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Original Article

Socio-demographic differences in opinions about 2009 pandemic influenza A (H1N1) and seasonal influenza vaccination and disease among adults during the 2009–2010 influenza season

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Background In April 2009, a novel influenza A virus emerged in the United States. By the end of July, influenza A (H1N1) 2009 monovalent (2009 H1N1) vaccine had been developed, licensed, and recommended by the Advisory Committee on Immunization Practices. Initial target groups for vaccination were identified and the first vaccine was publicly available in early October 2009.

Objective This study examines socio-demographic differences in opinions about 2009 pandemic influenza A (H1N1) (pH1N1) and seasonal influenza disease and vaccines and the association with receipt of influenza vaccinations during the 2009–2010 influenza season. Changes in opinions over the course of the pH1N1 pandemic were also examined.

Methods Data from the 2009 National H1N1 Flu Survey (NHFS) were analyzed. The NHFS was a CDC-sponsored telephone survey initiated in response to the 2009 pH1N1 pandemic to obtain weekly within-season estimates of vaccination coverage, opinions, and other information.

Results Opinions about influenza vaccine and disease varied significantly by race/ethnicity, income, and education level. In multivariable logistic regression analysis, adjusted 2009 H1N1 vaccination coverage was most strongly associated with opinions about the effectiveness of the vaccine and personal risk of disease, varying from 7 to 11% among adults who believed the vaccine to have low effectiveness and themselves at low risk of influenza, to 50–53% among those who thought vaccine effectiveness to be high and themselves at high risk of influenza.

Conclusion Improving communication about personal risk and the effectiveness of influenza vaccines may improve vaccination coverage. The findings of difference in opinions could be used to target communication.

Keywords Influenza, vaccination, adults.

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Introduction

In April 2009, the first cases of a new influenza virus, 2009 pandemic influenza A (H1N1) (pH1N1), were reported in the United States.[1,2] During the spring and summer months of 2009, there was widespread media attention as pH1N1 cases spread throughout the United States and around the world. On June 11, 2009, the World Health Organization announced a global pandemic. By the end of July 2009, the Advisory Committee on Immunization Practices (ACIP) made recommendations for use of influenza A (H1N1) 2009 monovalent (2009 H1N1) vaccine.[3] Because pH1N1 emerged too late to be included in the seasonal influenza vaccine, two types of vaccines were produced: the 2009 H1N1 vaccine and the seasonal trivalent vaccine. Both of these vaccines were recommended during the 2009–2010 influenza season. Those recommended to be in the initial target groups for receipt of the 2009 H1N1 vaccination included: (i) persons 6 months–24 years, (ii) persons 25–64 years who have medical conditions that put them at higher risk for influenza-related complications, (iii) pregnant women, (iv) persons who live with or provide care

for infants <6 months, and (v) health care and emergency medical services personnel.[3] Those recommended to receive seasonal influenza vaccination during the 2009–2010 influenza season included the groups mentioned for 2009 H1N1 with the addition of all persons 50 years and older and the exception that healthy persons 19–24 years old that do not fall into any other group were not specifically recommended unless they had medical conditions that put them at high risk for influenza complications.[4] The first doses of the 2009 H1N1 vaccine were distributed on October 5, 2009.

To monitor vaccination coverage with both the seasonal and the 2009 H1N1 influenza vaccines, CDC initiated a new survey, the National 2009 H1N1 Flu Survey (NHFS). The survey was used to produce weekly within-season estimates of vaccination coverage and variables related to vaccine uptake. Interim and final influenza vaccination coverage from this survey has previously been published.[5–9]

Estimates of influenza vaccination coverage in the past have shown persistently low coverage in many of the groups recommended for vaccination as well as persistent racial/ethnic disparities.[10,11] The relationship between opinions about influenza vaccine and disease and vaccine receipt has been studied for some age groups and some geographic areas.[12,13] Given the history of disparities, differences in influenza vaccination coverage during the 2009–2010 season were to be expected.[10] The objective of this study was to examine differences in opinions regarding influenza (pH1N1 and seasonal) vaccination and disease and their relationship to vaccination status among groups defined by race/ethnicity, income/poverty level, and education level during the 2009–2010 influenza season.

Methods

Data from the NHFS were analyzed. The NHFS was a CDC-sponsored, list-assisted random-digit-dialed telephone survey designed to provide timely within-season national- and state-level estimates for both 2009 H1N1 and seasonal influenza vaccination coverage for adults and children as well as among various influenza risk groups. Landline and cell phone (cell phone only or cell phone mainly*) households from all 50 states and District of Columbia were included in the sample. For the landline sample, one randomly selected adult from each household was sampled. For the cell phone sample, if an adult answered and their household did not contain a landline telephone or it contained a landline telephone but it was unlikely to be answered, then the adult who answered the cell phone was sampled otherwise they were not sampled. The survey included questions related to influenza vaccination status; recent respiratory illness and health risks; and knowledge, opinions, and practices regarding pH1N1 and seasonal influenza. If there were children in the household, a child was randomly selected and a parent or guardian who knew about the health and medical care of the child was asked the same questions with reference to this child. Monthly targets were set to achieve approximately 4889 completed interviews from landline households and 1111 from cellular-only or cellular-mostly households, for approximately 6000 interviews per month. Interviews were conducted in English and Spanish languages by trained interviewers using a computer-assisted telephone interviewing system which utilized legitimate range checks, automated skip patterns, and pick lists for response categories. Interviews were conducted from October 2009 through June 2010. The Council of American Survey Research Organizations (CASRO) response rate for the NHFS included in this report was 33·7% for landline telephone respondents and 26·1% for cellular telephone respondents.[14] The CASRO response rate is the product of three rates: the percentage of telephone lines identified as residential or non-residential (78·4% landline, 54·6% cell), the percentage of known households that completed the screening interview (99·6% landline, 85·8% cell), and the percentage of eligible respondents who completed the interview (43·2% landline, 55·8% cell).

