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The Student Human Papillomavirus Survey: Nurse Led Instrument Development and Psychometric Testing to Increase HPV Vaccine Series Completion in Young Adults

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Abstract

Background and Purpose—The Student Human Papillomavirus Survey (SHPVS) was developed to examine students' perceived benefits or barriers to HPV vaccination. The purpose of this paper is to describe the development and results of the psychometric evaluation of the SHPVS developed in 2008.

Methods—Survey development included: 1) two-phase integrative literature reviews; 2) draft of survey items based on the literature; 3) critique of survey items by young adults, nursing and psychology faculty, and healthcare providers; and 4) pilot testing. The psychometric properties of the SHPVS were evaluated using classical item analysis and exploratory factor analysis (EFA) among a sample of 527 university students' ages 18 to 24 years.

Results—The estimated Cronbach's alpha for the SHPVS is 0.74.

Conclusions—The SHPVS is a reliable measure of young adults HPV perceived vulnerability, perceived severity, perceived barriers and perceived benefits of HPV vaccination.

Keywords

HPV Vaccines; Health Surveys; Health Care Disparities; Adolescents; Young Adults

Introduction

The World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) report that the Human Papillomavirus (HPV) vaccine prevents the spread of HPV and cancers related to HPV, yet HPV vaccine rates in the United States still remain below 60 percent for young adults (CDC, 2011; Chou, Krill, Horton, Barat, & Trimble, 2011; Paavonen et al., 2009). The urgency to understand the poor acceptance and uptake of this vaccine among young adults led to the adaptation and use of the Parental Human Papillomavirus Survey (PHPVS) for use in college age and university populations (Thomas et al., 2013).

Purpose

The purpose of this paper is to describe the development and results of the psychometric evaluation of the Student HPV survey (SHPVS). The SHPVS was developed in 2008 as a response to poor HPV vaccine acceptance and poor HPV series completion by young adults despite access to the HPV vaccine on university campuses through academic student health care centers (Thomas, Yarandi, George Dalmida, Frados, & Klienert, 2014). The SHPVS instrument can assist health promotion researchers to explore and better understand young adults' perceptions of HPV infection and vaccination by measuring the perceived severity of HPV infection, perceived vulnerability of HPV infection, the perceived benefits of HPV vaccination, and the subsequent barriers to being vaccinated and completing the HPV vaccine series.

Scope of Measurement

The development of this survey was rooted in the construct of primary prevention from Neuman's Systems Model (NSM) (Neuman, 1990; Neuman, 1996) and then developed after further literature review on the Health Belief Model (HBM) (Rosenstock, 1975; Rosenstock, Strecher, & Becker, 1988). Use of the HBM model enabled the construction of questions to measure perceived vulnerability to HPV infection, perceived severity of HPV infection and young adults' perceived barriers to completion of the HPV vaccine series. The SHPVS could be used both as a screening tool in the primary care setting and also in research to identify points of intervention to increase HPV vaccination in this age group.

Background and Conceptual Framework

The controversy of vaccinating young adults with the HPV vaccine persisted in 2008 due to concerns that it would lead to behavioral dis-inhibition by encouraging adolescent sexual promiscuity, sexual irresponsibility, or early sexual activity (Hofferth, 1987; O'Sullivan, 2000). This was supported during 2006 and 2007 by longstanding parental concern that media exposure and discussion of sexually-related topics will increase the likelihood that their children will become sexually active (Hofferth, 1987).

Initial surveys conducted prior to the introduction of the HPV vaccine with the general public examined general vaccination patterns and only included a single or 2-3 items on HPV vaccination; results implied that young adults may not vaccinate against HPV for religious or moral reasons (Dempsey, 2006). While religious and moral reasons for not vaccinating has been an ongoing challenge for nursing and healthcare professionals, it is important to recognize this possible controversy and provide young adults with balanced and complete information about HPV vaccination and the importance of completing the HPV vaccine series (Thomas, 2008). The SHPVS was also developed to assist with the provision of accurate information in the context of what young adults may or may not understand about HPV related cancers and the HPV vaccine. Young adults' attitudes and knowledge about vaccination are essential to understand to help inform the development of culturally specific interventions. Additionally, screening young adults about their levels of perceived vulnerability and severity is crucial to help identify those most at risk. The SHPVS was also constructed to assist researchers in the development of culturally specific interventions to

educate misinformed young adults and adolescents who are at increased risk for HPV infection (McKee & Karasz, 2006).

The Health Belief Model (HBM) suggests that perceived vulnerability, perceived severity, perceived barriers, and perceived benefits are important to consider in assessing HPV vaccine knowledge and HPV acceptability. Research suggests that HPV vaccine acceptability may be influenced by multiple factors, including sexual activity and specific constructs of the health belief model: perceived susceptibility to HPV transmission, and perceived barriers and benefits to the HPV vaccine (Fernandez et al., 2009). Young men with less HPV knowledge have been shown to have higher levels of shame when discussing health promotion behavior like HPV vaccination (Gerend & Magloire, 2008). Preliminary research has indicated that higher levels of shame and sexual activity are associated with low HPV vaccine acceptability among adolescents (Das et al., 2010; Dorell, Yankey, & Strasser, 2011). Research also suggests that HPV vaccine acceptability may be even lower among male adolescents belonging to certain vulnerable populations, such as Latino cultural sub-groups (Thomas, Higgins, M., Stephens, D. P., Johnson-Mallard, V., 2012).

