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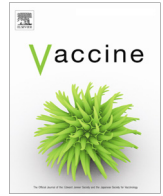
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## Review

# The benefit of the doubt or doubts over benefits? A systematic literature review of perceived risks of vaccines in European populations



Emilie Karafillakis<sup>a</sup>, Heidi J. Larson<sup>a,b,\*</sup>, On behalf of the ADVANCE consortium

<sup>a</sup> Vaccine Confidence Project, London School of Hygiene & Tropical medicine, London, United Kingdom

<sup>b</sup> Department of Global Health, University of Washington, Seattle, USA

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## ABSTRACT

**Objectives:** The success of vaccination strategies depends in part on population perceptions of benefits and risks of vaccines and related confidence in vaccination. Better knowledge of public concerns about vaccines and what is driving them is needed to inform vaccination strategies and communications. This literature reviewer examined studies on vaccine and vaccination risk perceptions and concerns across European populations.

**Methods:** A systematic literature review was conducted to identify studies published between 2004 and 2014 in Europe. A descriptive analysis was performed.

**Findings:** A total of 145 articles were selected, most of which were conducted in the UK, the Netherlands and France and studied seasonal influenza, HPV and pandemic influenza vaccination. Across all countries and vaccines, the primary area of concern was vaccine safety, followed by perceptions of low likelihood of contracting vaccine-preventable diseases (VPDs), perceived low severity of VPDs, beliefs that vaccines do not work, and overall lack of information. Concerns were found to be vaccine-, country- and population-specific.

**Conclusion:** In addition to identifying concerns about vaccination in Europe, this study confirmed the notion that individuals have many safety concerns about vaccination and often believe that the risks of vaccination outweigh their benefits. More research needs to be conducted to explore the impact of different types of communication strategies, which would frame the benefits of vaccination as well as risks of not vaccinating. Strategies to better inform public perceptions of vaccines should include the provision of unbiased, comprehensive information tailored to population information needs, and delivered using multiple and new communication technologies such as social media.

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\* Corresponding author at: Keppel Street, London WC1E 7HT, United Kingdom.

E-mail address: [heidi.larson@lshtm.ac.uk](mailto:heidi.larson@lshtm.ac.uk) (H.J. Larson).

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## 1. Introduction

Ever since the development of the first vaccines, individuals have raised concerns about the risks of vaccination [1]. Studies have tried to explain refusals or delays in vaccination as a consequence of imbalance between perception of the risks and benefits of vaccination: individuals weighing risks of vaccination higher than its benefits will tend to refuse or delay some or all vaccines [2–4].

As risks and benefits lack a common unit of assessment, they cannot easily be compared [5]. Furthermore, individuals have been shown to assess vaccination risks compared to other risks (i.e. diseases) differently than experts. Rather than mathematically weighing risks and benefits at the population level, individuals often rely on information consisting of individual stories and narratives which influence fear and uncertainties [6]. Parents will, for instance, think about the risks of vaccinating their children against risks of suffering from vaccine preventable diseases (VPDs) and will make a decision in favour of what they perceive as the “least risky option”.

Risk perception has been defined as the “*perceived vulnerability or likelihood of harm if no action is taken and perceived severity or seriousness of the consequences if harm was to occur*” [7]. Concerns about the risks of vaccination are known to be vaccine-specific and have been shown to vary across countries and population groups [8]. Responses to address these concerns should therefore take into account a comprehensive understanding of perceived vaccination risks as well as scientifically calculated ones. Previous systematic reviews have studied determinants of vaccine hesitancy, and reasons for refusing vaccinating, but few have focused on risk perceptions in relation to the benefits of vaccination and individual assessment of the risk-benefit balance. The aim of this study is to review all available research published between 2004 and 2014 on vaccination risk perceptions across Europe.

This study is part of the “Accelerated development of vaccine benefit-risk collaboration in Europe” (ADVANCE) project, which aims to establish a system that rapidly provides best available scientific evidence on vaccines benefits and risks.

