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DOI:

[10.1016/j.vaccine.2017.09.046](https://doi.org/10.1016/j.vaccine.2017.09.046)

Document Version

Version created as part of publication process; publisher's layout; not normally made publicly available

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Citation for published version (APA):

Smith, L. E., Amlôt, R., Weinman, J., Yiend, J., & Rubin, G. J. (2017). A systematic review of factors affecting vaccine uptake in young children. *Vaccine*, 35(45), 6059-6069. Advance online publication. <https://doi.org/10.1016/j.vaccine.2017.09.046>

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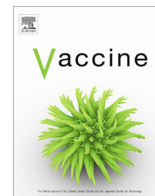
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Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Review

A systematic review of factors affecting vaccine uptake in young children

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ARTICLE INFO

Article history:

Received 16 March 2017
Received in revised form 11 September 2017
Accepted 13 September 2017
Available online xxxx

Keywords:

Child immunisation
Parents
Psychological factors
Uptake
Health behaviours

ABSTRACT

Background: Many parents make a conscious decision not to vaccinate their child. Multiple beliefs and perceptions surround this choice. If uptake of routine child vaccination is to increase, public health communications about vaccines must be informed by evidence on the factors affecting uptake.

Method: We conducted a systematic review to investigate psychological, social and contextual factors associated with uptake of routine vaccines in young children. Studies were included if they reported analyses of the association between psychological factors and uptake or included parents' self-reported reasons for or against vaccination.

Results: Our search identified 9110 citations after deduplication. Sixty-eight citations describing sixty-four studies were included in the review. The quality of the studies was mixed. There is strong evidence for an association between vaccination uptake and: not perceiving vaccines to cause adverse effects; general positive attitudes towards vaccination; positive vaccine recommendations; and perceiving fewer practical difficulties of vaccination. While there was good evidence for an association between vaccination and perceived susceptibility to the illness, evidence for an association between perceived severity of an illness and vaccination was weak. Other factors associated with vaccination include knowledge about the vaccine, social influences and trust in the healthcare profession. Having increased information about the vaccine was associated with vaccination, but the influence of different sources of information needs more research.

Conclusion: Understanding which factors are consistently associated with the decision to vaccinate one's child is important to identify messages which should be targeted by public health communications about routine child vaccinations.

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<https://doi.org/10.1016/j.vaccine.2017.09.046>

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Please cite this article in press as: Smith LE et al. A systematic review of factors affecting vaccine uptake in young children. Vaccine (2017), <https://doi.org/10.1016/j.vaccine.2017.09.046>

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1. Introduction

In 2015 almost six million children died globally before the age of five [1]. Over half died from preventable infectious diseases [2]. Although vaccines reduce morbidity and mortality [3], some parents do not vaccinate their children. While in developing countries lack of access to vaccination and family characteristics such as low education, literacy and socio-economic status make up the majority of reasons why children are not vaccinated [4], in developed countries parents make conscious decisions not to use readily available vaccines. Understanding how to encourage uptake is an important public health aim.

Many studies in this area are guided by an explicit theory of behaviour change (e.g. [5–7]), which identify factors which may predict vaccination behaviour [8]. Vaccine refusal has been associated with: perceived costs of vaccination, such as believing that vaccines cause short- or long-term side-effects [9] or are ineffective [10]; attitudinal factors such as believing that children receive too many vaccinations and that vaccines overload the immune system [11]; conflict with religious beliefs [12]; distrust of healthcare systems and governments [9,13]; and emotional factors such as preferring to suffer the negative consequences of inaction rather than those caused by vaccinating [10]. Other factors include forgetting and not knowing that the child needs a vaccine booster [9,13].

Past literature reviews have focused on vaccines such as MMR [11] and HPV [14]. However, it is difficult to generalise these findings to all routine vaccinations. We used a systematic review to identify psychological, social and contextual factors affecting the uptake of routine childhood vaccination for healthy children aged 5 and under in high-income countries.

2. Method

We carried out a review in accordance with PRISMA criteria [15]. We searched Embase, Medline, PsycINFO, Maternity and Infant Care, Health Management Information Consortium and Social Policy and Practice through OvidSP, and Scopus. Databases were searched from inception to the 22nd November 2016. We used the following search terms: ((vaccine* OR inocul* OR immunis*) AND (child* OR newborn OR infant OR baby) AND (uptake OR

adherence OR compliance OR decision* OR hesitanc* OR concern OR doubt)). Where possible, we limited the search to human studies. A MeSH terms search yielded 52,429 citations. Checking a random sample of 100 of these yielded no relevant papers. The MeSH search was therefore abandoned as impractical.

2.1. Inclusion criteria

Inclusion criteria were:

Participants: Studies were included if children were aged five or under. Studies were excluded if children were recruited because of pre-existing ill health.

