. respondents adjusting their answers to social norms or to the perceived opinion of the interviewers. To avoid the latter specifically, we presented the objectives of the survey in neutral terms. Furthermore, when creating novel sets of questions (i.e. those for which no validated questionnaires were available), we provided a variety of framings and, when possible, used evaluatively neutralized items (Bäckström and Björklund, 2013).

Based on a pre-registered power analysis (available on OSF), we aimed at recruiting $N = 400$ participants per country. Due to an administrative glitch the German sample was larger. 1457 parents of 1751 unvaccinated children completed the survey. Sample sizes and demographic variables for participants after exclusion are shown in Table 1 and Supplemental file (SF) 1. Participants on Prolific were compensated with \$5.40 (US) or £4.50 (UK). Qualtrics compensated participants via their own reward system. The survey took about 30 min.

2.2. Questionnaire

Our items were part of a larger survey (see SF1 for items in the present article and OSF for the full survey). For constructs with already validated questionnaires, we adopted items from the literature. To assess ethical judgments, we created novel ones, operationalizing issues from

Table 1

Participants. Sample sizes and demographic variables for the three countries. All parents reported that they identified as either male or female excepting two non-binary participants in the US. 6 children in the US, 2 in the UK and 5 in Germany were reported by their parents as non-binary. See SF 1 for further demographic information.

		DE	US	UK
N	Parents	641	395	381
	Children	824	519	411
Age (mean, SD)	Parents	38.9, 8.7	42.2, 8.1	42.8, 8.2
% female	Parents	65.0	49.6	50.1
	Children	51.6	46.3	55.7

the ethical literature, which we refined and recalibrated through pre-tests using structured interviews. Pre-testing ensured validity—that items were understood as intended and measured what they were supposed to. It also allowed us to calibrate items to yield sufficient response variance for data analysis, avoiding ceiling and floor effects (i.e. where responses cluster in one or both extremes of the scale).

Intention to vaccinate. We measured parents' intention to vaccinate their children using three items (e.g., “I do intend to vaccinate my child/children against HPV”) from [Caso et al. \(2021\)](#) on a five-point scale from “completely disagree” to “completely agree” with an internal consistency of $\alpha_{\text{Cronbach}} = 0.98$ (DE), $\alpha_{\text{Cronbach}} = 0.97$ (US), and $\alpha_{\text{Cronbach}} = 0.97$ (UK). To estimate whether parents had already decided or were close to deciding, we asked ‘Where in the process of deciding whether to vaccinate your child against HPV do you see yourself?’ and offered a slider with a visual analogue scale coded from ‘Before the decision’ to ‘After the decision.’

Ethical judgments. For ethical judgment questions participants had the option not to respond, which led to some missing data points. Whether parents perceive vaccination decisions as ethical in nature (rather than, e.g., prudential) was measured with one item (‘Whether or not to have my child vaccinated against HPV is an ethical decision’) on a six-point scale from ‘Strongly disagree’ to ‘Strongly agree.’ The items ‘I act in accordance with my own conscience if I have my child vaccinated against HPV’ and ‘I act in accordance with my own conscience if I refuse to have my child vaccinated against HPV’ were also evaluated with six-point scales from ‘Strongly disagree’ to ‘Strongly agree.’ For the overall ethical evaluation, we used one item (‘Having my child vaccinated against HPV is ...’) with response options on a six-point scale from ‘ethically very good’ to ‘ethically very bad’ (reverse coded). To evaluate the extremity of this answer, we generated a rank variable in which strong extremity corresponds to scores of 1 or 6 on the original scale, medium extremity to 2 or 5, and low extremity to scores of 3 or 4. Confidence in ethical judgements was measured directly afterward with one item (‘How confident are you about your response?’) with a visual analogue scale coded from 0 to 100.

It should be noted that we did not provide respondents with a definition of what ‘an ethical decision’ or ‘ethically good/bad’ meant; these items were directed at assessing whether parents believed that ethical aspects, however they defined them, were relevant to HPV vaccination. However, in the following questions we evaluated specific judgments about potential harms and benefits, sexual morality, and moral pressure. Judgments about potential harms and benefits (i.e., ethically relevant consequences of vaccination) were measured with three items (corresponding to H2–4): ‘A child's vaccination against HPV protects others’, ‘For the well-being of their own child, parents are ethically obligated to have their child vaccinated against HPV’, and ‘For the well-being of others, parents are ethically obligated to have their child vaccinated against HPV.’ Concerns about early sexual activity were measured with one item (‘Vaccination of my child will prompt early sexual activity’). We assessed moral pressure with the items ‘I feel morally pressured by others to have my child vaccinated against HPV’ and ‘I feel morally pressured by others to not have my child vaccinated against HPV.’ For all these, we provided six-point Likert scales ranging from ‘strongly

disagree' to 'strongly agree.'

Trust. Trust was measured using items from [Caso et al. \(2021\)](#) on five-point scales from 'Strongly disagree' to 'Strongly agree' with three items (e.g., 'The Ministry of Health approves the vaccination program, so it is safe') for trust in healthcare institutions ($\alpha_{\text{Cronbach}} = 0.90$ (DE), $\alpha_{\text{Cronbach}} = 0.94$ (US), $\alpha_{\text{Cronbach}} = 0.92$ (UK)), five items (e.g., 'Sometimes doctors care more about what is convenient for them than about their patients' medical needs'; reverse coded) for trust in physicians ($\alpha_{\text{Cronbach}} = 0.85$ (DE), $\alpha_{\text{Cronbach}} = 0.89$ (US), $\alpha_{\text{Cronbach}} = 0.89$ (UK)), and three items (e.g., 'We should trust that scientists are being honest in their work') for trust in science ($\alpha_{\text{Cronbach}} = 0.90$ (DE), $\alpha_{\text{Cronbach}} = 0.96$ (US), $\alpha_{\text{Cronbach}} = 0.93$ (UK)).