## 2. Methods

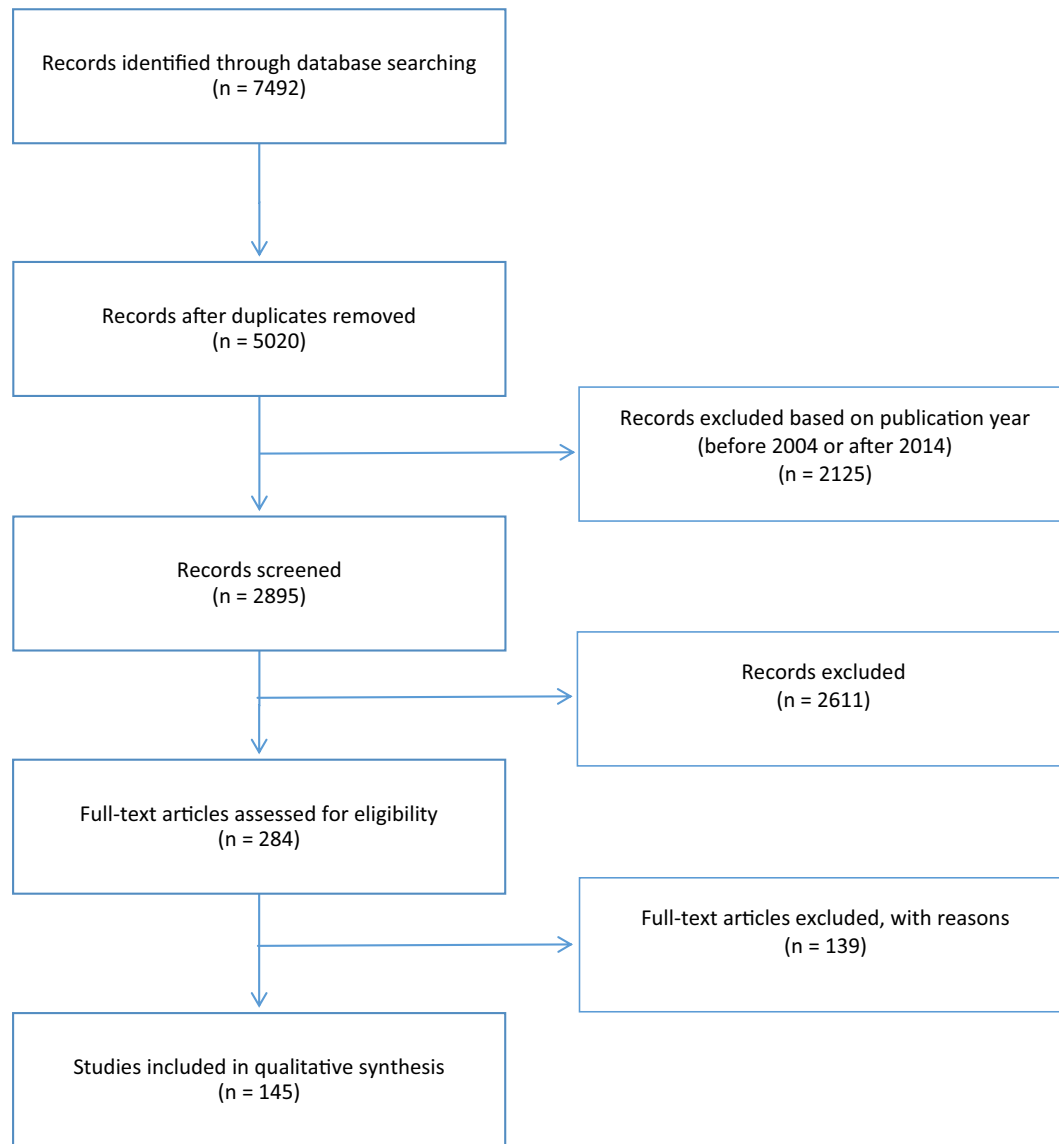
The search strategy for the systematic literature review was developed in the OVID Medline database by multiple reviewers (Table 1). Keywords were selected in an effort to capture perceptions of risks, as well as confidence and/or hesitancy in vaccination. The search aimed to identify studies published in English, French, or Spanish from January 2004 to November 2014, from any of the 28 countries of the European Union as well as Norway, Iceland, Liechtenstein, and Switzerland. It was performed in November 2014, across OVID Medline, Embase, and Global Health, as well as Scopus, Web of Science, and Open Grey.

Articles were imported into Endnote X7 (Thomson Reuters) to remove duplicates, screen, and sort articles. Exclusion and inclusion criteria were developed by multiple reviewers to facilitate consistent screening of articles by titles and abstracts, done by a single reviewer. Articles were included if they studied vaccine risk perceptions or concerns, vaccine confidence and/or hesitancy, public trust in vaccines, and general attitudes or beliefs about vaccination. There were no restrictions on study populations and types of vaccines (apart from animal vaccines or vaccines not yet available). The following were excluded: experimental studies, serologic investigations, efficacy and safety trials, immunogenicity studies, pre-clinical trials, cost-effectiveness or cost-benefit studies, editorials, commentaries, conference abstracts, letters, and literature or systematic reviews. Finally, articles focusing only on participants' knowledge, reasons for getting vaccinated, socio-economic determinants (i.e. age, level of income, education level), or interventions to increase vaccination coverage were excluded if they did not include results about risks, perceptions, beliefs, hesitancy, confidence, or trust in vaccines.