Predictors/Exposures: Studies were included if they presented data on the association between possible psychological predictors and childhood vaccination, or gave a quantitative account of parents' self-reported reasons for or against vaccination. Studies presenting only demographic predictors or predictors related to the mode of delivery of information, presence of an intervention (such as sending a reminder for the appointment) or frequency of vaccination appointment reminders were excluded.

Outcomes: Studies were included if they presented data on uptake of a named vaccine and if the vaccine was part of the routine vaccination schedule in that region.

Study reporting: Studies using quantitative methodology and conducted in high-income countries (as defined by the World Bank [16]) were included. For pragmatic reasons, we included only studies published in English.

2.2. Data extraction

For each study, we extracted details concerning country, study design, vaccine, psychological predictors of uptake and reasons for and against vaccination.

2.3. Risk of bias

Risk of bias was assessed using an adaptation of the Downs & Black [17] checklist, which is suitable for use in systematic reviews [18] and has been validated [19]. Items relating to interventions were dropped as they were not relevant to any included study.

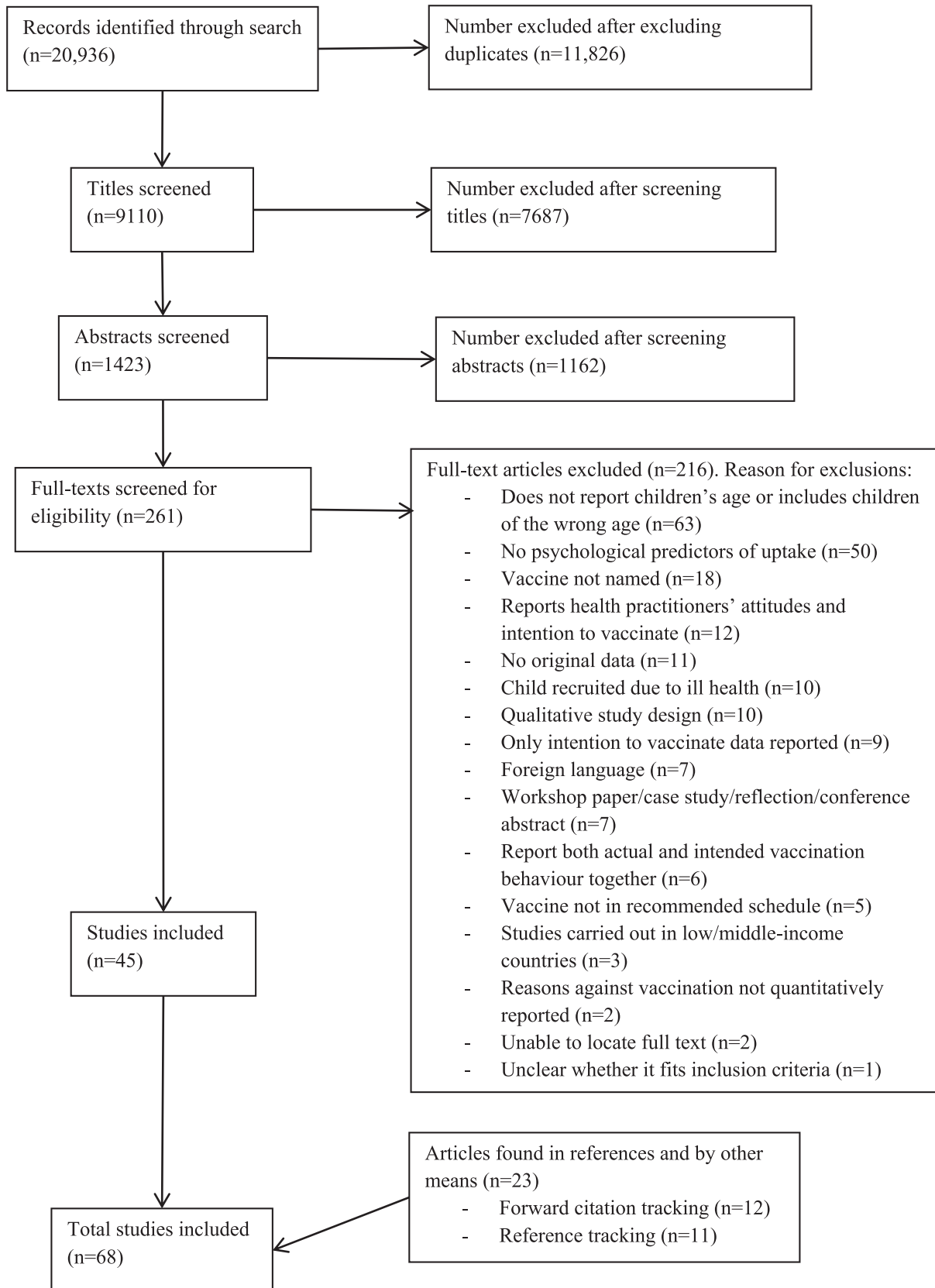


Fig. 1. Flowchart depicting the selection of studies included in the systematic review with reasons for exclusion.