Knowledge. We assessed factual knowledge with a validated test ([Perez et al., 2016](#)) consisting of two subscales, one for HPV-related knowledge (23 items, e.g., 'HPV can cause cervical cancer'), and one for HPV-vaccination-related knowledge (11 items, e.g., 'Someone who has had the HPV vaccine cannot develop cervical cancer') with a True/False response format. We measured assumed informedness with the item ('I am well informed about the HPV vaccination') on a six-point scale from 'Strongly disagree' to 'Strongly agree.'

Risk perception. We assessed parents' health risk perception concerning HPV vaccination using four items by [Perez et al. \(2016\)](#) with one additional item adapted from [Kim et al. \(2024\)](#): 'If your child/children got vaccinated with a HPV vaccine, what is the likelihood that your child/children suffered long-term negative health consequences from the vaccine?'. Responses were given on a seven-point scale from 'Disagree strongly' to 'Agree strongly'. The internal consistency of these items was $\alpha_{\text{Cronbach}} = 0.91$ (DE), $\alpha_{\text{Cronbach}} = 0.92$ (US), and $\alpha_{\text{Cronbach}} = 0.92$ (UK).

Mean item scores were used for all scales, except for factual knowledge, which is indicated by the sum of correct responses. We also collected sociodemographic information on parents and children ([Table 1](#) and [SF1](#)).

2.3. Analyses

All hypotheses were tested with Pearson correlation analyses (as pre-registered), except for H9 (trust moderates the relationship between perceived health risk and vaccination intention) and H12 (the 'illusion of knowledge' is negatively related to vaccination intention), which were tested using linear regression models, and H5 for which we used Spearman correlation in account of the extremity rank variable. Given that some assumptions of Pearson correlations might not be met on account of the use of discrete scales, we provide in [SF2](#) the results of non-parametric alternatives (Spearman correlation tests) and report in the text the cases in which results differ in statistical significance. To examine cross-cultural differences (exploratory, not pre-registered) we used Kruskal-Wallis tests, followed by pairwise Wilcoxon tests as post-hoc tests. The pre-registered inference criterion was $\alpha \leq 0.05$. Although corrections were not pre-registered, to acknowledge the risk of false positives due to multiple testing, we applied the Benjamini-Hochberg procedure with $Q = 0.05$ separately for the hypotheses at each country and for the country comparison.

All analyses were performed in RStudio ([RCore Team, 2023](#); [Rstudio Team, 2019](#)). With the exception of some of the pre-registered hypotheses for which non-parametric alternatives were used (see [SF2](#)), the prerequisites for the analyses were met. Deviations for normality were tolerated on account of the large sample sizes. Missing data were excluded.

2.3.1. Positionality statement

We conducted this work as part of a project aimed at increasing HPV vaccination rates. Here, we attempt to understand the reasons parents might have to vaccinate or not. While our research ultimately aims to devise strategies to increase vaccination rates and we consider HPV vaccination to be safe and effective, we also acknowledge parents'

concerns as valid. We have taken steps during the design and analysis of this study to minimize bias introduced by our stances.

3. Results

Responses to selected questionnaire items are shown in [SF1](#). For a summary of the results for all hypotheses (including those not reported here), see [SF2](#).

3.1. Descriptive findings

92% of the interviewees declared that the main decision-maker regarding their children's vaccination against HPV was either them, the other parent, or a doctor (DE: 90%, US: 95.8%, UK: 91.1%). Children were named as decision-makers in 8.9% (DE), 4.0% (US) and 8.1% (UK) of the cases. 68.1% of participants indicated intending to vaccinate their children against HPV. A Kruskal-Wallis test showed that the three countries differed ($\chi^2 = 54.7$, $p < 0.001$) in parents' intention to vaccinate, with all countries differing significantly, the US having the lowest mean rank intention score and Germany, the highest. This was reflected in the percentage of parents intending to vaccinate at least to some extent (DE: 78.3%, US: 53.0%, UK: 68.2%).

Across all countries, excluding participants who chose not to answer, 63.5% of parents at least somewhat agreed that the decision about HPV vaccination was ethical in nature (DE: 51.4%, US: 72.5%, UK: 74.5%). More specifically, 89.2% (DE: 92.0%, US: 83.6%, UK: 91.2%) rated HPV vaccination at least as ethically somewhat good. A majority of parents (77.1%) at least somewhat agreed that vaccinating their child protected others as well (DE: 81.8%, US: 73.9%, UK: 72.1%), and that vaccinating was ethically obligatory to protect one's own child (72.9%, DE: 79.2%, US: 63.9%, UK: 72.5%) and others (64.9%, DE: 71.2%, US: 56.9%, UK: 63.8%). This indicates that most parents expect vaccination to have beneficial effects for their child and others; and for most this justifies an ethical obligation to vaccinate.

3.2. Hypothesis tests

Ethical judgments. We found significant and similar correlations between ethical judgments and vaccination intention across countries ([Table 2A](#)). Parents who regarded vaccination as ethically good were more willing to vaccinate their children (H1), as were those who believed vaccinating one's children protected others (H2). Vaccination intention correlated positively with the belief that parents were ethically required to vaccinate their children to protect them (H3) and others (H4). The more parents considered vaccination to be in line with their conscience, the higher was their intention to vaccinate their children; conversely, parents who judged that not vaccinating was in-line with their conscience reported a lower intention (H5). Parents who gave more extreme ethical ratings were more confident in their rating (H6).