No meta-analysis was performed due to the substantial heterogeneity of studies. Data (study population, country, setting, vaccines, year of publication, method, and concerns) was extracted into a Microsoft Excel spreadsheet and a descriptive analysis of concerns, beliefs and perceptions about vaccines was undertaken instead. In order to combine and compare results across quantitative and qualitative studies, the frequency of concerns

**Table 1**  
Search strategy developed on Medline OVID.

1	((vaccin\$ or immunis\$ or immuniz\$) adj5 (anxiety or attitude\$ or awareness or behavior\$ or belief\$ or criticis\$ or doubt\$ or distrust or dropout\$ or exemption\$ or fear\$ or hesitanc\$ or trust or mistrust or perception\$ or refus\$5 or rejection or rumo?r\$ or intent\$5 or controvers\$ or misconception\$ or misinformation or opposition or delay or dilemma\$ or objector\$ or resist\$ or sceptic\$)).ti,ab
2	((vaccin\$ or immunis\$ or immuniz\$) adj3 (uptake or barrier\$ or choice\$ or mandatory or compulsory or concern\$ or accepta\$ or knowledge or parent\$ con\$)).ti,ab
3	((vaccin\$ or immunis\$ or immuniz\$) adj5 confidence) not confidence interval).ti,ab
4	((vaccin\$ or immunis\$ or immuniz\$) adj5 decision making).ti,ab
5	((vaccin\$ or immunis\$ or immuniz\$) and (anti-vaccin\$ or antivaccin\$)).ti,ab
6	1 or 2 or 3 or 4 or 5
7	exp vaccination/ or Vaccines/ or Mass Vaccination/ or Immunization/ or exp Immunization Programmes/
8	Public Opinion/ or Attitude to Health/ or Attitude/ or Health Knowledge, Attitudes, Practice/ or “Patient acceptance of health care”/ or Treatment Refusal/ or Parental Consent/ or Decision Making/ or Prejudice/ or Internet/
9	7 and 8
10	6 or 9
11	limit 10 to humans
12	europa/ or exp austria/ or exp belgium/ or exp estonia/ or exp latvia/ or exp lithuania/ or exp bulgaria/ or exp croatia/ or exp czech republic/ or exp hungary/ or exp poland/ or exp romania/ or exp slovakia/ or exp slovenia/ or exp finland/ or exp france/ or exp germany/ or exp greece/ or exp iceland/ or exp ireland/ or exp italy/ or exp liechtenstein/ or exp luxembourg/ or exp cyprus/ or exp malta/ or exp portugal/ or exp denmark/ or exp norway/ or exp sweden/ or exp spain/ or exp switzerland/ or exp great Britain/ or mediterranean region/ or mediterranean islands/ or netherlands/ or scandinavia/ or exp European Union/
13	11 and 12



**Fig. 1.** Selection of articles (PRISMA chart).

was calculated by adding the number of qualitative studies where specific concerns were mentioned to the number of quantitative studies where more than 20% of participants selected those concerns. Although no theoretical framework was used to analyse the results, the SAGE model of determinants of vaccine hesitancy was used to guide the design of the search strategy, inclusion and exclusion criteria, and data extraction and analysis [8].

### 3. Results

The search generated 2895 unique articles, from which 145 were selected for analysis (Fig. 1). Table 2 provides an overview of articles included by country, population, and vaccine(s) studied. The majority of articles included were from the United Kingdom (35.2%), the Netherlands (11.7%), France (11.7%), Germany (8.3%), Greece (7.6%), and Sweden (6.2%). They mostly studied vaccines against seasonal influenza, human papillomavirus (HPV), pandemic influenza, measles-mumps-rubella (MMR) and childhood VPDs in general. Finally, articles commonly studied healthcare workers (HCWs), parents, adults, and individuals at high risk of VPDs, including the elderly and patients with chronic illnesses such as inflammatory bowel disease or systemic sclerosis.

Across all articles, the most common beliefs related to balancing risks of vaccination to non-vaccination were about vaccine safety ( $n = 107/145$  articles) and the perceived low risk of contracting VPDs ( $n = 51/145$ ). Other important perceptions included beliefs that VPDs are not dangerous ( $n = 36/145$ ), vaccines do not work ( $n = 32/145$ ), vaccines are not needed ( $n = 24/145$ ), adults or children were healthy enough not to need vaccination ( $n = 20/145$ ), not enough evidence or adequate testing of vaccines ( $n = 21/145$ ), no recommendation to take the vaccine ( $n = 20/145$ ) or a lack of information about vaccines and/or VPDs ( $n = 31/145$ ). All concerns are listed in Fig. 2 and Figs. 3–5 provide an overview of the number of studies with the five most important concerns by country, population groups and vaccines. Concerns were analysed in more depth for specific vaccines. Articles looking at different vaccines without providing data on each vaccine separately [9–16] and vaccines for which there were only a handful of articles available [17–26] were excluded from the in depth analysis.

