

Original article

Acceptance of the HPV Vaccine for Adolescent Girls: Analysis of State-Added Questions from the BRFSS

W. Jay Christian, M.P.H.^a, Amy Christian, M.S.P.H.^a, and Claudia Hopenhayn, Ph.D.^{a,b,*}

^aMarkey Cancer Control Program, University of Kentucky, Lexington, Kentucky

^bDepartment of Epidemiology, College of Public Health, University of Kentucky, Lexington, Kentucky

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Abstract

Purpose: Previous research regarding human papillomavirus (HPV) awareness and vaccine acceptance has relied on convenience or other selected samples of the population. To assess the prevalence of HPV awareness and vaccine acceptance in Kentucky we added questions to the 2006 Kentucky Behavioral Risk Factor Survey System (BRFSS), a population-based survey of health behaviors.

Methods: Women who participated in the statewide BRFSS were asked two HPV-related questions: one assessed previous awareness of HPV, and another assessed vaccine acceptance for girls 10 to 15 years old. We used crosstabulations and multivariate logistic regression to determine which factors were associated with HPV awareness and vaccine acceptance. Because the HPV vaccine Gardasil was approved in June 2006, we conducted an analysis of pre- and postapproval HPV awareness and vaccine acceptance. We also compared results across Appalachian and non-Appalachian counties, two distinct regions of Kentucky.

Results: Overall, 57.6% of women had heard of HPV, and 70.2% accepted vaccination for girls. HPV awareness increased after Gardasil's approval, but the increase was much smaller among Appalachian women. Prevalence of vaccine acceptance was unchanged in both regions. Awareness of HPV was not associated with vaccine acceptance, and factors significantly associated with vaccine acceptance in multivariate analysis differed by Appalachian status.

Conclusions: This population-based survey of Kentucky women found relatively high vaccine acceptance for girls. Also, many respondents reported not knowing whether they accept vaccination, and factors associated with vaccine acceptance varied by Appalachian status. These findings suggest that acceptance of the HPV vaccine for girls may improve with targeted interventions. © 2009 Society for Adolescent Medicine. All rights reserved.

Keywords:

Human papillomavirus; HPV; Vaccine; Behavioral Risk Factor Surveillance System; BRFSS; Appalachia; Kentucky

Particular high-risk strains of the human papillomavirus (HPV) have been identified as a necessary factor in the development of cervical cancer [1]. In June 2006, the U.S. Food and Drug Administration (FDA) approved a vaccine, Gardasil, which protects against high-risk HPV strains 16 and 18, which are responsible for about 70% of cervical cancer cases, and low-risk HPV strains 6 and 11, which are linked to gen-

ital warts [2]. The vaccine is recommended for girls 11 to 12 years old, but it is approved for young women 9 to 26 years old [2]. To be most effective, the vaccine needs to be administered prior to initiation of sexual activity (and potential exposure to HPV); thus, its recommendation for preteen girls [2]. Although some parents might find it unnecessary, or even unacceptable, to administer the HPV vaccine to girls at such a young age, it is important to recognize that nationwide about 33% of ninth-grade students report having had sexual intercourse, increasing to about 62% of students by the time they are in 12th grade [3].

Although cervical cancer rates have decreased substantially in the last several decades in the United States [4], rates have been consistently higher among subgroups of the

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*Address correspondence to: Claudia Hopenhayn, Ph.D., Markey Cancer Control Program, University of Kentucky, 2365 Harrodsburg Road, Suite B100, Lexington, KY 40504-3381.

E-mail address: cmhope0@uky.edu

population, including Appalachian women [5–8], and particularly in Appalachian Kentucky [6,9]. In addition, cervical cancer rates tend to be higher in rural areas [10–12], again putting women in Appalachian Kentucky at increased risk, as 47 of the 51 Appalachian counties are considered rural [13,14]. Thus, the acceptance and widespread use of the HPV vaccine in Kentucky will be an important component in reducing the number of women diagnosed with cervical cancer.

