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RESEARCH ARTICLE

Shingles Vaccine Uptake Among Older Adults: Identifying Early, Later, and Nonadopters

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Introduction: There is growing interest in accelerating adoptions of vaccines. This study examined factors that differentiate the acceptance and timing of uptake of the first shingles vaccine, Zostavax, among older adults in the U.S.

Methods: Data from Health and Retirement Study respondents who were aged ≥62 years in 2008 were analyzed to determine whether they received a shingles vaccination from 2006 to 2016. Multinomial logistic regression was used to examine the characteristics associated with vaccine uptake and timing.

Results: Of those eligible, 15.2% were vaccinated early (between 2006 and 2010), 20.2% were vaccinated later, and 64.6% remained unvaccinated 10 years after the shingles vaccine was introduced. Respondents more likely to be vaccinated were those who had higher education and income, experience with influenza vaccination, more frequent social interaction with friends, or were residing in an area with higher shingles vaccination rates.

Conclusions: Shingles vaccination rates vary by social and geographic characteristics. Efforts to improve and expedite vaccination and other new preventive measures should target specific populations and geographic areas.

INTRODUCTION

Shingles affects 1 in 3 Americans over their lifetime. The painful rash resulting from this disease often leads to difficulties in physical functioning, a need for hospitalization or prolonged medical care, and poor social and emotional well-being.[1,2] Zostavax, the vaccine approved in 2006, and Shingrix, the vaccine approved in 2017, can prevent shingles or reduce its severity.[3,4] However, about two thirds of older adults have not received a shingles vaccine.[5]

Because the speed of adoption determines how fast the burden of preventable disease can be reduced, delays in shingles vaccination unnecessarily heighten the risk of disease. Understanding influences on the timing of vaccine acceptance could help in implementing strategies to increase vaccine adoption. Previous studies have identified several contributors to vaccine acceptance. These include advantaged socioeconomic backgrounds,[6,7] good health,[7–9] frequent healthcare encounters and physician's recommendation,[7,9–14] experience with immunization,[10,11,13] awareness of shingles risk or acquaintance with patients with shingles,[10,11] and residence in the West Central region of the U.S.[7,8] Such

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studies used cross-sectional data that could not predict uptake over time. Because diffusion of any new preventive measure occurs over time,[15] it is important to understand whether influences on vaccination might change over time.

Early shingles vaccination might be related to medical literacy[14] as well as financial resources and insurance coverage.[6,7] This is because the shingles vaccine is still the most expensive vaccine recommended for older adults[16] even after increases in levels covered by insurance. Personality traits such as conscientiousness can also influence the use of preventive health care,[16,17] as can peer recommendations[18,19] and immunization practices in the community.[20] This work uses longitudinal data to identify the characteristics of early, late, and nonadopters of the shingles vaccine in the 10 years after the first vaccine was approved.

METHODS

Study Sample

Data from the 2006−2016 Health and Retirement Study (HRS), a nationally representative longitudinal survey of adults aged >50 years, were analyzed. The HRS uses a multistage probability sampling design with an oversampling of African Americans and Hispanics. It collects extensive information on respondent demographics, health, healthcare use, and availability of insurance. In 2008, the HRS added questions on shingles vaccination. In addition to these variables, measures of social interaction and personality from the HRS Psychosocial and Lifestyle self-administered questionnaire were used in this study. This questionnaire is given to a rotating half-sample every 2 years and repeated after 4 years (e.g., one half of the sample received this questionnaire in 2006 and repeated it in 2010 and the other half received it in 2008 and repeated it in 2012).

