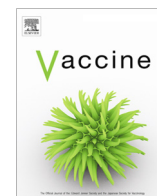




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An assessment of parental knowledge, attitudes, and beliefs regarding influenza vaccination

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ABSTRACT

Introduction: Seasonal influenza imposes a significant clinical and economic burden. Despite the availability of an annual vaccine to prevent influenza infection and reduce disease severity, influenza vaccination rates remain suboptimal. Research suggests personal experience, perceived effectiveness, and concerns regarding vaccine safety and side effects are the most influential factors in predicting a parent's decision to vaccinate. However, current literature is primarily focused on the vaccine decision-making of healthcare workers and those at high risk for influenza complications.

Methods: To assess parental attitudes and beliefs regarding the influenza vaccine, a brief mixed-methods survey was developed and optimized for an electronic platform. The Health Belief Model informed survey design and data analysis. Questions were classified into five core concepts: knowledge, barriers, benefits, experience, and severity. Participants were solicited from a population of parents whose children had participated in a school-based influenza surveillance study (n = 244, 73% response rate). We tested associations between responses and children's influenza vaccination status the prior season. Categorical questions were tested using Pearson's chi-squared tests and numerical or ordered questions using Mann-Whitney tests. P-values were corrected using the Bonferroni method.

Results: Doubting effectiveness, concerns about side effects, inconvenience, and believing the vaccine is unnecessary were barriers negatively associated with parents' decision to vaccinate their children during the 2017–18 flu season (p < 0.001). Knowledge that the vaccine is effective in lowering risk, duration, and severity of influenza; receiving the influenza vaccine as an adult; and recognizing the importance of vaccination to prevent influenza transmission in high-risk populations were positively associated with parents' decision to vaccinate (p < 0.001).

Conclusion: Understanding barriers and motivators behind parents' decision to vaccinate provides valuable insight that has the potential to shape vaccine messaging, recommendations, and policy. The motivation to vaccinate to prevent influenza transmission in high-risk populations is a novel finding that warrants further investigation.

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1. Introduction

Seasonal influenza and influenza-related illness impose a significant burden on the public, both clinical and economic. In the United States, influenza epidemics are responsible for an average of 610,660 life-years lost, 3.1 million hospitalized days, and \$10.4 billion in direct medical costs annually [1]. Despite the availability of

an annual vaccine to prevent influenza infection and reduce disease severity, influenza vaccination rates remain suboptimal: average coverage of children from 2010 to 2018 in the US was 56.7%, while adults fared far worse at 31.2% [2]. These numbers are in stark contrast with the goals of U.S. *Healthy People 2020*, which aims for 70% influenza vaccine uptake among children 6 months to 17 years, 80% coverage for adults, and 90% for healthcare providers [3].

The WHO established a global recommendation for influenza vaccination of high-risk groups (pregnant women, healthcare workers, the elderly, children 6 months–5 years, and those with chronic illnesses), and recommends countries “should decide

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which other risk groups to prioritize for vaccination based on burden of disease, cost-effectiveness, feasibility, and other appropriate considerations [4].” Since the 2010–2011 influenza season, the CDC has recommended vaccination for everyone over the age of 6 months, barring medical exceptions [3]. Children are especially vulnerable to influenza infection, with attack rates of 20–30% compared with 5–10% for adults [4]. Factors that motivate or deter parents from vaccinating their children, therefore, are particularly relevant in the United States and countries with similar influenza epidemiology and vaccination policies.

A growing body of research suggests that personal experience, perceived effectiveness, and concerns regarding vaccine safety and side effects are the most influential factors in predicting a parent’s decision to vaccinate their child and themselves [3,5,6]. Understanding these and other factors from the perspective of the general public and assessing influenza knowledge, attitudes, and beliefs (KABs) is necessary to create effective public health campaigns and promote routine vaccination. Parental attitudes regarding the influenza vaccine are especially important, as their beliefs determine not only their choice to vaccinate themselves, but the choice to vaccinate their children as well [7].