Table 1
Psychological predictors associated with not vaccinating child.

Factor	Psychological predictors of not giving child vaccinations/studies which investigated and did not find a significant association	Number of studies finding a significant association/number of studies investigating the factor
Perception of adverse effects from vaccination	Vaccine is unsafe [23,24,27–29,32,38,56,57,62,70,83]/[21,66,80]	12/15
	Vaccine causes side-effects [24,25,27,43,56,70,71,73,80,84,85]/[28,52,66]	11/14
	Child unwell at time of vaccine appointment [42,52]	2/2
	Belief that the vaccine is more dangerous than the illness [56]; injections are traumatic to the child [57]	2/2
	Can vaccinate child if they are ill (without fever) [70]/[83]; child is often too ill to receive vaccinations [52,71]	3/4
Appraisal of the illness	Previous side-effects from vaccination [80]/[29,39]; negative previous vaccination experience [79]	2/4
	Low perceived susceptibility to illness [21,23,32,46,56,61,63,73,84]/[43,66,86]	9/12
	Low perceived severity of illness [32,34,42,56,70]/[21–23,39,43,50,66,73,85,86]	5/15
General attitudes	Illness is dangerous [57]	1/1
	Perception that it is not important for child to be vaccinated [24,70,73]; vaccination is not useful [77]; vaccines are not protective [85]; no confidence in value of vaccines [62,69]	7/7
	Religious objection to vaccination [46,52]	2/2
Vaccine recommendations	Negative attitude towards vaccination [26]; do not agree with vaccination [68]	2/2
	No vaccine recommendation by health professional [22,25,38,43,56,70,77,84]/[71]	8/9
	No vaccine recommendation by friends or family [22,56]/[39]	2/3
	Government advice to vaccinate/[40]	0/1
Practicalities	Health professionals' advice/[40]	0/1
	Logistical barriers [63,87]; inconvenient time or place of vaccination [52,86]/[25,71]; perceived time pressure [68]	5/7
	Expense of vaccine [25,52]/[71]	2/3
	Vaccine course delivered in more doses [25]	1/1
Knowledge	Difficult to get the vaccine or appointment [29]/[25]	1/1
	Incorrect knowledge [43,66,71,86]; confusion about the vaccination schedule [52]; difficulty remembering vaccine schedule/[42]	5/6
	No knowledge about vaccination before appointment [21,31]	2/2
Social influences	Belief that the second dose of vaccine not essential [85]/[40]; not important if a child misses a dose [87]	2/3
	Normative beliefs [25]; subjective norms [56,61]	3/3
Information about the vaccine	Lack of perceived social approval of vaccination [33,34]/[88]	2/3
	Less satisfaction with information given [31,70]; information thought to be unhelpful [40]	3/3
	Information seeking behaviour [33]	1/1
	Influence of information from the media [85]	1/1
	No influence of information from the media [50]	1/1
	Influence of research findings as important [40]	1/1
	Influence of alternative/complementary medicine [70]	1/1
	Faith in the media [39]	1/1
	Less influence of healthcare provider [85]/[70]	1/2
	Perceived lack of information for vaccination decision [34]/[29]	1/2
Adverse media publicity/[29]	0/1	
Trust in the healthcare profession	Perception of a worse relationship with healthcare provider [62,70]	2/2
	No faith in the medical profession [24,39]/[29,69]	2/4
	Belief it is not right for health professionals to advise parents to vaccinate for the benefit of other children [34]	1/1
	Lack of perceived clinical support [26]	1/1
Perceived efficacy of vaccination	Lower parental satisfaction with care/[29,59,60]	0/2
	Vaccine is not effective [23,32,61–63,70,73,87]/[22,27,42,43,57,66,85,88]	8/16
Emotions	Worry about the vaccine [50,64]	2/2
	No fear that child will catch illness [56]	1/1
	Anxiety about vaccination [56]	1/1
	Inability to forgive oneself if child developed side-effects from vaccination [34]; guilt about consequences/[39]	1/2
	Maternal psychological distress/[68]	0/1
Trust in the government	No trust in the government [24,46]/[29]	2/3
	Belief there is a conspiracy [85]	1/1
	Perceive government pressure to vaccinate/[40]	0/1
Multiple/combo combination vaccines	Appropriateness of separate vaccines over combination vaccines [24]	1/1
	Combination vaccines are larger concern than single vaccines [34]	1/1
	Combination vaccines are too much in one go [34]	1/1
	Combination vaccines are harmful [85]	1/1
	Children receive too many vaccines [70]	1/1
	Not accepting multiple vaccines at once [29]/[25,83]	1/3
	Multiple vaccinations are unsafe/[66,87]; multiple vaccines overwhelm the immune system [70]	1/3