Both 2009 H1N1 and seasonal influenza vaccination coverage estimates were based upon self-report to the following questions, ''Since September 2009, have you had an H1N1 flu vaccination,'' if so, ''in which month?'' and ''Since August 2009, have you had a seasonal flu vaccination,'' if so, ''in which month?'' Those who reported receiving the seasonal influenza vaccination during August 2009 to the month of interview were defined as vaccinated with seasonal influenza vaccine while those who reported receiving the 2009 H1N1 vaccination during October to the month of interview were considered vaccinated with 2009 H1N1 vaccine.

The opinion questions utilized four-level Likert scale response options, with questions being similarly worded for 2009 H1N1 and for seasonal influenza. The questions regarding 2009 H1N1 were: (i) ''How effective do you think the H1N1 flu vaccination is in preventing the H1N1 flu? Would you say very effective, somewhat effective, not too effective, or not at all effective?'' (ii) ''If you [had not gotten/do not get] an H1N1 flu vaccination this fall or winter, what [would have been/are] your chances of getting sick with the H1N1 flu? Would you say very high, somewhat high, somewhat low, or very low?'' (iii) ''How wor-

*Cell phone mainly was defined using the following survey questions ''Thinking just about the land line home phone, not your cell phone, if that telephone rang and someone was home, under normal circumstances how likely is it that it would be answered? Would you say extremely likely, somewhat likely, somewhat unlikely, or not at all likely?'' Respondents reporting somewhat unlikely and not at all likely were considered cell phone mainly.

ried [were/are] you about getting sick from the H1N1 flu vaccine? Would you say very worried, somewhat worried, not too worried, or not at all worried about getting sick from the flu vaccination.''[†]. For ease of presentation and to maintain sufficient sample size in analyses, the four Likert response categories were collapsed into two groups each containing two response categories. In addition to analysis of the opinion questions separately, respondents were also categorized into one of eight mutually exclusive groups defined by their pattern of responses to all three opinion questions: (i) effective-low, risk-low, worry-low, (ii) effective-low, risk-low, worry-high, (iii) effective-low, risk-high, worry-low, (iv) effective-low, risk-high, worry-high, (v) effective-high, risk-low, worry-low, (vi) effective-high, risk-low, worry-high, (vii) effective-high, risk-high, worry-low, and (viii) effective-high, risk-high, worry-high. The analyses were restricted to adults 18 years or older because the opinion questions were asked only of adults. Demographic characteristics were self-reported and included: race/ethnicity, income/poverty status (based on reported income and number of persons in the household and using U.S. poverty thresholds), education level, gender, and variables defining the groups recommended to receive pH1N1 and seasonal vaccination by the ACIP.[3,4]

Changes in opinions over the course of the influenza season were examined graphically by stratifying the sample based on month of interview (October–June). Vaccination coverage estimates were calculated using the Kaplan–Meier survival analysis procedure to determine the cumulative proportion of persons vaccinated with at least one dose of 2009 H1N1 vaccine and the proportion of persons vaccinated with at least one dose of seasonal vaccine. For respondents who indicated they had been vaccinated but had a missing month and/or number of doses of vaccination (6·6% for 2009 H1N1 and 4·7% for seasonal), the month and year of vaccination was imputed based on donor pools matched for week of interview, age group, state of residence, and race/ethnicity.[6,9] Respondents who reported receiving a 2009 H1N1 vaccination in August or September (an invalid response because the 2009 H1N1 vaccine was not available at that time), ''don't know,'' or who refused to answer the question about receipt of vaccination were excluded from the vaccination coverage calculations (2·4% for 2009 H1N1 and 2·1% for seasonal). Official interim and final influenza vaccination coverage estimates based on this survey have previously been published.[5–9]

Tests of association between the opinion and demographic variables were conducted using Wald chi-square tests followed by *post hoc* pair-wise comparison *t*-tests when the overall test of association was statistically significant. Multivariable logistic regression analysis was used to determine variables independently associated with receipt of influenza vaccination. Adjusted prevalence (AP) and adjusted prevalence ratios (APR) based on predicted marginals from the logistic regression model are reported.[15,16] To support the validity of the multivariable logistic regression model, the tests of association and the logistic regression analyses were restricted to NHFS interviews conducted from January through June (i) to reduce the possibility of vaccinations given after the interview and (ii) because there was evidence of change in opinions after the first 3 months of the 2009 H1N1 vaccination program (October–December). There were no statistically significant sample differences in demographic characteristics between the October-December and the January-June samples. A two-sided significance level of 0·05 was adopted for all statistical tests. Reported percentages and corresponding 95% confidence intervals (95% CI) were weighted while reported sample sizes were unweighted. All analyses were weighted to population totals and to adjust for households having multiple telephone lines, unit non-response, non-coverage of non-telephone households. Analyses were conducted using SAS, release 10·0·1, (SAS Inc., Cary, NC, USA) and SUDAAN, release 10·0·1, (Research Triangle Institute, Research Triangle Park, NC, USA) to account for the complex survey design.

