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DOI

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ORIGINAL RESEARCH

Is the cultural context of MMR rejection a key to an effective public health discourse?

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Received 9 August 2005; received in revised form 4 February 2006; accepted 2 March 2006
Available online 7 July 2006

KEYWORDS

MMR;
Choice;
Homeopathy;
Vitamin K;
Survey

Summary Objectives: (1) To explore the social and cultural influences, and health beliefs associated with low uptake of MMR (measles, mumps and rubella vaccine). (2) To describe and explore the prevalence of health beliefs associated with non-compliance with MMR, with a view to improving the personal relevance and impact of information for parents, in the context of persisting low uptake following public controversy.

Methods: We undertook a survey of mothers' experiences of and attitudes to the MMR, developed through ethnographic study, which was linked to maternal and child information on the Child Health Database in Brighton, England.

Results: Mothers interpret MMR risk through concepts of child health embedded in family health history, with a majority both of compliers and non-compliers holding that each child's immune system is unique. Cultural 'risk factors' for non-compliance relate strongly to the use of complementary healthcare, such as homeopathy, with evidence that rejection of vitamin K is associated with MMR non-compliance. Forty per cent, both of compliers and non-compliers, did not consider the possible benefits to other children of MMR.

Conclusions: These findings have paradoxical and challenging consequences for the promotion of immunization in the policy context of increasing emphasis on healthy choices. They demonstrate the need for immunization information that acknowledges and addresses lay concepts of immunity.

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Introduction

Public debate about the safety of the measles, mumps and rubella (MMR) vaccine has continued in the UK since the publication of controversial data^{1–5} that raised concerns about adverse effects, but which has not been supported by epidemiological studies.^{6–8} Low rates of uptake, particularly of the first MMR dose at 13 months, followed. Governmental publicity campaigns aimed at reassuring parents continue, and are accompanied by surveys of maternal attitudes.⁹

The long duration of this downturn in MMR immunization rates, and the fact that it is not associated with economic deprivation (a risk factor for low uptake of immunization generally),^{9,10} have given rise to the hypothesis that MMR refusal may reflect a wider and developing distrust of government and its associated health institutions. This could have significance for a range of public health programmes, particularly immunization.

The need to combine qualitative and quantitative research methods in this field has been established.¹¹ In this study, we present data from a survey whose content was based on ethnographic study in a population with low rates of MMR uptake.¹² The survey drew on parental narratives about MMR decision-making and explored the relevance in a wider population of a range of social and cultural issues raised by parents in interviews and focus groups.

Materials and methods

Population and sampling

The sampling frame for our study consisted of all children aged 15–24 months listed on the Child Health Dataset held by South Downs Health NHS (National Health Service) Trust as resident in the catchment area of Brighton and Hove City PCT (Primary Care Trust), in early March 2004. Brighton and Hove is a coastal city, where uptake of MMR immunization as recorded on the Child Health Dataset is low with 69% recorded as having had MMR by age 2 in the financial year 2003–2004, by contrast with 86% in England as a whole.¹³ Children were categorized into those who had and had not had an MMR immunization recorded, and of the 1800 children eligible, a sample of 1000 MMR uptakers and non-uptakers in a ratio of 1:1 was randomly drawn, using the statistical program STATA™ Version 8. All the 135 registered children who had had no vaccination events recorded were also sampled.

A postal questionnaire addressed to the mother or guardian of each child was sent in March 2004. This contained a questionnaire for the mother, and also one to be passed where possible to the father of the child (not reported here). A follow-up letter with a second questionnaire was sent after 3–4 weeks to non-responders, with the exception of children who had had no vaccinations recorded, due to late receipt of the data needed for sampling.

Questionnaire design

The questionnaire was developed following 6 months of ethnographic study, reported elsewhere.¹² It was designed to explore hypotheses about emerging MMR concerns, and their relation with maternal demographic and compliance characteristics, in a representative population sample. The content and design of the questionnaire was developed by the multidisciplinary team of authors together with an advisory group, which included anthropologists, epidemiologists, public health specialists, community nursing specialists, vaccine damage activists and national policy makers.

The questionnaire explored the following issues: rank of child within the family; sources of information on parenting and immunizations; early health of the child (including its birth); views on the risks associated with measles and the MMR; interactions with healthcare professionals and others in relation to MMR; the process of decision-making, including attitudes to public bodies and governments as sources of advice and influence. In addition, a range of specific statements made by Brighton parents as part of the ethnographic study was offered for agreement or disagreement.