Table 1 (continued)

Factor	Psychological predictors of not giving child vaccinations/studies which investigated and did not find a significant association	Number of studies finding a significant association/number of studies investigating the factor
Preference for natural immunity	Belief that vaccination impairs body's natural immunity [56]	1/1
	Preference for the child to get immunity naturally, through having the illness [34]	1/1
	Belief that infections are good for the immune system [85]	1/1
	Vaccines are unhealthy [39]	1/1
Self-efficacy and perceived behavioural control	Belief it is not the government's responsibility to decide to vaccinate children [34]	1/1
	Less perceived behavioural control [67]; internal locus of control/[88]	1/2
	Self-efficacy/[87,88]	0/2
Intention	Intention to vaccinate [25]	1/1

Studies were classified as good quality if they scored 16 or over out of a possible 19, while poor quality studies were those that scored 10 or less. Moderate quality studies scored 11–15.

2.4. Procedure

The literature search, screening, data extraction and quality assessment were carried out by LS, with guidance from GJR and JY. Predictors were grouped according to categories identified by Bish and Michie in a review of factors associated with vaccination against pandemic flu [8]. We report results for discrete categories in our results section in order of strength of association. Other results are presented in [supplemental files](#).

2.5. Registration

We registered the protocol for this systematic review on PROSPERO (CRD42016037983) [20].

3. Results

3.1. Study characteristics

Following screening (Fig. 1), sixty-eight citations were included in the review, describing sixty-four studies. Studies were conducted in twelve countries and investigated thirteen vaccines. Thirty-seven studies used cross-sectional designs, fifteen used case-control designs and twelve used cohort designs.

3.2. Risk of bias

Scores on the amended Downs and Black checklist [17] ranged between two and eighteen out of a possible nineteen, with a median score of thirteen. Only ten studies reported a power calculation [21–30]. Forty-nine studies scored poorly for external validity [21,22,24–27,29–72]; twenty-eight scored poorly for reporting [25,27,30–32,35–38,40,45,47,49,51,53–55,62,64,65,69,70,72–79]; eight scored poorly for internal validity (bias) [31,32,35,36,45,50,53,72,74]; and six scored poorly for confounding (selection bias) [32,33,41,42,46,62]. Scores for individual studies are shown in the [supplementary materials](#).

3.3. Psychological, social and contextual predictors of uptake

Predictors and reasons for or against vaccinating are summarised in [Tables 1 and 2](#) (for full tables see [supplementary materials](#)). Only adjusted analyses are reported, where relevant.

3.3.1. Perception of adverse effects from vaccination

There is strong evidence for an association between perception of adverse effects and vaccination. Self-reported reasons for not

vaccinating included: believing the vaccine to cause side-effects [22,27,28,33,35–37,43,45,50,54,65,80,81] or to be unsafe [27,31,75,76]; believing one's child to be allergic to the vaccine [33,43,45,75]; previous experience of the child or someone else experiencing side-effects [75,78]; believing that vaccines are dangerous or cause trauma [57,81]; being concerned about the child becoming ill due to vaccination [78]. Although recommendations state that children can be vaccinated if they are mildly ill [82], parents in nine studies reported not vaccinating their child because they were unwell [27,32,35,43,45,49,54,65,75]. Reasons for vaccination included that parents themselves had been vaccinated without complication [31] and that vaccination would not harm the child even if it did not benefit them [33].

Twelve of fifteen studies found an association between perceiving vaccination to be unsafe and vaccine refusal [23,24,27–29,32,38,56,57,62,70,83]. Four studies were good quality [23,28,29,83]; all those not finding an association were moderate quality [21,66,80]. Eleven of fourteen studies found an association between perceiving a vaccine to cause side-effects and vaccine refusal [24,25,27,43,56,70,71,73,80,84,85]. All fourteen were moderate or good quality. An association was found between vaccine refusal and the child being ill at the time of vaccination [42,52] and the belief that the child is often too ill to receive vaccinations [52,71]. One study found that believing a child cannot be vaccinated if they are ill without a fever was associated with vaccination status [70], whereas another did not [83]. These were of moderate and good quality respectively. Another study found an association between refusal and believing that vaccination is more dangerous than the illness [56].