[†]The survey instrument can be found at: http://www.cdc.gov/nchs/data/nis/h1n1/pandemic_flu_questionnaire_q1.pdf

Results

Demographics

The sample characteristics and the Kaplan–Meier estimates of 2009 H1N1 and seasonal influenza vaccination coverage estimates are presented in Table 1 by demographic characteristics and by the groups recommended for vaccination. Overall coverage was higher for seasonal (43·1%) than for 2009 H1N1 (24·5%) vaccine. Non-Hispanic white adults had higher 2009 H1N1 and seasonal vaccination coverage than both Hispanics and non-Hispanic blacks (all $P < 0·05$). Adults with household income greater than $75 000/year had higher 2009 H1N1 and seasonal vaccination coverage compared to adults in households with income above poverty but <$75 000/year and compared to adults at or below the poverty level (all $P < 0·05$). Vaccination coverage for additional subgroups is shown in Table 1.

Changes in opinions about influenza and influenza vaccine over the course of the influenza season

More respondents rated the seasonal influenza vaccine as very/somewhat effective in preventing influenza compared to the 2009 H1N1 vaccine, with seasonal influenza vaccine ratings remaining stable across months (range: 80·0%–82·8%; Figure 1). The percentage of respondents rating the

Table 1. Socio-demographic characteristics of the sample and 2009 H1N1 and seasonal influenza vaccination coverage estimates, National 2009 H1N1 Flu Survey (NHFS), October 2009–June 2010 interviews, United States

	n	Demographic distribution*	2009 H1N1 vaccination**	Seasonal influenza vaccination**
		%±95% CI***	%±95% CI	%±95% CI
Overall	**55 850**	**100**	**24·5 ± 0·9**	**43·1 ± 0·9**
Race/ethnicity				
a. Hispanic	3612	13·7 ± 0·7	21·2 ± 3·8[b,c]	30·3 ± 3·1[b,c,d]
b. Black, non-Hispanic	4490	11·4 ± 0·6	16·6 ± 2·4[a,c,d]	34·9 ± 3·0[a,c,d]
c. White, non-Hispanic	44 472	68·5 ± 0·8	26·4 ± 1·0[a,b]	47·3 ± 1·0[a,b,d]
d. Other, non-Hispanic	3276	6·4 ± 0·4	24·4 ± 3·7[b]	40·3 ± 3·6[a,b,c]
Income†				
a. Above poverty, >$75 K/year	14 259	26·5 ± 0·7	30·2 ± 1·7[b,c,d]	48·9 ± 1·7[b,c,d]
b. Above poverty, ≤$75 K/year	26 719	43·7 ± 0·8	24·0 ± 1·4[a,d]	43·9 ± 1·3[a,c,d]
c. At or below poverty	5513	12·5 ± 0·6	20·9 ± 3·1[a]	31·2 ± 2·7[a,b,d]
d. Unknown	9359	17·3 ± 0·6	19·6 ± 1·8[a,b]	41·0 ± 2·3[a,b,c]
Education				
a. <12 years	4950	11·6 ± 0·6	21·8 ± 4·3[d]	35·2 ± 3·2[b,c,d]
b. 12 years	12 056	22·0 ± 0·7	22·2 ± 1·9[d,e]	40·7 ± 1·9[a,d]
c. Some college	14 731	28·3 ± 0·8	22·5 ± 1·6[d,e]	40·7 ± 1·7[a,d]
d. College graduate	21 170	38·1 ± 0·8	29·3 ± 1·4[a,b,c,e]	49·7 ± 1·4[a,b,c,e]
e. Unknown	2943	6·3 ± 0·4	17·9 ± 3·1[b,c,d]	36·5 ± 4·3[d]
Sex				
a. Men	22 714	48·1 ± 0·8	23·5 ± 1·4[b]	39·8 ± 1·4[b]
b. Women	33 136	51·9 ± 0·8	25·4 ± 1·2[a]	46·2 ± 1·2[a]
Priority group for pH1N1††				
Yes	20 677	41·9 ± 0·8	30·2 ± 1·7	
18–24 years old	3924	12·6 ± 0·6	19·6 ± 2·5	
High-risk medical condition†††	15 128	24·8 ± 0·7	33·0 ± 2·3	
Health care personnel	5952	11·3 ± 0·5	46·1 ± 3·8	
Close contact <6 months old	4540	9·7 ± 0·5	35·2 ± 4·5	
No	35 173	58·1 ± 0·8	20·4 ± 1·0	
25–64 years no priority group	22 526	43·2 ± 0·8	18·1 ± 1·2	
65+ years no priority group	12 647	14·8 ± 0·5	27·2 ± 1·9	
Recommended group for seasonal				
Yes	40 914	63·7 ± 0·8		52·8 ± 1·1
High-risk medical condition	15 128	24·8 ± 0·7		57·2 ± 1·8
Health care personnel	5952	11·3 ± 0·5		62·0 ± 2·8
Close contact <6 months old	4540	9·7 ± 0·5		44·7 ± 3·3
50–64 years old	17 357	24·9 ± 0·6		49·4 ± 1·7
65+ years old	14 210	16·6 ± 0·5		72·0 ± 1·7
No	14 936	36·3 ± 0·8		25·9 ± 1·4

*Sample characteristics are based on October 2009 through June 2010 interview data.