There are no specific instruments that have been developed using the HBM-related measures for young adults in college health literature. So the development of an instrument that is theoretically based with succinct questions is key to promoting HPV vaccine completion in this population.

HBM-related measures are prolific throughout the health promotion literature and have been used in many contexts to develop interventions and screen individuals for risk (Harrison, Mullen, & Green, 1992). But there have been some studies that have evaluated the psychometric properties of HBM-related measures associated with HPV vaccination and screening for mothers and women (Fernández et al., 2009; Gerend & Shepherd, 2012; Guvenc, Akyuz, & Açikel, 2011; Kahn et al., 2008; Marlow, Waller, Evans, & Wardle, 2009; McRee, Brewer, Reiter, Gottlieb, & Smith, 2010; Zimet et al., 2005). A few of these studies have used either exploratory or confirmatory factor analyses to evaluate the factor structures underlying HBM in the context of HPV vaccination and survey items for the SHPVS were developed based on these findings and recommendations (Gerend & Shepherd, 2012; Guvenc et al., 2011; Kahn et al., 2008; Marlow et al., 2009; McRee et al., 2010). The subscale reliabilities for these studies vary with Cronbach's alpha (α) ranging from .55 in Marlow et al. (2009) to .96 in Kahn et al. (2008). Most studies retained between 4 and 5 factors; however, one study (Kahn et al., 2008) yielded a 10 factor structure. In developing the procedures for instrument development we considered these findings.

Procedures for Instrument Development

Our methods and procedures used to develop and psychometrically evaluate the SHPVS are described below and included: 1) instrument development and refinement; 2) instrument administration and pilot testing; and 3) formal instrument evaluation. The development of the student HPV survey was completed in several steps. In the spring of 2008 an intensive literature search was completed, including review of other types of general vaccine surveys and surveys with items about HPV vaccination. Drafts of the SHPVS were then reviewed

and critiqued by approximately 20 young adults, developmental psychology faculty, nursing faculty and providers. At that time no items were removed only clarification of language such as replacing immunization with vaccination. Further evaluation and literature review then led to refinement of survey items that were adapted from the PHPVS (Thomas et al., 2013). Each survey item was reviewed for clarity and meaning for the young adult or university student to reflect the constructs of the Health Belief Model. This borrowing of theories proved to be essential to lending clarity to the SHPVS' development and applicability to nursing research (Villarruel et al., 2001).

The SHPVS items were organized by Health Belief Model theoretical constructs into subscales: Perceived Vulnerability, Perceived Severity, Perceived Benefits, and Perceived Barriers with items that addressed knowledge, attitudes, beliefs, and intent to vaccinate. This process took over 6 months and was essential to the development of an instrument that was: 1) theoretically framed, 2) could be used for quantitative research, 3) was simply enough to be translated to other languages as needed, 4) was brief and concise as to be "student friendly," and 5) could be implemented in primary care settings to inform healthcare providers about an individuals' knowledge and attitudes about HPV vaccination. In late 2008, SHPVS items were then organized into the final survey format described below.

Description of the Instrument

The SHPVS contains 278 survey items to describe young adult/student beliefs and attitudes about the HPV vaccine and vaccinations in general, decision-making, intentions, and the acceptability of completing an HPV vaccine series, along with experiential factors such as whether or not the young adult/student knows someone who has been diagnosed with a sexually transmitted disease. All survey items and their correlated theoretical concepts have demonstrated intent to vaccinate in other studies (Zimet et al, 1997). General questions about personal characteristics, such as age and gender, were placed at the beginning of the survey. Questions that were more sensitive, such as household income, educational level, and marital status, were placed at the end of the survey and included a "refuse to answer" option.

Administration of the Instrument

The university Institutional Review Board (IRB) approved the pilot study prior to participant recruitment. Participants were recruited using an IRB approved recruitment message system via the Internet through the University they were attending. Interested participants accessed an informative letter online that served as informed consent. After reading the letter, each participant anonymously completed the Student Human Papillomavirus Survey (SHPVS). They were also provided with the contact information for local and/or university Health Services, Women's Clinic, and Psychological Services. All participation was voluntary and no participant who declined to participate was penalized in any way and all students who participated understood and spoke English. All completed surveys were automatically assigned a unique computer-generated subject identification number and no name identifiers were collected.

Methods

Sample

For this statistical evaluation we chose to evaluate surveys completed by young adults who attended a large urban university the southeastern United States (n = 527). Inclusion criteria required that participants be: 1) over the age of 18 years 2) understand and speak English and 3) be enrolled students at the university where the study was done.