Recent research in the United States regarding the acceptance of an HPV vaccine has been based mostly on samples of convenience (e.g., medical clinics, classrooms, community settings) [15–23] or focused on particular groups (e.g., minorities, lower income, physicians) [24–27], whereas another study was a statewide survey of parents in California [28]. A literature review, which included most of these studies, showed that, in general, acceptability for an HPV vaccine was quite positive [29].

In the fall of 2005, we conducted a telephone survey of adult women in two Appalachian Kentucky counties regarding their knowledge of HPV and their attitudes toward a vaccine for themselves and for girls [30]. Some of the questions on that survey related to HPV awareness and vaccine acceptance were submitted to the Kentucky Behavioral Risk Factor Surveillance System (BRFSS), and were accepted as state-added questions for 2006. To our knowledge, Kentucky was the first state to use the BRFSS to survey a statewide sample of women regarding their awareness of HPV and acceptance of an HPV vaccine. Here we report the findings from this survey with respect to women's awareness of HPV and their acceptance of the HPV vaccine for girls.

Methods

The BRFSS is an annual telephone survey of noninstitutionalized adults (aged 18 years or more) concerning health conditions and risk behaviors [31]. It is supported by the Centers for Disease Control and Prevention and conducted in all 50 U.S. states. In Kentucky, the BRFSS is administered through the Kentucky Department for Public Health, Cabinet for Health and Family Services. The BRFSS includes a set of core questions required of all states; however, additional questions may be added to the survey at each state's discretion. For the 2006 BRFSS, our request to include a few questions concerning HPV awareness and acceptance of an HPV vaccine was approved. The analysis presented here focuses on two of these questions:

1. Have you ever heard of HPV before? (the "awareness question")
2. If an HPV vaccine was available, do you think girls aged 10 to 15 should be vaccinated? (the "acceptance question")

It is important to note that the questions were designed prior to the approval of the vaccine, and thus formatted to assess the acceptance of a hypothetical or potential vaccine.

Gardasil, an HPV vaccine manufactured by Merck, was approved for distribution about halfway through the survey period, on June 8, 2006 [2].

Kentucky's 2006 survey included 6174 respondents, about 67% ($n = 4154$) of which were women. The HPV questions were administered only to female respondents who indicated they had not previously had a hysterectomy ($n = 2221$), and were preceded by a short introduction about HPV and its link to cervical cancer. The awareness question allowed the following responses: yes, no, don't know. The acceptance question allowed these options: definitely yes, probably yes, probably no, definitely no, don't know. For this analysis, the first two responses to the latter question were recoded to "yes" and the following two to "no," to produce a binary outcome variable for the assessment of respondents' acceptance of vaccination for girls. We included the "don't know" responses in bivariate analysis, but eliminated them from multivariate analysis.

We conducted bivariate analysis for the Appalachian and non-Appalachian regions separately to (1) provide for a comparison between this study and Hopenhayn et al [30], which was limited to two Appalachian counties, and (2) to discern whether there were any differences between Appalachian and non-Appalachian regions regarding factors associated with acceptance of the vaccine. The analysis consisted of calculating and comparing prevalence estimates of acceptance of HPV vaccination for girls by key socioeconomic, demographic, and health behavior indicators also available in the BRFSS. These included age (coded as a categorical variable), marital status (categorical), income (categorical), educational attainment (categorical), health insurance coverage (binary), smoking status (binary), race (binary: white vs. black only), recent Pap test (binary: last Pap test less than 3 years ago vs. more than 3 years ago or never), urban versus rural county residence (binary), presence of children in the home (binary), and Appalachian county residence (binary). As noted, the race categories include only white and black respondents who comprised 92.4% and 3.7%, respectively, of those who answered the HPV-related questions. The remaining 3.9%, made up of missing values and other race categories rare in Kentucky, were excluded from the subsequent multivariate modeling. Urban and rural counties were so designated using rural–urban continuum codes, with codes 1–3 indicating urban counties and 4–9 indicating rural [14]. The exact coding of other variables is largely equivalent to what we had used in a previous analysis of similar questions [30], and can be found in Table 1.