**The Kaplan–Meier survival analysis procedure was used to estimate vaccination coverage using November through June interview data for 2009 H1N1 and October through June interview data for seasonal influenza. The presence or absence of superscripted letters denotes whether that estimate was statistically significantly different at $P < 0{\cdot}05$ from another row, and denotes which row it differed from (a, b, c, d, or e), based on pair-wise comparison *t*-test. Pair-wise comparisons were not carried out for the priority and recommended groups because they consist of overlapping groups.

***95% Confidence Interval half-width.

†Poverty level based on reported income and number of persons in the household and using U.S. poverty thresholds.

††Priority group for 2009 H1N1 defined as: 18–24 years, high-risk medical condition, health care worker, close contact with children <6 months, or pregnant women. Pregnant women were not broken out separately in Table 1 for either pH1N1 or seasonal; these estimates have been published.[8]

†††High-risk medical condition was defined as having a high-risk condition associated with serious complications following influenza infection including current asthma or other underlying medical condition (i.e., a lung condition other than asthma, a heart condition, diabetes, a kidney condition, a liver condition or a weakened immune system caused by a chronic illness or by medicines taken for a chronic illness).

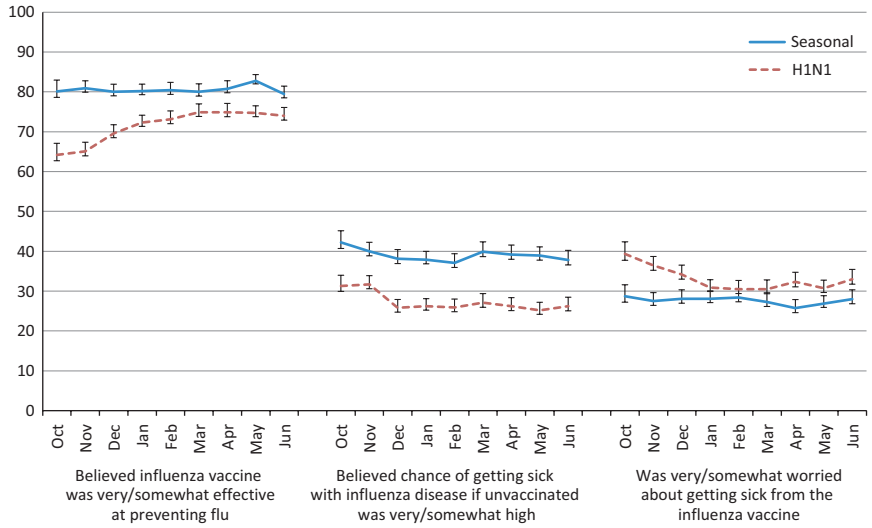

Figure 1. Changes in opinion ratings over the months of the survey, National 2009 H1N1 Flu Survey (NHFS), October 2009–June 2010 interviews, United States.

2009 H1N1 vaccine as effective at preventing pH1N1 increased over the months of the survey, from 64·2% in October to 74·9% in March and April. Ratings of belief in the likelihood of getting sick with seasonal or pH1N1 influenza disease if not vaccinated were higher for seasonal influenza vaccine (range: 37·1%–42·2%) than for 2009 H1N1 influenza vaccine with ratings for 2009 H1N1 approximately 31% in October and November and then dropping to approximately 25% for the subsequent months. More respondents were worried about getting sick from the 2009 H1N1 vaccine than from the seasonal influenza vaccine, but the percentage decreased over the months of the survey for 2009 H1N1 vaccine (39·3% October and 30·7% in May; Figure 1) and remained stable for seasonal influenza vaccine. When examined by race/ethnicity, the confidence intervals were too wide to make meaningful comparisons of trends between groups.

Belief in effectiveness of the influenza vaccine

Overall, more than three-quarters of the respondents rated the influenza vaccine as very or somewhat effective (Table 2). The percentage of respondents rating the influenza vaccine as very or somewhat effective varied by race/ethnicity, income, and education for both the 2009 H1N1 and the seasonal vaccines (Table 2). Fewer blacks (69·2%) compared to Hispanics (73·5%), whites (74·9%), and others (74·2%) believed the 2009 H1N1 vaccine was effective (all $P < 0·05$). Fewer blacks (75·3%) compared to whites (81·9%) and others (80·2%) believed the seasonal vaccine was effective (both $P < 0·05$). A higher percentage of respondents with income >$75 000/year (79·9%) believed the 2009 H1N1 vaccine was effective compared to those above poverty but <$75 000/year (75·4%), below poverty (74·6%), and unknown income level (60·4%; all $P < 0·05$). Higher income was also associated with higher ratings of effectiveness for the seasonal influenza vaccine (Table 2). A higher percentage of college graduates believed the 2009 H1N1 and the seasonal influenza vaccines were effective compared to respondents with lower education levels (all $P < 0·05$). For the seasonal influenza vaccine only, a higher percentage of women rated the vaccine as effective compared to men ($P < 0·05$).