While traditional promotion strategies can change participant perception of vaccine safety and efficacy, recent studies have revealed that intention to vaccinate still remains low [6]. In fact, providing information dispelling myths about the flu vaccine (i.e., illness caused by the vaccine) can have a counterproductive ‘backfire effect’, making some participants less likely to seek vaccination [6,8,9]. While research has been done on parental vaccine decision-making in relation to various childhood vaccines, studies describing or characterizing factors related to influenza vaccine hesitancy and refusal are primarily conducted among healthcare workers or individuals considered high-risk for influenza complications (i.e., elderly population, those with chronic diseases) [10–17]. Consequently, there is a dearth of information, both qualitative and quantitative, on factors that may influence parents’ decision to vaccinate their children against influenza. It is important to focus on these factors at a community level, as they may vary by geographic region and demographic profile. In this paper, we seek to provide a comprehensive assessment of these factors from the perspective of parents in a suburban-rural region of South Central Wisconsin.

2. Methods

2.1. Subjects

Survey participants were solicited from a population of parents whose children had previously participated in a school-based influenza surveillance study in the Oregon School District (OSD), and who indicated interest in future studies on a consent form. The OSD is suburban-rural school district located in South Central Wisconsin estimated to enroll more than 4,100 students annually. The population of OSD is less racially and ethnically diverse, wealthier, and better educated than the average community in the United States [18]. Although participants were not selected at random, the demographics of respondents are similar to the populations of the Oregon School District and the communities of Oregon and Brooklyn, Wisconsin [18]. One parent or guardian from each eligible household was invited to participate. Participants received a \$10 Amazon eGift card shortly after survey completion.

2.2. Instrument

A 50-question mixed-methods survey with several open-ended questions was developed and optimized for use with Qualtrics©2018 Survey Software. The authors consulted with the UW

Survey Center, who reviewed the survey and provided feedback on question format, order, and language. Because of the survey format and the complex branching logic of several questions, the survey was provided only in digital format, accessible online via computer or smartphone.

The Health Belief Model (HBM) informed survey design and data collection, as well as subsequent data analysis. The HBM is a conceptual framework commonly used to understand health behavior, and has been applied in several studies on vaccine decision-making [5,19–21]. Questions were designed to explore factors related to vaccine acceptance according to the HBM, all of which have support in the literature: (1) cues to action, (2) perceived susceptibility to the flu, (3) perceived severity of the flu, (4) perceived benefits of the flu vaccine, (5) perceived risks or barriers to vaccination, and (6) self-efficacy [5,22].

Survey data collection was divided into five sections:

Personal experience consisted of 17 questions focused on perceived susceptibility and severity of influenza, history of influenza vaccine uptake for themselves and their children, and experience with other childhood vaccines.

Basic knowledge contained 8 questions aimed at gauging parents’ understanding of the influenza virus, associated symptoms, infection prevention measures, and current vaccination recommendations.

Barriers and promoters contained 5 questions evaluating cues to action, parents’ perceived benefits of the influenza vaccine, and barriers that might deter parents from vaccinating their children. Questions that explore barriers that might have affected parents’ ability to seek vaccination for their children in the past (e.g. lack of health insurance, high cost, and inconvenience) address concerns of self-efficacy.

Beliefs (3 questions) contained questions pertaining to perceived vaccine effectiveness and perceived side effects due to vaccination.

Demographic information consisted of 15 questions querying participants on personal information (e.g. race, ethnicity, education, and employment) (Table 1).

The survey included several short-answer questions about vaccine decision-making designed to capture a more complete picture of how parents’ attitudes and beliefs are formed and to provide a richer context in which to view their answers. This survey was submitted to the UW-Madison Health Sciences IRB and granted exemption from IRB review on the basis of a QI (Quality Improvement) and/or Program Evaluation designation.

2.3. Recruitment

Surveys were distributed by email for participants with known email addresses ($n = 291$), and an invitation to provide an email address was mailed to a subset of parents without a known email address ($n = 49$). Initial survey distribution occurred on July 16, 2018, and email survey reminders continued through October 3, 2018. Non-respondents were re-contacted three and seven weeks after the initial survey distribution, according to the modified Dillman Method [23]. Authors elected to re-contact potential participants by email up to an additional five times on varied days of the week and times of the day to maximize response rates. Mail non-respondents were re-contacted by SMS text up to three times after the initial mailing.