#### 3.1. Seasonal influenza vaccines

The majority of studies ( $n = 50$ ) investigated beliefs about the seasonal influenza vaccine [27–76] and reported fears of adverse

**Table 2**  
Characteristics of included studies.

Countries		Studied populations		Vaccines		Study method	
Country	#	Population	#	Vaccine	#	Method	#
United Kingdom	51	HCWs	37	Seasonal influenza	50	Structured questionnaires (mailed, online, telephone or face to face)	98
The Netherlands	17	Parents	30	Pandemic influenza	34	Qualitative interviews	23
France	17	Adults	17	HPV	29	Focus groups	10
Germany	12	High risk groups	17	MMR	12	Focus groups and qualitative interviews	6
Multiple countries	13	Multiple populations	10	Childhood	11	Mixed methods: qualitative interviews/focus groups and structured questionnaires	5
Greece	11	Medical students	7	Hepatitis B	2	Web monitoring	2
Sweden	9	Young women	5	Anthrax	2	National statistics	1
Spain	3	Children & teenagers	6	Varicella	1		
Italy	3	Pregnant women	5	DTaP/IPV/Hib	1		
Romania	2	Religious communities	3	Pertussis	1		
Denmark	1	Anthroposophical communities	2	Pneumococcal	1		
Austria	1	Internet users	2	All vaccines in general	1		
Hungary	1	Armed forces	2				
Ireland	1	Households	2				
Poland	1						
Slovenia	1						
Switzerland	1						

reactions [27,29,33–37,41,43,45–49,57,59–63,71,73,74], and more specifically, that vaccination causes influenza or flu-like symptoms [34,35,44,71,74]. The second most common perception described was that there was a low risk of contracting influenza [29,33,35,40,51,53,54,67,70,71,76] – many studies mentioned feelings of strength and being healthy enough to fight influenza [34,35,39,44,50,55,64,76], which was often described by study participants as a mild illness [27,33,52,56–58,61,62,74,75]. Some studies also reported feelings of protection linked to not having had flu in the past [30,34,59,65], or because of regular exposure to the virus [28,38]. Many studies reported that participants also believed they did not qualify for the vaccine as they were not part of a high risk group [28,37,38,44,51,52,54,55,61,64,71,72,76], while others explained they had not been offered the vaccine [27,51,52,54,61,63,66,68,69,71,74]. On the other hand, other studies reported beliefs that seasonal influenza vaccination is not effective in preventing infection [50,60,63,67], that vaccination is not a priority [30,34,44,47,47,52,54,64,66,71], or not necessary [31,35,42,43,65,69].

General mistrust was reported around influenza vaccination, with some studies showing individuals refusing all vaccines [37,56,67,69,72], and others describing conspiracy theories [75] and mistrust of health authorities [49,75], of the seasonal influenza vaccines [69,75], or of pharmaceutical companies [75]. Some studies reported a perceived lack of information [35,75], misunderstandings [48,74], beliefs that the vaccine is developed too quickly every year [49], and negative information about vaccine safety in the media [69,71]. Perceptions were reported to be influenced by a negative previous experience with the vaccine [34,68], and advice from others against vaccination [62,68]. Finally, some studies discussed the balance (or imbalance) of risk perceptions over perceived benefits of vaccination [61,74], fear of injections [34], adjuvants [73], and/or a preference for homeopathy [37].

### 3.2. Pandemic influenza vaccines

Out of 34 articles on pandemic influenza vaccination, one studied the H5N1 [77] and 33 the AH1N1 [27–32,65,72,78–103] pandemic influenza vaccines. The most frequent concern cited across studies was the opinion that these vaccines could have dangerous adverse reactions [27–31,77–79,81–90,92,94–103]. This was often explained by study participants as a perception that these new vaccines were developed too quickly [80,100], resulting in insufficient

testing and evidence [31,80,85,86,93,94,98,100,102] and information about long term adverse reactions [82,83,93,95,96]. Studies reported that concerns about inadequate testing also resulted in perceptions of low vaccine effectiveness [32,79,81,86,89,96,98].

The second most important reason for hesitating to vaccinate was the belief that pandemic influenza is not a threatening illness and is comparable to a mild flu [27,72,78,80,81,86,89,96,98,99,101–103]. Many studies also discussed a perceived low risk of contracting pandemic influenza [31,65,77,84,86,88,89,91,94,97,101] because of protection from a strong immune system [27,31,86] or previous exposure to the virus [28]. Some studies mentioned that healthcare workers were not part of at risk groups or they did not come into contact with patients [28,72,80].

Other studies discussed participants being influenced by negative media reports [82,86] and contradictory messages [98] about vaccines; while some believed the media overstated the seriousness of AH1N1 [103]. Mistrust was reported towards vaccines [100,103], national and international health authorities [86], and pharmaceutical companies [86]. Other studies reported a preference for natural prevention methods [78,86,97,100], a lack of health care provider recommendation [97], previous negative experiences with vaccination [27], the belief that the vaccine could cause flu [78], doubts about the risk-benefit balance [93], the belief that infection strengthens the immune system and that individuals should be brave and face diseases [86], notions of fatalism [86], and fear of injections [86].

### 3.3. HPV vaccines

In the 29 articles that studied HPV vaccination [104–132], the most common concerns identified were about safety, and particularly unknown adverse reactions that might develop long after vaccination [104–110,112,113,115–120,123–127,129–132]. These concerns often came with discussion around the newness of the vaccine [104,107,112,113,117,126,129], and claims that it has not been tested long enough [104,105,107,115,122,129–131]. Many articles reported concerns about a lack of clear information around HPV infection and vaccination, and individuals feeling that they have insufficient knowledge to make an informed decision [104,108,109,112,116,118–121,127,128,132]. Some also mentioned that participants believed insufficient testing of the vaccine meant there were too many uncertainties around long-term effectiveness of the vaccine [107,109,112,113,119,131].