Belief in chances/risk of getting influenza disease if unvaccinated

Overall, the percentage of respondents who believed their chance/risk of getting sick with influenza disease if unvaccinated was high or somewhat high was 26·1% for pH1N1 and 38·5% for seasonal (Table 2). Belief in the chance of getting influenza disease if unvaccinated varied by race/ethnicity, income, education, and gender for both pH1N1 and seasonal influenza (Table 2). More Hispanics (39·3%) than blacks (25·0%), whites (23·4%), and others (28·0%) said their chances were very high or somewhat high of getting sick with pH1N1 if they were unvaccinated (all $P < 0·05$). Likewise, more Hispanics (45·5%) than blacks (33·3%), whites (37·9%), and others (38·7%, all $P < 0·05$) said their chances were very high or somewhat high of getting sick with seasonal influenza if they were unvaccinated. Fewer blacks (33·3%) believed they were susceptible to seasonal influenza than whites (37·9%), and others [(38·7%); both $P < 0·05$]. A higher percentage of respondents below the poverty level believed they would be at risk of getting influenza disease if unvaccinated compared to respondents with higher income and those with unreported income (Table 2). Respondents who were college graduates or who had completed some college had lower ratings of belief in risk of getting influenza, both seasonal and pH1N1, as compared to respondents with lower levels of education (Table 2). Females believed they were more at risk

Table 2. Association of belief variables with race/ethnicity, income, education, and gender, National 2009 H1N1 Flu Survey (NHFS), January–June 2010 interviews, United States

	Believed influenza vaccine was very/somewhat effective		Believed chance of getting sick with influenza disease if unvaccinated was very high or somewhat high		Was very/somewhat worried about getting sick from the influenza vaccine	
	H1N1	Seasonal	H1N1	Seasonal	H1N1	Seasonal
	%±95% CI*	%±95% CI	%±95% CI	%±95% CI	%±95% CI	%±95% CI
Overall	**74·0 ± 0·8**	**80·6 ± 0·8**	**26·1 ± 0·9**	**38·5 ± 0·9**	**31·3 ± 0·9**	**27·4 ± 0·9**
Race/ethnicity						
a. Hispanic	73·5 ± 3·1**,b	79·0 ± 2·9	39·3 ± 3·5[b,c,d]	45·5 ± 3·6[b,c,d]	45·9 ± 3·5[b,c,d]	41·6 ± 3·5[b,c,d]
b. Black only, non-Hispanic	69·2 ± 2·9[a,c,d]	75·3 ± 2·8[c,d]	25·0 ± 2·7[a]	33·3 ± 3·0[a,c,d]	36·8 ± 3·1[a,c]	31·7 ± 2·8[a,c]
c. White only, non-Hispanic	74·9 ± 0·9[b]	81·9 ± 0·8	23·4 ± 0·8[a,d]	37·9 ± 1·0[a,b]	26·6 ± 0·9[a,b,d]	23·2 ± 0·8[a,b,d]
d. Other, non-Hispanic	74·2 ± 3·3[b]	80·2 ± 3·0	28·0 ± 3·8[a,c]	38·7 ± 4·0[a,b]	38·5 ± 3·9[a,c]	32·0 ± 4·0[a,c]
Income/poverty***						
a. Above poverty, >$75K/year	79·9 ± 1·4[b,c,d]	83·8 ± 1·4[c,d]	24·2 ± 1·5[c]	38·5±1·7[c,d]	25·9 ± 1·5[b,c,d]	21·1 ± 1·4[b,c,d]
b. Above poverty, ≤$75K/year	75·4 ± 1·2[a,d]	82·3 ± 1·1[c,d]	24·5 ± 1·2[c]	38·5±1·4[c,d]	29·6 ± 1·3[a,c,d]	26·4 ± 1·2[a,c,d]
c. At or below poverty	74·6 ± 2·6[a,d]	77·7 ± 2·6[a,b,d]	38·6 ± 3·2[a,b,d]	45·4±3·2[a,b,d]	47·3 ± 3·2[a,b,d]	41·3 ± 3·1[a,b,d]
d. Unknown	60·4 ± 2·3[a,c]	73·2 ± 2·1[a,b,c]	23·6 ± 2·1[c]	32·6±2·3[a,b,c]	32·2 ± 2·3[a,b]	29·2 ± 2·3[a,b,c]
Education level						
a. <12 years	70·5 ± 3·0[d,e]	77·2 ± 2·9[b,d,e]	35·8 ± 3·3[b,c,d,e]	42·9 ± 3·3[c,d,e]	43·4 ± 3·4[b,c,d,e]	38·5 ± 3·3[b,c,d,e]
b. 12 years	73·5 ± 1·8[d,e]	81·4 ± 1·6[a,d,e]	28·8 ± 2·0[a,c,d]	40·6 ± 2·1[c,d,e]	34·3 ± 2·0[a,c,d]	30·7 ± 2·0[a,c,d]
c. Some college	72·9 ± 1·6[d,e]	79·6 ± 1·5[d,e]	23·1 ± 1·6[a,b,e]	36·3 ± 1·8[a,b]	29·6 ± 1·7[a,b,d,e]	27·4 ± 1·7[a,b,d]
d. College graduate	78·3 ± 1·2[a,b,c,e]	83·5 ± 1·1[a,b,c,e]	23·4 ± 1·2[a,b,e]	38·0 ± 1·4[a,b]	26·5 ± 1·3[a,b,c,e]	21·6 ± 1·2[a,b,c,e]
e. Unknown	59·7 ± 4·6[a,b,c,d]	68·9 ± 4·6[a,b,c,d]	28·6 ± 4·5[a,c,d]	34·4 ± 5·0[a,b]	36·5 ± 4·9[a,c,d]	30·6 ± 4·8[a,d]
Sex						
a. Men	73·9 ± 1·3	79·6 ± 1·2[b]	22·5 ± 1·3[b]	34·8 ± 1·4[b]	27·2 ± 1·4[b]	25·1 ± 1·3[b]
b. Women	74·1 ± 1·1	81·6 ± 1·0[a]	29·6 ± 1·2[a]	42·0 ± 1·2[a]	35·3 ± 1·2[a]	29·5 ± 1·2[a]
Priority group for pH1N1†						
a. Yes	78·0 ± 1·3[b]	82·7 ± 1·2[b]	33·3 ± 1·5[b]	44·7 ± 1·5[b]	36·0 ± 1·5[b]	30·0 ± 1·4[b]
b. No	71·0 ± 1·1[a]	79·1 ± 1·0[a]	20·8 ± 1·0[a]	33·8 ± 1·2[a]	27·9 ± 1·1[a]	25·5 ± 1·1[a]
Recommended group for seasonal						
a. Yes	73·8 ± 1·0	82·5 ± 0·8[b]	28·0 ± 1·0[b]	41·8 ± 1·1[b]	31·2 ± 1·1	27·2 ± 1·0
b. No	74·3 ± 1·5	77·3 ± 1·5[a]	22·8 ± 1·5[a]	32·5 ± 1·7[a]	31·5 ± 1·7	27·8 ± 1·6