Sexual morality and moral pressure. Only 15% of the parents (DE: 19.8%, US: 12.3%, UK: 9.8%) believed that HPV vaccination would prompt early sexual activity in their child. Only in the US and the UK were there significant Pearson correlations between this concern and vaccination intention (H7) or the ethical rating of vaccination ([Table 2B](#)), although the correlations were also significant in Germany when using the Spearman method. Only 29.9% of parents reported perceiving at least some moral pressure from others to vaccinate their child (DE: 26.8%, US: 28.4%, UK: 37.7%), while 17.5% declared being at least somewhat pressured to *not* vaccinate (DE: 23.1%, US: 14.8%, UK: 10.2%). An intersection of these, 13.3%, reported feeling both kinds of pressure at least somewhat (DE: 16.7%, US: 9.3%, UK: 11.3%). Across countries, there were significant differences in parents' perception of moral pressure to vaccinate ($\chi^2 = 21.85$, $p < 0.001$), where the UK parents had a higher mean rank perception. No significant differences were found between DE and US. We also found no significant differences for the pressure to not vaccinate.

Table 2

A: Ethical judgments (1-6) correlations with vaccination intention. Correlation of the extremity of the ethical rating and confidence (7). Correlations of sexual morality, vaccination intention (8) and ethical rating of vaccination (9). The table shows correlation coefficients (r values); Spearman r values given in brackets when only the Spearman test is significant. **B: Sexual morality and moral pressure.** Percentages of parents who report some degree of moral pressure to vaccinate (1) or to not vaccinate (2). Correlations (r values) between perceived pressure and trust in physicians (3), science (4), and healthcare institutions (5). Spearman r values given in brackets when only the Spearman test is significant.

	DE	US	UK
A. Ethical judgments			
1. Vaccination intention correlates with ethical rating of vaccination (H1)	0.62***	0.79***	0.70***
2. Vaccination intention correlates with judgment that vaccine protects others (H2)	0.51***	0.70***	0.58***
3. Vaccination intention correlates with judgment that vaccination is ethically required to protect own child (H3)	0.44***	0.75***	0.69***
4. Vaccination intention correlates with judgment that vaccination is ethically required to protect others (H4)	0.42***	0.73***	0.60***
5. Vaccination intention correlates with vaccination being in-line with one's own conscience (H5)	0.57***	0.41***	0.39***
6. Vaccination intention correlates negatively with not vaccinating being in-line with one's own conscience (H5)	-0.26***	-0.25***	-0.24***
7. Extremity of ethical judgment correlates with confidence (H6)	0.45***	0.54***	0.67***
8. Concerns about early sexual activity correlates with vaccination intention (H7)	-0.06§ [-0.22]	-0.21***	-0.30***
9. Correlation of concern about sexual activity and ethical rating of vaccination	-0.07§ [-0.13]	-0.24***	-0.25***
B. Moral pressure and trust			
1. Percentage of parents perceiving moral pressure to vaccinate	26.8	28.3	37.7
2. Percentage of parents perceiving moral pressure to not vaccinate	23.1	14.8	10.2
3. Correlation of moral pressure and trust in physicians (H8)	-0.12*	-0.05	-0.23***
4. Correlation of moral pressure and trust in science (H8)	0.07§ [-0.14]	-0.11*§	-0.13*
5. Correlation of moral pressure and trust in healthcare institutions (H8)	-0.05§ [-0.10]	-0.01	-0.26***

*p < 0.05, **p < 0.01, ***p < 0.001, § significance differs for Spearman correlation.

Trust. As it could be expected given the differences in health systems and socio-cultural context for the three countries, we found cross-cultural variation in items regarding the trust in doctors, science and medical institutions. For example, 49.2% of parents agreed or strongly agreed with the statement that they, all in all, completely trusted their physicians, but only in Germany this was a majority position (DE: 57.8%, US: 38.2%, UK: 46.2%). While 57.8% of parents agreed or strongly agreed with the statement that they trust vaccines are safe because they are offered by their national health institution, in the US less than half had this position (DE: 60.5%, US: 48.3%, UK: 63.0%). Despite these differences, most parents (64.5%) agreed or strongly agreed with the statement that the work of scientists should be trusted, with similar values for the three countries (DE: 64.1%, US: 61.5%, UK: 68.5%). In line with [Caso et al. \(2021\)](#) and given the high internal consistency ($\alpha_{Cronbach} > 0.85$), we combined variables for the trust in doctors, science and institutions respectively.

The correlations between these and other variables differed between countries. Only in the UK did we find highly significant negative Pearson correlations between perceived pressure to vaccinate and trust in physicians, science and institutions (H8): the lower the trust, the higher the perceived pressure ([Table 2B](#)). These correlations were significant in

Germany when using the Spearman method. However, none were significant for the US.

Perceived health risks of vaccination correlated negatively to vaccination intention. However, regression models suggest this effect was moderated by trust (H9), since the interaction effects between the trust-variables and perceived risk were significant. This means that, for trusting parents, the negative relationship between perceived risk and vaccination intention was less pronounced ([Fig. 1](#); for a separate visualization and model overviews, see SF3).

Knowledge. Most parents (76.1%, DE: 76.9%, US: 72.3%, UK: 79.4%) at least rather agreed that they were well informed about the HPV vaccine, but only 19.7% (DE: 10.2%, US: 33.0%, UK: 20.1%) answered at least 75% of the questions correctly. Still, we found positive and significant correlations between how much participants knew about HPV and the vaccination and how informed they regarded themselves to be (H10, [Table 3](#)). Knowledge correlated positively in all three countries with how ethically good parents judged vaccination to be (H11). We found partial evidence that such knowledge correlates positively with vaccination intention.

Although parents mostly overestimated their own knowledge, we found no evidence that this influenced the decision to vaccinate when being at least 75% into the decision process (H12). In the regression models for vaccination intention, neither the main effects of knowledge, subjective knowledge, nor their interaction had a statistically significant effect (see SF4).

4. Discussion

The study reported here, aimed at informing possible interventions against HPV vaccine hesitancy, investigated how ethical concerns, trust, and actual and perceived knowledge relate to parents' intention to vaccinate their children against HPV. In what follows, we discuss our main results before elaborating on sociocultural aspects and limitations.