3.3.2. Appraisal of the illness

There is strong evidence for an association between perceived susceptibility to an illness and child vaccination, however the link with perceived severity of the illness is tenuous. In terms of self-reported reasons against vaccination, studies variously identified a belief that the child had already had the illness [32,33,45,49,65]; perceived low severity of the illness [28,31,38,80]; perceived low susceptibility to the illness [22,36,37,80]; belief that complications of the illness were not frequent enough [38]; and because the parents have had the illness without harm [31]. Conversely, reasons for vaccinating included believing the child to be susceptible to the illness [33,78]; because the illness could be severe [33]; and to prevent complications of the illness [31].

Twelve studies investigated the association between perceived susceptibility to illness and vaccination, with nine finding a significant association [21,23,32,46,56,61,63,73,84]. Most studies were moderate quality, with one good quality study [23] and one poor quality study [32]. Fifteen studies investigated the association between perceived severity of the illness and child vaccination, with five finding an association [32,34,42,56,70]. Studies that

Table 2
Self-reported reasons for and against vaccinating child.

Factor	Reasons given for not vaccinating	N	Reasons giving for vaccinating	N
Perception of adverse effects from vaccination	Vaccine causes side-effects [22,27,28,33,35–37,43,45,50,54,65,80,81]	14	Parents have been vaccinated without complication [31]	1
	Child was unwell at time of vaccination [27,32,35,43,45,49,54,65,75]	9	Won't harm the child even if vaccination does not benefit them [33]	1
	Vaccine is unsafe [27,31,75,76]	4		
	Allergy to vaccine [33,43,45,75]	4		
	Vaccines are dangerous [57,81]	2		
	Previous side-effects: self [75]; other person [78]	2		
	Concern about vaccination [44]	1		
Appraisal of the illness	Child has had the illness already [32,33,45,49,65]	5	Child is susceptible to illness [33,78]	2
	Low perceived susceptibility to illness [22,36,37,80]	4	Illness can be severe [33]	1
	Illness is not serious [28,38,80]; illness is harmless [31]	4	To prevent complications of illness [31]	1
	Complications of illness not frequent enough [38]	1		
	Parents have had the illness without harm [31]	1		
General attitudes	Parental choice, did not want vaccination [32,43,49,75,81]	5	Vaccine is important [64]	1
	Vaccination is unnecessary [31,43]; vaccination is not useful [25]	3		
	Child is too young [43,57,75]	3		
	Disagree with immunisation [44]	1		
Vaccine recommendations	Advised against vaccination by health professional [32,49,54,74]	4	Vaccine recommendation by health professional [33,64]	2
	No vaccine recommendation by health professional [43]; weak vaccination recommendation by health professional [38]	2	Vaccine recommendation by government [33]	1
	Negative influence of health visitor [50]	1		
Practicalities	Practical barriers [33,44,81]; inconvenient time or place of vaccination [32,35,49,75]	7		
	Appointment not offered or missed appointment [27,32,44,49,65,75];	6		
	Expense of vaccine [25,27,38,43]	4		
	Lack of time [43,54,76]	3		
	Vaccine out of stock [43,54,75]	3		
Knowledge	Inadequate knowledge about vaccine [43]	1		
	Incorrect knowledge about the vaccination schedule (both parent and physician) [22,37,43,44,51,65]	6		
	Lack of knowledge where to get vaccine [43]	1		
	Lack of prior knowledge [54]	1		
	Child was unwell (no fever or major illness) [27,32,35,43,45,49,54,65,75]	9		
	Previous dose is still effective [43]; one dose of vaccine is enough [50]	2		
Social influences	Other parents don't vaccinate child either [33]	1	Friends and family have accepted the vaccine [33]	1
Information about the vaccine	Adverse media publicity [33,37,74,81]	4		
	Lack of information [76]	1		
	Lack of scientific data [54]	1		
	Heard problems with the vaccine [78]	1		
Trust in the healthcare profession	Doctors vaccinate without differentiation [57]	1	Trust in healthcare provider [57,78]	2
Perceived efficacy of vaccination	Vaccine is not effective [27,33,43,65]	4	To protect child from illness [31] [57]	1
			Trust in effectiveness of vaccine [33]	1
Emotions	Fear about vaccination [32,49,81]	3	Anticipated regret if do not vaccinate [33]	1
			Concern about child becoming ill [78]	1
Trust in the government	No trust in the government [33]	1	Required by law [64]	1
			Child receives vaccines according to National Immunisation Program [33]	1
Multiple/combination vaccines	Child receiving too many injections [28,80]; child receiving enough injections [37]	3		
	Did not want child to have vaccines all at once [75]	1		
Preference for natural immunity	Preference for natural immunity [36,65]	2	Vaccination will strengthen the child's immune system [31]	1
	Illness strengthens child's immune system [31]	1		
	Illness is beneficial for child [31]	1		
	Prefer to use homeopathic alternative [33,75]	2		
Intention	Postpone vaccination to a later date, intend to vaccinate child later [22,35,37,65,80]	5		

found no association were generally of better quality, with four good quality studies [22,23,85,86].