*95% Confidence Interval half-width.

**The presence or absence of superscripted letters denotes whether that estimate was statistically significantly different at $P < 0·05$ from another row, and denotes which row it differed from (a, b, c, d, or e), based on pair-wise comparison *t*-test. For example, the percentage of Hispanics (a) believing the 2009 H1N1 vaccine was effective (73·5%) was statistically significantly different from the percentage of black, non-Hispanics (b) with this belief (69·2%).

***Poverty level based on reported income and number of persons in the household and using U.S. poverty thresholds.

†Priority group for 2009 H1N1 defined as age 18–24 years, or high-risk medical condition, health care worker, close contact with children <6 months, and pregnant women.

compared to males for both pH1N1 and seasonal influenza (both $P < 0·05$).

Worry about getting sick from the influenza vaccine

Overall, 31·3% (2009 H1N1) and 27·4% (seasonal) of respondents reported they were very/somewhat worried about getting sick from the influenza vaccine (Table 2). Worry about getting sick from the influenza vaccine varied by race/ethnicity, income, education, and gender for both 2009 H1N1 and seasonal influenza (Table 2). A higher percentage of Hispanic respondents (45·9%) reported being very or somewhat worried about getting sick from the 2009 H1N1 vaccine compared to blacks (36·8%), whites (26·6%), and others (38·5%, $P < 0·05$). This result was similar for worry about getting sick from the seasonal influenza vaccine (Table 2). Worry about getting sick from the 2009 H1N1 and the seasonal influenza vaccines was lower among respondents with higher income levels or education levels, and among male respondents (Table 2).

Association of opinions about influenza disease and vaccine with vaccination coverage

In bivariate analysis, all three opinion questions were statistically significantly associated with vaccination coverage for both 2009 H1N1 and seasonal influenza (Figure 2). Respondents who believed the vaccine was effective in preventing influenza and those who thought they were likely to get sick with influenza if not vaccinated had significantly higher influenza vaccination coverage than those who did not have these opinions. Respondents who were very/somewhat worried about getting sick from the influenza vaccine were also associated with vaccination coverage but the difference was small for seasonal and the opposite of what was expected for 2009 H1N1.

Based on the logistic regression analysis, variables significantly associated with receipt of 2009 H1N1 influenza vaccination included: white non-Hispanic race/ethnicity or other race, higher income level, college graduate, opinions about the vaccination and disease, and being in a priority group for vaccination (Table 3). Demographic variables significantly associated with receipt of seasonal influenza vaccination included all of those mentioned for 2009 H1N1 as well as female gender. In both models, the adjusted prevalence of vaccination varied widely according to opinions about vaccine effectiveness and personal risk for influenza. Concern about getting sick from the vaccine had little additional effect on vaccination coverage. Respondents who believed the 2009 H1N1 vaccine not to be effective and also believed they were at low risk of getting influenza had the lowest adjusted vaccination coverage (11·1% and 7·4% with high and low concern about getting sick from the vaccine, respectively). Respondents who believed the pH1N1 vaccine was effective and believed they were at high risk of disease had the highest adjusted vaccination coverage (50·1% and 52·6%, with high or low concern about getting sick from the vaccine, respectively). Respondents who held the belief that either the vaccine was effective or that they were at risk of the disease had intermediate adjusted vaccination coverage levels (Table 3). Similar patterns were found for seasonal influenza vaccine. Respondents who believed both that the vaccine was effective and that their chances of getting influenza if unvaccinated were high had the highest adjusted coverage for both 2009 H1N1 and seasonal influenza vaccines (Table 3).