Procedures

The ethical considerations of all aforementioned research projects were addressed and approved prior to data collection by ethics committees from the university institutional review board. The SHPVS survey in English was used to survey 527 young adults/university students attending a large urban university in the southeastern United States. A letter was given to each young adult, which explained that all results would be reported anonymously and in group format. Young adults who spoke and read English (met inclusion criteria) were then invited to complete the anonymous survey. In addition, privacy for each participant was maintained by providing a separate area to complete the survey with returned surveys considered implied consent.

Scoring of the Instrument

A five-choice Likert response scale is used to score the SHPVS. Respondents are instructed to respond to each item by circling 1 = disagree, 2 = slightly disagree, 3 = unsure, 4 = slightly agree, or 5 = agree. Scores are cumulative with higher scores indicating greater knowledge and intention to be vaccinated.

Approaches to Reliability and Validity Assessments

Data was analyzed using the IBM Statistical Package for Social Science (IBM® SPSS) software version 20 (IBM® Company, 2010) and AMOS v.20. All data were reviewed prior to analysis for data entry errors, potential outliers, and extent of missing data. Distributions of all variables included in the analyses were assessed for normality. Descriptive statistics were calculated for all variables (demographics and 27 items of the SHPVS instrument) for the sample, both overall and for each group (YES intend to be vaccinated or NO do not intend to be vaccinated). Factor analysis of these 27 SHPVS survey items was completed using principal axis factoring methods (focusing on common variance) with oblique rotation (δ=0), given the expectation of correlation among the health belief constructs (Thomas, Strickland, Diclemente, & Higgins, 2013).

Comparisons between the groups were performed using t-tests and chi-square tests (Table 2). Multivariate logistic regression was used to develop a model for predicting intent to vaccinate from subject demographics and their individual item responses on the SHPVS instrument. To optimize the best set of predictors, reduce multicollinearity, and create the most parsimonious model for intent to vaccinate, forward stepwise variable selection methods were used based on the likelihood ratio statistic (p=.05 for entry, p=.10 for removal). All statistical analyses were performed using SPSS v.20 and AMOS v.20. Statistical significance was assessed using an alpha level of 0.05.

We evaluated the psychometric properties of the SHPVS using classical item analysis and exploratory factor analysis (EFA) among a sample of 527 young adults/university students. Using classical item analysis we evaluated the item level statistics/functioning including scale reliability (Cronbach's alpha α), inter-item correlations, and standard errors. An exploratory factor analysis was conducted in order to identify general or latent variables. Exploratory factor analysis identifies the factor structure for a given set of variables through determining the number of factors and the pattern of factor loadings (Stapleton, 1997; Yanai & Ichikawa, 2006). This method allows the researcher to identify the minimal number of dimensions necessary to delineate relationships among the variables.

Factor analysis was performed using the principal axis factor extraction method, which focuses on the shared (common) variance within the 28 items. Oblique rotation (delta = 0) was used since it was expected that the resulting factors would be correlated. The Kaiser-Meyer-Olkin (KMO) measure of adequacy was calculated to evaluate sampling adequacy. Bartlett's test of sphericity was performed to assure that the items included in the factor analysis were related and not independent (i.e. factor analysis was appropriate) (Field, 2009; Tabachnick & Fidell, 2007).

The following three methods were used to determine the optimal number of factors to retain: number of eigenvalues greater than 1, Velicer's minimum average partial (MAP) test, and the parallel analysis approach (O'Connor, 2000). Since each extraction method has inherent limitations, it is prudent to compare results (Zwick & Velicer, 1986).

Item and subscale level Cronbach's alpha and inter-item correlations were calculated as measures of reliability. Factor analysis and reliability statistics were performed on the entire instrument of 28 items as well as on each of the 4 theory-derived subscales. Tests for external validity were precluded by the lack of similar measures.

Structural equation modeling (SEM) was performed to further verify the alignment of the items within each health belief construct for the 15 items retained and to assess the extent of correlation between these constructs for perceived benefits, perceived barriers and perceived severity.

Results

Sample Characteristics

Young adults who participated in the pilot indicated that they had lived in the US for 17.2 years (SD 5.2(Table 1). The participants were female (67.0%), Hispanic (66.8%), had completed some college education, i.e., had not graduated yet (85.5%), single (79.5%), and lived off campus with their parents (73.6%). A small percentage (2.3%) were graduate students.

Demographic Differences in Intent to Vaccinate

More than half of participants indicated their intention to be vaccinated: (59.6%) said "Yes," they did intend to get the vaccine and (40.4%) indicated, "No," they did not intend to be vaccinated. The results of *t*-tests showed that Participants who reported that they intended to

get the vaccine, were significantly more likely to be female and although not statistically significant, trended to self-identify as Hispanic (71.5% “Yes” versus 64.3% “No”, p=.084). No other significant demographic differences were noted between the two vaccination intention groups (Table 1).