First, our findings are consistent with the hypothesis that ethical judgments affect parents' intention to vaccinate. For one thing, the ethically better parents think vaccination is, the stronger is their intention to vaccinate. Specifically, participants appear sensitive to other-regarding ethical reasons. This is evidenced by our findings that their intention to vaccinate is stronger the more they agree that vaccination protects others and that vaccination is ethically required to protect their children and others. Furthermore, the more extreme ethical ratings of vaccination, the more confident parents were about them. Taken together, this suggests a role of ethical judgment in vaccination intention.

This result is significant in two respects. Firstly, it indicates that folk morality (i.e. what laypeople judge to be right and wrong) broadly aligns with ethical theory in this specific domain: in-line with a utilitarian trade-off of harms and benefits for the affected parties, parents seem to take the benefit of their children and others into account when judging vaccination, and in their intention to vaccinate. These concerns align with ethical reasons for vaccination to promote the greater good ([Li et al., 2020](#)).

Secondly, this indicates avenues for interventions against vaccine hesitancy: making ethical reasons salient or providing ethical arguments may strengthen parents' intention to vaccinate their children against HPV. This aligns with similar findings in the experimental literature, which so far has been largely focused on the role of such arguments in acute situations like the COVID-19 pandemic: a sense of collective responsibility in medical students has been shown to increase their willingness to get vaccinated ([Betsch et al., 2018](#)) and appeals to protect others seem to motivate individuals to get vaccinated ([Dorman et al., 2021](#); [Rieger, 2020](#)). A game-theoretic experiment modeling vaccination decisions has suggested that attending to vulnerable groups may increase vaccine uptake ([Cucciniello et al., 2022](#)). Moreover, a meta-analysis of papers on COVID-19 has concluded that mentioning "the common good" and emphasizing cooperation as "the right thing to

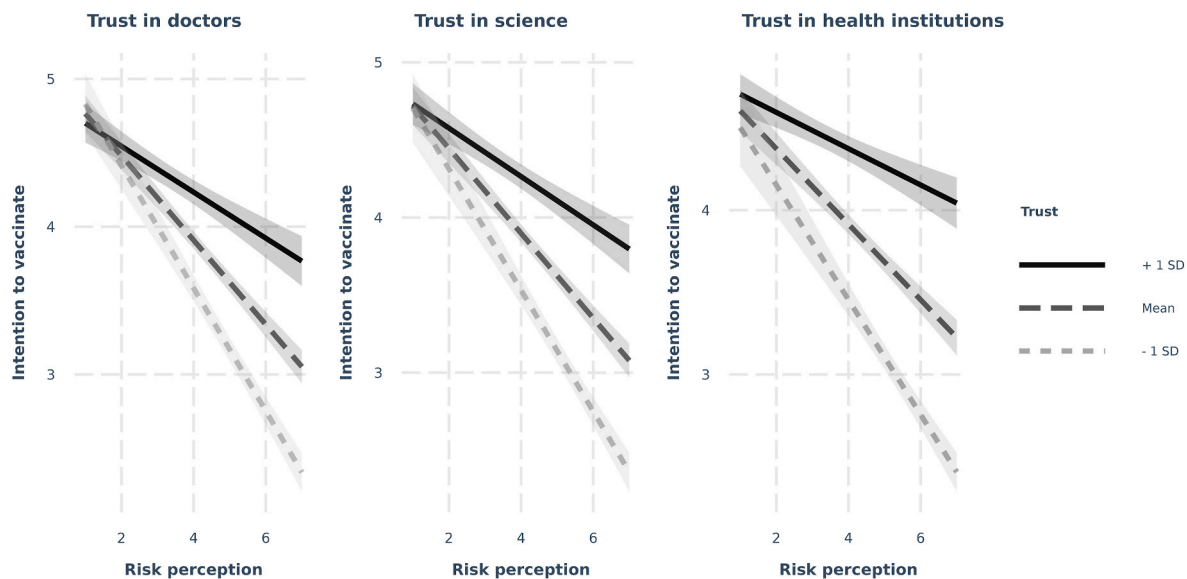


Fig. 1. Trust moderates negative relation of perceived risk and vaccination intention. Intention to vaccinate is plotted over perceived risk in parents with high (≥ 1 SD above mean), mean, or low (≤ 1 SD below mean) trust in physicians (left), science (center), and healthcare institutions (right) in all three countries.

Table 3

Knowledge. Pearson correlations between knowledge about HPV and the vaccine and perceived informedness (top row, H10), ethical judgment of HPV vaccination (middle row, H11) and vaccination intention (bottom row, not pre-registered).

Knowledge about:	DE		US		UK	
	Virus	Vaccine	Virus	Vaccine	Virus	Vaccine
& perceived informedness (H10)	0.28***	0.26***	0.24***	0.29***	0.18**	0.20**
& ethical judgment (H11)	0.10*	0.11*	0.14**	0.16**	0.27***	0.18*§
& vaccination intention	0.08*†	0.10*	0.07	0.11*	0.10	0.21***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; †: not significant after Benjamini-Hochberg correction, § significance differs for Spearman correlation.

do" can, combined with a sense of identity, improve adherence to public health recommendations (Ruggeri et al., 2023). Our findings align with these previous observations, although in the context of routine vaccination. Future interventions to increase HPV vaccination rates in children and young teenagers could, e.g., appeal to parents' sense of ethical duty towards their own and other children or spell out the harm-benefit balance of the HPV vaccination by communicating risks and potential gains of vaccination in a clear manner (Capasso et al., 2021a,b; Lewandowsky et al., 2023).