Discussion

This study demonstrates the importance of perceived susceptibility to influenza and belief in vaccine effectiveness on receipt of influenza vaccination and the variability of these opinions by demographic subgroups. The patterns found were similar for 2009 H1N1 and seasonal vaccination. There was much more variation in adjusted vaccination coverage by opinions than by any of the socio-demographic factors, with respondents who believed the 2009 H1N1 vaccine was both effective and that they were susceptible to pH1N1 influenza if unvaccinated having 2009 H1N1 vaccination coverage over seven times higher than those with opposite beliefs. Although opinions about 2009 H1N1 vaccination effectiveness and safety improved over time, opinions were least favorable during the key period (October and November 2009) when 2009 H1N1 vaccination was becoming available and pH1N1 disease was still circulating, reaching, or recently past peak levels in different areas of the United States.

Opinions about the vaccine and disease changed over time, but not dramatically so. Belief in the effectiveness of 2009 H1N1 vaccine was initially lower than for seasonal vaccine but increased over the first 3 months of the vaccination program but not to the level of seasonal vaccination. This increase could be the result of the public's accumulating experience with the vaccine over time and/or more

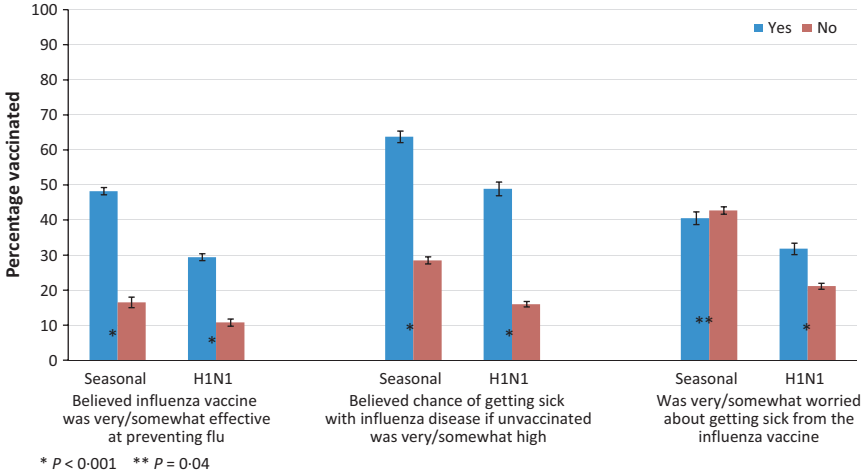

Figure 2. Association of belief variables with influenza vaccination, National 2009 H1N1 Flu Survey (NHFS), January–June 2010 interviews, United States.

Table 3. Factors associated with influenza vaccination, by influenza vaccine type, National 2009 H1N1 Flu Survey (NHFS), January–June 2010 interviews, United States

Variables in the model	2009 H1N1			Seasonal		
	APR*	95% CI**	AP***%	APR	95% CI	AP %
Race/ethnicity						
Hispanic	Referent	Referent	16·5	Referent	Referent	34·2
Black, non-Hispanic	1·1	(0·9–1·3)	17·9	1·1	(1·0–1·3)	38·2
White, non-Hispanic	**1·6**	**(1·3–1·8)**	25·6	**1·3**	**(1·2–1·4)**	44·2
Other, non-Hispanic	**1·4**	**(1·1–1·7)**	22·7	**1·2**	**(1·1–1·4)**	42·6
Income/poverty†						
Above poverty, >$75 K/year	**1·3**	**(1·2–1·5)**	25·8	**1·3**	**(1·1–1·4)**	44·5
Above poverty, ≤$75 K/year	**1·2**	**(1·0–1·4)**	22·9	**1·2**	**(1·1–1·3)**	41·7
At or below poverty	Referent	Referent	19·3	Referent	Referent	35·5
Unknown	**1·2**	**(1·0–1·4)**	22·6	**1·3**	**(1·1–1·4)**	44·5
Education level						
<12 years	Referent	Referent	19·5	Referent	Referent	38·0
12 years	1·1	(0·9–1·2)	20·7	1·0	(0·9–1·1)	39·2
Some college	1·1	(0·9–1·3)	21·6	1·1	(1·0–1·2)	41·3
College graduate	**1·4**	**(1·2–1·6)**	27·2	**1·2***	**(1·1–1·3)***	45·9
Unknown	1·0	(0·8–1·3)	19·5	1·0	(0·9–1·2)	38·4
Opinion						
Risk (Low) Effective (Low) Worry (Low)	Referent	Referent	7·4	Referent	Referent	14·7
Risk (Low) Effective (Low) Worry (High)	**1·5**	**(1·2–2·0)**	11·1	0·9	(0·6–1·2)	12·8
Risk (Low) Effective (High) Worry (Low)	**2·2**	**(1·9–2·5)**	16·0	**2·4**	**(2·1–2·7)**	35·1
Risk (Low) Effective (High) Worry (High)	**3·1**	**(2·6–3·7)**	22·9	**2·0**	**(1·7–2·3)**	29·7
Risk (High) Effective (Low) Worry (Low)	**3·1**	**(2·3–4·3)**	23·3	**2·7**	**(2·2–3·4)**	40·0
Risk (High) Effective (Low) Worry (High)	**3·8**	**(2·9–4·9)**	28·0	**2·3**	**(1·7–3·1)**	33·8
Risk (High) Effective (High) Worry (Low)	**7·1**	**(6·1–8·2)**	52·6	**4·7**	**(4·2–5·3)**	69·3
Risk (High) Effective (High) Worry (High)	**6·8**	**(5·8–7·8)**	50·1	**4·0**	**(3·5–4·5)**	58·8
Sex						
Men	1·0	(1·0–1·1)	23·4	**0·9**	**(0·9–1·0)**	40·7
Women	Referent	Referent	23·0	Referent	Referent	43·4
Priority group††						
Yes	**1·3**	**(1·2–1·3)**	26·2	**1·7**	**(1·6–1·8)**	49·2
No	Referent	Referent	20·8	Referent	Referent	28·7