Data linkage

Completed questionnaires were linked with children's data as recorded on the Child Health Database, from which additional information was derived relating to: gestational age, number of previous live births, age of mother at child's birth and immunizations given within the NHS. After linkage, the dataset was anonymized.

Approach to analysis

Following construction of maternal and child demographic and health variables, a response rate was calculated for responders, non-responders and those who had no vaccinations recorded. Responses to the questionnaires were used to classify mothers

into self-reported 'compliant' and 'non-compliant groups' of which further details are given below, and characteristics of responders and non-responders described. Associations between responses to the questionnaire and compliance were then explored using the χ^2 test. Finally a multivariate analysis was undertaken, in which odds ratios (OR, adjusted and unadjusted) for compliance in relation to measurable objective variables of potential use in predicting non-compliance were calculated.

Ethical review and research governance

The study was approved by the Brighton Local Research Ethics Committee, and appropriate research permissions given by South Downs Health NHS Trust and Brighton and Hove City PCT. Apart from mailing lists, all person-identifiable data were handled by JC on secure NHS servers with appropriate permissions. Anonymized data have been lodged at the ESRC National Data Archive (<http://www.data-archive.ac.uk>).

Results

Response rate

Of 1135 mothers' questionnaires, 452 (39.8%) were returned, with 45% response from those for whom MMR was recorded, 37.4% from those having some

vaccinations but not MMR recorded, and 29.6% response from mothers of children for whom no vaccinations were recorded on the Child Health Database ('non-vaccinators'). Table 1 describes and compares the characteristics of responders and non-responders. The 40 non-vaccinator mothers had a similar age distribution to others, but slightly more previous live births (1.0 compared to 0.8, $P = 0.009$), and more of their children were male (60% compared to 49.9%, $P = 0.081$).

Vaccination decisions

Table 2 summarizes the relationship between vaccine decision and demographic characteristics. There was no association between graduate status ($P = 0.14$) or age at the birth of this child ($P = 0.12$) and the decision whether to have MMR at the recommended time. However, mothers were more likely to accept MMR for a first child than for subsequent children (61.1% v 53.6%, $P = 0.002$).

Of all mothers, 17.5% reported that they had chosen 'single jabs' (i.e. separate measles, mumps and rubella antigens, available only privately or overseas). None of these children were reported as having had MMR in the Child Health Dataset. These children were less likely to be firstborn ($P = 0.02$), while there was no difference in maternal age or graduate status. Of all respondents, 10.6% reported a decision to delay the MMR.

Mothers were classified into the categories of 'compliant' or 'non-compliant' for the analysis on

Table 1 Characteristics of responders and non-responders.

	Responder (<i>N</i> = 452) <i>n</i> (%)	Non-responder (<i>N</i> = 683) <i>n</i> (%)	Base (<i>N</i> = 1153)	<i>P</i> value for difference
Age at birth of this child:				
< 18	1 (0.2)	13 (2.0)		
18–20	5 (1.1)	45 (7.0)		
21–24	28 (6.4)	71 (11.1)		
25–34	233 (53.2)	315 (49.1)		
35+	171 (39.0)	197 (30.7)	1079 (56)	<0.001
MMR before 15 months according to child health records:				
Yes, had MMR	225 (49.8)	275 (40.3)		
No, but had some other vaccinations	187 (41.4)	313 (45.8)		
No vaccinations recorded	40 (8.9)	95 (13.9)	1135 (0)	0.002
Born 36 weeks or less gestation:				
≤ 36 weeks	32 (7.3)	45 (7.0)		
> 36 weeks	406 (92.7)	594 (93.0)	1077 (58)	0.869
Sex (this child):				
Male	237 (52.4)	343 (50.2)	1135 (0)	0.465
Previous live births (mean (SD))	0.7 (0.9)	0.9 (1.2)	1069 (66)	0.063

Table 2 Vaccination decision in relation to characteristics.