When the shingles vaccine first became publicly available in 2006, it was recommended for individuals aged ≥60 years. Therefore, this analysis was limited to the 12,568 respondents who were ≥62 years at the time of the 2008 HRS interview. In addition, 83 individuals who did not report their shingles vaccination experience, 124 respondents whose timing of vaccination was unknown or who reported a date before the vaccine was available, and 2,361 respondents who had missing data on social interactions, personality, or other covariates were eliminated. Each respondent was linked to the estimated level of vaccination in their hospital referral region (HRR) of residence, eliminating respondents who had missing data on their geographic residence (n=40) or who were the sole respondent in an HRR (n=26). The final analytic sample had 9,934 respondents. Relative to the final analytic sample, respondents who were eliminated for missing information (n=2,634) were older (75.6 years vs 72.5 years, $p<0.001$) and less likely to be non-Hispanic White (72.4% vs 84.3%, $p<0.001$) but did not differ significantly by sex.

Measures

In this study, respondents who were not vaccinated by 2016 were classified as nonadopters, those who were vaccinated between 2006 and 2010 were classified as early adopters, and those who were vaccinated between 2011 and 2016 were classified as late adopters. Information on receipt and timing of vaccination from 2 HRS questions was obtained. The first question was, *Have you ever had the shingles vaccine?* The HRS asked this question to all respondents in 2008 and to respondents who had not previously reported receiving the vaccine in 2010, 2012, and 2016. Second, for respondents who reported receiving a vaccine in the 2008 or 2010 surveys, the HRS asked the year of vaccination.

In assessing vaccine uptake, individual demographic characteristics such as age, sex, race/ethnicity (non-Hispanic White as reference category plus non-Hispanic Black, Hispanic, and other), and marital status (married and unmarried) were considered. Measures of socioeconomic status (SES) were logged household income and highest level of education (less than high school as reference category, high school, and at least some college). This study controlled for respondents having prescription drug insurance, perceived health status (fair or poor compared with good, very good, or excellent), and past preventive health care (having ever had an influenza vaccine).

Indicators of personality (conscientiousness) and social interaction with family or friends were included. Conscientiousness is the average self-rating (from 1=not at all to 4=a lot) on 5 items: organized, responsible, hardworking, carelessness (reverse-coded), and thoroughness. Social interaction was measured by 2 scales indicating the average frequency (1=less than once a year or never, 2=once or twice per year, 3=every few months, 4=once or twice per month, 5=once or twice per week, and 6=3 or more times per week) in 3 modes of contacts (written or e-mail, telephone, and in-person contact). All individual-level characteristics were derived from data collected in 2008 except for information on social interactions and conscientiousness that were collected for half the sample in 2006 and the other half in 2008 or in 2010/2012 if missing in 2006/2008.

Shingles vaccination rates were calculated for each respondent's HRR of residence based on other respondents' reports of vaccination. This indicated both prevailing practice and exposure to vaccinated persons in the

area. The study participants lived in 245 of the 306 HRRs in the U.S. On average, 104 participants lived in each HRR; only 2.5% of the study sample lived in an HRR with ≤5 study participants. The vaccination prevalence rate in an HRR was computed as the number of survey respondents vaccinated through 2016 divided by the number of respondents living in the HRR. The individual respondent from both the numerator and denominator was excluded when calculating the rate for their HRR. For analysis, HRRs were divided into quartiles by their vaccination rate.

Statistical Analysis

Differences in descriptive profiles of early adopters, late adopters, and nonadopters of vaccines were examined. Thereafter, multinomial logistic regression models were used to investigate the independent effects of factors associated with early and late adopters relative to those who did not get vaccinated. Stata, version 16 (Stata Corporation) was used to conduct these analyses and results were weighted to represent the national population.

RESULTS

Table 1 presents weighted characteristics for the full sample and by vaccine adopter category. Most respondents (64.2%) remained unvaccinated after 10 years of vaccine availability; that is, they were nonadopters. Among the rest, late vaccine adopters (20.2%) outnumbered early adopters (15.2%).