Our results also support previous findings on trust and vaccination intention, according to which mistrust in the medical profession (Douglas et al., 2019) or family physicians (Reuben et al., 2020) predict vaccine hesitancy. We replicate these results for HPV vaccination. Our data is consistent with trust moderating the relationship between perceived health risks of vaccination and vaccination intention: Perceived risks would affect intention less negatively in individuals who trust physicians, science and healthcare institutions than in those who trust less. These results hold for the three countries, which broadly differ in the characteristics of their health systems. Notably, recent literature shows variation between and within countries for trust in physicians, science, scientists, and vaccination (Sturgis et al., 2021; Yuan and Lee, 2022; Cologna et al., 2025). Although the mechanisms underlying trust might differ across countries or within a country, an aspect we did not evaluate (but see Yuan and Lee, 2022; Cologna et al., 2025), our results provide support for its importance in parents' decision-making. Targeting distrust and risk perception jointly could thus have a stronger effect than focusing on each separately. For example, discussing risk with trusted parties may mitigate the negative impact of perceived risks on vaccination intention. Our results align with recommendations to rely on trusted sources like peers or healthcare providers to combat vaccine

hesitancy (Ruggeri et al., 2023; Jolley and Douglas, 2014; Hudson and Montelpare, 2021). For instance, Ruggeri et al. (2023) found that coupling messages and examples from respected members of the community with the expectation of social approval could have large positive impacts. Sturgis et al. (2021) also highlight the role of social norms and social pressure, as confidence in vaccines would be determined both by a high aggregate level of trust in science and scientists, and by the social consensus on such trust. Furthermore, given the apparent weight of ideas about harm and protection on parents' considerations regarding vaccines, it is likely that trust is associated with their ethical stances on vaccination. If so, interventions targeting distrust should concomitantly increase parents' ethical ratings of vaccines.

Third, our findings put the role of knowledge in perspective. We found positive, significant correlations between knowledge about HPV vaccination and vaccination intention. For the German sample, we also found a significant correlation for knowledge about HPV. However, these correlations were weaker than those for ethical judgments and intention. Our results also show no evidence that an 'illusion of knowledge' is statistically associated with lower willingness to vaccinate. In addition, although only about 20% of parents answered at least 75% of questions about HPV and HPV vaccination correctly, most of them regarded themselves as well informed. Parents might feel this way because they believe that they already have *sufficient* information. In other words, parents may believe that they have sufficient reason to opt in for or against vaccination and need not know more to make a decision. Taken together, these results indicate that information campaigns could be less effective against hesitancy than previously thought (Betsch and Wicker, 2012). Campaigns targeting ethical aspects of vaccination may be more effective. In particular, interventions may target ethically relevant considerations or empower individuals to take

action on their ethical views. For example, instead of focusing on facts about HPV and the vaccine, materials could visualize harms and benefits to improve ethical trade-offs (Schnepf et al., 2021).

Fourth, an individual's ethical judgments are likely related to their culture and social environment. For example, although German parents were the most likely to believe that vaccination can lead to early sexual activity, these concerns correlated less strongly with their ethical rating of vaccination than in the US and the UK. We also found cross-cultural differences for the perception of moral pressure. In the UK, more parents tended to report pressure to vaccinate their kids than in the other two countries. Furthermore, in the UK and Germany, but not in the US, this perceived pressure to vaccinate correlated negatively with trust in physicians and institutions, with the associations in the UK being stronger in magnitude. The lower the trust, the higher was the perceived pressure to vaccinate one's child. These discrepancies might stem from different prevailing social and cultural norms, health systems, and sociopolitical context, although sampling biases cannot be discounted.

Together, these findings favor interventions tailored to the cultural-specific ethical outlook of sub-groups rather than general populations (Schnepf et al., 2021). Strategies like moral reframing, in which arguments align with a person's moral values (Feinberg and Willer, 2019) can be useful where discrepancies in moral values generate group-specific resistance to policy. In particular, appeals to the duty towards one's own child could be combined with messages targeting the prominent moral values of different groups. For example, Graham et al. (2009) suggest framing discussions about policy in terms of fairness for more liberal parents and in terms of purity and protection of one's own group for more conservative parents. In addition, targeted policy measures could counteract systemic racism and discrimination against minorities and vulnerable groups (Mithani et al., 2021; Sabatello et al., 2020, 2021).

The main limitations of our study mainly concern issues arising from our design. First, our survey approach allowed for correlational findings only, precluding us to reach conclusions on causality. Further intervention studies should corroborate both whether these associations hold and whether vaccination intention is improved by addressing ethical considerations, health risks assessment and trust. At the same time, we should note that our study itself might constitute an intervention, as it may raise awareness of HPV and the vaccine in participants that had not yet considered the issue.

Furthermore, we conducted our survey online in three so-called WEIRD (Western, educated, industrialized, rich, democratic) countries. Moreover, sampling biases cannot be discounted: Respondents voluntarily joined the platforms, chose to complete the survey, and were financially rewarded. It remains an open question whether our findings generalize to the general public in these and other countries. To this end, future surveys offline and in non-WEIRD countries are required.

Lastly, although our results are informative for vaccination of children and teenagers, where often parents or doctors are the main decision-makers, vaccination in young adults (including catch-up schemes) likely involves a different profile of considerations. Our findings might not equally apply when self-interest is the main driver of vaccination.

However, our main findings on the connection between ethical judgments about vaccination and vaccination intention are remarkably robust. We used various items to measure ethical judgments and sampled three different populations with similar results. We may thus build on this study into the ethics and moral psychology of vaccination for future research. Ultimately, we hope to have provided preliminary evidence that will be useful for successful interventions to increase vaccination rates, reduce the circulation of HPV and the incidence of HPV-related cancers.

Ethical approval

This study was approved by the Ethics Committee of the University

of Konstanz (approval 33/2018).

Funding

This work was supported by Deutsche Krebshilfe (grant number 70114357).

CRediT authorship contribution statement

M. Alejandra Petino Zappala: Conceptualization, Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Andrea Quint:** Data curation, Formal analysis, Investigation, Writing – review & editing. **T.N. Phuc Nguyen:** Investigation, Writing – review & editing. **Julia V. Schulz:** Data curation, Investigation, Writing – review & editing. **Johannes T. Doerflinger:** Funding acquisition, Investigation, Writing – review & editing. **Nora C. Heinzelmann:** Conceptualization, Funding acquisition, Investigation, Project administration, Supervision, Writing – original draft, Writing – review & editing.