We conducted multivariate analysis using all the variables from the bivariate analysis described above. This analysis consisted of two survey-weighted logistic regression models, one each for the Appalachian and non-Appalachian regions.

Finally, we also employed an ancillary bivariate analysis to discern whether the FDA's regulatory approval of the HPV vaccine, as well as the associated news media coverage and public debate regarding the vaccine, might have influenced HPV awareness and/or acceptance of the vaccine for

Table 1
 Characteristics of all women in the Kentucky Behavioral Risk Factor Surveillance System (2006) and the women included in the study analysis^a

	Percent	
	Women in this study	All women
Age group		
18–29	23.5	17.6
30–39	25.8	19.9
40–49	20.0	18.7
50–59	15.7	18.3
60–69	7.4	11.0
70+	7.4	14.0
Missing	0.2	0.3
Marital status		
Married	63.8	61.8
Divorced/separated	12.8	14.1
Widowed	8.0	11.9
Never married	15.1	11.8
Missing	0.3	0.4
Household income		
<\$15,000	11.2	12.3
\$15,000–\$25,000	14.5	15.3
\$25,000–\$50,000	26.2	23.6
\$50,000+	29.2	27.8
Missing	18.9	21.2
Education		
Less than high school	13.1	15.9
High school graduate	34.7	35.7
Some college	27.1	25.8
College graduate	24.7	22.3
Missing	0.4	0.4
Health insurance		
No	19.4	15.9
Yes	80.6	83.9
Missing	0.0	0.2
Smoking status		
Nonsmoker	69.6	71.9
Smoker	30.4	28.0
Missing	0.0	0.1
Race		
Black	6.3	5.3
White	88.9	90.8
Other	4.5	3.6
Missing	0.3	0.4
Pap test history		
No recent Pap	17.3	18.4
Had a recent Pap (<3 years)	81.0	70.1
Missing	1.7	11.5
Appalachian status		
Non-Appalachian	68.7	69.7
Appalachian	31.3	30.3
Urban–rural status		
Urban	51.1	46.2
Rural	48.9	53.8
Children in household		
Yes	52.2	43.0
No	47.7	56.9
Missing	0.1	0.1
Awareness of HPV		
No	41.8	—
Yes	57.6	—
Don't know	0.6	—
Missing	—	—

(Continued)

Table 1
 Characteristics of all women in the Kentucky Behavioral Risk Factor Surveillance System (2006) and the women included in the study analysis^a (Continued)

	Percent	
	Women in this study	All women
Acceptance of HPV vaccine for girls		
Yes	70.2	—
No	12.8	—
Don't know	16.2	—
Missing	0.9	—

Note: percentages may not add to 100 due to rounding.

^a Females who have not had a hysterectomy and responded to the HPV awareness question and HPV vaccine acceptance for girls question.

girls. Because the FDA approved the vaccine in June, 2006, we compared rates of HPV awareness and vaccine acceptance between those who were surveyed in the first and last 6 months of the 2006 BRFSS survey. Using the original BRFSS variable that records the month of each respondent's telephone interview, we created a new binary variable and crosstabulated it with dichotomized results from both questions.

For this study we used Stata 10 [32], which can accommodate the complex survey design of the BRFSS, for data management and statistical analysis. Sampling weights from the BRFSS were used in all analyses, including summary statistics in Table 1.

This study was approved by the University of Kentucky Medical Institutional Review Board.