Instrument Reliability Results

Each of the 27 SHPVS item scores ranged from 0 to 4, where 0=disagree, 1=somewhat disagree, 2=unsure, 3=somewhat agree, and 4=agree with higher scores representing higher perceived benefits, vulnerability, severity or barriers related to HPV vaccination. The average scores for each of the 27 items are presented in Table 2 for the overall sample and for the different intent to vaccinate groups. Nineteen of the 27 SHPVS items yielded significant score differences between participants intending to vaccinate versus those who did not (Table 2). There were significant correlations between the 27 SHPVS items. However, some of the HPV items also had low or non-significant correlations with the other HPV items. After initial review of the complete correlation matrix and assessment of the “scale if item deleted” calculations for reliability, a final subset of 15 items were retained: 8 of the perceived benefits construct items, 5 of the perceived barrier construct items and 2 of the perceived severity construct items (Table 4). Seven of these 15 were reversed coded to maximize positive correlations (Table 5). The reliability for these 15 items overall was acceptable with a Cronbach’s alpha of 0.74.

Factor Analysis Results

Factor analysis of these 15 items was completed using principal axis factoring methods (focusing on common variance) with oblique rotation (δ=0) given the expectation of correlation among the health belief constructs(Thomas et al., 2013). Sample size was more than adequate (Kaiser-Meyer-Olkin [KMO] was 0.80) and the assumptions of the appropriateness for factor analysis were met (Bartlett’s test of sphericity p<.001). Three eigenvalues were > 1 indicating three underlying factors. The majority of the 8 perceived benefits items aligned with factor 1, the 5 perceived barriers items aligned most closely with factor 3 and the two perceived severity items aligned with factor 2 (Table 6). As expected, significant correlation was noted between factor 1 “perceived benefits” and factor 3 “perceived barriers”.

Structural Equation Modeling Results

The SEM results (Figure 1) were similar to those from the factor analysis with an overall acceptable fit of the SEM model: RMSEA=0.058 (90% confidence interval 0.049, 0.067) which is less than the threshold of 0.1 as recommended by Browne and Cudeck (1993). The associated p-value for testing the null hypothesis that the RMSEA ≤ 0.05 was also not significant (PCLOSE=0.064). The ratio of the model chi-square statistic (CMIN=240.891) to the degrees of freedom (df=87) was CMIN/DF=2.769 which was also below the recommended threshold of 5 (Wheaton et.al., 1977; Carmines and McIver, 1985; and Marsh and Hocevar, 1985). While normed fit index (NFI) and comparative fit index (CFI) were not as close to 1 as recommended by Bentler and Bonett (1980) and Bentler (1990), they were also not too low (NFI=0.790 and CFI=0.850). We feel that this is secondary to overall very

low levels of knowledge about actual HPV transmission and the importance of HPV vaccine series completion.

Limitations

The limitations of this work include the data collection done via computer generated surveys as there is always the possibility of incorrect answer entry. The majority of the sample self identified as Hispanic and this could be considered a limitation but maybe as strength in the future as the demographics of the United States are becoming more diverse.

Discussion

The development and psychometric evaluation of the SHPVS instrument provides a tool that can assist nurses and other health professionals in both screening young adults about their perceived vulnerability to HPV infection and identifying barriers to HPV vaccine series completion. The additional utility of using the SHPVS in health promotion research can assist researchers in both descriptive studies and intervention development. By understanding levels of perceived vulnerability, severity and both the perceived benefits and barriers, researchers can begin to understand the unique context and decision making that occurs when personal choices are made to begin HPV vaccination in this population. While the majority of the participants self identified as Latino we do not this as a limitation but a strength.

Our participants were all over the age of 18, giving them the ability to give consent for vaccination. As young adults and students on a university campus they could also access the HPV vaccine. The challenge is completion of the series and with the use of the SHPVS, barriers can also be identified to completion. This makes the SHPVS survey a useful tool both nurses and healthcare providers in primary care. Using the SHPVS in clinic settings to assist providers as they educate patients is essential, the tool helps identify targeted areas to pin point educational information.

Finally, health promotion researchers are in need of a tool to identify intervention points in this population. At this time modifications of several tools have been used but the development of a specific instrument to identify young adults' perceived severity and vulnerability to HPV infection, and the subsequent barriers to starting and completing the HPV vaccine series.

Conclusions

In conclusion, it is crucial that all providers begin education and discussions about HPV vaccination in this population with information on what their young adult patients understand about HPV transmission. It is important to stress the connection between chronic HPV infection and the resulting cancers (including, but not limited to, the genital area, in the mouth, tongue, palate, and throat). This educational approach may be seminal in increasing uptake. Working in this population it is important to understand what constitutes personal urgency and assist young people to make the connection between HPV infection and cancer.

The SHPVS is a reliable tool for nurses, other healthcare providers and researchers to use in these endeavors.