Declaration of interest statement

The authors report there are no competing interests to declare.

Acknowledgments

We thank Anja Köngeter for her support during the early stages of this project. We thank the team of the “E-health = Better health?” project Gabriele Oettingen, Peter Gollwitzer, Katrin Platzer, and Frank Rösl. We thank Matthew Liao and Daniel Fogal for reading this text and providing wonderful comments and feedback on how to improve the manuscript. We thank two anonymous reviewers for having engaged with our analysis and for pointing out ways to improve it. We also thank the members of the Empirical Bioethics Working Group and Xphi UK, and the participants of the 2023 meeting of the European Society for Philosophy and Psychology, the 2024 meeting of the Society for Philosophy of Science in Practice, and the 2023 German Cancer Research Congress, for their comments and suggestions on our presentations of this work.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2026.119374>.

Data availability

The datasets and code used in the analyses are openly available in OSF at https://osf.io/x6vw8/?view_only=b87219cc903149bbbc36a8c6fbaee222.

References

- Amin, A.B., Bednarczyk, R.A., Ray, C.E., Melchiori, K.J., Graham, J., Huntsinger, J.R., Omer, S.B., 2017. Association of moral values with vaccine hesitancy. *Nat. Hum. Behav.* 1 (12), 873–880.
- Ashkenazi, S., Livni, G., Klein, A., Kremer, N., Havlin, A., Berkowitz, O., 2020. The relationship between parental source of information and knowledge about measles/measles vaccine and vaccine hesitancy. *Vaccine* 38 (46), 7292–7298.
- Bayefsky, M.J., 2018. The ethical case for mandating HPV vaccination. *J. Law Med. Ethics* 46 (2), 501–510.
- Bäckström, M., Björklund, F., 2013. Social desirability in personality inventories: symptoms, diagnosis and prescribed cure. *Scand. J. Psychol.* 54 (2), 152–159.
- Bednarczyk, R.A., 2015. Human papillomavirus vaccine and sexual activity: how do we best address parent and physician concerns? *JAMA Intern. Med.* 175 (4), 624–625.
- Betsch, C., Schmid, P., Heinemeier, D., Korn, L., Holtmann, C., Böhm, R., 2018. Beyond confidence: development of a measure assessing the 5C psychological antecedents of vaccination. *PLoS One* 13 (12), e0208601.
- Betsch, C., Wicker, S., 2012. E-health use, vaccination knowledge and perception of own risk: drivers of vaccination uptake in medical students. *Vaccine* 30 (6), 1143–1148.