Early adopters were older than late adopters (72.3 years vs 70.2 years, $p<0.001$) but younger than nonadopters (73.2 years, $p<0.001$). Early adopters were more likely to be non-Hispanic White (92.9%) compared with late adopters (86.1%, $p<0.001$) or nonadopters (81.6%, $p<0.001$). The proportion of respondents with at least some college education was highest among early adopters (61.2%) and lower among nonadopters than late adopters (38.2% vs 48.4%, $p<0.001$). Early adopters were least likely to report poor health (15.6%), and nonadopters were most likely to do so (31.1%). Previous vaccine experience was lowest among nonadopters (65.5%) and highest among early adopters (89.6%) ($p<0.001$). Early adopters tended to be more conscientious (3.5) than late adopters (3.4, $p<0.001$) or nonadopters (3.3, $p<0.001$). Early adopters were more likely to live in an area with the highest shingles vaccination rate.

Table 2 displays multinomial logistic regression results from this study, controlling for other variables, comparing early adopters (column 1) and late adopters (column 2) with the unvaccinated and to each other (column 3). These results show that older adults were less likely to be vaccinated, whereas adults with higher levels of income and education were more likely to be vaccinated. Individuals with prescription drug plans were 1.77 times more likely to get vaccinated later than those without them. Respondents reporting poor health were about 40% less likely to be vaccinated. Respondents who had influenza vaccines were about 3 to 4 times more likely to have had a shingles vaccine as well. Those who more frequently engaged with friends were also more likely to receive the vaccine early (RRR=1.16; 95% CI=1.07, 1.25) and late (RRR=1.08; 95% CI=1.01, 1.15) than those not vaccinated. Those living in regions above the lowest quartile of shingles immunization rate were more likely to receive vaccination than their counterparts in areas with the lowest rates of immunization.

Among adopters, older respondents were more likely to have received the vaccine early, that is, between 2006 and 2010 (RRR=1.04; 95% CI=1.03, 1.05). Non-Hispanic Black respondents were less likely to have received the vaccine earlier than non-Hispanic White respondents. Socioeconomic characteristics also influenced early vaccination. Among the vaccinated, those with at least some college education or higher income levels were more likely to have received the vaccine early. Those who had received an influenza vaccine were also 2 times more likely to receive the shingles vaccine early. Respondents with more conscientious personalities were more likely to receive early than late vaccination. Finally, after controlling for all individual characteristics, it was found that respondents in areas of greatest vaccine prevalence were more likely to have received the vaccine earlier than later.

DISCUSSION

During the first 10 years when the shingles vaccine was available, the vaccine uptake rate remained low at 35.4% in this national sample aged ≥60 years. This rate is similar to the 33% national immunization rate for adults ≥60 years reported by the Centers for Disease Control and Prevention in 2016.[5] The slightly higher rate in this study may reflect the inclusion of the institutionalized population in this sample, whereas the Centers for Disease Control and Prevention relies on estimates of the non-institutionalized population from the National Health Interview Survey.

The longitudinal findings of this study add to the literature by identifying facilitators of shingles vaccine adoption. This study finds that vaccine adoption, overall and early, was facilitated by higher education and income, influenza vaccination experience, and frequent social interaction with friends. These findings also show that, controlling for individual characteristics, those who resided in an area with higher shingles vaccination rates

Table 1. Descriptive Statistics for the Full Sample and by Vaccine Adopter Category, HRS, 2006–2016

