

# The Carolina HPV Immunization Attitudes and Beliefs Scale (CHIAS): Scale Development and Associations With Intentions to Vaccinate

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**Background:** No standardized instruments, to our knowledge, exist to assess attitudes and beliefs about human papillomavirus (HPV) vaccination.

**Methods:** We developed the Carolina HPV Immunization Attitudes and Beliefs Scale (CHIAS), using data collected on 783 parents who had not yet vaccinated their daughters against HPV. We conducted a principal components analysis of 16 HPV vaccine attitude and belief items, assessed the scale's psychometric properties, and used linear regression to examine the relationship of CHIAS factors and parents' vaccination intentions.

**Results:** Analyses identified 4 CHIAS factors, all of which had acceptable scale alphas and 1-year test-retest reliability. In multivariate models, higher vaccination intentions were associated with: believing HPV vaccine is effective ( $\beta = 0.06$ ) or has less harmful effects ( $\beta = -0.47$ ), perceiving more barriers to access ( $\beta = 0.18$ ), and having less uncertainty about the vaccine ( $\beta = -0.23$ ) (all  $P < 0.05$ ).

**Conclusions:** Findings suggest that parent attitudes about HPV vaccine are important to their intentions to vaccinate their adolescent daughters against HPV. The CHIAS offers researchers a compact, standardized measure of important HPV vaccine attitudes and beliefs.

**H**uman papillomavirus (HPV) vaccine has the potential to prevent 70% of cervical cancers in the United States.<sup>1,2</sup> It is likely to be most effective if received before the onset of

sexual activity when exposure to common types of oncogenic HPV typically begins.<sup>3</sup> For this reason, acceptability of HPV vaccine to parents of adolescent girls is critical to its success.<sup>4</sup> This article describes the development of a scale to measure parents' beliefs about HPV vaccination.

A large and growing body of research has identified numerous beliefs associated with HPV vaccine acceptability. Higher willingness or intentions to vaccinate against HPV are associated with beliefs about the person (e.g., higher perceived risk, anticipated regret), the vaccine (e.g., higher perceived vaccine effectiveness, fewer anticipated side effects), and the external environment (e.g., cues to action such as a doctor's recommendation, partner beliefs).<sup>5</sup> We focus here on beliefs about the vaccine because the content and domains of these beliefs are not well understood, whereas beliefs about the person<sup>5,6</sup> and the environment<sup>7,8</sup> have received greater attention. Furthermore, HPV vaccine-specific beliefs have been shown to be stronger predictors of vaccination intentions than general vaccination knowledge and attitudes.<sup>9</sup> Higher perceived effectiveness of HPV vaccine has been associated with greater intention to vaccinate against HPV,<sup>10–12</sup> while more concerns about potential harms, such as poor vaccine safety,<sup>12</sup> sexual disinhibition,<sup>13,14</sup> and practical barriers to vaccination<sup>11,15</sup> have been associated with lower HPV vaccination intentions.

Although HPV vaccine beliefs are likely to be important to parents' decisions about vaccinating their adolescent daughters, no standardized instruments, to our knowledge, exist to assess these attitudes. To address this gap, we developed the Carolina HPV Immunization Attitudes and Beliefs Scale (CHIAS) and explored its factor structure. Scale items addressed perceived HPV vaccine effectiveness and potential harms, as well as barriers to getting the vaccine. We also examined the extent to which these attitudes and beliefs were associated with parents' intention to vaccinate their adolescent daughters against HPV.

## METHODS AND MATERIALS

The Carolina HPV Immunization Measurement and Evaluation (CHIME) project was designed to investigate HPV vaccine decision making in an area where women are at high risk of cervical cancer. The sampling and data collection methods used for a CHIME survey of caregivers of adolescent girls are reported in detail elsewhere<sup>16</sup> and outlined briefly below.

## Participants

We identified 1 urban and 4 rural counties in southeastern North Carolina that had (a) high rates of invasive cervical cancer, (b) 20% or more black residents, and (c) at least 1500 girls in the targeted age range of 10 to 18 years (to allow for a

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minimum number of caregivers). The included rural counties (Duplin, Harnett, Sampson, and Wayne) were geographically clustered, and the fifth (Cumberland) was the only urban county in the region that met inclusion criteria.

Interviewers contacted a sample of households with telephone line access in these 5 counties. Households were sampled using random digit-dialing (5%) and a nonoverlapping targeted-list frame of directory-listed residential telephone numbers with available recent household demographic information (95%). Based on available demographics, households thought likely to contain a female child between ages 10 and 18 (ages for which HPV vaccine is recommended) or blacks, as well as rural telephone exchanges, were oversampled. Rural residence was defined using the United States Census classification.<sup>17</sup>

Participants were caregivers for females aged 10 to 18 including parents, grandparents, or any other individual who self-identified as being responsible for the adolescent's care. Female caregivers were preferred, but male caregivers were interviewed if a female caregiver was unavailable. If a household had more than one female aged 10 to 18 years, one was randomly selected as the index female for interview questions.