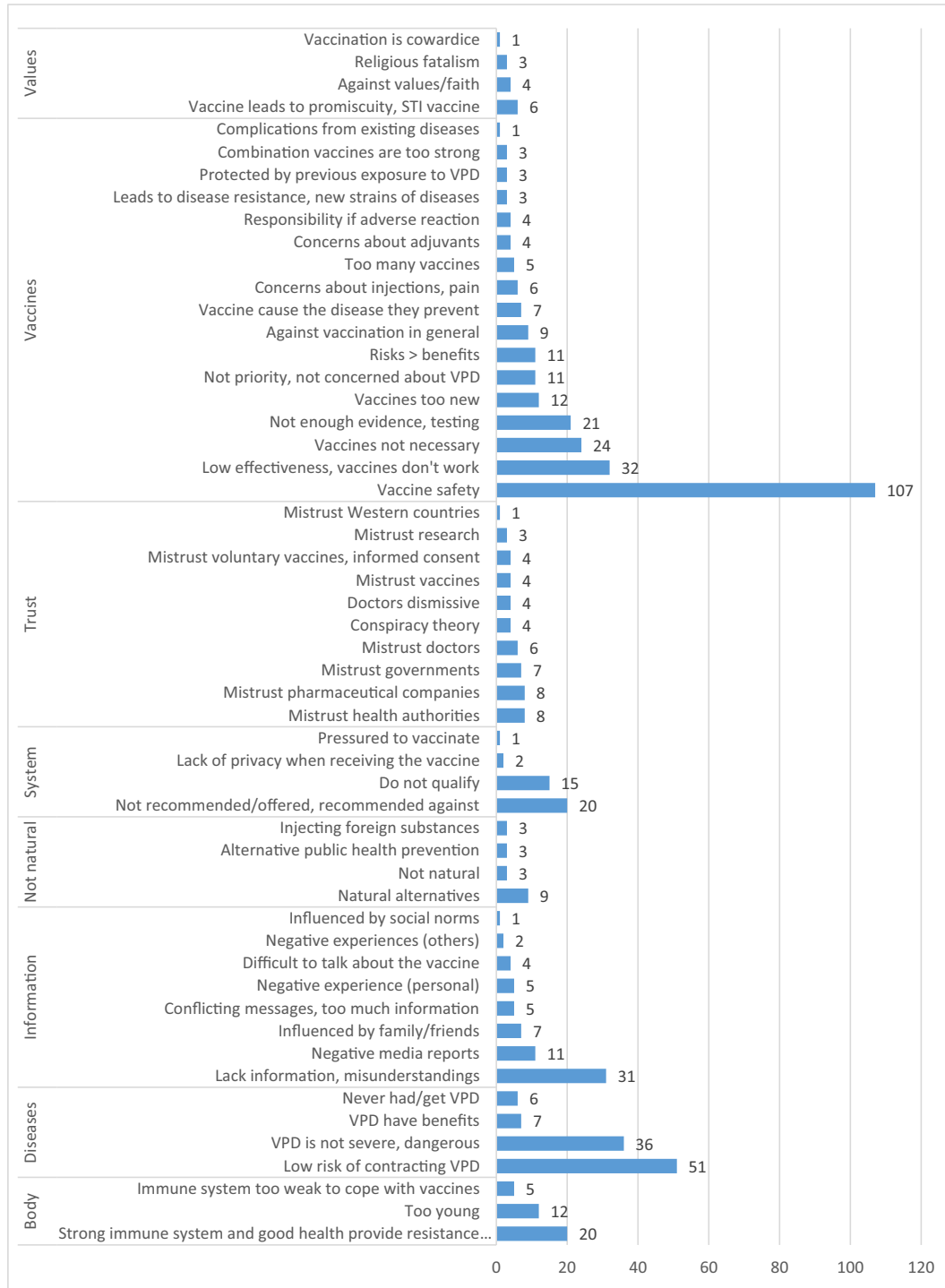


Fig. 2. Most common concerns about risks and benefits of vaccination in Europe.

Some studies reported beliefs that children are too young to receive the HPV vaccine [104,107,118,119,121,122,126], and fears of a “sexually transmitted infection vaccine” leading to unsafe sexual behaviours and increased promiscuity [107,110,117,121,124,125,130]. Some also discussed personal values or faith issues [104,110,122], and others the difficulty of talking about a “sex vaccine” [110,112,117,132]. Another important belief was that there is no risk of contracting HPV [112,114,122,129,130] and therefore no need for vaccination [105,112,115,122,130]. The perception that

the risks of vaccination are higher than benefits were more common than for other vaccines [106,107,118,130] and one study mentioned the perception that HPV infection is not a serious illness [129].