2.4. Statistical analysis

Questions were classified into five core concepts commonly defined in the literature: knowledge, barriers, benefits, experience, and severity. These concepts are often related to vaccine acceptance and rejection in the context of the Health Belief Model

Table 1

Population demographics of survey respondents compared by child vaccination status in 2017–2018.

Variable	Total (n = 244)	Not vaccinated (n = 77)	Vaccinated (n = 167)
Adults in household, mean (sd)	1.94 (0.66)	2.05 (0.83)	1.89 (0.56)
Age, mean (sd)	42.04 (5.95)	41.68 (6.00)	42.20 (5.93)
Children in household, (sd)	2.24 (0.86)	2.38 (0.95)	2.18 (0.82)
Gender, (%)			
Female	90.98	97.40	88.02
Male	9.01	2.60	11.98
Race/ethnicity, (%)			
White non-Hispanic	95.49	97.40	95.81
Hispanic and/or not white	2.87	3.90	2.40
Missing	1.64	1.30	1.80
Education, (%)			
Some high school, no diploma	0.41	0	0.60
High school graduate, diploma or equivalent	1.64	1.30	1.80
Some college credit, no degree	8.61	12.99	6.59
Associate degree	9.43	9.09	9.58
Bachelor's degree	47.13	51.95	44.91
Master's degree	22.13	11.69	26.95
Professional degree	3.69	3.90	3.59
Doctorate degree	4.92	5.19	4.79
Missing	2.05	3.90	1.20
Chronic Illness, (%)			
No	85.25	81.82	86.83
Yes	13.11	18.18	10.78
Missing	1.64	0	2.40
Employment, (%)			
Employed full time	61.07	53.25	64.67
Employed part time	24.18	28.57	22.16
Unemployed not looking for work	6.56	7.79	5.99
Unemployed looking for work	1.64	2.60	1.20
Retired	0.82	0	1.20
Student	0.41	0	0.60
Unable to work	0.41	0	0.60
Other	4.92	7.79	3.59

[19,21,24]. Statistical analyses were used to determine if significant associations exist between survey questions (grouped into demographics and five core concept categories) and a vaccination outcome. The primary outcome considered was an indication (parent self-report) of the child(ren) in the household vaccinated for the 2017/2018 flu season. Pearson's chi-squared tests were used to test associations with categorical questions and vaccine status; counts (%) were reported. Mann-Whitney-Wilcoxon tests were used to test associations with numerical and Likert variables and vaccine status; "counts (%)" were reported for Likert variables and "mean (standard deviation)" for numerical. Education was analyzed using Mann-Whitney tests ordered by the approximate years of education. Significance was assessed per test by a type 1 error rate of 0.0011; a Bonferroni correction was applied to p-values based on $n = 45$ tests to maintain a family-wise error rate of 5%. P-values below 0.001 after this threshold was applied were deemed significant.

3. Results

3.1. Demographics

A total of 244 completed surveys were received from 340 potential participants, five of whom opted out, for a response rate of 73%. The mean age of respondents was 42.04 (sd = 5.95) years. Respondents were predominantly white non-Hispanic (95.5%), female (91%), educated to undergraduate level or above (77.9%), and employed full- or part-time (85.25%). The average number of children living in the household was 2.24 ± 0.86 , and the mean

number of adults living in the household (including the respondent) was 1.94 ± 0.66 (Table 1). There were no significant demographic differences between parents who reported vaccinating their children during the 2017–18 influenza season, and those who did not (Table 1).