	Have MMR <i>n</i> (%)	Delay MMR <i>n</i> (%)	Single jabs <i>n</i> (%)	None <i>n</i> (%)	Not sure/ undecided <i>n</i> (%)	Base <i>N</i> = 452 <i>n</i> (missing)	<i>P</i> value for difference
All	258 (57.2)	48 (10.6)	79 (17.5)	53 (11.8)	13 (2.9)	452 (1)	
Maternal age at birth of this child:							
<18	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	
18–20	4 (80)	0 (0)	0 (0)	0 (0)	1 (20)	5 (100)	
21–24	18 (66.7)	1 (3.7)	5 (18.5)	2 (7.4)	1 (3.7)	27 (100)	
25–34	143 (61.4)	17 (7.3)	45 (19.3)	23 (9.9)	5 (2.2)	233 (100)	
35+	84 (49.1)	27 (15.8)	29 (17.0)	25 (14.6)	6 (3.5)	171 (100)	0.119
First child:							
Yes	132 (61.1)	10 (4.6)	41 (19.0)	28 (13.0)	5 (2.3)		
No	126 (53.6)	38 (16.2)	38 (16.2)	25 (10.6)	8 (3.4)	451 (1)	0.002
Education:							
Non-graduate	134 (62.3)	19 (8.8)	34 (15.8)	20 (9.3)	8 (3.7)		
Graduate	124 (52.5)	29 (12.3)	45 (19.1)	33 (14.0)	5 (2.1)	451 (1)	0.14

Table 3 Vaccination decision according to dataset record.

	Have MMR <i>n</i> (%)	Delay MMR <i>n</i> (%)	Single jabs <i>n</i> (%)	None <i>n</i> (%)	Not sure/ undecided <i>n</i> (%)	Base <i>N</i> = 452 <i>n</i> (missing)	<i>P</i> value for difference
MMR recorded	217 (96.9)	6 (2.7)	1 (0.5)	0 (0)	0 (0)		
MMR not recorded, but at least one other vaccination given	39 (20.9)	41 (21.9)	78 (41.7)	16 (8.6)	13 (7.0)		
No vaccinations recorded (Non- vaccinator)	2 (5)	1 (2.5)	0 (0)	37 (92.5)	0 (0)	451 (1)	<0.001

the basis of self-reported 'intention-to-treat', which enabled us to capture decisions to delay MMR, or to give single vaccines, in this analysis. These self-reports were compared with data from the Child Health Dataset, and this comparison is reported in Table 3. This shows that only one child whose mother reported choosing not to give MMR or to give single jabs was recorded as having had MMR, while a few children whose mothers reported a decision to give MMR did not have MMR reported on the dataset.

In the analysis below, we define 'compliant' mothers as those who reported choosing to have MMR on time, and 'non-compliant' mothers as those choosing to delay MMR, not to vaccinate with MMR, to obtain single jabs, or who remained undecided.

Use of complementary and conventional therapies

Of the non-compliant mothers, 32.6% had consulted a homeopath, by contrast with 10.1% of compliers

($P = 0.001$). No significant association was seen with consulting herbalists, acupuncturists, ayurvedic practitioners or kinesiologists. No association was seen with attendance at yoga for childbirth classes.

Rejection of the vitamin K injection routinely offered at birth was strongly associated with non-compliance. Only 19/63 (30.2%) of those who declined this injection went on to comply with MMR, by contrast with 221/363 (60.9%) of those accepting it ($P < 0.001$).

We tested for differences between the various 'non-compliant' groups, in order to explore the potential for confounding by social factors, in particular non-vaccinator status (a multivariate analysis is therefore reported below in Table 7).

Among non-vaccinator mothers, as defined by the Child Health Database, 27/40 (67.5%) were graduates, by contrast with 160/412 (38.8%) of those who had accepted some vaccinations, a difference which was not statistically significant ($P < 0.822$).

Non-vaccinators were significantly more likely to have visited a homeopath (27/40 (67.5%) versus 62/412 (15.1%), $P < 0.001$), and less likely to have accepted vitamin K ((13/37 (35.1%) versus 351/390 (90.0%), $P < 0.001$), while the child was no more likely to be their first.

Mothers who delayed MMR were no more likely to be graduates than others (29/48 (60.4%) versus 207/403 (51.4%), $P = 0.24$), while the child was less likely to be their first (10/48 (20.8%) versus 206/403 (51.1%), $P < 0.001$). They were no more likely to refuse vitamin K, or to have visited a homeopath.

Mothers reporting a choice of single jabs were no more likely to be graduates (45/79 (57.0%) versus 191/372 (51.3%), $P = 0.4$), while the child was no more likely to be their first, and they were no more or less likely to have visited a homeopath or declined vitamin K.