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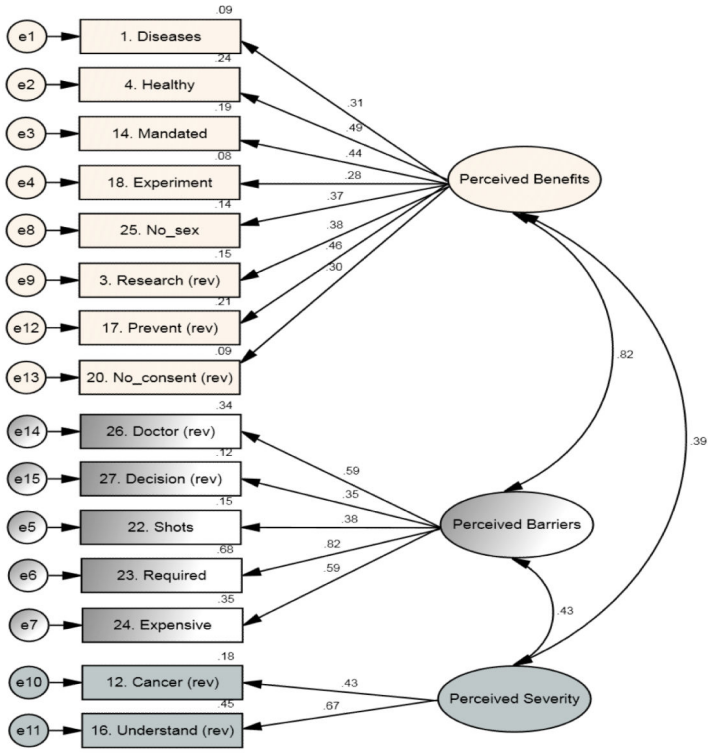

Figure 1.

Structural Equation Model of 15 Items Allowing Correlations Between 3 Constructs

SMCs (squared multiple correlations) shown upper right corner of each SHPV item

Factor Loadings (standardized regression weights) shown above each path (single arrow)

Correlations between constructs shown next to two-way double-headed arrows

RMSEA=0.058 [90% CI 0.049, 0.067]; PCLOSE=0.064

CMIN/DF=2.769; NRI=0.7960; CFI=0.850

Table 1

Demographics – Descriptive Statistics Overall and Comparison by Intent to Vaccinate Groups

	Overall		NO		YES		Difference
Continuous Measures	**n**	**Mean (SD) [range]**	**n**	**Mean (SD) [range]**	**n**	**Mean (SD) [range]**	**Test statistic (p-value)**
Age	527	19.9 (2.0) [17 – 25]	207	20.0 (2.1) [17 – 25]	305	19.7 (1.8) [17 – 25]	t=1.449 (df=399.3) (p=.148)
Years in US	515	17.2 (5.2) [0 – 25]	207	17.5 (5.3) [0 – 25]	303	17.0 (5.0) [0 – 25]	t=1.163 (df=508) (p=.245)
Categorical Measures	n	%	n	%	n	%	Test statistic (p-value)
Gender	527		207		305		$\chi^2_{(df=1)}$=24.803 (p<.001)
Male	174	33.0 %	93	44.9 %	73	23.9 %	
Female	353	67.0 %	114	55.1 %	232	76.1 %	
Ethnicity	527			207	305		$\chi^2_{(df=1)}$=2.985 (p=.084)
Hispanic	352	66.8 %	133	64.3%	218	71.5%	
Black†	75	14.2 %	35	16.9%	39	12.8%	
White†	65	12.3 %	23	11.1%	39	12.8%	
Other†	35	6.7 %	16	7.7%	9	2.9%	
Education	516		207		304		$\chi^2_{(df=1)}$=0.164 (p=.685)
Some High School	1	0.2 %			1	0.3%	
High School	62	12.0 %	27	13.0%	35	11.5%	
Some College†	441	85.5 %	179	86.5%	258	84.9%	
Bachelor's Degree†	11	2.1 %	1	0.5%	9	3.0%	
Graduate School†	1	0.2 %			1	0.3%	
Marital Status	516		207		304		$\chi^2_{(df=1)}$=0.597 (p=.440)
Single	410	79.5 %	161	77.8%	245	80.6%	
Married†	11	2.1 %	5	2.4%	5	1.6%	
Divorced†	1	0.2 %			1	0.3%	
Long-term Relationship†	94	18.2 %	41	19.8%	53	17.4%	
Residence	508		201		295		$\chi^2_{(df=1)}$=1.210 (p=.271)

	Overall		NO		YES		Difference
Continuous Measures	**n**	**Mean (SD) [range]**	**n**	**Mean (SD) [range]**	**n**	**Mean (SD) [range]**	**Test statistic (p-value)**
On campus – dorm †	77	15.2 %	24	11.9%	49	16.6%	
On campus – apartment †	12	2.4 %	3	1.5%	9	3.1%	
Off campus – apartment †	45	8.9 %	20	10.0%	24	8.1%	
Off campus – home with parents	374	73.6 %	154	76.6%	213	72.2%	

† categories combined for Chi-square test

SD (standard deviation)

t (Student's t-test test statistic)

df (degrees of freedom)

χ^2 (Chi-square test statistic)

Table 2

Descriptive Statistics for 27 Items of HPV Survey and Comparison by Intent to Vaccinate Groups