3.2. Quantitative results

The outcome of interest was parental report of vaccinating their child during the most recent influenza season at the time of survey distribution, the 2017–18 season. 'Vaccinated' and 'Not vaccinated' groups were defined by whether or not parents indicated '2017–2018' when asked, "Please select the years in which the child (ren) in your household received the influenza vaccine". Overall, 167 (68.4%) parents reported vaccinating their child(ren) during the 2017–18 season. Participant responses positively associated with vaccinating children during the 2017–2018 influenza season are shown in Table 2. Factors and survey questions not associated with vaccination are shown in Appendix A.

Parents who vaccinated themselves against influenza in adulthood were more likely to vaccinate their children during the 2017–2018 influenza season. Knowledge that the vaccine is effective in lowering risk and reducing the duration and severity of influenza illness and recognizing the importance of vaccination to prevent influenza transmission in high-risk populations were positively associated with parents' decision to vaccinate their children. Identifying young children as a group at high risk for serious influenza complications was also positively associated with

Table 2

Factors positively associated with parents vaccinating their children during the 2017–2018 influenza season. P-values that remained significant after a Bonferroni correction are indicated with an asterisk.

Variable	Not vaccinated (n = 77)	Vaccinated (n = 167)	pval
Vaccinated as an adult, (%)			<0.001*
Yes	87.01	98.20	
No	12.99	1.80	
Agreement with statements, (%)			
Flu vaccine causes flu	31.17	14.97	0.003
Flu vaccine lowers risk of flu	72.73	94.61	<0.001*
Flu vaccine reduces duration of flu illness	80.52	95.21	<0.001*
Flu vaccine reduces severity of flu illness	80.52	97.01	<0.001*
Shot more effective than nasal spray	55.84	71.26	0.018
Side effects are body aches, fever, fatigue	81.82	71.26	0.078
Importance of flu vaccine to prevent transmission to high-risk people, (%)			<0.001*
Extremely important	15.58	50.30	
Very important	35.06	39.52	
Somewhat important	35.06	8.38	
A little important	9.09	0.60	
Not at all important	5.19	1.20	
People who are at high risk, (%)			
Elderly adults	100	100	
Healthy adults	11.69	12.57	0.845
People with chronic illness	100	100	
Pregnant women	83.12	87.43	0.366
Young children	89.61	98.80	<0.001*
Effectiveness at protecting you from influenza, (%)			<0.001*
Not at all effective	6.49	0.60	
A little effective	27.27	4.19	
Somewhat effective	42.86	48.50	
Very effective	18.18	37.72	
Extremely effective	5.19	8.98	

parents' decision to vaccinate their children. Believing that the annual influenza vaccine is effective protection against the influenza virus was positively associated with parents' decision to vaccinate their children.

Participant responses negatively associated with vaccinating their children during the 2017–2018 influenza season are shown in Table 3. Concerns about negative side effects, reportedly knowing someone who had side effects due to a vaccine, doubting effectiveness, inconvenience, and believing the vaccine is unnecessary for health were barriers negatively associated with parents' decision to vaccinate their children during the 2017–18 flu season. A general hesitancy about childhood vaccines was negatively associated with parents' decision to vaccinate their children. Over half (57.79%) of respondents reported not being hesitant at all about childhood vaccines, while 29.5% reported being 'a little hesitant'.

According to parents who reported vaccinating their children during at least one flu season, the two most important reasons were 'protecting those at high risk for complications' (96.49%) and 'keeping my child healthy' (93.86%) (Table 4). For the 2014–15, 2015–16, and 2016–17 influenza seasons, a child receiving the flu vaccination the year before was associated with that child getting vaccinated in the current year (Fig. 1). Vaccination for each season was compared with the previous season, except for vaccination during the 2013–2014 season, which was compared with 'vaccination prior to 2013–2014'. Vaccination the previous year was not an accurate predictor of flu vaccination during the 2013–14 and 2017–18 seasons (Fig. 2).

Table 3
Factors negatively associated with parents vaccinating their children during the 2017–2018 influenza season. P-values that remained significant after a Bonferroni correction are indicated with an asterisk.