The process of decision-making and attitudes of healthcare professionals to decision-making

Non-compliers reported earlier concerns about the MMR than others, with 58.0% reporting that it was an issue for them before the child's birth. These respondents were more concerned about family health issues related to the MMR, and less likely to see measles as a 'very' or 'quite' serious disease. Table 4 reports variables relating to the process of decision-making, which is notably reported to begin before birth in a majority of non-compliers. This association remained significant after controlling for number of previous children ($P < 0.001$).

We also explored non-compliers' perceptions of their health professionals' attitudes to their decisions. Of respondents answering the question, 60.0% of 193 non-compliers considered that their GP would disapprove of their choice, while 31.9% considered that he or she 'approved' or 'wouldn't mind'. By contrast, 45.5% considered that their health visitor would disapprove, with 46.8% believing she or he 'approved' or 'wouldn't mind'.

General views on the MMR

We explored a range of issues raised by parents in the course of ethnographic work, through presenting statements for agreement or disagreement. These are presented in Table 5. A third of non-compliant mothers reported knowing of children 'knocked back by MMR', and these mothers were more likely also to consider that not enough

research had been done, or that they had insufficient information to make a decision.

Non-compliers were significantly more likely to report having attended public meetings on immunization (23.4% versus 3.5%, $P < 0.001$), and having read books on MMR (32.6% versus 13.6%, $P < 0.001$). Although they were no more or less likely to report seeing television/radio news (67.4% versus 70.9%, $P = 0.6$) or newspaper articles (85.5% versus 80.6%, $P = 0.4$), they more commonly reported having seen TV/radio documentaries (66.8% versus 57.0%, $P = 0.048$). There was a difference in the extent of finding information oneself on the internet (53.4% for non-compliers, 31.4% compliers, $P < 0.001$) but not in seeing information found by others on the internet (20.7% non-compliers, 15.9% non-compliers, $P = 0.4$).

Child health and the MMR

Of the mothers who reported that their child had had generally 'strong' health since birth, 96.3% were compliant and 92.4% were non-compliant, and there was no association between compliance and general health ($P = 0.257$). The questionnaire specifically explored aspects of health that were related to MMR in the ethnographic work, but there was no evidence of an association between compliance and the general health of the child, nor with the specific health problems eczema, allergies, eating problems and breathing problems. In total, 8.2% of non-compliant, but only 3.7% of compliant mothers reported worrying about the MMR because of their child's behaviour ($P = 0.04$).

Family health history was seen as relevant by many non-compliant mothers. In explaining more about this in free text, seven mothers mentioned a family history of Asperger's syndrome; two mentioned autism in the family; three mentioned experiences of autism onset following MMR in the family; 13 referred to relatives reacting badly to vaccines; ten referred to a family history of eczema, asthma or arthritis; five referred to a family history of irritable bowel; and several gave examples referring to neurological problems, auto-immune problems or ME (myalgic encephalomyelitis).

Personal and social responsibilities, and the role of government

Table 6 reports feelings of responsibility and attitudes to the state in relation to the MMR. It shows that an overwhelming majority both of compliant and non-compliant mothers take personal responsibility for the risks associated with MMR,

Table 4 When MMR became a concern and process of decision-making.

	Compliant <i>n</i> (%)	Non-compliant <i>n</i> (%)	Base N	<i>P</i> value for difference
Time MMR became a concern:				
When MMR due	78 (31.2)	18 (10.2)		
When baby jabs due	87 (34.8)	39 (22.2)		
At time of birth	18 (7.2)	14 (8.0)		
Before birth	61 (24.4)	102 (58.0)		
Not sure	6 (2.4)	3 (1.2)	426	<0.001
Concern about family health in relation to MMR:				
Yes	39 (15.2)	57 (29.5)		
No	215 (83.7)	133 (68.9)		
Don't know	3 (1.2)	3 (1.6)	450	0.001
How serious is measles seen to be:				
Very or quite	241 (93.4)	155 (80.3)		
Mild	10 (3.9)	13 (6.7)		
Don't know	2 (0.8)	2 (1.0)		
Other	5 (1.9)	23 (11.9)	451	<0.001
Who decides:				
Me	59 (23.1)	45 (23.3)		
Me and partner	195 (76.2)	148 (76.7)		
Partner	2 (0.8)	0 (0)	449	0.430
Who approves:				
Health visitor approves	232 (91.3)	18 (9.7)	440	<0.001
GP approves	239 (94.5)	19 (10.1)	441	<0.001
Reasons for choice different from most people you know:				
Yes	33 (12.8)	77 (39.9)	451	<0.001
Do you feel certain you made the right decision?				
Very certain, or fairly certain	245 (95.0)	179 (92.8)		
Not very certain	13 (5.0)	14 (7.3)	451	0.022
Is there anything else you would have wanted to know about MMR to help you make a decision				
Yes	170 (69.4)	83 (44.2)		
No	75 (30.6)	105 (55.9)	433	<0.001
I tend to avoid talking to my friends about the MMR issue ^a	34 (13.2)	27 (14.0)	451	0.803

