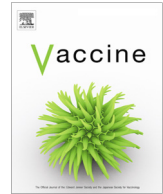




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Parental acceptance of and preferences for administration of routine varicella vaccination in the UK: A study to inform policy

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ABSTRACT

Objectives: To explore acceptability of and preferences for the introduction of varicella vaccination to the UK childhood immunisation schedule.

Design: We conducted an online cross-sectional survey exploring parental attitudes towards vaccines in general, and varicella vaccine specifically, and their preferences for how the vaccine should be administered.

Participants: 596 parents (76.3% female, 23.3% male, 0.4% other; mean age 33.4 years) whose youngest child was aged 0–5 years.

Main outcome measures: Willingness to accept the vaccine for their child and preferences for how the vaccine should be administered (in combination with the MMR vaccine [MMRV], on the same day as the MMR vaccine but as a separate injection [MMR + V], on a separate additional visit).

Results: 74.0% of parents (95% CI 70.2% to 77.5%) were extremely/somewhat likely to accept a varicella vaccine for their child if one became available, 18.3% (95% CI 15.3% to 21.8%) were extremely/somewhat unlikely to accept it and 7.7% (95% CI 5.7% to 10.2%) were neither likely nor unlikely. Reasons provided by parents likely to accept the vaccine included protection from complications of chickenpox, trust in the vaccine/healthcare professionals, and wanting their child to avoid their personal experience of chickenpox. Reasons provided by parents who were unlikely included chickenpox not being a serious illness, concern about side effects, and believing it is preferable to catch chickenpox as a child rather than as an adult. A combined MMRV vaccination or additional visit to the surgery were preferred over an additional injection at the same visit.

Conclusions: Most parents would accept a varicella vaccination. These findings highlight parents' preferences for varicella vaccine administration, information needed to inform vaccine policy and practice and development of a communication strategy.

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1. Introduction

1.1. Varicella infection

Varicella (chickenpox) is a common, highly infectious disease caused by the varicella-zoster virus (VZV) with a peak age for infection in the UK before the age of five years.[1] Although generally mild, it can be severe in immunocompromised individuals, adults, pregnant women and neonates. However, most children requiring hospitalisation for complications are previously healthy.[2]

Following a primary VZV infection the virus remains dormant in the dorsal root ganglia and can reactivate, causing herpes zoster (shingles). This typically occurs later in life due to reduced immunity, but it can also affect younger people.

Although varicella is not notifiable in England and Wales,[3] a recent study estimated that there were, on average, 4,694 hospital admissions per year in England between 2004 and 2017, of which 38.14% had known complications such as skin, neurological or gastrointestinal problems.[4] Admissions were highest in the 0–1 years age category, while complications were highest in adult age groups; they were also higher in children over 1 year of age compared to younger children. Hobbelen et al estimate the cost of varicella to the NHS for 2013/14 was £6.8 million.[5]

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1.2. Varicella vaccine

Safe, effective live attenuated varicella vaccines have been available since the 1980s, with the reported effectiveness of one dose about 80% against all varicella and almost 100% against moderate to severe varicella disease.[6] The World Health Organization (WHO) recommends the inclusion of the vaccine in routine vaccination programmes in countries where the infection is an important public health burden. As of 2018, 36, mainly higher-income, countries had implemented a universal varicella vaccination programme. Varicella vaccine can be given to individuals over one year of age with at least a four-week interval between the two doses and administered as a monovalent vaccine (V) or as a quadrivalent vaccine combined with measles, mumps and rubella (MMRV). Both monovalent and quadrivalent vaccines have been demonstrated to be safe and effective, although there is a small increased risk of fever and febrile seizures associated with MMRV vaccine given to children aged two or younger compared with MMR + V.[7] Nevertheless, several countries such as Germany, Australia and the US routinely offer MMRV.

A range of approaches can be taken in implementing the two-dose varicella vaccine within the routine childhood vaccination schedule. The most common is a first dose at 12–18 months with a second between 4 and 6 years; a shorter interval of at least three months between doses can be used. [8] In the UK, a monovalent vaccine offered at 12 months at the same time as existing vaccines according to the current (2023) vaccination schedule would require an additional injection, making five in total.

1.3. UK varicella vaccination policy

Currently in the UK, a selective vaccination policy recommends two doses of a single antigen varicella vaccine for family members of immunocompromised individuals and healthcare workers.[9] Varicella vaccine is also available on a private basis, although it is not possible to estimate coverage.