We interviewed 889 (73%) of 1220 eligible caregivers at baseline.<sup>16</sup> The present analysis is based on data from 783 respondents who had not yet vaccinated their child ( $n = 780$ ) or who did not know if their child had been vaccinated against HPV by the baseline interview ( $n = 3$ ). Descriptive statistics for the sample appear in Table 1. The majority of caregivers (94%) were female. Most respondents were white (69%) or black (23%). Respondents' mean age was 43 years ( $SD = 7.2$ ). Forty percent had a college degree and most had at least some college education (78%). Most respondents had a median annual household income of more than \$50,000 (63%). About half (49%) lived in a rural area. Parents who participated in the follow-up interview did not show statistically significant differences from parents who did not in demographic characteristics at baseline.<sup>18</sup> The majority of caregivers interviewed (97%) reported being the parent or guardian of the index child. For the sake of simplicity, we refer to all participants as "parents."

**TABLE 1.** Characteristics of Baseline Study Participants ( $n = 783$ )

	n	(%)
Gender (female)	733	(93.6)
Race/ethnicity		
Non-Hispanic white	543	(69.3)
Non-Hispanic black	183	(23.4)
Hispanic and other	57	(7.3)
Area of residence (rural)	386	(49.3)
Respondent's education		
High school or less	175	(22.3)
Some college or greater	608	(77.7)
Household income		
$\geq$ \$50,000	490	(62.6)
$<$ \$50,000	257	(32.8)
Missing	36	(4.6)
	Mean	(SD)
Parent's age	43.1	(7.2)
Child's age	14.7	(2.5)

SD indicates standard deviation.

## Procedures

Trained interviewers conducted baseline telephone interviews between July and October 2007, about 1 year after HPV vaccine licensure.<sup>19</sup> Follow-up telephone interviews were conducted with 74% (650/873) of eligible baseline respondents in October and November 2008. The Institutional Review Board at the University of North Carolina approved the study.

## Measures

Before questions about HPV vaccine, interviewers read brief informative statements about both HPV and HPV vaccine: "HPV is a common sexually transmitted infection that sometimes leads to genital warts, abnormal Pap tests, and cervical cancer." And "An HPV vaccine is now available that protects against most genital warts and cervical cancer. Sometimes it is called the cervical cancer vaccine, HPV shot, or Gardasil." CHIME Caregiver Study Surveys are online, available at: <http://www.unc.edu/~ntbrewer/hpv.htm>.

Eighteen items measured a range of parent attitudes and beliefs about HPV vaccine at baseline (Table 2). Most items used a 4-point response scale labeled "strongly disagree," "somewhat disagree," "somewhat agree," and "strongly agree." Responses were coded so that higher values indicate stronger agreement with the statement. Four items assessing perceived difficulty of finding a provider to get HPV vaccine were measured using a response scale labeled "not hard at all," "somewhat hard," and "very hard." To better match the other scales, these variables were rescaled to values of 1, 2.5, and 4, respectively, with higher values indicating greater barriers. Two items assessing vaccine effectiveness had 4-point response scales labeled "slightly effective," "moderately," "very," and "extremely effective." Higher values indicate higher perceived effectiveness. For all items, we recoded responses of "do not know" to the mean. The follow-up survey was shortened due to logistical and time constraints. The survey reassessed 14 of the 18 attitude and belief items from the baseline survey, excluding 4 items about perceived difficulty of finding a provider to get HPV vaccine.

Before assessing vaccination intentions, interviewers provided additional information to participants about HPV vaccine, including the recommended age range, that it protects against most genital warts and cervical cancer, and requires 3 doses (or shots) over 6 months. A 4-item scale ( $\alpha = 0.97$ ) measured vaccination intentions. The items asked about how likely parents were to vaccinate their daughters in the next year under 4 conditions: with no conditions described, if the vaccine were free, if it protected against cervical cancer only, and if it required only 1 shot. Response options for these 4 items were "definitely won't," "probably won't," "probably will," and "definitely will." We coded responses so that higher values indicated a greater intention to vaccinate (possible range = 1.0–4.0). The mean of the 4 items was used for subsequent data analyses.

## Data Analysis

We conducted an exploratory factor analysis of the 18 HPV vaccine attitude and belief items, using principal components analysis with direct oblimin rotation, using baseline data. The oblique rotation method for this analysis was appropriate because it did not require the assumption that the underlying factors were uncorrelated. Kaiser criterion of eigenvalues  $\geq 1.0$  and Cattells scree test<sup>20</sup> were used to select factors to retain. Examining the factor loadings in the rotated solution, we retained variables with loadings larger than 0.4. We then reran