- Blunden, C.T., 2019. Libertarianism and collective action: is there a libertarian case for mandatory vaccination? *J. Med. Ethics* 45 (1), 71–74.
- Burruss, G.W., Johnson, A., 2021. Online survey research. The encyclopedia of research methods in criminology and criminal justice 1, 104–107.
- Canady, B.E., Larzo, M., 2023. Overconfidence in managing health concerns: the dunning–kruger effect and health literacy. *J. Clin. Psychol. Med. Settings* 30 (2), 460–468.
- Capasso, M., Caso, D., Conner, M., 2021a. Anticipating pride or regret? Effects of anticipated affect focused persuasive messages on intention to get vaccinated against COVID-19. *Soc. Sci. Med.* 289, 114416.
- Capasso, M., Caso, D., Fabbicatore, R., Conner, M., 2021b. Understanding the psychosocial determinants of Italian parents' intentions not to vaccinate their children: an extended theory of planned behaviour model. *Psychol. Health* 37 (9), 1111–1131.
- Capasso, M., Caso, D., Zimet, G.D., 2022. The mediating roles of attitude toward COVID-19 vaccination, trust in science and trust in government in the relationship between anti-vaccine conspiracy beliefs and vaccination intention. *Front. Psychol.* 13, 932064.
- Caso, D., Capasso, M., Fabbicatore, R., Conner, M., 2021. Understanding the psychosocial determinants of Italian parents' intentions not to vaccinate their children: an extended theory of planned behaviour model. *Psychol. Health* 37 (9), 1111–1131.
- Casper, M.J., Carpenter, L.M., 2008. Sex, drugs, and politics: the HPV vaccine for cervical cancer. *Sociol. Health Illness* 30 (6), 886–899.
- Cologna, V., Mede, N.G., Berger, S., Besley, J., Brick, C., Joubert, M., et al., 2025. Trust in scientists and their role in society across 68 countries. *Nat. Hum. Behav.* 9 (4), 713–730.
- Cucciniello, M., Pin, P., Imre, B., Porumbescu, G.A., Melegaro, A., 2022. Altruism and vaccination intentions: evidence from behavioral experiments. *Soc. Sci. Med.* 292, 114195.
- Datar, R.S., Fette, L.M., Hinkelman, A.N., Hammershaimb, E.A., Friedman-Klabanoff, D. J., Mongraw-Chaffin, M., Sauer, L.M., Labrique, A.B., Marsolo, K.A., Evans, M.D., 2023. Factors associated with COVID-19 vaccination during June–October 2021: a multi-site prospective study. *Vaccine* 41 (20), 3204–3214.
- Deleré, Y., Böhrer, M.M., Walter, D., Wichmann, O., 2013. HPV vaccination coverage among women aged 18–20 years in Germany three years after recommendation of HPV vaccination for adolescent girls: results from a cross-sectional survey. *Hum. Vaccines Immunother.* 9 (8), 1706–1711.
- Dorman, C., Perera, A., Condon, C., Chau, C., Qian, J., Kalk, K., Gorfinkel, I., 2021. Factors associated with willingness to be vaccinated against COVID-19 in a large convenience sample. *J. Community Health* 46 (5), 1013–1019.
- Douglas, K.M., Uscinski, J.E., Sutton, R.M., Cichocka, A., Nefes, T.S., Ang, C.S., Deravi, F., 2019. Understanding conspiracy theories. *Polit. Psychol.* 40 (S1), 3–35.
- Eitze, S., Felgendreiff, L., Korn, L., Sprengholz, P., Allen, J., Jenny, M.A., Fauser, D., Sprengholz, L., Betsch, C., 2021a. Vertrauen der Bevölkerung in staatliche Institutionen im ersten Halbjahr der Coronapandemie. *Bundesgesundheitsblatt - Gesundheitsforsch. - Gesundheitsschutz* 64 (3), 268–276.
- Eitze, S., Heinemeier, D., Schmid-Küpke, N.K., Betsch, C., 2021b. Decreasing vaccine hesitancy with extended health knowledge: evidence from a longitudinal randomized controlled trial. *Health Psychol.* 40 (2), 77–88.
- Feinberg, M., Willer, R., 2019. Moral reframing: a technique for effective and persuasive communication across political divides. *Soc. Personal. Psychol. Compass* 13 (12), e12501.
- Field, R.L., Caplan, A.L., 2008. A proposed ethical framework for vaccine mandates: competing values and the case of HPV. *Kennedy Inst. Ethics J.* 18 (2), 111–124.
- Giubilini, A., 2019. The Ethics of Vaccination. Palgrave Macmillan.
- Gostin, L.O., 2018. HPV vaccination: a public good and a health imperative. *J. Law Med. Ethics* 46 (2), 511–513.
- Graham, J., Haidt, J., Nosek, B.A., 2009. Liberals and conservatives rely on different sets of moral foundations. *J. Personality Soc. Psychol.* 96 (5), 1029–1046.
- Heinzelmann, N., Tran, V., 2022. Extremists are more confident. *Erkenntnis* 89 (5), 2031–2056.
- Hendry, M., Lewis, R., Clements, A., Damery, S., Wilkinson, C., 2013. “HPV? Never heard of it!”: a systematic review of girls' and parents' information needs, views and preferences about human papillomavirus vaccination. *Vaccine* 31 (45), S152–S167.
- Holman, D.M., Benard, V., Roland, K.B., Watson, M., Liddon, N., Stokley, S., 2014. Barriers to human papillomavirus vaccination among US adolescents: a systematic review of the literature. *JAMA Pediatr.* 168 (1), 76–82.
- Hudson, A., Montelpare, W.J., 2021. Predictors of vaccine hesitancy: implications for COVID-19 public health messaging. *Int. J. Environ. Res. Publ. Health* 18 (15), 8054.
- Jolley, D., Douglas, K.M., 2014. The effects of anti-vaccine conspiracy theories on vaccination intentions. *PLoS One* 9 (2), e89177.
- Kim, S., Gollwitzer, P.M., Oettingen, G., 2024. Mental contrasting of a negative future facilitates COVID-19 preventative behaviors: two randomized controlled trials. *Psychol. Health* 39 (1), 1–23.
- Kombe, A.J.K., Li, B., Zahid, A., Mengist, H.M., Bounda, G.-A., Zhou, Y., Jin, T., 2021. Epidemiology and burden of human papillomavirus and related diseases, molecular pathogenesis, and vaccine evaluation. *Front. Public Health* 8, 552028.
- Kornides, M.L., Badlis, S., Head, K.J., Putt, M., Cappella, J., Gonzalez-Hernandez, G., 2023. Exploring content of misinformation about HPV vaccine on Twitter. *J. Behav. Med.* 46 (1), 239–252.
- Kraaijeveld, S.R., Gur-Arie, R., Jamrozik, E., 2024. A scalar approach to vaccination ethics. *J. Ethics* 28 (1), 145–169.
- Kreuter, F., Presser, S., Tourangeau, R., 2008. Social desirability bias in CATI, IVR, and web surveys: the effects of mode and question sensitivity. *Public Opin. Q.* 72 (5), 847–865.
- Kwok, K.O., Li, K.K., Wei, W.I., Tang, A., Wong, S.Y.S., Lee, S.S., 2021. Influenza vaccine uptake, COVID-19 vaccination intention and vaccine hesitancy among nurses: a survey. *Int. J. Nurs. Stud.* 114, 103854.