In the UK in 2010, the Joint Committee on Vaccination and Immunisation (JCVI) recommended a two-dose childhood varicella vaccination programme should not be introduced, due to lack of cost-effectiveness. Subsequently, consideration was given to introducing a one-dose programme but modelling showed this too would not be cost-effective.[10] Key considerations regarding the introduction of a varicella vaccine programme in the UK relate to concerns that it would result in reduced exposure to VZV, which is thought to play a role in boosting immunity among immune individuals. Hypothetically, without this boosting, there could be an increased incidence of herpes zoster, making the programme not cost-effective. A herpes zoster vaccine programme for adults aged 70 to 79 was introduced in 2013, which may lessen this concern. Very high varicella vaccine uptake rates are also required, since less than optimal uptake could reduce but not eliminate infection, increasing the age of acquisition of varicella to older age groups, in whom disease is more severe.[11].

The introduction of universal varicella vaccine in the UK is being re-considered.[4] Ensuring the successful introduction of any childhood vaccine programme requires an understanding of parents' knowledge and attitudes regarding the disease and acceptability of the vaccine to inform policy and development of a vaccine communication strategy. However, UK research on current parental attitudes to childhood varicella and varicella vaccine is limited. In one 2007 study of over 800 parents in three primary care trusts, most rated the severity of chickenpox to be no more than unpleasant, with only 40% saying they would accept a recommended vaccine.[12] In contrast, 61% parents attending two London hospitals considered varicella to be serious, with 67% accepting a vaccine.[13] and more recently, in a 2020 survey of

1,510 parents commissioned by Public Health England (PHE), 66% of parents would accept a varicella vaccine. Parents in this survey considered chickenpox to be the least serious (44% serious or fairly serious) compared with other vaccine-preventable childhood infections (L Letley, personal communication, 2022).

This study aimed to explore parents' knowledge of and views regarding varicella infection and varicella vaccination in the UK, including preferences for timing and administration (combination or separate vaccine), with the findings intended to inform any future implementation of routine varicella vaccination.

2. Method

2.1. Design

We conducted a cross-sectional survey between July and August 2021. Participants completed the survey online on the web-based survey tool "Qualtrics".

2.2. Participants

Participants (n = 601) were recruited through Prolific (<https://prolific.co/>), an online research panel. Participants were eligible to take part if they were resident in the UK and their youngest child was born between 2017 and 2021. Of 628 people who began the survey, 605 completed it (96.3% completion rate). Three participants were omitted from the sample as they did not meet quality control checks and one was omitted as they left their country of residence blank. Participants were paid £1.75 per completed survey.

2.3. Sample size

A sample size of 601 was chosen to provide appropriately precise estimates of proportions, with a margin of error no worse than $\pm 4\%$, at a 95% confidence level.

2.4. Measures

The questionnaire was developed based on a literature review of determinants of childhood vaccine uptake. The final questionnaire is available online <https://osf.io/gx9zd/>.

Participants were asked for demographic details of themselves and their child(ren), specifically age, gender, ethnicity, religion, highest level of education or professional qualification, current working situation, total household income, marital status and whether they had a disability. The age and gender of their (up to four) youngest child(ren) was sought and whether they had heard of chickenpox prior to this survey.

Questions regarding chicken pox and varicella vaccine included: perceptions of the seriousness of the disease, acceptability of a varicella vaccine and preferences for administration; attitudes towards vaccination generally were also sought. Participants were asked to respond with their youngest child ('index child') in mind.

All participants who had previously heard of chickenpox were asked whether their child had already had it. Participants were asked to indicate on a 5-point Likert scale (from strongly agree to strongly disagree) the extent to which they were worried that their child might catch chickenpox, and if they would intentionally expose their child to it. Parents were asked to indicate their agreement with statements: "chickenpox is usually a mild disease in healthy children"; "chickenpox can cause serious complications"; "it is better to have chickenpox when you are a child than when you are an adult".

Participants were asked if their child had already had the chickenpox vaccine and, if not, we informed them that it is already recommended for children in some countries and asked them to rate on a 5-point scale how likely it was (from extremely unlikely to extremely likely) they would accept the vaccine if it was recommended in the UK; parents were asked if *any* of their children had had chickenpox.

We then provided *all* parents with basic information about the infection and the vaccine and that it is recommended for children in some countries (see Appendix); they were asked again to rate how likely it was that they would accept a chickenpox vaccine if recommended in the UK. A follow-up open-ended question sought the main reason for accepting or declining the vaccine for their child.

To explore preferences for administration of varicella vaccine, three possible scenarios for each of two vaccine doses for including varicella vaccine in the UK vaccination schedule were provided. Participants were asked to indicate for each scenario the likelihood of accepting the vaccine for their child. These were: 1) chickenpox vaccine given as a combination 4-in-1 vaccine with MMR (MMRV) at 12 months (2nd dose at 3 years 4 months); 2) a separate vaccine given at the same time as the 12 month vaccines (2nd dose at the same time as the 2nd MMR vaccine pre-school); 3) separately at another visit after the 12 month vaccines (2nd dose at 15–18 months). The maximum number of injections parents considered acceptable for their child on any one occasion was sought.