^aBy contrast, 10 (25%) of non-vaccinators strongly agreed, compared with 33 (10.9%) of vaccinators, *P* = 0.01.

whether they see those predominantly as the risks of preventable disease or side effects of immunisation. Parental choice was highly valued by nearly all parents, while herd immunity was unimportant to 40% of both compliant and non-compliant mothers. The right of health professionals to advise vaccination on the basis of the need for herd immunity was particularly questioned by non-compliers.

A large 71% of those who did not comply, but even 35% of those who did, strongly agreed that 'you can't trust the government over science'. Even higher proportions of mothers strongly ex-

pressed suspicion of the influence of pharmaceutical companies over the MMR issue (52% of those who complied, and 82% of those who did not). Over both these statements concerning trust, however, the difference between those who did and did not comply is statistically significant, with a higher proportion of those who did not comply expressing lack of trust.

Table 6 extends this consideration of how mothers relate to public issues involving science by exploring attitudes and practices around bovine spongiform encephalopathy (BSE) and genetically

Table 5 Views on MMR.

	Compliant <i>n</i> (%)	Non-compliant <i>n</i> (%)	Base N	<i>P</i> value for difference
<i>General issues</i>				
I know parents whose children have been knocked back by the MMR				
Strongly my view	13 (5.1)	56 (29.8)	444	<0.001
Friends and family have had the MMR and they were fine				
Strongly my view	215 (85.0)	109 (57.4)	443	<0.001
You can get bogged down in the detail, too much research and you don't do anything				
Strongly my view	101 (41.1)	46 (25.0)	430	<0.001
There is no scientific proof that the MMR vaccine causes autism or any other problems				
Strongly my view	162 (64.0)	30 (16.0)	441	0.001
All the stuff you hear about the negative effects of the MMR is media hype				
Strongly my view	92 (36.1)	14 (7.4)	445	<0.001
Not enough research has been done on the MMR				
Strongly my view	83 (32.8)	159 (83.7)	443	<0.001
I don't feel we have enough information to make an informed decision				
Strongly my view	59 (23.4)	119 (62.6)	442	<0.001
<i>Immunity</i>				
There is a chance of serious side effects from MMR if there is a weakness in that child				
Strongly agree	50 (19.5)	103 (53.9)	448	<0.001
Each child's immune system is different				
Strongly agree	155 (60.6)	147 (77.0)	447	<0.001
Single vaccines concern me but not as much as MMR				
Strongly agree	60 (23.6)	96 (50.8)	443	<0.001
The MMR is too much in one go				
Strongly agree	54 (21.7)	158 (85.9)	433	<0.001
It's better to get immunity naturally				
Strongly agree	18 (7.1)	79 (42.3)	440	<0.001

modified foods. A significantly higher proportion of those who did not comply with MMR claimed to have stopped eating beef because of BSE and this proportion might have been higher still but for the fact that 35% of non-compliers were vegetarian already. Of those who did not comply with MMR, 87% (and 62% of those who did) claimed that they checked food labels to see if they contain genetically modified organisms (GMOs)—again, a statistically significant difference, and a surprisingly high number in both groups.

Predicting non-compliance?

Given the variety of mothers' views on MMR, identifying characteristics that are both predictive

of MMR uptake and relevant to the kind of immunisation information which individual parents are likely to find meaningful and convincing, is of interest to clinical and public health practitioners. Table 7 reports a multivariate analysis exploring the association between compliance with MMR and the objectively measurable variables graduate status, whether the child was a firstborn, maternal age, vitamin K injection at birth, consultation with a homeopath for the child and non-vaccinator status.

The data show that only use of a homeopath was independently associated with non-compliance. Vitamin K rejection (a less common decision) was no longer of significance after adjustment, possibly due to lack of statistical power, while there was no interaction between these two variables.