Mistrust was common, especially of pharmaceutical companies [105,106,118,130], government [104,109,123], research [112,130], and health authorities [118,130]. Two studies reported conspiracy theories about vaccines causing sterilisation [118,130] and others expressed concerns about the vaccine not being natural

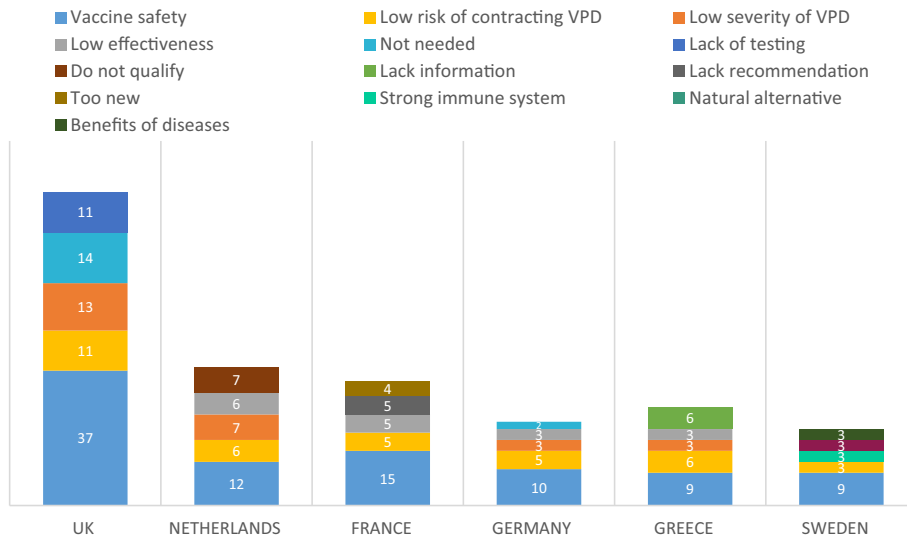


Fig. 3. Five most common concerns about risks and benefits of vaccination in Europe by country (n = number of studies).

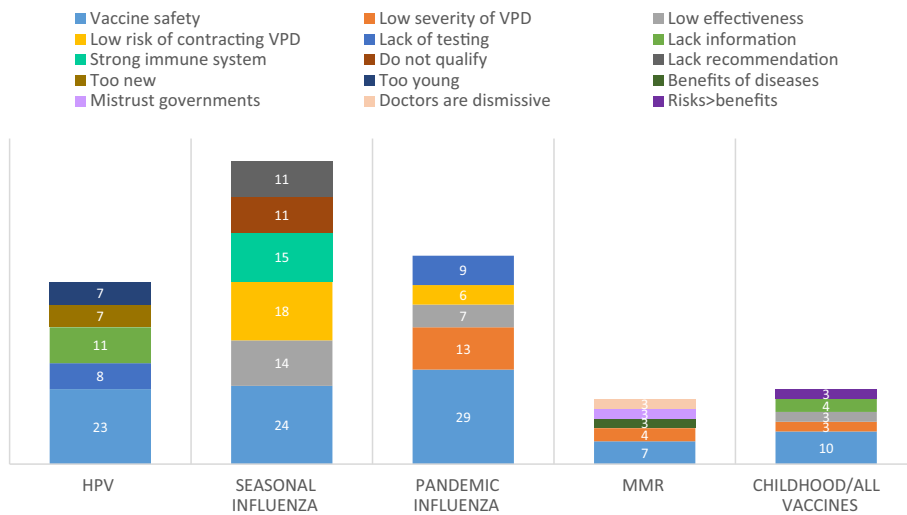


Fig. 4. Five most common concerns about risks and benefits of vaccination in Europe by vaccine (n = number of studies).

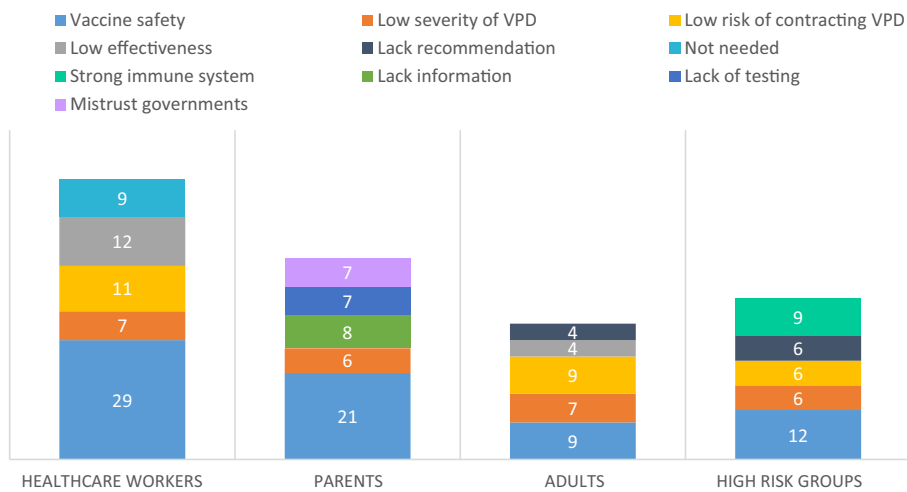


Fig. 5. Five most common concerns about risks and benefits of vaccination in Europe by population group (n = number of studies).