Results

There were 2169 respondents to both the awareness question and the acceptance question. Their characteristics are shown in Table 1, with those of all women in the 2006 Kentucky BRFSS for comparison. There were very few missing values for most variables (less than 1% in most cases), the most notable exception being that 18.9% did not answer the household income question. The vast majority of the study population was white (88.9%), with blacks being the next largest group (6.3%). The proportion of the population from non-Appalachian Kentucky was just over two-thirds (68.7%). Urban and rural populations were roughly equivalent (51.1% and 48.9%, respectively). The BRFSS subgroup of women in our analysis did not differ much from the entire female population surveyed in the 2006 Kentucky BRFSS, with the exception of age distribution. The larger proportion of younger women in our subject population was likely because of our exclusion of women who had had a hysterectomy (38.9% of BRFSS respondents in 2006, yielding a hysterectomy prevalence estimate of 29.9% for women in Kentucky). In turn, the difference in age distribution probably accounts for the fact that we had a greater proportion of women who had children at home (52.2% vs. 43.0%), and together with the hysterectomy exclusion, also explains the difference in

the proportion who reported having had a recent Pap test (81.0% vs. 71.1%). The overall rates of HPV awareness and vaccine acceptance in our study population were 57.6% and 70.2%, respectively.

Table 2 displays the results of the bivariate analysis of vaccine acceptance by Appalachian status of respondents. Overall, 73.1% of Appalachian women and 69.7% of non-Appalachian women signaled acceptance of vaccination for girls. The percentages of women who were not accepting

of the vaccine, as well as those who didn't know, were similar in Appalachia and non-Appalachia. In both regions, a greater percentage of women answered that they did not know whether to accept vaccination than rejected it.

In Appalachian counties, women over 70 years of age were much less likely to accept HPV vaccination for girls. A similar trend was apparent in non-Appalachian Kentucky, but was not statistically significant. Regarding marital status, women in both regions who were divorced or never married

Table 2
Women's acceptance of an HPV vaccine for girls, by selected factors (BRFSS 2006)

	Appalachian Percent			<i>p</i> -value	Non-Appalachian Percent			<i>p</i> -value
	Yes	No	Don't know		Yes	No	Don't know	
Total	73.1	11.5	15.4	—	69.7	13.6	16.7	—
Age group								
18–29	79.7	11.3	9.1	<.01	75.1	12.3	12.6	.15
30–39	82.5	8.4	9.1		72.8	13.8	13.4	
40–49	74.0	9.9	16.1		64.8	16.1	19.0	
50–59	63.1	15.1	21.8		72.2	12.2	15.6	
60–69	67.9	13.2	18.9		66.1	12.0	21.9	
70+	42.7	17.2	40.1		55.0	14.0	31.0	
Marital status								
Married	72.5	11.8	15.7	.11	66.8	15.4	17.8	.01
Divorced/separated	79.1	11.1	9.8		76.3	9.4	14.3	
Widowed	59.3	12.4	28.3		63.4	7.6	29.0	
Never married	79.4	9.9	10.8		79.8	12.9	7.3	
Annual income								
<\$15,000	79.8	7.3	12.9	<.01	89.3	6.1	4.6	<.01
\$15,000–\$25,000	84.6	8.4	7.0		78.7	10.0	11.3	
\$25,000–\$50,000	70.8	15.8	13.4		75.5	10.7	13.7	
\$50,000+	72.3	11.0	16.7		63.3	18.4	18.3	
Missing	59.7	12.6	27.7		57.3	15.1	27.6	
Education								
Less than high school	72.2	8.5	19.3	.29	80.2	8.8	11.0	<.01
High school graduate	77.2	11.0	11.8		72.4	12.6	15.0	
Some college	71.7	14.1	14.2		74.7	11.0	14.3	
College graduate	67.9	10.8	21.3		58.0	18.9	23.1	
Health insurance								
No	83.5	7.5	9.0	.01	82.8	6.1	11.1	<.01
Yes	69.5	12.9	17.5		67.2	15.0	17.8	
Smoking status								
Nonsmoker	67.0	14.5	18.5	<.01	67.7	14.2	18.2	.19
Smoker	84.6	5.8	9.6		74.9	12.1	13.0	
Urban/rural status								
Rural	72.4	11.5	16.1	.75	75.8	10.5	13.7	.01
Urban	75.8	11.5	12.8		66.1	15.4	18.5	
Awareness of HPV								
No	70.1	12.7	17.2	.29	70.8	12.1	17.1	.61
Yes	76.3	10.7	13.0		69.4	14.7	15.9	
Race								
Black	90.8	0.0	9.2	.55	79.4	14.2	6.4	.09
White	72.8	11.5	15.7		68.8	13.6	17.6	
Pap test history								
No recent Pap	73.7	10.2	16.1	.82	68.9	11.9	19.2	.73
Recent Pap (<3 years)	73.3	12.0	14.7		70.0	13.8	16.2	
Children in household								
No	64.1	15.5	20.4	<.01	68.2	13.0	18.8	.38
Yes	81.0	7.6	11.4		71.2	14.1	14.7	