To explore parental attitudes to vaccination generally, we modified the WHO SAGE Vaccine Hesitancy Scale (VHS) [14,15] for use in a UK setting. Although developed to measure parental vaccine hesitancy, some statements were adapted to assess general attitudes rather than hesitancy specifically. Perceptions of vaccine safety and effectiveness were sought by including definitions of 'safe' ('means serious side effects are rare') and 'effective' ('means that most vaccines give good protection') to ensure consistent interpretation by respondents. The scale is composed of five-point Likert items (scored 1–5). Two subscale scores were derived by summing scores on these individual items: a 'lack of confidence score' (from eight items; possible range 5–40) and a 'risk' score (from two items; possible range 2–10) (see Table 4). In each case higher scores indicate greater hesitancy.

Sources of information about vaccination (all sources and main source) were sought from a list of 19 options based on those provided in the PHE childhood immunisation tracking surveys. [16] Lastly, participants were asked to indicate the extent to which they agreed or disagreed with a series of statements about trust in various sources of vaccination advice.

Three unrelated attention check questions were included as a quality control measure. Participants were excluded if they answered two or more of these questions incorrectly.

2.5. Patient and public involvement

The public were not involved in the design, conduct, reporting or dissemination plans of our study.

The study was reviewed and approved by Keele University's Psychology Research Ethics Committee (reference: PS-210200).

2.6. Analysis

Descriptive statistics (means, standard deviations, counts and percentages) are provided for all measures. The open-ended responses for reasons why participants were likely or unlikely to have a chickenpox vaccination, were analysed with content analysis using an emergent coding approach, whereby codes were identified from the data.[17]

Potential predictors of vaccination likelihood were analysed through ordinal logistic regression. Predictors were identified *a priori* and included: parental demographics (age and gender); whether the respondent had ever refused a vaccine for his or her child; whether the index child had had chickenpox; a belief that chickenpox is usually a mild disease in healthy children; a belief that chickenpox can cause serious complications; and the hesitancy subscales (lack of confidence and risk). The proportional odds assumption of the analysis was checked and statistical significance was set at $p \leq 0.05$ (two-tailed). Estimates are presented as odds ratios, with 95% confidence intervals (CIs). The predictive power of the whole regression model is expressed by the Nagelkerke pseudo- R^2 statistic, which ranges from 0 to 1, with higher values indicating greater predictive power. The predictive power of an ordinal variable (which is represented by more than one odds ratio) is expressed by the increase in the Nagelkerke R^2 that its addition to the model produced.

3. Results

The survey was completed by a total of 601 participants. Five had not previously heard of chickenpox and so their data were not analysed further, leaving 596 participants aged between 19 and 50 years (mean = 33.4, standard deviation = 5.2) who were included in the data analysis. Participant characteristics and those of their children are detailed in Table 1.

3.1. Parents' experiences of and attitudes to varicella infection

Parents generally considered varicella to be mild in children but more severe in adulthood. However, over half agreed that it could cause serious complications (Table 2). Over half the parents disagreed with intentionally exposing their child to others with varicella, and those whose child had not already had chickenpox expressed worry that their child would catch it. Vaccination intention is shown in Table 3; of 546 participants, after receiving information about varicella and the vaccination, 404 (73.9%; 95% CI 70.2% to 77.5%) were extremely/somewhat likely to accept a chickenpox vaccine for their child if available, 100 participants (18.2%; 95% CI 15.3% to 21.8%) were extremely/somewhat unlikely to accept it, and 42 participants (7.7%; 95% CI 5.7% to 10.2%) were neither likely nor unlikely.

3.2. Effect of information on parents' acceptance of a varicella vaccine

Before reading information on varicella infection and vaccine, 76.0% of participants responded that they would be extremely or somewhat likely to accept a varicella vaccine for their child; this changed little after the information was provided, with 73.9% extremely or somewhat likely to accept the vaccine (Table 3). Respondents were asked to describe the main reason for accepting or declining a varicella vaccine. The content analysis generated 115 unique codes. The most frequent codes generated from those likely to accept the vaccine were Protect child ($n = 158$), Avoid complications ($n = 58$) and Follow recommendations ($n = 38$). The most frequent codes from those who were uncertain, were Need more info ($n = 8$), Mild illness ($n = 6$), Already had chickenpox ($n = 3$). The most frequent codes for those who were unlikely, were Mild illness ($n = 30$), Unnecessary ($n = 20$), Chickenpox complications rare ($n = 10$). The full list of codes is in the [Supplementary Materials](#).

3.3. Attitudes towards options for administration of varicella vaccine

Two thirds of respondents (65.6%) reported they would be extremely or somewhat likely to accept a varicella vaccine for their

Table 1
Participant characteristics.