Variable	Not vaccinated (n = 77)	Vaccinated (n = 167)	pval
Concerns about negative side effects, (%)			<0.001*
No	49.35	177.84	
Yes	50.65	21.56	
Missing	0	0.60	
Know someone with side effects from a vaccine, (%)			<0.001*
Yes	23.38	7.19	
No	76.62	92.22	
Missing		0.60	
Factors preventing influenza vaccination, (%)			
Difficulty locating vaccine	24.68	37.13	0.055
Do not believe vaccine is effective	67.53	26.35	<0.001*
High cost	24.68	34.13	0.138
Inconvenience	31.17	11.98	<0.001*
Lack of health insurance	27.27	34.13	0.286
Unnecessary for health	58.44	29.94	<0.001*
Hesitancy about childhood vaccines, (%)			<0.001*
Extremely hesitant	2.60	0.60	
Very hesitant	6.49	1.20	
Somewhat hesitant	18.18	4.19	
A little hesitant	37.66	25.75	
Not at all hesitant	35.06	68.26	

Table 4
Responses to the question 'How important are these factors to you when considering whether or not to vaccinate your children against influenza?'

Question	Missing	Not important	Somewhat important	Very important
Avoiding missed school & work	16 (6.6)	14 (5.7)	74 (30.3)	140 (57.4)
Following my doctor's recommendation	18 (7.4)	15 (6.1)	100 (41.0)	111 (45.5)
Keeping my child(ren) healthy	17 (7.0)	3 (1.2)	12 (4.9)	212 (86.9)
Protecting those at high risk for flu complications	16 (6.6)	8 (3.3)	57 (23.4)	163 (66.8)
Protecting those who cannot receive the flu vaccine	17 (7.0)	14 (5.7)	73 (29.9)	140 (57.4)

3.3. Qualitative results

Thirteen parents reported they had never received the flu vaccine as an adult. The most common reasons cited for not receiving the flu vaccination as an adult were believing the vaccine is ineffective (3), not believing themselves at risk (3), believing the vaccine causes the flu (2), and believing the flu vaccine caused negative, lasting side effects to someone they know (2).

Twenty-six parents indicated that they do not follow all recommended vaccination schedules for their children. When asked which vaccine schedules they do not follow, 11 parents mentioned the flu vaccine, 7 mentioned the HPV vaccine, and 8 parents reported following a delayed or 'spaced out' schedule for vaccinating their children.

4. Discussion

Many of the factors we found to be significantly associated with parents' decision to vaccinate their children against influenza are consistent with the Health Belief Model's theory of vulnerability, and reflect themes identified in the literature. Previous research has indicated that perceived effectiveness, personal experiences of vaccines and adverse side effects, and vaccination the previous year are significantly linked to vaccine acceptance among adults [5,25,26]. The results of our survey confirm these findings, and posit new associations to consider as well.

In our study, two factors were cited as 'very important' in the decision to vaccinate by over 2/3 of informants – 'keeping my child healthy' and 'protecting those at high-risk'. Recognizing the importance of influenza vaccination in preventing transmission of influenza to high-risk groups and identifying young children as a high-risk group were both significantly associated with parental decision to vaccinate their children. Together, these results demonstrate parents' desire to protect their children from sickness and harm by vaccination, especially when they recognize the risks that accompany a severe influenza illness in children.

The factors described above also represent altruistic motivations for vaccination, a premise often overshadowed by discussions of efficacy and the personal benefits of vaccination [27]. While the influenza vaccine offers protection against the flu for those who receive it, many parents indicate protecting others (i.e. children and high-risk individuals) as their primary concern. Research has shown that touting vaccine efficacy and attempting to dispel myths and misinformation about the influenza vaccine have not improved vaccine acceptance, and in fact, can reinforce vaccine hesitancy [6,8]. As vaccine effectiveness estimates fluctuate from year to year, tapping into altruistic motives provides a novel, stable public health perspective with which to approach vaccine education and messaging.