Yes = probably yes and definitely yes; No = probably no and definitely no.

Children in household = children of either gender, under age 18.

Percentages may not add to 100 due to rounding.

were the most likely to accept vaccination for girls, and widows were the least likely. Progressively higher annual income was clearly inversely associated with acceptance in the non-Appalachian area, but this trend was less clear in Appalachia, although rates of acceptance differed significantly by income group. Those with a college education or more were the least likely to be accepting of vaccination, but this association was strong and significant in non-Appalachian Kentucky, while slight and nonsignificant in Appalachia. Health insurance coverage was significantly associated with lower acceptance in both Appalachia and non-Appalachia, with rates of acceptance being similar in both areas. We observed significant differences between smokers' and non-smokers' rates of acceptance, but this difference was statistically significant in Appalachia only, and the rate of acceptance among Appalachian women was considerably higher than that among women in non-Appalachia. Residence in a rural county was significantly associated with vaccine acceptance in non-Appalachia only. Acceptance of the vaccine did not seem to be related to awareness of HPV in either region. Race was marginally associated with vaccine acceptance in non-Appalachia. In neither region did a history of recent Pap testing appear to be related to vaccine acceptance. Last, the presence of children in the household was significantly associated with vaccine acceptance in Appalachia, but this was not the case in non-Appalachia. The bivariate analysis thus suggests that the factors associated with vaccine acceptance differ between Appalachian and non-Appalachian regions of Kentucky.

Our multivariate analysis results are shown in Table 3. Broadly speaking, the results confirm those of the bivariate analysis; they suggest that significant predictors of HPV vaccine acceptance differ between Appalachian and non-Appalachian regions. In Appalachia, only smoking (odds ratio [OR] = 2.59) and the presence of children in the household (OR = 2.23) were significantly associated with vaccine acceptance, after adjusting for all other factors. Being married was marginally significant in predicting nonacceptance of the vaccine. These associations were not present in the non-Appalachian group. There were, however, significant, or near-significant, associations with age group (greatest acceptance among the youngest group), education (more acceptance among the less educated), health insurance coverage (more acceptance among those with no coverage), and rurality (more acceptance in rural areas) in non-Appalachia. These associations were absent or nonsignificant in Appalachia.

Table 4 displays the results of the bivariate analysis conducted to compare the responses to both study questions before and after FDA approval of the vaccine. Statewide, awareness of HPV was substantially higher among those surveyed in the latter half of 2006 (47.5% vs. 66.9%). Awareness of HPV was increased in both Appalachian and non-Appalachian areas, but this increase was large and significant in non-Appalachian Kentucky (46.8% to 70.9%), while modest and nonsignificant in Appalachia (49.2% to 58.3%). Additionally, awareness of HPV in non-Appalachian

counties was significantly greater than in Appalachian counties in the final 6 months of the year, but not in the first 6. These results suggest awareness of HPV increased much less in Appalachian Kentucky, if at all, compared to the rest of the state.

Interestingly, the rates of vaccine acceptance for girls remained virtually unchanged in both regions. Similarly, rates of "don't know" responses were very similar in both regions, and for both time periods.