Table 6 Personal and social responsibilities, the place of the state, and attitudes to risk in food.

	Compliant <i>n</i> (%)	Non-compliant <i>n</i> (%)	<i>N</i> (missing)	<i>P</i> value for difference
<i>Personal responsibility</i>				
If my child ever got measles, I couldn't forgive myself				
Strongly agree	165 (64.7)	68 (36.2)	443	<0.001
I couldn't forgive myself if she got autism or any other side effects				
Strongly agree	295 (66.4)	171 (89.5)	444	<0.001
The most important thing is that parents have the choice				
Strongly agree	189 (73.8)	177 (91.7)	449	<0.001
It would be so much easier if you were just told, and it wasn't your decision				
Strongly my view	32 (12.6)	10 (5.3)	445	<0.001
When deciding about MMR...did you consider possible benefits to other children				
Yes	154 (59.9)	118 (61.5)	449	<0.742
<i>The role of state and government</i>				
Is it right for health professionals to advise parents to have their child vaccinated for the benefit of other children				
Yes	173 (67.3)	71 (37.4)		
No	40 (15.6)	74 (39.0)		
Not sure	44 (17.1)	45 (23.7)	447	<0.001
It is the government's responsibility to decide whether children should be vaccinated				
Strongly agree	40 (15.6)	7 (3.7)	441	<0.001
You can't trust the government over science				
Strongly agree	88 (34.4)	137 (71.4)	448	<0.001
I am suspicious of the influence of the pharmaceutical companies				
Strongly agree	132 (52.2)	158 (82.3)	445	<0.001
<i>Food and risk</i>				
Did you stop or reduce eating beef because of BSE				
Yes	89 (34.8)	86 (44.8)		
No	125 (48.8)	38 (19.8)		
Already vegetarian	42 (16.4)	68 (35.4)	448	<0.001
Do you check food labels to see if they contain GMOs				
Always/sometimes	160 (62.3)	167 (87.0)	449	<0.001

Discussion

The relevance of lay concepts of child health and alternative healthcare

An individualistic view of child health, manifest through family history as well as the health of the child, is experienced by mothers as highly relevant to their risk assessment for MMR. This survey confirms the importance of lay theories of immunity, focussed on the possibilities of immune overload in the context of individual 'weakness' in a child, which play a role in MMR decision-making,

and puts it in the context of other health-seeking attitudes and behaviours. Homeopathy and public immunization debates appear to be influential in this context.

We were surprised by the lack of association between child health and compliance. It might suggest that children with allergic-type problems have closer early interactions with health services, with the effect of making them more likely to comply.

A view of the immune system as an individual characteristic, needing individualized healthcare, emerged in this survey as in the ethnography. Most

Table 7 Multivariate model showing predictors of MMR compliance.

Variable	% Reporting compliance	Crude OR (95% CI) for compliance	Adjusted ^a OR (95% CI) for compliance	Number of cases ^b
All	53.9%	—	—	413
Vitamin K injection at birth		$P < 0.0001$	$P = 0.159$	
Yes	60.9%	1	1	353
No	30.0%	0.28 (0.15, 0.50)	0.60 (0.30, 1.22)	60
Mother is a graduate ^e		$P = 0.006$	$P = 0.611$	
No	63.6%	1	1	195
Yes	50.0%	0.57 (0.39, 0.85)	0.89 (0.56, 1.40)	218
Used a homeopath		$P < 0.0001$	$P = 0.001$	
No	63.0%	1	1	332
Yes	29.6%	0.25 (0.15, 0.42)	0.36 (0.20, 0.64)	81
Mother's first child		$P = 0.165$	$P = 0.209$	
Yes	60.0%	1	1	195
No	53.2%	0.76 (0.51, 1.12)	0.75 (0.48, 1.18)	218
Mother's age ^d		$P = 0.0033$	$P = 0.0614$	
< 30	73.9%	1	1	69
30–34	57.8%	0.48 (0.26, 0.91)	0.51 (0.25, 1.02)	147
35–39	51.7%	0.38 (0.20, 0.71)	0.46 (0.23, 0.93)	149
40+	41.7%	0.25 (0.11, 0.55)	0.30 (0.12, 0.74)	48
Vaccinated ^c		$P < 0.0001$	$P = 0.002$	
Yes	61.1%	1	1	380
No	3.0%	0.02 (0.003, 0.15)	0.04 (0.01, 0.35)	33

^aAdjusted OR net of the effect of the other variables in the Table.