		Overall		NO		YES		Difference
Construct	**HPV Survey Item *[variable name]***	**n**	**Mean (SD)**	**n**	**Mean (SD)**	**n**	**Mean (SD)**	**Test statistic (df) (p-value)**
Benefits	1. People should only get vaccinated for serious diseases *[diseases]*							
		525	1.62 (1.5)	207	1.89 (1.4)	303	1.43 (1.5)	t=3.56 (508) p<.001
Benefits	2. I am more likely to trust vaccinations that have been around awhile *[trust]*							
		527	3.40 (0.8)	207	3.44 (0.8)	305	3.37 (0.8)	t=0.95 (510) p=.344
Benefits	3. Vaccinations are getting better all the time because of research *[research]*							
		527	3.13 (0.9)	207	2.93 (1.0)	305	3.25 (0.9)	t=−3.99 (510) p<.001
Benefits	4. Healthy people do not need vaccinations *[healthy]*							
		526	0.60 (0.9)	207	0.89 (1.1)	304	0.41 (0.8)	t=5.61 (346.3) p<.001
Vulnerability	5. HPV is a sexually transmitted disease *[STD]*							
		525	2.93 (1.3)	206	2.85 (1.3)	304	3.00 (1.4)	t=−1.24 (508) p=.214
Vulnerability	6. Using condoms can prevent HPV *[condoms]*							
		527	2.34 (1.4)	207	2.25 (1.3)	305	2.39 (1.4)	t=−1.16 (510) p=.248
Vulnerability	7. Genital warts are caused by HPV *[warts]*							
		526	2.51 (1.2)	207	2.47 (1.1)	304	2.56 (1.2)	t=−0.83 (509) p=.407
Vulnerability	8. People with HPV might not have symptoms *[symptoms]*							
		527	3.14 (1.0)	207	3.02 (1.0)	305	3.21 (1.0)	t=−2.20 (510) p=.028
Vulnerability	9. HPV makes you unable to have children *[unable_children]*							
		527	1.98 (1.2)	207	1.98 (1.2)	305	1.99 (1.2)	t=−0.10 (510) p=.919
Severity	10. I worry that I may get HPV *[worry]*							
		527	1.74 (1.5)	207	1.40 (1.4)	305	1.95 (1.5)	t=−4.14 (510) p<.001
Vulnerability	11. Men are at risk for contracting HPV *[men]*							
		526	2.5 (1.4)	207	2.46 (1.3)	304	2.51 (1.4)	t=−0.41 (467.6) p=.686
Severity	12. HPV can cause cervical cancer *[cancer]*							
		527	2.46 (0.9)	207	3.35 (0.9)	305	3.52 (0.8)	t=−2.22 (425.0) p=.027
Severity	13. Treatment for HPV is painful *[painful]*							
		527	1.85 (0.9)	207	1.90 (0.8)	305	1.80 (1.0)	t=1.18 (495.4) p=.241
Benefits	14. I am opposed to any mandated vaccination requirements because they go against freedom of choice *[mandated]*							
		526	1.63 (1.5)	207	2.08 (1.6)	304	1.30 (1.4)	t=5.78 (408.4) p<.001

		Overall		NO		YES		Difference
Construct	**HPV Survey Item *[variable name]***	**n**	**Mean (SD)**	**n**	**Mean (SD)**	**n**	**Mean (SD)**	**Test statistic (df) (p-value)**
Severity	15. Required vaccinations protect people from getting disease from unvaccinated children *[protect]*							
		527	2.57 (1.2)	207	2.38 (1.2)	305	2.67 (1.2)	t=−2.69 (510) p=.007
Severity	16. I understand exactly what the HPV vaccine is for *[understand]*							
		526	2.51 (1.3)	207	2.19 (1.3)	304	2.75 (1.2)	t=−5.07 (509) p<.001
Benefits	17. A vaccine against HPV could prevent future problems for me *[prevent]*							
		526	3.02 (1.1)	207	2.55 (1.2)	304	3.36 (0.9)	t=−8.08 (363.2) p<.001
Benefits	18. Getting a new vaccine is like being part of an experiment *[experiment]*							
		527	2.68 (1.2)	207	2.86 (1.2)	305	2.55 (1.2)	t=2.81 (451.9) p=.005
Benefits	19. Most people I know think vaccinating children with the HPV vaccine before they are teenagers is a good idea *[vacc_children]*							
		527	2.03 (1.2)	207	1.85 (1.2)	305	2.14 (1.3)	t=−2.66 (510) p=.008
Benefits	20. A teen should be able to get a vaccination for HPV without a parent's consent *[no_consent]*							
		527	2.36 (1.5)	207	1.98 (1.5)	305	2.62 (1.5)	t=−4.80 (510) p<.001
Severity	21. Having genital warts makes it difficult to find a sexual partner *[diff_partner]*							
		527	3.40 (0.9)	207	3.38 (1.0)	305	3.45 (0.9)	t=−0.83 (510) p=.405
Barriers	22. Shots are very painful so I would rather not be vaccinated *[shots]*							
		527	0.51 (1.0)	207	0.78 (1.2)	305	0.31 (0.8)	t=4.88 (318.6) p<.001
Barriers	23. If the new HPV vaccine is not required I will not get vaccinated *[required]*							
		527	1.50 (1.4)	207	2.47 (1.2)	305	0.84 (1.1)	t=15.29 (399.8) p<.001
Barriers	24. I understand that this vaccine is very expensive so I will not get vaccinated *[expensive]*							
		519	1.26 (1.2)	207	1.86 (1.2)	305	0.83 (1.0)	t=10.58 (510) p<.001
Vulnerability	25. I do not need this vaccine because I choose not to have sex until I am married *[no_sex]*							
		519	0.84 (1.3)	207	1.30 (1.5)	305	0.54 (1.1)	t=6.11 (345.2) p<.001
Barriers	26. Generally I do what my doctor recommends, so I will get vaccinated *[doctor]*							
		517	2.76 (1.2)	207	2.13 (1.2)	305	3.21 (0.9)	t=−11.08 (352.3) p<.001
Barriers	27. When I make a decision to get vaccinated my mind is made up *[decision]*							
		511	3.13 (1.0)	205	2.97 (1.1)	301	3.25 (1.0)	t=−3.05 (504) p=.002