Demographic questions	Level	n (%)
Gender	Female	455 (76.3)
	Male	139 (23.3)
	Non-binary	1 (0.2)
Ethnicity	Prefer not to say	1 (0.2)
	White	505 (84.7)
	Other ethnic groups	91 (15.3)
Religion	No religion	362 (60.7)
	Christian	175 (29.4)
	Other religion	56 (9.4)
	Prefer not to say	3 (0.5)
Highest qualification	Degree equivalent or higher	336 (56.4)
	Other or no qualifications	254 (42.6)
	Prefer not to say/don't know	6 (1.0)
Employment	Full time (30 h per week or more/furloughed)	269 (45.1)
	Part time (8–29 h per week/furloughed)	167 (28.0)
	Not working or other	159 (26.7)
	Prefer not to say	1 (0.2)
	Under £10,000	16 (2.7)
Household income	£10,000–£19,999	57 (9.6)
	£20,000–£29,999	86 (14.4)
	£30,000–£39,999	121 (20.3)
	£40,000–£49,999	96 (16.1)
	£50,000–£74,000	133 (22.3)
	£75,000 or over	68 (11.4)
	Don't know	1 (0.2)
	Prefer not to say	18 (3.0)
Marital status	Married or living with partner	520 (87.2)
	Single or other	75 (12.6)
	Prefer not to say	1 (0.2)
Disability	No	572 (96.0)
	Yes	22 (3.7)
	Prefer not to say	2 (0.3)
Number of children in family	1 child only	242 (40.6)
	2 children	251 (42.1)
	3 children	50 (8.4)
	4 children or more	53 (8.9)
Age of youngest child	0–1 Years	138 (23.2)
	1	147 (24.7)
	2	132 (22.1)
	3	118 (19.8)
	4	54 (9.1)
	5 + years	7 (1.2)

child if it were part of a combination vaccine given at 12 months of age at the same time as other vaccines. Fewer parents (46.5%) would be extremely or somewhat likely to accept the vaccine at 12 months if it were given separately at the same time as the other vaccines. If the vaccine was offered separately at another vaccine visit, 61.6% reported they would be extremely or somewhat likely to accept it (Table 4). Responses to items in the vaccine hesitancy scale are shown in Table 5. 93.6% of parents indicated that they had never refused a vaccine for their child/children, with only 5.9% indicating that they had.

Information sources used by parents on vaccination are detailed in Table 6, including their main source. A breakdown of specific internet sites used is provided in Supplementary Materials. Table 7 details parents' level of trust in different information sources.

Based on the percentage of those somewhat or strongly agreeing with the statement "I trust advice" from each source, the most trusted were reported to be GPs (93.2%), practice nurses (92.9%), the NHS (92.3%), health visitors (87.8%), pharmacists (79.6%) and the government (67.9%) (Table 7). The least trusted source was social media (6.4% somewhat or strongly agreeing).

Table 2
Parents' attitudes to and experience of chickenpox disease.

Chickenpox knowledge and beliefs	Level	n (%)
I am worried that my child may get chickenpox *	Strongly agree	52 (9.9)
	Somewhat agree	195 (37.3)
	Neither agree nor disagree	88 (16.8)
	Somewhat disagree	126 (24.1)
	Strongly disagree	62 (11.9)
If my friend's child had chickenpox, I would try and make sure my child had close contact with them in the hope they would catch chickenpox *	Strongly agree	23 (4.4)
	Somewhat agree	102 (19.5)
	Neither agree nor disagree	93 (17.8)
	Somewhat disagree	147 (28.1)
	Strongly disagree	158 (30.2)
Chickenpox is usually a mild disease in healthy children	Strongly agree	132 (22.1)
	Somewhat agree	339 (56.9)
	Neither agree nor disagree	85 (14.3)
	Somewhat disagree	28 (4.7)
	Strongly disagree	12 (2.0)
Chickenpox can cause serious complications	Strongly agree	97 (16.3)
	Somewhat agree	233 (39.1)
	Neither agree nor disagree	154 (35.8)
	Somewhat disagree	107 (18.0)
	Strongly disagree	5 (0.8)
It is better to have chickenpox when you are a child than when you are an adult	Strongly agree	398 (66.8)
	Somewhat agree	161 (27.0)
	Neither agree nor disagree	28 (4.7)
	Somewhat disagree	8 (1.3)
	Strongly disagree	1 (0.2)
Experience of chickenpox		
Has your child already had chickenpox?	Yes	73 (12.2)
	No	517 (86.7)
	Don't know	6 (1.0)
Have any of your children had chickenpox? *	Yes	141 (27.0)
	No	378 (72.3)
	Don't know	4 (0.8)
Chickenpox vaccine		
Has your child already had the chickenpox vaccine?	Yes	49 (8.2)
	No	490 (82.2)
	Don't know	55 (9.2)
	Prefer not to say	2 (0.3)

* Participants who reported their child had already had chickenpox were not given these statements and were excluded from the percentage calculation ($n = 523$).