	Full sample Mean (SD)/%	(1) Nonadopters (64.6%) Mean (SD)/%	(2) Early adopters (15.2%) Mean (SD)/%	(3) Late adopters (20.2%) Mean (SD)/%	*p* for (1) and (2)	*p* for (1) and (3)	*p* for (2) and (3)
Individual-level variable							
Age, years	72.5 (7.9)	73.2 (8.2)	72.3 (7.3)	70.2 (6.7)	***	***	***
Female	56.3%	56.2%	58.9%	54.7%			*
Race/ethnicity							
Non-Hispanic White	84.3%	81.6%	92.9%	86.1%	***	***	***
Non-Hispanic Black	7.6%	9.4%	2.2%	6.2%	***	***	***
Hispanics	6.0%	6.8%	2.8%	5.5%	***		**
Other	2.2%	2.2%	2.1%	2.2%			
Married	60.9%	57.5%	67.3%	67.0%	***	***	
Education							
Less than high school	23.1%	27.7%	11.1%	17.7%	***	***	***
High school	33.1%	34.1%	27.7%	33.9%	***		***
Some college or above	43.7%	38.2%	61.2%	48.4%	***	***	***
Logged household income	10.6 (1.0)	10.4 (0.9)	10.9 (1.0)	10.7 (0.9)	***	***	***
Has prescription drug plans	93.9%	92.6%	96.3%	96.2%	***	***	
Self-reported poor health	26.3%	31.1%	15.6%	18.8%	***	***	*
Received influenza vaccine	72.1%	65.5%	89.6%	80.0%	***	***	***
Conscientious personality	3.4 (0.5)	3.3 (0.5)	3.5 (0.4)	3.4 (0.5)	***	***	***
Social interaction with family/children	3.7 (0.9)	3.6 (0.9)	3.8 (0.9)	3.7 (0.9)	***	***	*
Social interaction with friends	3.7 (1.1)	3.6 (1.1)	4.0 (1.0)	3.8 (1.0)	***	***	***
Area-level variable							
Shingles vaccination rate in HRR							
First quartile (0%–26.3%)	23.2%	27.0%	13.4%	18.5%	***	***	***
Second quartile (26.7%–33.3%)	24.9%	24.9%	23.8%	25.8%			
Third quartile (33.7%–39.8%)	25.1%	23.4%	26.5%	29.6%	*	***	
Fourth quartile (40%–100%)	26.7%	24.7%	36.2%	26.1%	***		***
n	9,934	6,586	1,445	1,903			

Note: Statistical significance (*$p<0.05$, **$p<0.01$, **$p<0.001$) for test of difference between (1) and (2), (1) and (3), and (2) and (3).
HRR, hospital referral region; HRS, Health and Retirement Study.

Table 2. Multinomial Logistic Regression Models Predicting Early Vaccine Adopters and Late Vaccine Adopters (N=9,934)

	Early adopters versus nonadopters (ref)		Late adopters versus nonadopters (ref)		Early adopters versus late adopters (ref)	
	RRR	95% CI	RRR	95% CI	RRR	95% CI
Individual-level variable						
Age, years	**0.98 *****	**(0.97, 0.99)**	**0.94 *****	**(0.93, 0.95)**	**1.04 *****	**(1.03, 1.05)**
Female	1.15	(0.99, 1.34)	0.98	(0.86, 1.12)	1.17	(0.99, 1.39)
Race/ethnicity						
Non-Hispanic White						
Non-Hispanic Black	**0.36 *****	**(0.25, 0.52)**	0.82	(0.66, 1.02)	**0.44 *****	**(0.30, 0.65)**
Hispanic	0.70	(0.45, 1.07)	1.09	(0.83, 1.43)	0.64	(0.40, 1.01)
Other	1.03	(0.63, 1.71)	1.04	(0.66, 1.62)	1.00	(0.57, 1.75)
Married	1.04	(0.88, 1.24)	1.02	(0.88, 1.19)	1.02	(0.83, 1.24)
Education						
Less than high school						
High school	**1.30 ***	**(1.04, 1.62)**	1.18	(0.99, 1.40)	1.10	(0.86, 1.42)
College or above	**2.00 *****	**(1.61, 2.50)**	**1.26 ***	**(1.05, 1.50)**	**1.59 *****	**(1.24, 2.05)**
Logged household income	**1.27 *****	**(1.14, 1.41)**	**1.12 ***	**(1.03, 1.21)**	**1.14 ***	**(1.01, 1.28)**
Has prescription drug plan	1.42	(0.98, 2.07)	**1.77 *****	**(1.26, 2.47)**	0.81	(0.50, 1.28)
Self-reported poor health	**0.59 *****	**(0.49, 0.71)**	**0.62 *****	**(0.53, 0.73)**	0.95	(0.76, 1.18)
Received influenza vaccine	**4.68 *****	**(3.73, 5.88)**	**2.57 *****	**(2.20, 3.01)**	**1.82 *****	**(1.41, 2.35)**
Conscientious personality	**1.43 *****	**(1.21, 1.69)**	1.12	(0.98, 1.29)	**1.27 ***	**(1.05, 1.53)**
Social interaction with family/children	**1.10 ***	**(1.02, 1.20)**	1.06	(0.99, 1.14)	1.04	(0.95, 1.14)
Social interaction with friends	**1.16 *****	**(1.07, 1.25)**	**1.08 ***	**(1.01, 1.15)**	1.07	(0.98, 1.17)
Area-level variable						
Quartile of shingles vaccination rate						
First quartile						
Second quartile	**1.90 *****	**(1.52, 2.37)**	**1.48 *****	**(1.23, 1.77)**	1.28	(0.99, 1.66)
Third quartile	**1.96 *****	**(1.57, 2.45)**	**1.70 *****	**(1.42, 2.04)**	1.15	(0.90, 1.48)
Fourth quartile	**2.28 *****	**(1.84, 2.82)**	**1.36 ****	**(1.13, 1.63)**	**1.68 *****	**(1.31, 2.15)**