SD (standard deviation)

t (Student's t-test test statistic)

df (degrees of freedom)

Table 3

Correlations Between 27 SHPV Survey Items

Item #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	1.00																										
2	0.18	1.00																									
3	−0.08	0.16	1.00																								
4	**0.28**	−0.03	**−0.24**	1.00																							
5	0.02	−0.04	0.05	−0.03	1.00																						
6	0.10	0.07	0.10	0.05	**0.39**	1.00																					
7	−0.02	−0.03	0.02	−0.04	**0.30**	0.16	1.00																				
8	0.03	0.04	0.09	−0.11	0.18	0.10	0.16	1.00																			
9	−0.08	0.01	0.07	−0.03	0.03	0.10	−0.02	0.17	1.00																		
10	−0.04	0.04	0.01	−0.02	0.00	0.02	0.09	0.11	−0.02	1.00																	
11	0.03	−0.09	−0.06	−0.05	**0.21**	**0.20**	**0.25**	0.13	−0.08	**0.21**	1.00																
12	0.00	0.00	0.10	−0.12	0.09	−0.03	0.16	**0.39**	0.14	0.02	−0.01	1.00															
13	0.00	−0.01	0.04	0.04	0.10	−0.02	0.08	−0.02	0.09	0.01	0.07	−0.07	1.00														
14	**0.24**	−0.01	**−0.19**	**0.21**	−0.03	0.02	0.02	0.04	−0.02	0.07	−0.07	0.01	0.03	1.00													
15	−0.01	0.02	0.14	−0.08	0.12	0.04	0.05	−0.05	0.02	0.04	0.00	−0.06	0.12	−0.15	1.00												
16	0.02	−0.13	0.09	−0.10	**0.20**	0.01	0.11	**0.19**	0.02	0.05	0.09	**0.30**	−0.05	−0.07	0.05	1.00											
17	−0.12	0.06	0.16	**−0.19**	0.07	0.03	0.16	0.11	−0.03	0.17	0.07	0.18	−0.08	**−0.20**	0.12	**0.26**	1.00										
18	0.08	0.13	−0.17	0.18	−0.05	0.03	0.02	−0.02	0.01	0.13	0.11	−0.06	0.12	**0.19**	0.06	−0.11	−0.05	1.00									
19	0.06	−0.06	0.08	−0.02	0.08	0.10	0.04	−0.09	−0.07	0.08	0.03	−0.08	0.02	−0.07	0.04	0.08	0.05	−0.02	1.00								
20	−0.14	−0.11	0.05	**−0.19**	0.08	0.05	0.03	0.02	0.04	0.12	0.06	0.03	−0.03	−0.11	0.11	0.05	0.14	−0.01	0.15	1.00							
21	0.03	0.10	0.13	−0.05	0.10	−0.01	0.01	0.05	0.05	0.03	−0.02	−0.01	0.05	−0.04	0.13	−0.03	0.04	0.01	−0.03	0.02	1.00						
22	0.04	−0.04	−0.10	0.17	−0.07	−0.11	0.00	−0.07	0.03	0.00	−0.02	0.01	0.09	0.10	−0.10	−0.05	**−0.21**	0.08	−0.01	−0.11	−0.03	1.00					
23	**0.20**	0.04	**−0.22**	**0.31**	0.01	−0.01	−0.04	−0.12	−0.01	−0.16	−0.02	−0.15	0.11	**0.27**	−0.14	**−0.24**	**−0.34**	**0.22**	−0.03	**−0.21**	−0.02	**0.32**	1.00				
24	0.08	0.05	−0.08	**0.22**	−0.03	0.06	0.00	−0.13	0.01	0.01	−0.01	**−0.24**	0.16	0.17	0.05	**−0.27**	−0.17	0.14	−0.03	−0.11	0.01	**0.25**	**0.51**	1.00			
25	0.09	−0.03	−0.13	0.17	0.01	−0.06	−0.02	−0.09	0.05	−0.15	−0.05	−0.11	0.03	0.13	−0.06	−0.07	−0.17	0.02	−0.08	−0.14	−0.10	0.18	**0.30**	**0.23**	1.00		
26	**−0.19**	0.02	**0.27**	**−0.27**	0.03	0.05	0.03	−0.01	0.01	0.03	0.01	−0.02	0.02	**−0.37**	**0.25**	0.08	**0.28**	−0.14	0.09	**0.24**	0.09	**−0.19**	**−0.48**	**−0.26**	−0.14	1.00	
27	−0.03	0.05	0.17	−0.08	0.01	−0.04	0.02	0.05	0.00	−0.05	−0.01	0.10	−0.07	−0.15	0.04	**0.20**	0.15	−0.10	0.06	0.07	0.04	−0.15	**−0.24**	**−0.25**	−0.06	**0.26**	1.00