In our regression analysis (Table 8), parental age and gender were non-significant predictors of vaccination intention; the other predictors were significant. For the vaccination hesitancy subscales, higher scores on 'lack of confidence' and 'risk' indicated lower odds (less likelihood) of a higher score on the intention scale.

Table 3
Parental intention to vaccinate; n (%).

		Before information (n = 547) *	After information (n = 546) *
If a vaccine to protect against chickenpox was recommended in the UK, how likely is it that you would accept it for your child?	Extremely likely	231 (42.2)	233 (42.6)
	Somewhat likely	185 (33.8)	171 (31.3)
	Neither likely nor unlikely	42 (7.7)	42 (7.7)
	Somewhat unlikely	53 (9.7)	62 (11.3)
	Extremely unlikely	36 (6.6)	38 (6.9)

* Participants whose children had already had chickenpox vaccine were not asked how likely they would accept a chickenpox vaccine and they are not included in the totals.

Across the categories of the 'chicken pox is a mild disease in healthy children' variable, there was a weak (R^2 change = 0.016) negative association with vaccination intention, indicating that stronger agreement with this statement predicts weaker vaccination intention. For the 'chickenpox can cause serious complications' variable, there was a somewhat stronger (R^2 change = 0.054) positive association, indicating that stronger agreement with this statement predicts stronger vaccination intention.

Table 4
Parental intention to accept different options for administration of the varicella vaccine (n = 596).

Item	Level	n (%)	
First dose of chickenpox vaccine			
First dose of chickenpox vaccine given in combination with MMR vaccine as a 4-in-1 vaccine (MMRV)	Extremely likely	187 (31.4)	
	Somewhat likely	204 (34.2)	
	Neither likely nor unlikely	51 (8.6)	
	Somewhat unlikely	89 (14.9)	
	Extremely unlikely	65 (10.9)	
First dose as a separate vaccine at the same time as the vaccines given at 12 months	Extremely likely	104 (17.5)	
	Somewhat likely	173 (29.0)	
	Neither likely nor unlikely	77 (12.9)	
	Somewhat unlikely	142 (23.8)	
	Extremely unlikely	99 (16.6)	
First dose of chickenpox vaccine given separately at another visit after the vaccines given at 12 months	Left blank	1 (0.2)	
	Extremely likely	169 (28.4)	
	Somewhat likely	198 (33.2)	
	Neither likely nor unlikely	74 (12.4)	
	Somewhat unlikely	96 (16.1)	
Extremely unlikely		59 (9.9)	
	Second dose of chickenpox vaccine		
	Second dose of chickenpox vaccine given separately at another visit at 15–18 months	Extremely likely	172 (28.9)
		Somewhat likely	208 (34.9)
		Neither likely nor unlikely	65 (10.9)
Somewhat unlikely		99 (16.6)	
Extremely unlikely		52 (8.7)	
Second dose of chickenpox vaccine given in combination with the pre-school dose of MMR vaccine as a 4-in-1 vaccine (MMRV) at 3 years 4 months	Extremely likely	187 (31.4)	
	Somewhat likely	220 (36.9)	
	Neither likely nor unlikely	59 (9.9)	
	Somewhat unlikely	74 (12.4)	
	Extremely unlikely	56 (9.4)	
Second dose of chickenpox vaccine given as a separate vaccine at the same time as the pre-school MMR vaccine	Extremely likely	119 (20.0)	
	Somewhat likely	200 (33.6)	
	Neither likely nor unlikely	90 (15.1)	
	Somewhat unlikely	117 (19.6)	
	Extremely unlikely	70 (11.7)	
Injections per visit			
How many injections would you want your child to have on any one occasion?	No more than 2	183 (30.7)	
	No more than 3	61 (10.2)	
	No more than 4	93 (15.6)	
	No more than 5	5 (0.8)	
	I would be happy to go along with whatever the NHS recommends	241 (40.4)	
	Not applicable	13 (2.2)	

4. Discussion

We found high levels of acceptability of a varicella vaccine among UK parents of young children with preference for a combined MMRV vaccine or varicella vaccine delivered at an additional immunisation visit rather than as an additional vaccination at an existing visit. Higher likelihood of accepting the vaccine was associated with agreeing that varicella can cause complications, while lower likelihood of acceptance was associated with agreeing that varicella is normally a mild illness and with a lack of confidence in vaccines and concern about risk (both generally and of serious adverse events) as measured by the vaccine hesitancy scale. Our content analysis provides more detail, with parents who were likely to accept the vaccine being most concerned about protecting their child (from complications, from suffering in adulthood and from experiencing the discomfort of chickenpox) and other people, especially vulnerable others.