A national online survey using different MMR vaccine messaging found that emphasizing both societal benefits and benefits to the child improved vaccination intention, while information emphasizing only societal benefits did not significantly change intention [28]. A survey exploring game theory in the context of influenza vaccination decisions estimated that altruism may

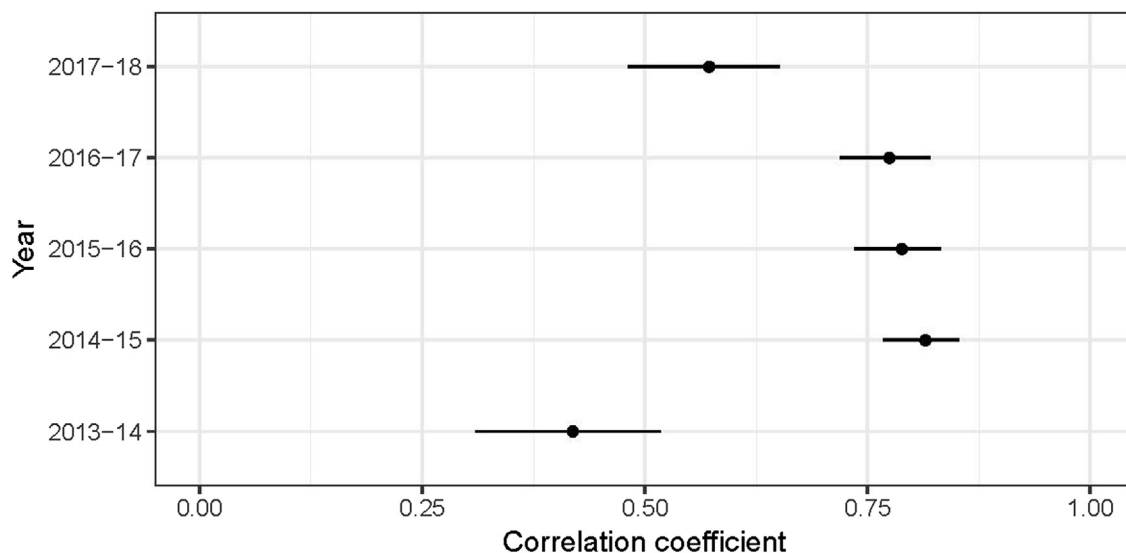


Fig. 1. Correlation of vaccinating one's child in the indicated year with the previous year*. The 2013-14 year was compared with 'prior to the 2013-14 season'.