^bBased on 413 individuals for whom data is complete.

^cDenotes any vaccinations prior to MMR recorded in the Child Health Dataset.

mothers agreed that each child's immune system was different (although significantly more non-compliant mothers (77%) strongly agreed with this, compared with 61% of those who complied).

What does differ, however, is how mothers evaluate how MMR plays into this, with 86% of mothers who did not comply strongly agreeing that 'the MMR is too much in one go' compared with only 22% of those who complied. Equally, more than half of the non-compliers agreed that there is a chance of serious side effects from MMR if there is a weakness in that child, compared to only 19% of those who complied. Of mothers who did not comply, 43% strongly agreed that it was better to 'get immunity naturally', compared with only 7% of those who complied.

The relevance of a belief that immunizations harm the immune system has been noted elsewhere,^{14,15} and our study quantifies a striking influence of homeopathy in this respect. Although our ethnographic work, along with other studies, points to the relevance of concerns about child health here, our mixed quantitative and qualitative methodology was able to show that this did *not* focus on specific illnesses, but on concepts of

weakness and family health traits, which are less well captured by conventional concepts of health. The relevance of wider lay concepts of health, not captured in healthcare professionals' discourses on immunization, is likely to be of importance in addressing persistent concerns about the safety of MMR,¹⁶ which are not well explained in terms of 'rational' risk perception.¹⁷

Determinants of uptake and 'single jabs'

The uptake of measles immunization in Brighton may be up to 17% higher than measured by MMR uptake in the Child Health Database, if all those reporting that they chose single jabs in fact had these vaccines. This confirms findings by Wroe et al., and may have important implications for our capacity to predict the resurgence of measles.¹⁸ Our data also confirm their suggestion that many parents may be delaying MMR—a finding which has important implications for coverage estimates, and also for developing effective 'catch-up' policies. Records of the Medicines and Healthcare Regulatory Agency on the number of

single dose measles vaccine doses authorized for import (not all of which will necessarily have been imported) show that that 103 358 were authorized in 2003 and 91 197 in 2004.¹⁹

By contrast with the suggestion of previous work that MMR anxiety is concentrated in more affluent groups,^{9,10} non-compliance was not associated in our study with graduate status, and concerns about MMR safety were reported in a wide range of compliers and non-compliers. This contradicts national parent opinion survey work by suggesting that that anxiety about MMR is a widespread phenomenon in all social classes,⁹ while confirming the findings of other researchers based in local health services.^{14,20–22}

Interestingly, the total non-vaccinators in this study were a more educated group than other respondents, and more likely to use homeopaths and reject vitamin K than women choosing single jabs. Rather than an underprivileged group whose access to healthcare is marginal, these women are likely to have the economic advantages associated with graduate status. However, they may not be opinion leaders in the context of MMR, since (as reported in Table 3) they were less willing than others to discuss MMR with other mothers, in the social networks reported by our group and others.^{12,23}

Personal, social and governmental responsibility

A major finding in the ethnographic work was that the MMR issue has become a focal point of social talk among mothers, which is consistent with a 'social contagion' model of immunization discourse.²⁴ A question to probe this (Table 3) asked if mothers agreed that they tend to avoid talking to their friends about the MMR issue. As we expected, those who did and did not comply were very similar in this respect, with only 14% agreeing. However, it is notable that half of the non-compliers who did avoid talking about MMR were complete non-vaccinators (representing 25% of them), suggesting that total non-vaccination is a different social issue, a finding confirmed elsewhere²². These data are consistent with other work suggesting that social networks are important in the reinforcement of understanding and beliefs in relation to MMR.²³

Parental choice emerged as an important value for both compliers and non-compliers, as is evidenced in a range of questions probing freedom of choice and the role of government in Table 5. Very few mothers, whether or not they complied,

strongly agreed that it would be easier if the decision were made for them.

A substantial proportion of all mothers, but more non-compliers, distrusted the government over science. This, together with suspicions of the influence of pharmaceutical companies, suggests a widespread perception of bias in official statements of MMR safety.

A strong theme that emerged in the ethnography was a pronounced sense of personal responsibility, and assumption of personal blame, for any harm that might come to a child either through disease or through vaccination adverse effects. The survey responses in Table 5 confirm this sense of personal responsibility, though unsurprisingly those who complied expressed their personal responsibility more in worry about measles than about possible MMR side effects.