*APR = Adjusted prevalence ratio; estimates in bold are statistically significantly different from the referent ($P < 0·05$); all variables listed in the table were included in the model.
**95% Confidence Interval.
***AP = Adjusted prevalence (i.e., adjusted vaccination coverage estimate).
†Poverty level based on reported income and number of persons in the household and using U.S. poverty thresholds.
††Priority group for 2009 H1N1 defined as age 18–24 years, or high-risk medical condition, health care worker, close contact with children <6 months, and pregnant women.

agreement with the positive communication messages about the vaccine, such as that the vaccine was made the way seasonal influenza vaccine is made every year, as the strains included in the vaccine are changed as needed to match circulating disease strains. Surprisingly, our data found that the perception of risk from pH1N1 was lower than for seasonal influenza, even in October and November, and this perception of risk decreased after November. In the United States during October and November of 2009, pH1N1 was by far the dominant strain of influenza circulating.[17] Additionally, there was a large increase in demand for the seasonal influenza vaccine at this time, which could indicate some confusion about what strains were included in the seasonal influenza vaccine and a mistaken belief the seasonal vaccine would provide protection from pH1N1.

Opinions about vaccine effectiveness, safety, and risk of influenza were associated with socio-demographic characteristics. This result has been found in a previous study of 50- to 64-year-olds, suggesting that racial/ethnic differences in opinions about influenza vaccination and disease may be a mediating factor in the racial/ethnic disparities in adult influenza vaccination coverage.[12,18] We found that a lower

percentage of blacks rated the influenza vaccine as effective, as did those with lower income and lower education levels, suggesting that improved communication about vaccine effectiveness to these groups by providers and others may be needed. Hispanics had the highest percentage of belief in susceptibility to get pH1N1 disease or seasonal influenza disease but also the highest percentage that worried about getting sick from the vaccinations. In our study, Hispanics, blacks, and others were all more likely than whites to say they worried about getting sick from both the seasonal and 2009 H1N1 influenza vaccines. However, in the multivariable model, this variable was not predictive of vaccination behavior as were the other beliefs.

The findings of this study suggest that opinions about vaccine effectiveness and perception of personal risk are important determinants of coverage. Hence, improving communication about personal risk and the effectiveness of the vaccine may improve vaccination coverage. The use of audience segmentation for communication messages that consider these demographic differences also may allow for more effective and targeted communication to promote influenza vaccination.[19] This could be carried out in partnership with providers, community leaders, and community and faith-based organizations using a variety of strategies including social media.[20–22]

Another important component is to engage providers in recommending and administering vaccines. Influenza vaccination is now recommended for all persons ≥6 months old. Studies have shown the importance of provider recommendation and provider recommendations can override patient negative opinions if their doctor recommended vaccination.[13,23] Systems approaches, such as standing orders to enable consistent offering of influenza vaccination to all patients during the influenza season, should be emphasized alongside patient education. Systems approaches have been shown to be the most effective strategy, and while education is necessary, it is not sufficient by itself.[24–26]

This study is subject to at least five limitations. First, all results are based upon self-report and vaccination status was not validated with medical records; there may have been confusion by the respondent as to which vaccine he/she received. Second, there is possibly some selection bias owing to the non-inclusion of households with no telephone service. Third, the CASRO response rate was low. Non-response bias may remain after weighting adjustments were made. Fourth, opinions were ascertained at the time of the interview and not at the time of vaccination or vaccination decision and may have changed by the time the interview occurred. Fifth, the question about concern about getting sick from vaccination may have been interpreted by respondents in very different ways. If a respondent had no intention of receiving an influenza vaccination, then they may have no worry about getting sick from it or a respondent who was unvaccinated may have elected to not receive the vaccine specifically because of worry about safety. A person who was already vaccinated and did not get sick may say at the time of the interview that they were not worried although they may or may not have had worry at the time of vaccination. The wording of survey and poll questions about vaccine safety has varied widely. More study is needed on the most valid ways to capture concern about vaccine safety.

In conclusion, demographic differences in opinions about influenza vaccine and disease suggest that improving communication strategies to these groups may improve vaccination coverage. Based on our study, beliefs in the effectiveness of the vaccine and susceptibility to influenza disease are strongly associated with influenza vaccination. Although opinions about 2009 H1N1 vaccination effectiveness and safety improved over time, opinions were least favorable during the key period (October and November 2009) when 2009 H1N1 vaccination was becoming available and pH1N1 disease was still circulating, reaching, or recently past peak levels in different areas of the United States. Efforts to improve communications during inter-pandemic periods, segmented appropriately for particular demographic groups and linked to proven systems approaches such as provider recommendation and reminder recall, may help further the success of future influenza vaccination efforts.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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