Discussion

Because some HPV strains can be transmitted through sexual contact, they should be viewed as sexually transmitted infections. Also, because infection with a high-risk HPV strain is a necessary condition for the development of invasive cervical cancer, this disease can also be considered to be sexually transmitted. Because of this, there are issues regarding administration of an HPV vaccine to girls for the prevention of cervical cancer based on the association of HPV infection and sexual behavior. Some adults are concerned that a vaccine for a sexually transmitted infection (STI) will encourage sexual activity or condone unsafe or risky behavior [17,19,33]. To our knowledge, this is the first large, population-based study addressing vaccine acceptance among women of all ages.

The results of this study suggest that overall rates of vaccine acceptance were reasonably high at 70.2%, particularly considering that the survey was initiated 6 months before the HPV vaccine was approved, and before the widespread media coverage that has ensued since then. The rate of HPV vaccine acceptance for girls was similar to results found in a number of other recent studies in the United States, where rates varied from about 66% to 75% of adults [17,18,21,23,28,30]. Interestingly, there was no significant shift toward greater acceptance in the second half of the year after the vaccine entered the market and became more visible through advertisement, even though this probably had an impact on the increased awareness of HPV.

Despite similar rates of a positive response, the factors associated with acceptance of HPV vaccination for adolescent girls among Appalachian and non-Appalachian women of Kentucky differed. In the non-Appalachian region, younger age, lack of a college degree, and residence in a rural county were factors positively related to vaccination for girls. In Appalachia, on the other hand, smoking and having children living at home were the factors linked to vaccine acceptance, while being married had a negative impact. These differences in the factors associated with vaccine acceptance by Appalachian status suggest that strategies to promote HPV vaccination need to be tailored somewhat differently depending on regional or population characteristics.

Related to some extent is the association between vaccine acceptance and rural residence only in the non-Appalachia region. It is possible the lack of such associations in Appalachia was because of the fact that the three largest urban areas

Table 3
Multiple logistic regression with survey weights for vaccine acceptance, by region (BRFSS 2006)

	Appalachian				Non-Appalachian			
	OR	<i>p</i> -value	95% CI		OR	<i>p</i> -value	95% CI	
Age group								
18–29	1.23	.78	0.28	5.48	5.33	.04	1.05	27.10
30–39	1.25	.75	0.32	4.93	3.76	.06	0.93	15.19
40–49	1.17	.82	0.31	4.35	2.92	.11	0.80	10.70
50–59	1.07	.92	0.27	4.19	3.65	.04	1.06	12.54
60–69	1.18	.81	0.31	4.43	2.58	.16	0.70	9.51
70+	Ref.				Ref.			
Marital status								
Married	0.38	.06	0.14	1.04	0.60	.33	0.22	1.67
Divorced/separated	0.48	.24	0.14	1.63	1.12	.85	0.34	3.73
Widowed	0.57	.44	0.13	2.42	3.29	.13	0.72	15.12
Never married	Ref.				Ref.			
Household income								
<\$15,000	1.47	.46	0.52	4.15	1.42	.52	0.49	4.05
\$15,000–\$25,000	1.51	.39	0.59	3.89	0.91	.87	0.30	2.81
\$25,000–\$50,000	0.60	.25	0.25	1.44	1.36	.40	0.66	2.81
\$50,000+	Ref.				Ref.			
Education								
Less than high school	0.91	.87	0.28	2.92	2.35	.18	0.67	8.29
High school graduate	1.13	.81	0.43	2.95	1.99	.05	1.00	3.94
Some college	0.68	.45	0.25	1.85	1.74	.10	0.89	3.39
College graduate	Ref.				Ref.			
Health insurance								
Yes	0.89	.77	0.41	1.95	0.44	.11	0.16	1.20
No	Ref.				Ref.			
Smoking status								
Smoker	2.59	.02	1.17	5.70	1.10	.80	0.53	2.28
Nonsmoker	Ref.				Ref.			
Race ^a								
Black	—	—	—	—	0.83	.76	0.25	2.74
White	—				Ref.			
Pap test history								
Recent Pap (<3 years)	1.16	.71	0.53	2.51	1.25	.65	0.48	3.26
No recent Pap	Ref.				Ref.			
Urban/rural status								
Rural	0.90	.84	0.34	2.39	1.66	.07	0.97	2.83
Urban	Ref.				Ref.			
Awareness of HPV								
Yes	1.48	.38	0.62	3.50	1.20	.53	0.67	2.16
No	Ref.				Ref.			
Children in household								
Yes	2.23	.03	1.10	4.52	0.76	.50	0.35	1.66
No	Ref.				Ref.			