However, the assuming of responsibility appears to relate mainly to a mother's own child. This—taken with the high sense of personal responsibility evident in mothers' responses—suggests that the MMR issue has become so important that personal parenting concerns are paramount, leaving less space for wider social considerations. Nevertheless a much higher proportion (67% of those who complied, and 38% of those who did not) felt that it was right for health professionals to push this social message.

The high prevalence of vegetarianism, concerns about BSE and about GMOs suggest that while many mothers across the vaccination spectrum may be taking a precautionary approach around these other issues of scientific uncertainty, there is for many mothers a close connection between health behaviours relating to food and those relating to vaccination.

Limitations of this study

This study focuses on a single urban locality, which has particularly low rates of MMR uptake, and in offering an 'alternative' lifestyle may not be representative of the UK as a whole. However, the social factors causing low uptake in Brighton may well be similar in kind to those operating elsewhere, even if their distribution is different. A response rate of 39.8%, though lower than desirable, is higher than average for postal surveys of the public, and is similar to the effective participation rate in other published survey work.¹⁸ It is likely to be an underestimate of the true response rate (especially for total non-vaccinators), due to high rates of migration locally, and in young families particularly, as well as 'ghost'

patients. A smaller questionnaire study of infant immunization estimates the 'ghost' rate at 14.7%,¹⁶ a finding which if applied to our data would give a response rate of 46.7%. Due to lack of resources, we were not able to verify the true response rate in Brighton.

The single mailing to non-vaccinators, in contrast to the follow-up questionnaire sent to others, is a potential source of bias and is likely to account for the lower response rate in this group. This would be of importance for a detailed study of this group, but as the main focus of this study was MMR non-compliance, and this group was relatively small, this bias is likely to have had minimal impact on our comparisons between non-compliers and others.

Relevance of this study for further work and for health promotion policy

This study has important implications for health promotion in general, and the promotion of immunization in particular. Non-compliant mothers appear to be well-informed individuals who have considerable interest in health-related issues, as manifest through food choices, and an early onset of interest in the MMR issue. Health promotion theory and practice tends to encourage awareness and empowerment among disadvantaged and marginalized groups. In the case of MMR, health awareness appears (at least for some individuals) to be associated with reduced acceptance of MMR and with acceptance of lay theories of immune function and health. This finding is in keeping with data showing that the provision of additional detailed information does not improve MMR uptake in children not yet immunized at 21 months.²⁵

The emergence of homeopathy and vitamin K (the latter of borderline significance, probably due to limited power) as predictors of non-compliance is both a striking finding, and an opportunity. Previous research has shown that most homeopaths do not recommend MMR vaccination.^{26,27} However, there has been less publicity over concerns about a possible link between vitamin K and childhood cancer²⁸ than about MMR. We show in this study that views of immunity associated with homeopathic conceptions of health disease are widespread, while consultation with a homeopath was itself strongly associated with non-compliance. This suggests that health promotion materials must take into account widely disseminated views on immunity that are very different from the immunological theories on which immunization practice and policy are based. Our finding that rejection of vitamin K and use of homeopathy for a child both strongly

predict MMR non-compliance provides an opportunity to identify a 'community' defined by health beliefs for developing such work.

This presents a paradox for evidence-based health promotion. In order to convince those most likely to become MMR non-compliers of its safety, there is a need to engage with, and share the discourse of, concepts of immunity which western science and medicine explicitly reject. The public health community will need to consider whether evidence-based practice needs to presume shared paradigms of the nature and mechanisms of healthcare interventions, or whether it is prepared to develop 'propaganda' which promotes immunization through concepts of health it cannot share.

The challenge of developing immunization educational materials for a public who have a developed, dissonant scientific view is both a practical and an ideological challenge, whose implications reach beyond the MMR debate into ethical questions of what constitutes informed consent to public health interventions in a diverse society.

Acknowledgements

We would like to thank our advisory group (Graham Bickler, Mark Jones, Martina Pickin, Tom Scanlon, Isabella Thomas and Joanne Yarwood) for helpful comments. We would also like to acknowledge practical support from Surrey and Sussex Health Protection Agency, South Downs NHS Health Trust, and Brighton and Hove City Primary Care Trust). The study was funded by the Economic and Social Research Council. Peter Trail provided assistance with data management and Hannah Evans assisted in the statistical analyses.

The authors declare that they have no competing interests.

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