- Ladwig, P., Dalrymple, K.E., Brossard, D., Scheufele, D.A., Corley, E.A., 2012. Perceived familiarity or factual knowledge? Comparing operationalizations of scientific understanding. *Sci. Publ. Pol.* 39 (6), 761–774.
- Lewandowsky, S., Schmid, P., Habersaat, K.B., Nielsen, S.M., Seale, H., Betsch, C., Cook, J., Eitze, S., Kritzing, S., Larson, H., Okullo, D., Pachur, T., Pickles, M., Rossmann, C., Söderberg, E., 2023. Lessons from COVID-19 for behavioural and communication interventions to enhance vaccine uptake. *Communications Psychology* 1, 35.
- Li, H.-L., Jecker, N.S., Chung, R.Y.-N., 2020. Reopening economies during the COVID-19 pandemic: reasoning about value tradeoffs. *Am. J. Bioeth.* 20 (7), 136–138.
- Luthy, K.E., Beckstrand, R.L., Meyers, C.J., 2013. Common perceptions of parents requesting personal exemption from vaccination. *J. Sch. Nurs.* 29 (2), 95–103.
- Mithani, Z., Cooper, J., Boyd, J.W., 2021. Race, power, and COVID-19: a call for advocacy within bioethics. *Am. J. Bioeth.* 21 (2), 11–18.
- Motta, M., Callaghan, T., Sylvester, S., 2018. Knowing less but presuming more: dunning-kruger effects and the endorsement of anti-vaccine policy attitudes. *Soc. Sci. Med.* 211, 274–281.
- Navarro-Illana, P., Diez-Domingo, J., Navarro-Illana, E., Tuells, J., Alemán, S., Puig-Barberá, J., 2014. Knowledge and attitudes of Spanish adolescent girls towards human papillomavirus infection: where to intervene to improve vaccination coverage. *BMC Public Health* 14, 490.
- Perez, S., Tatar, O., Ostini, R., Shapiro, G.K., Waller, J., Zimet, G., Rosberger, Z., 2016. Extending and validating a human papillomavirus (HPV) knowledge measure in a national sample of Canadian parents of boys. *Prev. Med.* 91, 43–49.
- Phillips, A., Patel, C., Pillsbury, A., Brotherton, J., Macartney, K., 2017. Safety of human papillomavirus vaccines: an updated review. *Drug Saf.* 41 (4), 329–346.
- Pingali, C., Yankey, D., Elam-Evans, L.D., Markowitz, L.E., Valier, M.R., Fredua, B., Crowe, S.J., DeSisto, C.L., Stokley, S., Singleton, J.A., 2022. National vaccination coverage among adolescents aged 13–17 years — national immunization survey—teen, United States, 2021. *MMWR (Morb. Mortal. Wkly. Rep.)* 71 (35), 1101–1108.
- RCore Team, 2023. R: a Language and Environment for Statistical Computing. R Foundation for Statistical Computing.
- Reinhart, A.M., Tian, Y., Lilly, A.E., 2022. The role of trust in COVID-19 vaccine hesitancy and acceptance among black and white Americans. *Vaccine* 40 (50), 7247–7254.
- Reuben, R., Aitken, D., Freedman, J., Einstein, G., 2020. Mistrust of the medical profession and higher disgust sensitivity predict parental vaccine hesitancy. *PLoS One* 15 (9), e0237755.
- Rickwood, D.J., Coleman-Rose, C.L., 2023. The effect of survey administration mode on youth mental health measures: social desirability bias and sensitive questions. *Heliyon* 9 (9), e20131.
- Rieger, M.O., 2020. Triggering altruism increases the willingness to get vaccinated against COVID-19. *Social Health and Behavior* 3 (3), 78–82.
- RKI (Robert Koch-Institut), 2020. *Epidemiol. Bull.* 32–33. https://www.rki.de/DE/Content/Infekt/EpidBull/Archiv/2020/Ausgaben/32-33_20.pdf.
- Robertson, R., Appleby, J., Hemmings, N., Evans, H., 2019. Public Satisfaction with the NHS and Social Care in 2018: Results and Trends from the British Social Attitudes Survey. The King's Fund. <https://www.kingsfund.org.uk/insight-and-analysis/reports/public-satisfaction-nhs-social-care-2018>.
- Rosenfeld, D.L., Tomiyama, A.J., 2022. Jab my arm, not my morality: perceived moral reproach as a barrier to COVID-19 vaccine uptake. *Soc. Sci. Med.* 294, 114699.
- RStudio Team, 2019. Rstudio: Integrated Development for R. Rstudio, PBC.
- Ruggeri, K., Stock, F., Haslam, S.A., Capraro, V., Boggio, P., Ellemers, N., Cichocka, A., Douglas, K.M., Rand, D.G., van der Linden, S., Jetten, J., Wilks, D.C., Alparone, F.R., Azevedo, F., Bak, M., Balazs, B.A., Banai, I.P., Bender, V.S., Bergeron, K.E., et al., 2023. A synthesis of evidence for policy from behavioural science during COVID-19. *Nature* 623 (7985), 1–14.
- Sabatello, M., Jackson Scroggins, M., Goto, G., Santiago, A., McCormick, A., Morris, K.J., Daulton, C.R., Darien, G., 2021. Structural racism in the COVID-19 pandemic: moving forward. *Am. J. Bioeth.* 21 (3), 56–74.
- Sabatello, M., Landes, S.D., McDonald, K.E., 2020. People with disabilities in COVID-19: fixing our priorities. *Am. J. Bioeth.* 20 (7), 187–190.
- Schnepf, J., Lux, A., Jin, Z., Formanowicz, M., 2021. Left out — feelings of social exclusion incite individuals with high conspiracy mentality to reject complex scientific messages. *J. Lang. Soc. Psychol.* 40 (5–6), 627–652.
- Sprengholz, P., Betsch, C., Böhm, R., 2021. Reactance revisited: consequences of mandatory and scarce vaccination in the case of COVID-19. *Appl. Psychol.: Health and Well-Being* 13 (4), 986–995.
- Sturgis, P., Brunton-Smith, I., Jackson, J., 2021. Trust in science, social consensus and vaccine confidence. *Nat. Hum. Behav.* 5 (11), 1528–1534.
- Tappin, B.M., McKay, R.T., 2017. The illusion of moral superiority. *Soc. Psychol. Personal. Sci.* 8 (6), 623–631.
- Trémolière, B., Djeriouat, H., 2021. Exploring the roles of analytic cognitive style, climate science literacy, illusion of knowledge, and political orientation in climate change skepticism. *J. Environ. Psychol.* 74, 101561.
- UK Health Security Agency, 2022. Human papillomavirus (HPV) vaccination coverage in adolescents in England: 2021 to 2022. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1126762/hpr1322-HPV2.pdf.
- Van den Hoven, M., 2012. Why one should do one's bit: thinking about free riding in the context of public health ethics. *Public Health Ethics* 5 (2), 154–160.

- Vranic, A., Hromatko, I., Tonković, M., 2022. “I did my own research”: overconfidence, (dis)trust in science, and endorsement of conspiracy theories. *Front. Psychol.* 13, 931865.
- World Health Organization, 2019. Ten threats to global health in 2019. <https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019>.
- World Health Organization, 2023. Cervical cancer. <https://www.who.int/news-room/fact-sheets/detail/cervical-cancer>.
- Yuan, Y., Lee, K.S., 2022. General trust in the health care system and general trust in physicians: a multilevel analysis of 30 countries. *Int. J. Comp. Sociol.* 63 (3), 91–104.