CI = confidence interval; OR = odds ratio.

^a Race variable dropped due to colinearity in Appalachian model.

in Kentucky (Louisville, Lexington, and northern Kentucky [part of metropolitan Cincinnati]) are located in the non-Appalachian region. The difference between urban and rural nature of counties in this part of the state is likely greater than in Appalachia, where urban areas are much smaller and less metropolitan. In subsequent analysis (not shown), however, we found that substituting the original rural–urban continuum code (with nine categories) for our dichotomized version in the multivariate models did not yield appreciably different results with regard to this or other variables. Thus, for simplicity, we reverted back to the original dichotomiza-

tion of these codes into “urban” and “rural” for reporting our findings. Nevertheless, we believe it is likely there are some fundamental differences between urban areas, possibly even those of the same size, from Appalachia and non-Appalachia. These findings suggest other states might similarly benefit from geographic analysis of different factors to uncover regional differences associated with vaccine acceptance.

The association we found in this study between smoking status and vaccine acceptance in the Appalachian region is consistent with our previous study conducted a year earlier,

Table 4
HPV awareness and vaccine acceptance, before and after FDA approval of HPV vaccine (BRFSS 2006)

	Appalachia			Non-Appalachia			All Kentucky		
	Jan–Jun	Jul–Dec	Change	Jan–Jun	Jul–Dec	Change	Jan–Jun	Jul–Dec	Change
Awareness of HPV									
Yes	49.22%	58.26%	9.04%	46.75%	70.90% ^a	24.15%	47.51%	66.86% ^a	19.35%
No	49.33%	41.60%	−7.73%	52.32%	28.95% ^a	−23.37%	51.40%	33.00% ^a	−18.40%
Don't know	1.45%	0.14%	−1.31%	0.93%	0.15%	−0.78%	1.10%	0.14% ^a	−0.96%
Acceptance of vaccine for girls									
Yes	74.51%	71.74%	−2.77%	69.88%	69.60%	−0.28%	71.30%	70.34%	−0.96%
No	9.76%	13.07%	3.31%	14.09%	13.08%	−1.01%	12.76%	13.05%	0.29%
Don't know/refused	15.73%	15.19%	−0.54%	16.03%	17.32%	1.29%	15.94%	16.61%	0.67%

^a Jul–Dec estimate is significantly different ($p < .05$) than Jan–Jun estimate; the statistical comparisons are between the two time periods, for each geographical region.

and using the same questions in a telephone survey of two Appalachian Kentucky counties [30]. Additionally, this study further demonstrates that this association was not observed in the non-Appalachian region of the state. It is likely that the observed association with smoking is actually a marker of other factors, whether social, cultural, or behavioral, and warrants further investigation. Research into the social correlates of health behaviors has found, for example, that behaviors and psychosocial dispositions potentially harmful to health, such as smoking, are more common among those who experienced poor childhood conditions, have a low level of education, and obtain blue-collar employment [34]. Similarly, residence in a disadvantaged community has been shown to encourage smoking and undermine cessation efforts independent of an individual's socioeconomic status [35]. Although we have attempted to account for some of these factors in our analysis by including education and income variables, the BRFSS does not include questions on personal residential or domestic histories. In addition, some studies show high-risk sexual behaviors and early pregnancy are correlated with cigarette smoking among adolescents [36,37]. It is possible that women who smoke tend to be more accepting of sexual activity among adolescent girls, as many might have been sexually active at an earlier age themselves. The increased risk of cervical cancer associated with cigarette smoking has been well established [38], and it is possible that an increasing number of women are become aware of this relationship. However, it is not clear why the association with smoking was only observed in the Appalachian region. There might be cultural, religious, or other factors in Appalachian areas that somehow divide smokers and nonsmokers more than in other regions. Clearly, this divergent effect warrants more study.