Note: Boldface indicates statistical significance (*$p<0.05$, ***$p<0.01$, and ***$p<0.001$).

were more likely to receive the vaccine (and if so, earlier). Other data (not shown) indicate that areas in the West and Midwest were more likely to have the highest rates of shingles vaccination, which is consistent with earlier research.[7,8] At the same time, the results of additional analysis separated by region indicated that the effect of living in an area with high shingles vaccination rates (highest quartile HRR) was present within each region. This suggests that the overall national pattern of differences in shingles vaccination rates is important in creating disparities, rather than just differences between specific regions.[8,10]

In contrast to earlier research,[7,12] it was found that vaccination was lower at older ages. The discrepancy here between this work and earlier research may be the result of differences in sample ages and study periods. Sample members of this study were aged ≥60 years in 2006 and reported vaccination status in prospective interviews over 10 years. This made them older than other samples who were aged ≥60 years and reported receiving a vaccine at later years. Given that the risk of shingles increases with age,[21] lower vaccination rates among older adults are concerning and indicate that such persons should be a target of vaccine promotion efforts. Given the positive influences of frequent social interactions and of local vaccination prevalence on vaccine usage, dissemination of accurate information about shingles and the vaccine through social and local networks may help increase vaccination rates among older individuals. Additionally, receiving a recommendation from a healthcare professional to get vaccinated can increase the likelihood of vaccine uptake.[11] However, the distribution of such recommendations across socioeconomic groups may not be equal, and individuals with lower SES are less likely to receive preventive health services, including vaccination. Therefore, targeted public education may be required to address vaccine refusal resulting from erroneous information about vaccine risks, and healthcare providers should strive to provide equitable information and care to all patients regardless of their background or circumstances.

This study also demonstrated that early vaccine adopters differed from late adopters. Among adopters, older adults were more likely to be early adopters, that is, to have received the vaccine between 2006 and 2010. In contrast to this finding showing lower overall vaccination rates among older respondents, this reversed age effect may indicate that older adults who are willing to receive the vaccine choose to do so quickly because they are aware of the greater risks of shingles at older ages.