[104,130], and a preference for homeopathy, screening or sexual abstinence [105,117,130]. There were also beliefs that HPV infection can strengthen the immune system [104].

Issues about vaccine providers were raised in some studies, such as a lack of patient trust in their doctors [130], the fact that some doctors do not recommend the HPV vaccine [117,130], doctors being dismissive of parents' concerns [104,123], or doctors pressuring to vaccinate [104]. Some studies reported that parents discussed parental responsibility to protect children against vaccine adverse reactions [104,105,107], and others the influence of negative media reports [104,129].

Finally, there were also reports of general anti-vaccination feelings [104,130], beliefs that children receive too many vaccines [123,124], that their immune systems are too fragile [104,107], a lack of privacy when being vaccinated [111,132], concerns about pain of injection and cleanliness of needles [111,116], and the importance of parental consent for vaccination [115,130].

### 3.4. MMR vaccines

Twelve articles studied MMR vaccination [132–142] and found that the most important concerns were about safety, with some articles reporting particular worries about autism [132,134,136–138,140,141]. A few studies also reported beliefs that the diseases prevented by the MMR vaccine are mild, treatable, and not dangerous [135,138,140,142] and that children actually benefit from these infections [134,141,142]. Mistrust of governments was high [135,137,139], together with perceptions that doctors are dismissive of parents safety concerns [133,137,142]. Lack of trust was reported towards health authorities [132], pharmaceutical companies [139], researchers [135], and doctors [142].

Some information challenges were reported, including a lack of information [139,140], perceptions about inadequate evidence of vaccine safety [137,139], and reports of conflicting messages [133,135]. Some studies found that participants felt that children are too fragile [133] to receive vaccines with too many antigens [134], and therefore preferred homeopathy [134,136]. Two studies reported influences from negative previous experiences with MMR vaccination [139,142] and another two studies found participants believed healthy children do not need the vaccine [134,138]. One study found that parents believe the risks of vaccinating are higher than benefits [142]. Other parents were reported to believe that children are too young to be vaccinated [136] and to express concerns about adjuvants as well as the fear vaccination could create new disease strains [138]. Finally, studies found that parents of autistic children blamed themselves for vaccinating their children [133].

### 3.5. Childhood vaccination

Eleven articles studied concerns about childhood vaccination in general [143–154]. The most common concerns were about adverse reactions [144–148,150–154]. Other studies reported that participants believed that vaccine preventable diseases are not dangerous [147,148,150] but instead are beneficial for child development [149,150]. Some also believed that risks of vaccination outweigh benefits [147,150,154]. Studies found that interviewed participants reported inadequate information and evidence [143,144,147,153] and disagreements between experts on vaccine safety [144]. There were beliefs that vaccines do not work or have a short duration of protection [143,146,150,154], supporting the perception that vaccines are not useful [146,153,154].

Lack of trust in health authorities [147,154] and doctors [147] was reported, with patient reports of doctors only discussing the benefits of vaccination [145]. Studies found that parents reported being influenced by friends and families [150], negative reports

in the media [150,153], previous negative personal experience [150], and society [152]. Other concerns mentioned in studies were about combination vaccines [147], adjuvants [150], children receiving too many vaccines [145], and injecting foreign substances into the body [152].

Studies found that parents from religious communities reported strong trust in God, and beliefs that they should not interfere with divine providence [151,152], as well as the perception that separation from other communities lowers the risk of infectious diseases transmission [152]. Some studies also reported that parents who visit anthroposophical child welfare centres explained that healthy children do not require vaccination [149], and that alternative prevention methods should be favoured as the immune system is not developed enough to handle vaccines [150].

## 4. Discussion

Over the past decade, a number of studies have been published that help to characterise risk perceptions relating to vaccines and vaccination by European populations, and their findings have been reviewed, analysed and summarised in this article. The majority of studies were conducted in the United Kingdom, France and the Netherlands, with a main focus on the seasonal influenza vaccine, the HPV vaccine and the pandemic influenza vaccine. These characteristics could be a reflection of the presence of research institutes in these countries with relevant research interests but could also be linked to the introduction of and the high number of safety concerns about the HPV vaccine, the poor uptake of H1N1 vaccination during the 2009 pandemic, as well as previous historic vaccination crisis in these countries such as the MMR-autism crisis in the UK [144,155] or the hepatitis B-multiple sclerosis crisis in France [156]. As no country is safe from a potential decrease of public confidence in vaccination, more robust behavioural research needs to be conducted particularly in countries where fewer studies were identified, such as Eastern Europe. This review also points to the need for the use of media monitoring tools that listen to populations' concerns in "real-time" given the changing nature of sentiments. While surveys, questionnaires and qualitative research are useful for exploring public concerns about vaccination, they fail to detect sudden changes in confidence levels. For instance, although this study reviewed articles published between 2004 and 2014, it failed to detect concerns raised in Denmark about HPV vaccination that started in 2013. There are currently very few such systems in place [157], but as European citizens are increasingly exposed to health information on the internet and social media [158], it is important to continuously monitor and analyse online information to detect any changes in perceptions of vaccinations risks.