3.3.3. General attitudes

There is good evidence for an association between parental attitudes and child vaccination. Self-reported reasons against vaccina-

tion included thinking that vaccination is not necessary or useful [25,31,43]; and disagreeing with immunisation [44]. Parental reasons for vaccinating included perceiving the vaccine to be important [64].

Attitudinal factors positively associated with uptake included believing the vaccine to be important or useful; protective; having

confidence in the value of vaccines; holding a positive attitude towards immunisation; agreeing with vaccination; and not having religious objections to vaccination. All eleven studies investigating these attitudinal factors found a significant association with uptake [24,26,46,52,62,68–70,73,77,85]. All were moderate quality, apart from two high quality [26,85] and one poor quality [62] studies.

3.3.4. Vaccine recommendations

Across multiple studies, parents reported not vaccinating their child because: they were advised against vaccination [32,49,54,74]; did not receive a vaccine recommendation by a health professional [43]; received a weak vaccination recommendation from a health professional [38]; or because a health visitor had a negative influence [50]. Two studies reported that parents vaccinated their child because they received a recommendation from a health professional or the government [33,64].

Of the ten studies investigating receiving vaccine recommendations from a health professional, friend or family member, eight found an association with uptake [22,25,38,43,56,70,77,84]. One study was good quality [22], while others were moderate quality. The two studies which did not find an association were both moderate quality [39,71].

3.3.5. Practicalities

Seven studies reported practical barriers, inconvenient timings or clinic locations as reasons against vaccination [32,33,35,44,49,75,81]; six cited missing or not being offered an appointment [27,32,44,49,65,75]; four cited the expense of the vaccine [25,27,38,43]; and three each cited a lack of time [43,54,76] and the vaccine being out of stock [43,54,75].

Perceiving logistical barriers towards vaccination; inconvenient appointment location or time; and time pressure were investigated as risk factors by seven studies, of which five found an association with refusal [52,63,68,86,87]. Two were good quality [68,86]. Both studies which found no association were moderate quality [25,71]. Having to pay for the vaccine was associated with vaccine refusal in two studies [25,52], while one [71] found no association; all were moderate quality. Perceiving it to be difficult to get the vaccine or a vaccination appointment was associated with not vaccinating in one of two studies [29]; as was having a vaccine course delivered in multiple doses [25].

3.3.6. Knowledge

Overall, there is good evidence for an association between increased knowledge about the vaccine and uptake. Six studies reported that parental reasons against vaccination included incorrect knowledge of the vaccine schedule by the parent or physician [22,37,43,44,51,65]. Perceived inadequacy of knowledge about the vaccine or where to get it [43,54] and believing that previous doses of the vaccine were still effective or that one dose was enough [43,50] were also self-reported reasons for not vaccinating.

Six studies found an association between vaccine refusal and incorrect knowledge, confusion or difficulty remembering the vaccination schedule [43,52,66,71,86]; or not knowing about the vaccination before the appointment [31]. Of these, one study was good quality [86], one was low quality [31] and the rest were moderate quality. One moderate quality study found no association between difficulty remembering the vaccine schedule and vaccination [42]. Not believing that it is important if a child misses a vaccination dose, or that the second dose is not essential was found to be associated with uptake in two of three studies investigating it [85,87]. Studies finding an association were good [85] and moderate quality [87]; the study not finding an association was also moderate quality [40].

3.3.7. Social influences

There is mixed evidence for an association between social influences and vaccination. Parents' self-reported reasons against vaccination included that other parents did not vaccinate their child [33], while reasons for vaccinating included that friends and family had vaccinated their child [33].

Two moderate quality studies found an association between lack of perceived social approval of vaccination and vaccine refusal [33,34], whereas one good quality study did not find an association [88]. Subjective norms were associated with vaccine uptake [56,61], as were normative beliefs [25].

3.3.8. Information about the vaccine

There is some evidence for an association between information about the vaccine and vaccination, whereas there is mixed evidence for the direction of the association between the influence of the information source and vaccination. Studies indicated that parents reported not vaccinating their child because of adverse media publicity [33,37,74,81]; perceived lack of information [76]; lack of scientific data [54]; and having heard there were problems with the vaccine [78].

Three studies found an association between vaccine uptake and whether parents were satisfied with the information provided or thought it helpful [31,40,70]. One of two studies investigating perceived lack of information and vaccine refusal found an association [34]. Information seeking behaviour was associated with vaccine refusal [33]. No association between vaccination and adverse media publicity was found in a good quality study [29].