This study found similar influences on both adoption of the vaccine and the timing of vaccine uptake. Higher levels of education and income influence both vaccine adoption and early adoption in particular. This may be because those with greater socioeconomic resources are better positioned to take a new and effective preventive medicine or medical technology when it is first introduced.[7,22] Non-Hispanic White respondents were also more likely to adopt the vaccine as well as do so early, revealing another possible area of disparity in health care.[23,24] Interestingly, having a prescription drug plan did not differentiate early from late adopters. This result is unexpected given that older adults with a prescription drug plan should be more likely to get the shingles vaccine than those without coverage; prescription drug plan coverage should reduce the out-of-pocket costs that older adults have to pay when obtaining the vaccine. This result may be due to incomplete coverage of the shingles vaccine by prescription drug plans in the initial period (i.e., cost sharing for the shingles vaccine in 2009 averaged $57 and in some cases was as high as $195).[25] A copayment >$30 is often regarded as the limit of willingness to pay.[26] How the level of shingles vaccine coverage by prescription drug insurance plans before the zero-cost sharing policy for the shingles vaccine that started in January 2023 was related to vaccine uptake and its timing, especially among socioeconomically disadvantaged individuals, would be an important topic for further examination.[25]

Beyond the demographic and socioeconomic characteristics, an individual's personality and preventive healthcare behavior affected vaccine uptake. Those with a more conscientious personality and whose care included other vaccines were more likely to get the shingles vaccine early. This may be because those who are more alert to managing their health matters may get early vaccination without waiting for adoption of the vaccine by others.

The significant positive effect on early individual vaccine uptake of living where vaccination rates are highest is a unique and important finding of this paper. This finding may reflect a disparity in medical practice across HRRs or inequities in the distribution of the shingles vaccine during the national vaccine shortage. Another plausible explanation may be individuals' desire to conform to peers' medical practices.[18,19] Geographic variation in older adults' vaccination rates seems to be associated with communities' historical, sociocultural, political, and religious values, which can influence one's willingness to adopt a new healthcare option. Such insights can help in concentrating resources where vaccines are most needed.

Limitations

This analysis has some limitations. First, the experience and year of vaccination were self-reported in this study's

data. Recall bias could affect the ability to classify vaccine adopters into early and late categories and hence the ability to predict accurately what influences the timing of vaccine uptake. However, there is a possibility that potential recall bias in this study was minimized because reports are based on very recent events in contrast to other studies in which vaccines may be reported after a longer period. Because people were asked every 2 years about their receipt of vaccine, reports of getting a vaccine were made on average a year after vaccination. The cognitive status of respondents was analyzed in this study and similar differences across vaccine categories and cognitive impairment status for both self-respondents and proxy respondents were observed, suggesting that cognitive impairment did not differentially bias recall of vaccination history. In addition, given the consistency between self-reported adult vaccination uptake and health administrative records,[23] it seems unlikely that recall bias substantially affected the study's findings. Second, independent variables are time-invariant; therefore, they do not capture changes in characteristics such as income and insurance coverage that may change over time. Third, this sample was limited to those aged ≥60 years when the shingles vaccine was first introduced because the shingles vaccine was not recommended for younger individuals at that time. Recently, the Advisory Committee on Immunization Practices updated recommendations for usage of the new shingles vaccine to include persons aged between 50 and 59 years. Future studies should consider these younger individuals to counter nonadoption or delay of vaccine uptake among them.

CONCLUSIONS

Unequal uptake of the shingles vaccine by race/ethnicity, SES, and area of residence indicates social inequity in the prevention of shingles. The newer shingles vaccine (Shingrix) approved in 2017 is still in the phase of dissemination and is expensive without insurance coverage. Efforts to address medical literacy and financial barriers among individuals of disadvantaged SES as well as efforts to increase accessible vaccination sites in medically underserved areas can help improve the shingles vaccination rate. Targeted communication on the risk of shingles and the effectiveness and safety of a vaccine in communities with lower vaccination rates may also encourage timely vaccination. The sooner older adults receive the vaccine, the more the occurrence of shingles—and the medical and social costs associated with the disease—will be reduced.

DECLARATIONS OF INTEREST

None.

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