Across all countries and vaccines, the largest area of concern was vaccine safety. Different types of concerns about vaccine safety were however identified for different vaccines: for instance, while perceived adverse events described for HPV vaccination were often long-term and severe, those for influenza vaccination were milder and often consisted of the beliefs that the vaccine causes flu-like symptoms. There were also reports of more general fears observed for all vaccines, related to uncertainty about the safety of the vaccine. Uncertainty issues reveal a different challenge: the one of mistrust, for instance of information provided about the safety of the vaccine. While providing comprehensive and up-to-date information to the public about the risks and the benefits of vaccination is essential, these findings show that they need to be complemented by trust building strategies to sustain vaccine coverage and acceptance. Population perceptions of risk might also reveal real safety issues; and it is therefore important



not to dismiss those concerns, but instead to consider them carefully and to investigate them further where appropriate.

Other major concerns identified included perceptions of low likelihood of contracting VPDs and perceived low severity of diseases. These results can partially be explained by the high number of new vaccine products which have been introduced in Europe over the past decade, as well as the decrease in prevalence of VPDs for older and routine vaccines [7,156,159,160]. Vaccination is often thought to be a victim of its own success [1,161]: as VPDs are eliminated from regions with high vaccination coverage and adverse VPDs outcomes become less visible, individuals have no first-hand knowledge of the risks of these diseases and start questioning the benefits of vaccination over the risks [7]. The review also found that although some concerns are important for all vaccines (i.e. perceived adverse events, or mistrust), some are more common in relation to specific vaccines. For instance, concerns about flu vaccination are typically related to not perceiving a need for the vaccine or not believing the disease is severe, while concerns about new vaccines such as H1N1 or HPV are linked to uncertainties and the belief there is insufficient evidence or testing of the vaccine.

Reports of individuals believing that risks outweigh the benefits of vaccination were reported for all vaccines. This is problematic, as individual decision-making has been shown to be more affected by perceived losses rather than equivalent gains [162–165]. If individuals make decisions about vaccination based on how they perceive different risks, it is important that they understand the risks of not vaccinating in terms of susceptibility to and severity of VPDs. While scientists tend to talk about risks for populations and public health (i.e. rate of VPDs in a population), individuals are mostly interested in individual risks for themselves and their children (i.e. individual side effects), which should be considered when designing communication strategies. This could be reflected in vaccine provider communication to parents, which should acknowledge parental individual risk perceptions and present both risks and benefits of vaccination at an individual rather than a population level. Official information documents about vaccination should also be developed to focus both on individual and population risks and benefits of vaccination.

Another important issue reported in this review is the public perception that there is a lack of adequate information about all vaccines. Although this is partly linked to quality of the communication and information system, it is also largely influenced by mistrust. This is reflected by the fact that some studies found that participants were still describing concerns that MMR might cause autism although they knew that experts and scientists had not found any evidence for this association. Providing information is not, by itself, sufficient to change people's behaviour. Some studies show that vaccine refusers are usually more informed than vaccine acceptors, as they often research information themselves online or talk to other parents about their experiences with vaccination [7,157,166]. It is therefore important to move beyond "knowledge deficit models of communication" and develop tailored communication and engagement strategies with an effective listening mechanism, that provide for continuous listening to populations' perceptions of vaccines. A proactive approach to responding to vaccination scares should be encouraged with communication strategies ready in advance to respond to different types of challenges and concerns [158]. Certain tools, such as the WHO guidance on "How to respond to vocal vaccine deniers in public" [167], are available to help national immunisation programme managers prepare such strategies. Managing inaccurate perceptions of vaccinations risks is as important as the management of scientifically confirmed risks [157]. Communication strategies should be developed as a dynamic process and include input from a range of actors such as immunisation managers, vaccine providers, but also parents [7,158].

#### 4.1. Limitations

There are some limitations to this review which should be considered when interpreting results. The selection of articles and data extraction of the systematic review was conducted by one researcher and quality assessment of the articles was not performed. The impact of this limitation was attenuated by using multiple researchers to develop the search strategy and the exclusion and inclusion criteria, and closely review the data extraction and analysis. Only articles published in English, French and Spanish were included in the analysis which might have led to under-representation of certain countries. Two separate analysis for qualitative and quantitative studies identified by the review might have provided more detailed results, while the arbitrary decision to select concerns reported by a minimum of 20% of study participants might have impacted the results. Finally, articles published after November 2014 were not included in this review; the authors suggest updating the review regularly to detect any changes in concerns about the risks and benefits of vaccination in Europe.

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#### Contributors

EK and HL co-lead the review, analysed and interpreted the data and prepared the manuscript. EK lead the data collection and the review of papers.

#### Conflict of interest

None.

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