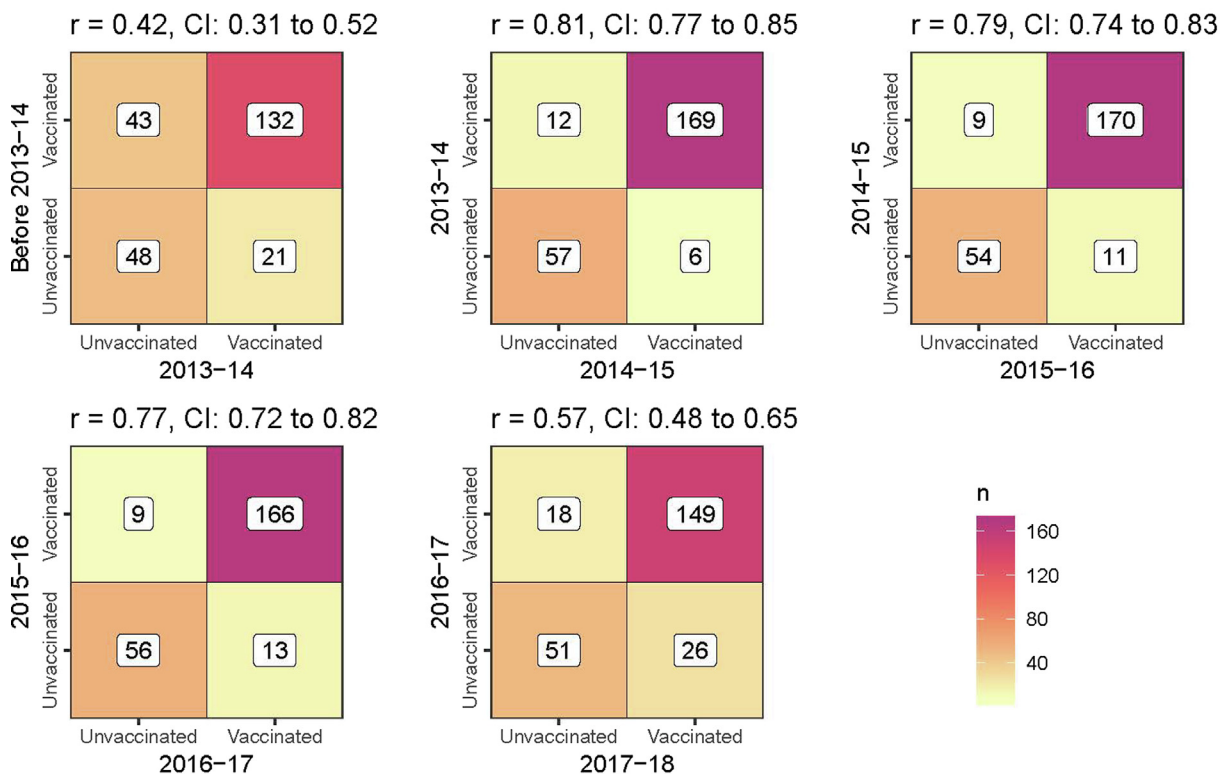


Fig. 2. Correlation coefficient calculations for the comparison of vaccinating in the current year with the previous year.

account for 25% of the motivation to vaccinate oneself, but did not evaluate its effect on parents' decision to vaccinate their children [27]. Whether our findings are true for other populations, and whether parent populations seek to protect their children, high-risk family members, or the community as a whole through vaccination remains to be seen and warrants further investigation.

This study is also unique in the finding that hesitancy about general childhood vaccines extends to hesitancy regarding the influenza vaccine. Parents' hesitancy about childhood vaccines in general was associated with not vaccinating their children against influenza during the 2017-18 flu season. This finding suggests con-

gruent attitudes among parents regarding seasonal vaccines and other regularly scheduled immunizations.

4.1. Limitations

This study has several limitations. The surveyed population was selected from a group of families who had previously participated in an influenza surveillance study by our research group, and is therefore subject to selection bias.

Although the demographic characteristics of respondents are representative of the communities in which they live, our survey

population is less racially and ethnically diverse, wealthier, and better educated than the average community in the United States, and is therefore not representative of the broader, national parental population. However, we believe that understanding local culture and concerns about the influenza vaccine can lead to more effective, targeted messages delivered by community health providers. Recruitment by email address was designed to allow one parent from each eligible household to participate, and since mothers were often the point of contact for the influenza surveillance study from which this participant pool was drawn, mothers and female guardians account for 91% of respondents.

We have no way of determining whether non-respondents differ significantly from respondents. That being said, a robust response rate of 73% reduces the effect of nonresponse bias.

Although vaccination statuses for parents and children were self-reported by parent participants and were not verified for accuracy, studies have shown that self-report is generally reliable for receipt of current and prior season vaccinations [29]. Additionally, parent recall of vaccinations was used to determine association between vaccinating in the current year compared with the previous year. Parents were asked to recall current season vaccination, as well as the influenza vaccinations over the past five seasons. Parental recall of influenza vaccination has been found to be 92.1% accurate, but recall past this point has not been studied in relation to influenza vaccination [30].

Finally, the findings of this study are based on correlations between children's vaccination status during the 2017–18 influenza season and various factors. These correlations do not prove, nor do they imply, a causal nature of these factors on the outcome of vaccination status.

4.2. Conclusions

Our study provides valuable insight into the factors that influence parental vaccine decision-making regarding influenza vaccination. This understanding has important implications for local education initiatives and health promotion messaging surrounding influenza vaccination. The importance of altruism in this population was a novel finding that should be further explored for its potential to boost vaccination acceptance rates. Further research is necessary to fully understand the relationship between belief and intention regarding influenza vaccination, and whether targeted messaging can be employed to inform parents' choices and affect vaccination rates.

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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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Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2019.11.040>.

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