Increased influence of information disseminated by the media was associated with both increased [50] and decreased child vaccination [85]. The study finding an association with decreased vaccination was better quality. Faith in the media [39], influence of a provider of alternative or complementary medicine [70], and perceiving research findings to be important [40] were associated with vaccine refusal. An association between influence of information from a healthcare provider and child vaccination was also found by one study [85], but was not replicated in another lower quality study [70].

3.3.9. Trust in the healthcare profession

There is mixed support for an association between child vaccination and trust in the healthcare profession. One study reported that parents did not vaccinate their child because they believed that doctors vaccinate without differentiation [57]. Parents in two studies gave trusting their healthcare provider as a reason for vaccination [57,78].

An association between uptake and faith in the medical profession was found by two of the four studies which investigated it [24,39]; both were moderate quality. One of the two studies which did not find an association was good quality [29]. Two studies found an association between better perceived relationship with the healthcare provider and vaccination [62,70]; perceived clinical support was also associated with vaccination [26]. Parental satisfaction with care was not associated with vaccination in either of two studies [29,59,60], one of which was good quality [29].

3.3.10. Perceived efficacy of vaccination

Evidence for an association between perceived efficacy and child vaccination is mixed. Not believing that the vaccine was effective was reported by parents as a reason against vaccination in four studies [27,33,43,65]. Two found that parents vaccinated their child to protect them from the illness [31,57], and another cited trust in the effectiveness of the vaccine [33].

Perceived efficacy was found by eight studies to be associated with child vaccination [23,32,61–63,70,73,87]. Of these, two were poor quality [32,62] and one was good quality [23]. Eight more

studies found no significant association [22,27,42,43,57,66,85,88], including three good quality studies [22,85,88].

3.3.11. Emotions

There is good evidence for an association between parental emotions about the vaccine and uptake. Four studies cited fear of or concern about the vaccination as a self-reported reason against vaccination [32,44,49,81]. Reasons for vaccination included anticipated regret if parents refused vaccination and their child developed the illness [33].

Studies investigating parental worry about vaccination [50,64]; fear of the illness [56]; and anxiety about vaccination [56] all found an association with vaccine refusal. One study investigating maternal psychological distress did not find an association [68]. Two studies investigated feelings of guilt or the inability to forgive oneself if the child developed side-effects from vaccination [34,39]. Only one found an association [34]; both were of similar quality.

3.3.12. Trust in the government

Taken together, there is weak evidence for an association between trust in the government and child vaccination. Parents in one study reported not vaccinating their child because they did not trust the government [33]. Parental self-reported reasons for vaccination included because it was required by law [64] and because the child received vaccines according to the national immunisation programme [33].

An association was found by two of three studies that investigated trust in the government and child vaccination [24,46]. Both were moderate quality, however, the study not finding an association was good quality [29]. Belief that there is a conspiracy was also associated with vaccine refusal [85], whereas the perception that there is government pressure to vaccinate was not associated with vaccination [40].

3.3.13. Multiple/combination vaccines

There is mixed evidence of an association between perceptions surrounding multiple vaccination and uptake of combination vaccines. Three studies reported that parents did not vaccinate their child because they felt that they received too many or enough injections [28,37,80]; another reported that parents did not want the child to have multiple vaccines at once [75].

One study found an association between vaccine refusal and the belief that children receive too many vaccines, and that multiple vaccinations overwhelm the immune system [70], whereas two studies found no association [66,87]. Similarly, only one of three studies found an association between not accepting multiple vaccines in a single appointment and vaccine refusal [29]. Although this was a good quality study, one of the studies that did not find an association was also good quality [83], whereas the other was moderate quality [25]. The perception that combination vaccines are a greater concern than single vaccines and are too much in one go [34]; that combination vaccines are harmful [85]; and that separate vaccines are more appropriate than combination vaccines [24] were also associated with vaccine refusal.

3.3.14. Preference for natural immunity

There is some evidence for an association between parents' preference for natural immunity and vaccine refusal. Parental reasons against vaccination included having a preference for natural immunity [36,65] or a homeopathic alternative [33,75]; and believing that having the illness was beneficial for the child and strengthened their immune system [31]. Parents' reasons for vaccinating also included wanting to strengthen the child's immune system [31].

An association was found between vaccine refusal and parents' preference for acquiring immunity through illness over vaccination

[34]; believing that infections are good for the immune system [85]; believing that vaccination impairs natural immunity [56]; and believing that vaccines are unhealthy [39]. All studies were moderate quality bar one, which was good quality [85].

3.3.15. Self-efficacy and perceived behavioural control

Generally, there is weak evidence for an association between self-efficacy and perceived behavioural control and child vaccination. Perceived behavioural control was associated with vaccination in one moderate quality study [67], whereas locus of control was not associated with vaccination status in a good quality study [88]. Two studies investigating the association between self-efficacy and child vaccination found no association [87,88].