Our findings provide a snapshot of views in the midst of the COVID-19 pandemic when a much-publicised COVID-19 vaccine programme was being rolled out for adults. While this may have affected responses, making parents more aware of vaccination (both positively and negatively), the positive attitudes to a childhood vaccination reported by our participants reflect other UK studies of attitudes towards childhood vaccines generally [16,18] and attitudes towards specific vaccines, including new ones such as the meningococcal group B (MenB) vaccine.[19] Our study confirms that parents value vaccination, consider it to be important,

Table 5
General vaccination views ($n = 596$).

Item	Level	n (%)
Vaccine hesitancy scale		
Childhood vaccines are important for my child/children's health*	Strongly agree	451 (75.7)
	Somewhat agree	123 (20.6)
	Neither agree nor disagree	10 (1.7)
	Somewhat disagree	7 (1.2)
	Strongly disagree	5 (0.8)
Childhood vaccines are effective ('effective' means that most vaccines give good protection)*	Strongly agree	430 (72.1)
	Somewhat agree	136 (22.8)
	Neither agree nor disagree	20 (3.4)
	Somewhat disagree	5 (0.8)
	Strongly disagree	5 (0.8)
Vaccines are generally safe ('safe' means serious side effects are rare)*	Strongly agree	371 (62.2)
	Somewhat agree	175 (29.4)
	Neither agree nor disagree	36 (6.0)
	Somewhat disagree	8 (1.3)
	Strongly disagree	6 (1.0)
Having my child/children vaccinated is important for the health of others in my community*	Strongly agree	395 (66.3)
	Somewhat agree	139 (23.3)
	Neither agree nor disagree	38 (6.4)
	Somewhat disagree	13 (2.2)
	Strongly disagree	11 (1.8)
All childhood vaccines offered by the NHS are beneficial*	Strongly agree	384 (64.4)
	Somewhat agree	139 (23.3)
	Neither agree nor disagree	50 (8.4)
	Somewhat disagree	15 (2.5)
	Strongly disagree	8 (1.3)
New vaccines carry more risk than older vaccines [#]	Strongly agree	56 (9.4)
	Somewhat agree	153 (25.7)
	Neither agree nor disagree	173 (29.0)
	Somewhat disagree	143 (24.0)
	Strongly disagree	71 (11.9)
The information I receive about vaccines from the NHS is reliable*	Strongly agree	315 (52.9)
	Somewhat agree	197 (33.1)
	Neither agree nor disagree	62 (10.4)
	Somewhat disagree	14 (2.3)
	Strongly disagree	8 (1.3)
Getting vaccines is a good way to protect my child/children from disease*	Strongly agree	422 (70.8)
	Somewhat agree	143 (24.0)
	Neither agree nor disagree	18 (3.0)
	Somewhat disagree	8 (1.3)
	Strongly disagree	5 (0.8)
Generally I do what my doctor or health care provider recommends about vaccines for my child/children*	Strongly agree	345 (57.9)
	Somewhat agree	171 (28.7)
	Neither agree nor disagree	54 (9.1)
	Somewhat disagree	21 (3.5)
	Strongly disagree	5 (0.8)
I am concerned about serious adverse effects of vaccines [#]	Strongly agree	60 (10.1)
	Somewhat agree	192 (32.2)
	Neither agree nor disagree	130 (21.8)
	Somewhat disagree	162 (27.2)
	Strongly disagree	52 (8.7)

* Items comprising the 'lack of confidence' hesitancy subscale (scored 1 = strongly agree, to 5 = strongly disagree). [#] Items comprising the 'risk' hesitancy subscale (scored 1 = strongly disagree, to 5 = strongly agree).

and are receptive to the inclusion of a varicella vaccine in the routine programme. Although they have a preference for their child having fewer injections, many parents would still accept a varicella vaccine even if this required an additional injection, with a clear demonstration of trust in health care professionals and in the NHS and a willingness to follow recommendations.

To our knowledge, this is the largest recent study of parental views about varicella conducted in the UK. The sample is broadly representative for ethnicity and there was a high completion rate. One possible limitation is that the participants in this study were recruited through an online research panel and by definition therefore more willing to take part in research. In addition, despite it being a common childhood illness, only 12% of youngest children were reported to have had chickenpox and only 27% of those whose youngest children had not had it reported that their other children had. This may have been affected by the timing of the

survey during the COVID-19 pandemic: a time when reports of other childhood infections such as measles have also been less common due to public health measures such as lockdowns, social distancing and restrictions on overseas travel.[20] It is possible this lack of direct experience of varicella may have influenced parents' responses. As 93.6% of our sample reported never having refused a vaccine for their child, our sample is unlikely to have captured the views of parents who decline vaccines and who may be less likely to accept additional vaccines. Finally, although the sample was broadly representative for ethnicity, the sample was generally more highly educated and with a higher income than the population of the UK, and since the data were collected online, only parents with internet access were represented.