It is noteworthy that compared to the rest of the state there was a relatively minor increase in awareness of HPV in Appalachian Kentucky during the 6 months after vaccine approval. Although both regions showed greater awareness of HPV than a 2005 survey of U.S. women, which indicated that about 40% of women had heard of HPV [39], the differential increase after vaccine approval raises questions about

how individuals are informed about health issues. Further, it suggests there might be differences between Appalachian and non-Appalachian regions of Kentucky with regard to mass media (television, radio, and Internet) access and/or consumption. Although awareness of the vaccine was not associated with acceptance in this study, this finding might have serious implications for policy decisions. Without more widespread awareness of the disease (and presumably the vaccine) among citizens, legislation or policies at the state level that support vaccination might not be considered important priorities.

In a possibly related matter, the high proportion of “don't know” replies to the acceptance question warrants brief discussion, because overall, 16.2% of the respondents did not know if they would accept the vaccine, whereas only 12.8% gave a negative response. As noted previously, several demographic or social groups (e.g., higher income and education, older age) had higher rates of this reply than either a positive or negative one. This suggests potential receptivity and can be viewed as an opportunity for intervention with health promotion strategies that may sway a substantial number of uncertain adults (parents in particular) toward vaccine acceptance for girls. Interventions designed to encourage acceptance among those who are unsure might be important for increasing overall acceptance.

There were some limitations to this study that merit consideration. First of all, there are implicit limitations with any telephone survey which excludes, by design, institutionalized individuals, those under the age of 18 years, those without a landline telephone, and in the case of the Kentucky BRFSS, non-English speakers. In addition, the response rate of the BRFSS in general has been decreasing over time. The 2006 Kentucky BRFSS response rate was 56.1% [40], suggesting the possibility of a bias in the generalization of the survey to the population of all females in the state. Also, we did not limit participation in this study to women who had daughters 10 to 15 years old, the recommended age range for vaccination, because of the sampling design of the BRFSS. Nor were we able to add more questions to be able to assess who had daughters in this age range. By including

the BRFSS variable indicating the presence of children in the respondent's home, however, we believe we have addressed this issue to some extent. Another limitation is related to the implementation of our HPV-related questions. Because they were state-added questions to the Kentucky BRFSS, they were asked near the end of a rather lengthy survey. This led to a relatively high number of "hang ups" ($n = 486$), or eligible subjects who did not participate in the BRFSS long enough to answer the HPV questions. Losing these subjects led to a decrease in our sample size that might have limited the power of our statistical analysis somewhat, but the total number of respondents was still large. Furthermore, those who hung up before the HPV questions could be asked did not differ greatly from those who completed the survey in any of the demographic variables examined (analysis not shown).

The greatest strength of this study is the ability to use of the BRFSS as a means to administer the questions to a large sample of women across all socioeconomic, demographic, and lifestyle in the entire state. This is important to note because most previous studies of HPV vaccine acceptance have relied on convenience samples, or groups of women in specific groups, and therefore not representative of the general population [16–23]. By incorporating our questions into this survey, we have produced reliable, population-based estimates for awareness and acceptance of HPV vaccination.

Future research in this area might benefit from the development and implementation of a stand-alone survey. With a more comprehensive set of questions, researchers might be better able to characterize attitudes regarding the HPV vaccine. A more comprehensive survey might also provide greater insight into the role of familial status (e.g., whether the respondent has female children, and whether they are within the age range of recommended HPV vaccination), religion and beliefs, behavioral factors, experiences of women with sexually transmitted infections, and other relevant factors probably related to acceptance of the vaccine. Additionally, future study could reveal temporal trends that have developed in years following the rush of media attention elicited by regulatory approval of the vaccine, especially as more individuals and families elect to receive the vaccine and/or learn more about it.

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