3.3.16. Intention

Parents of unvaccinated children reported intending to vaccinate their child in the future in five studies [22,35,37,65,80].

One longitudinal study found that intention to vaccinate one's child was associated with subsequent behaviour [25].

4. Discussion

This is the first comprehensive review describing psychological, social and contextual factors associated with vaccination in young children. In line with findings from previous reviews of child vaccination [9,11] and wider reviews of medication adherence [89], perceiving vaccination to cause adverse effects was consistently associated with vaccine refusal. Many high quality papers [23,28,29,83] found this association and it was also the most commonly self-reported reason against vaccination. While there was strong evidence of an association between low perceived susceptibility to an illness and vaccine refusal, evidence for a role of perceived illness severity was weak. This may be because parents will first consider whether their child is susceptible to an illness before considering how severe the illness may be. Future communications should focus on children's susceptibility to an illness rather than severity of the illness.

Few studies have investigated information about vaccination or the influence of different sources of information, with inconsistent results. Although parental satisfaction with information was associated with vaccination uptake [31,70], information seeking behaviour was associated with vaccine refusal [33]. One possible explanation is that parents' distrust of information causes them to seek information from multiple sources, including the internet and social media [90]. Unfortunately, many websites perpetuate vaccine 'myths' [91]. Likewise, influence of information disseminated by the media (in newspapers, magazines and on the television) was associated with vaccine uptake [50] and refusal [39,85]. No studies included investigated the influence of social media on vaccine uptake, even though it likely affects vaccination behaviour in certain countries. This is perhaps due the fact that social media is a relatively new phenomenon. More research is needed on the influence of information to improve the content and dissemination of public health messages. Messages could focus on increasing individuals' capability, opportunity and motivation to vaccinate their child, as suggested by the behaviour change wheel [92].

We found no experimental studies using interventions to alter parental attitudes using vaccination uptake as an outcome for this age group. This is a logical next step for vaccine uptake research. Although research on interventions to change parental attitudes towards vaccination has been carried out [93], outcomes are usually only measured as a change in attitudes or intentions. Other intervention studies have investigated the impact of additional reminders through new modes of communication, such as text

message reminders [94,95], rather than investigating the content of different messages. Our review highlights factors which could be targeted by such messages.

4.1. Limitations of the literature

Studies included in the review varied in quality and reported different details of methods used. For example, some studies defined 'vaccinated' by specifying a number of vaccine doses, a time frame and how it was ascertained that the child was vaccinated, while others simply stated that children 'were vaccinated.' Papers also differed in factors adjusted for in their analyses.

Most included studies were cross-sectional, therefore causal inferences between psychological predictors and vaccine uptake can only be made with caution. However, twelve cohort studies were included in the review. More prospective longitudinal or intervention studies are now needed.

4.2. Limitations of the review

Demographic predictors of vaccination and qualitative research were excluded from the review for pragmatic reasons, meaning some potential predictors of vaccination may have been overlooked. Reviews of qualitative literature investigating child vaccination yield similar results to those found in this review [9]. Results were not split by vaccine. Differing strengths of association between factors and particular vaccines may exist.

Some studies investigated differences between parents who did not vaccinate their child on time and those who did not vaccinate their child at all (e.g. [27,96]). We did not differentiate between these outcomes. It may be that important differences exist between hesitancy and refusal that could be usefully studied further by future research.

Literature not published in English was excluded due to time and cost constraints. Finally, as one person (LS) carried out the review, completing data extraction and risk of bias assessment, we cannot rule out human error or experimenter bias.

4.3. Conclusions

This is the first systematic review identifying psychological predictors of uptake of routine child vaccinations. Our results indicate that to improve uptake, communications to parents should address concerns over vaccines causing adverse effects and focus on children's susceptibility to the illness as well as promoting the belief that the vaccine is effective. Increasing parents' knowledge of the vaccine schedule and ensuring all healthcare providers recommend vaccination may also increase uptake. More research on the influence of different sources of information is needed to determine the best way to disseminate information to parents.

Author contributions

LS designed the search strategy with guidance from GJR, JY, JW and RA. LS carried out the search, screening, data extraction and quality appraisal with guidance from GJR and JY. All authors read and approved the final version of the manuscript.

Funding sources

LS is funded by the Economic and Social Research Council through a Doctoral Training Centre Studentship. The research was funded by the National Institute for Health Research Health Protection Research Unit (NIHR HPRU) in Emergency Preparedness and Response at King's College London in partnership with Public

Health England (PHE). The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR, the Department of Health or Public Health England.

Conflict of interest

None.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.vaccine.2017.09.046>.

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