The WHO recommends introducing routine varicella vaccination only if 80% or greater coverage can be achieved.[21] Although our study suggests that the majority of parents would accept a

Table 6
Sources of vaccination information (n = 596).

General sources Item	Source of vaccination information n (%)	Main source of vaccination information n (%)
Your GP	541 (90.8)	207 (34.7)
Practice nurse/Nurse in GP clinic	336 (56.4)	91 (15.3)
Health Visitor	382 (64.1)	78 (13.1)
Midwife	189 (31.7)	3 (0.5)
Pharmacist	56 (9.4)	1 (0.2)
School nurse	58 (9.7)	0 (0)
NHS.uk	374 (62.8)	110 (18.5)
Alternative health practitioner e.g. homeopath	7 (1.2)	0 (0)
NHS leaflets	209 (35.1)	15 (2.5)
NHS 111 telephone service	28 (4.7)	0 (0)
Red book/Personal Child Health Record	270 (45.3)	29 (4.9)
Other parents	122 (20.5)	0 (0)
Friends	122 (20.5)	3 (0.5)
Family	156 (26.2)	3 (0.5)
Television	31 (5.2)	0 (0)
Books	25 (4.2)	3 (0.5)
Newspapers	22 (3.7)	0 (0)
Magazines	11 (1.8)	0 (0)
Internet	219 (36.7)	48 (8.1)
Not applicable	1 (0.2)	1 (0.2)
Other (please describe)	6 (1.0)	2 (0.3)
Left blank	0 (0.0)	2 (0.3)

varicella vaccine, the well documented intention-behaviour gap, [22] whereby intention is usually higher than behaviour, means that steps would need to be taken to maximise uptake. Delivering the vaccine in line with parental preferences would be important and our data suggest that this should involve a combined MMRV vaccination, which would avoid an increase in both the number of injections and the number of appointments needed. It is also reassuring that more than 80% of parents reported usually following the advice of their healthcare provider.

Although there was little evidence of vaccine hesitancy in our cohort as measured by the VHS, responses were uneven to the question about whether new vaccines carry more risk than old vaccines. It will be important to emphasise to parents that the varicella vaccine is well established, having been administered routinely in many countries for many years and been available privately in the UK. Another implication of our findings for vaccine communication is a need to advise parents that although chickenpox is usually a mild childhood disease, it can have serious side effects. In our open-ended question, for those parents who reported being unlikely to have the vaccine for their child, one of the most frequently reported reasons was that chickenpox is a mild disease and this was also a predictor of lower likelihood of acceptance in our regression analysis.

Our study has provided insight into the likely views and preferences of parents should varicella be added to the routine childhood immunisation schedule in the UK. It would be useful to also understand knowledge and views of health care professionals involved in vaccine programmes who would be recommending and administering the vaccine, and research is underway to capture this information.

5. Conclusion

Our survey of UK parents reveals that introducing varicella vaccination to the routine childhood immunisation schedule would

likely be well received. By introducing it as a combined MMRV vaccine, and by advising parents that chickenpox can have complications and emphasising that varicella is a well-established and safe vaccine, there is the real potential to achieve WHO-recommended levels of uptake and significantly reduce the burden of both serious complications and unpleasant, albeit mild symptoms, from this common childhood infection on families and the NHS. These findings provide important information for policy makers in their discussions about introducing a varicella vaccine programme, regarding acceptability of a varicella vaccine, how it should be implemented and in developing appropriate immunisation information materials for parents.

Data availability

Data are available online <https://osf.io/gx9zd/>.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Transparency declaration

The authors affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as originally planned have been explained.

Data sharing statement

Data are available online <https://osf.io/gx9zd/>.

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Appendix

Information provided to all survey participants about varicella and varicella vaccine.

Table 7
Trust in vaccination sources ($n = 596$).