n=502 listwise deletion

See Table 2 for complete descriptions for the 27 HPV Survey Items

Pearson Correlations $r \geq 0.19$ or $r \leq -0.19$, which were significant ($p<.001$) are highlighted in bold with shaded cells

Table 4

Correlations between 15 optimal HPV items (sorted by construct)

	1	4	14	18	25	3	17	20	22	23	24	26	27	12	16
Perceived Benefits															
1. Diseases	1.00														
4. Healthy	**0.27**	1.00													
14. Mandated	**0.24**	**0.21**	1.00												
18. Experiment	0.08	0.18	**0.19**	1.00											
25. No_Sex	0.08	0.17	0.12	0.00	1.00										
3. Research (reversed)	0.08	**0.25**	**0.19**	0.17	0.13	1.00									
17. Prevent (reversed)	0.11	**0.19**	**0.19**	0.04	**0.19**	0.15	1.00								
20. No_consent (reversed)	0.13	**0.19**	0.11	0.00	0.15	0.05	0.15	1.00							
Perceived Barriers															
22. Shots	0.04	0.17	0.11	0.08	0.18	0.10	**0.20**	0.10	1.00						
23. Required	**0.19**	**0.31**	**0.27**	**0.23**	**0.29**	**0.23**	**0.34**	**0.21**	**0.32**	1.00					
24. Expensive	0.07	**0.23**	0.17	0.14	**0.23**	0.09	0.16	0.12	**0.25**	**0.52**	1.00				
26. Doctor (reversed)	**0.19**	**0.27**	**0.37**	0.14	0.14	**0.27**	**0.27**	**0.24**	**0.19**	**0.48**	**0.26**	1.00			
27. Decision (reversed)	0.03	0.09	0.14	0.09	0.07	0.17	0.15	0.08	0.15	**0.24**	**0.25**	**0.27**	1.00		
Perceived Severity															
12. Cancer (reversed)	0.00	0.12	−0.01	0.06	0.11	0.11	0.18	0.03	−0.01	0.16	**0.24**	−0.02	0.10	1.00	
16. Understand (reversed)	−0.02	0.11	0.07	0.12	0.07	0.10	**0.25**	0.06	0.05	**0.24**	**0.28**	0.08	**0.20**	**0.30**	1.00

n=506

See Table 2 for complete descriptions for the 27 HPV Survey Items

Cronbach's alpha for these 15 items with 7 reversed items noted (Cα = 0.737)

Pearson Correlations r ≥ 0.19 or r ≤ −0.19, which were significant (p<.001) are highlighted in bold with shaded cells

Table 5

Factor Analysis of 15 items: Pattern Matrix of Factor Loadings and Communalities

Construct HPV Items	Communalities	Factor 1	 2	 3
Perceived Benefits (~ Factor 1)				
1. Diseases	.157	**.407**	−.106	.014
4. Healthy	.254	**.423**	.062	−.103
14. Mandated	.291	**.530**	−.070	−.031
18. Experiment	.098	**.289**	.108	.020
25. No_Sex	.137	.012	.030	**−.353**
3. Research (reversed)	.182	**.410**	.111	.031
17. Prevent (reversed)	.201	.197	.179	**−.219**
20. No_consent (reversed)	.098	.151	−.065	**−.216**
Perceived Barriers (~ Factor 3)				
22. Shots	.195	−.035	−.073	**−.476**
23. Required	.645	.162	.082	**−.674**
24. Expensive	.428	−.082	.246	**−.579**
26. Doctor (reversed)	.450	**.480**	−.129	−.298
27. Decision (reversed)	.134	.124	.160	**−.201**
Perceived Severity (Factor 2)				
12. Cancer (reversed)	.303	−.013	**.552**	−.002
16. Understand (reversed)	.352	.032	**.561**	−.068

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization

3 Factors with Eigenvalues > 1 explained 40.0% of the variance

KMO=0.80; Bartlett’s Test of Sphericity p<.001

Table 6

Oblique Factors Correlation Matrix

	F1	F2	F3
Factor 1: Perceived Benefits	C_α = 0.554		
Factor 2: Perceived Severity	.171	C_α = 0.423	
Factor 3: Perceived Barriers	−.548	−.296	C_α = 0.683

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

Cronbach's alphas for each factor shown on the diagonal