Item	Level	n (%)
I trust the advice on vaccination that I am given by my GP	Strongly agree	361 (60.6)
	Somewhat agree	194 (32.6)
	Neither agree nor disagree	26 (4.4)
	Somewhat disagree	8 (1.3)
	Strongly disagree	7 (1.2)
I trust the advice on vaccination that I am given by my practice nurse	Strongly agree	356 (59.7)
	Somewhat agree	198 (33.2)
	Neither agree nor disagree	28 (4.7)
	Somewhat disagree	7 (1.2)
	Strongly disagree	7 (1.2)
I trust the advice on vaccination that I am given by my health visitor	Strongly agree	296 (49.7)
	Somewhat agree	227 (38.1)
	Neither agree nor disagree	46 (7.7)
	Somewhat disagree	16 (2.7)
	Strongly disagree	11 (1.8)
I trust the advice on vaccination that I am given by the NHS	Strongly agree	372 (62.4)
	Somewhat agree	178 (29.9)
	Neither agree nor disagree	31 (5.2)
	Somewhat disagree	8 (1.3)
	Strongly disagree	7 (1.2)
I trust the advice on vaccination that I am given by the Government	Strongly agree	182 (30.5)
	Somewhat agree	223 (37.4)
	Neither agree nor disagree	109 (18.3)
	Somewhat disagree	53 (8.9)
	Strongly disagree	29 (4.9)
I trust the advice on vaccination that I am given in the newspapers, magazines, television or radio	Strongly agree	18 (3.0)
	Somewhat agree	109 (18.3)
	Neither agree nor disagree	197 (33.1)
	Somewhat disagree	198 (33.2)
	Strongly disagree	74 (12.4)
I trust the advice on vaccination that I am given by a pharmacist	Strongly agree	209 (35.1)
	Somewhat agree	265 (44.5)
	Neither agree nor disagree	92 (15.4)
	Somewhat disagree	20 (3.4)
	Strongly disagree	10 (1.7)
I trust the advice on vaccination that I am given by family and friends	Strongly agree	37 (6.2)
	Somewhat agree	106 (17.8)
	Neither agree nor disagree	242 (40.6)
	Somewhat disagree	179 (30.0)
	Strongly disagree	32 (5.4)
I trust the advice on vaccination that I am given on the internet	Strongly agree	18 (3.0)
	Somewhat agree	116 (19.5)
	Neither agree nor disagree	247 (41.4)
	Somewhat disagree	142 (23.8)
	Strongly disagree	73 (12.2)
I trust the advice on vaccination that I am given on social media	Strongly agree	9 (1.5)
	Somewhat agree	29 (4.9)
	Neither agree nor disagree	147 (24.7)
	Somewhat disagree	210 (35.2)
	Strongly disagree	201 (33.7)

Chickenpox

Chickenpox is caused by a virus which spreads very easily. Most people have the infection in early childhood when it is usually a mild disease. Most children with chickenpox have a fever, an itchy rash and are unwell for a few days. Serious complications can occur but are rare, these include pneumonia and other serious infections. Chickenpox is more serious in adults and in children who have a problem fighting infections.

Chickenpox vaccine

The chickenpox vaccine is given from the age of 12 months. It is given by injection. In the UK, two doses of the vaccine are recommended with a gap of at least 4 weeks between the doses.

Chickenpox vaccine can be given as a separate vaccine at the same time as other vaccines, or as a combined 4-in-1 vaccine with measles, mumps and rubella (MMRV). Both the separate and combined vaccines are safe with side effects including tenderness where the injection was given and occasionally a mild fever. However, for children under two years of age, there is a very small increased risk of a child having a fever fit when they are given the combination MMRV vaccine compared with the MMR vaccine and a separate chickenpox vaccine given on the same day.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2023.01.027>.

Table 8

Results of the ordinal logistic regression analysis. The outcome variable is the likelihood of vaccination (five-point scale from extremely unlikely to extremely likely). The association between an ordinal predictor and the outcome variable is quantified by the change in the Nagelkerke R^2 when the predictor is added to the model. $n = 536$. Nagelkerke R^2 for full model is 0.481.

	Odds ratio*	95% Wald confidence interval	Change in Nagelkerke R^2	p value
Age	0.983	0.950, 1.017		0.331
Gender (reference: male)	0.838	0.548, 1.281		0.414
Refused vaccine for children (reference: yes)	0.440	0.204, 0.949		0.036
Index child has already had chickenpox (reference: yes)	0.419	0.247, 0.710		0.001
Chickenpox is usually a mild disease in healthy children (reference: strongly agree)			0.016	0.011
Strongly disagree	1.575	0.334, 7.430		
Somewhat disagree	3.316	1.253, 8.775		
Neither	2.800	1.490, 5.261		
Somewhat agree	1.538	0.997, 2.373		
Chickenpox can cause serious complications (reference: strongly agree)			0.054	<0.001
Strongly disagree	0.071	0.008, 0.620		
Somewhat disagree	0.211	0.111, 0.403		
Neither	0.229	0.125, 0.421		
Somewhat agree	0.612	0.345, 1.084		
Vaccine hesitancy:				
Lack of confidence (8–40)	0.792	0.755, 0.831		<0.001
Risk (2–10)	0.774	0.695, 0.861		<0.001

* The odds ratios indicate the increase or decrease in the odds of a one-unit increase in the outcome variable for a one-unit increase in the predictor variable for continuous predictors, or for a shift from the reference category to the category in question for binary predictors. For an ordinal predictor the odds ratio is cumulative; it indicates the increase or decrease in the odds of a one-unit increase in the outcome variable for being a particular category in the predictor variable compared with being in any one of the lower categories.

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