TABLE 2. HPV Vaccine Attitude and Belief Means and Factor Loadings

	Mean (SD)	Factors			
		Harms	Barriers	Effectiveness	Uncertainty
The HPV vaccine might cause short term problems, like fever or discomfort.*	3.06 (0.56)	0.66 <sup>†</sup>	-0.02	0.17	-0.18
The HPV vaccine is being pushed to make money for drug companies.	2.29 (0.91)	0.63 <sup>†</sup>	0.01	-0.24	-0.05
The HPV vaccine might cause lasting health problems.*	2.39 (0.71)	0.60 <sup>†</sup>	-0.02	-0.11	0.28
If a teenage girl gets the HPV vaccine, she may be more likely to have sex.	1.77 (0.95)	0.55 <sup>†</sup>	0.08	-0.19	0.01
I think the HPV vaccine is unsafe.*	1.85 (0.66)	0.52 <sup>†</sup>	-0.01	-0.19	0.30
[Child's name] is too young to get a vaccine for a sexually transmitted infection like HPV.	1.92 (1.13)	0.52 <sup>†</sup>	-0.04	0.05	0.29
How hard do you think it would be to find a provider or clinic where you can afford the vaccine? <sup>‡</sup>	1.63 (0.89)	-0.00	0.84 <sup>†</sup>	-0.04	-0.02
How hard do you think it would be to find a provider or clinic that is easy to get to? <sup>‡</sup>	1.18 (0.52)	0.12	0.69 <sup>†</sup>	0.08	-0.07
How hard do you think it would be to find a provider or clinic that has the vaccine available? <sup>‡</sup>	1.46 (0.77)	-0.10	0.65 <sup>†</sup>	-0.12	0.05
I am concerned that the HPV vaccine costs more than I can pay.	1.99 (1.01)	-0.01	0.62 <sup>†</sup>	-0.14	0.08
How hard do you think it would be to find a provider or clinic where you don't have to wait long to get an appointment? <sup>‡</sup>	1.89 (1.07)	0.03	0.61 <sup>†</sup>	-0.03	-0.01
How effective do you think the HPV vaccine is in preventing genital warts? <sup>‡§</sup>	2.36 (0.67)	0.03	-0.06	0.85 <sup>†</sup>	0.09
How effective do you think the HPV vaccine is in preventing cervical cancer? <sup>‡§</sup>	2.53 (0.73)	-0.08	0.08	0.79 <sup>†</sup>	-0.06
I don't have enough information about the HPV vaccine to decide whether to give it to [child's name].	2.94 (1.14)	0.06	-0.03	0.08	0.82 <sup>†</sup>
The HPV vaccine is so new that I want to wait a while before deciding if my daughter should get it.	2.93 (1.07)	0.17	0.00	-0.01	0.80 <sup>†</sup>
Other parents in my community are getting their daughters the HPV vaccine.* <sup>§</sup>	2.63 (0.71)	-0.12	0.06	-0.04	0.54 <sup>†</sup>
Factor score: mean (SD)	—	2.21 (0.53)	1.65 (0.59)	2.42 (0.60)	2.90 (0.76)
Cronbach's alpha ( $\alpha$ )	—	0.69	0.69	0.61	0.66

Data are from baseline interviews (n = 783). Unless otherwise specified, items used a 4-point scale ("strongly disagree" to "strongly agree") with responses of "do not know" recoded to the variable's mean. Higher values indicate stronger agreement. Two items were dropped from the factor analysis due to low factor loadings: "The HPV vaccine lasts a person's entire life" (mean = 2.67, SD = 0.67) and "My daughter will get the most benefit from the HPV vaccine if she gets it sooner rather than later" (mean = 3.06, SD = 0.94).

\*Item had >20% of respondents reporting "do not know."

<sup>†</sup>Loadings for items used to calculate factor scores.

<sup>‡</sup>Item was measured using a 3-point scale ("not hard at all" to "very hard") that was rescaled to a 1-4 range. Responses of "do not know" were recoded to the variable's mean. Higher values indicate greater perceived barriers.

<sup>§</sup>Item was reverse-coded.

<sup>¶</sup>Item used a 4-point scale ("slightly effective," to "extremely effective). Responses of "do not know" were recoded to the variable's mean. Higher values indicate higher perceived effectiveness.

the principal components analysis to confirm that the factor structure had not changed. To create a single score per respondent for each factor, we calculated the mean of items with a primary loading on that factor (after reverse-coding items with negative correlations to other items on the factor). Cronbach's coefficient  $\alpha$  was then used to evaluate the internal reliability of each individual factor. To examine the utility of factors identified in exploratory analyses, we conducted a confirmatory factor analysis (CFA) treating the factors as latent variables.

To assess reliability of factor scores over time, we conducted a test-retest analysis using data from the 420 parents who participated at follow-up and had not yet gotten their daughter HPV vaccine. We calculated test-retest correlations and conducted paired-sample t-tests on factors for which attitudes and belief items were collected at both time points.

We used linear regression to examine bivariate and multivariate associations between mean factor scores and HPV

vaccination intentions at baseline. A multivariate regression model included all factors while also controlling for socio-demographic characteristics associated ( $P \leq 0.10$ ) with intentions in bivariate analyses (daughter's age and household income). Results of regression analyses are reported as standardized regression coefficients ( $\beta$ s). Analyses were unweighted and conducted in SPSS version 16.0 (Chicago, IL), except for the confirmatory analysis which was conducted in AMOS version 17.0 (Chicago, IL). Statistical tests were 2-tailed with a critical  $\alpha$  of 0.05.

## RESULTS

### Factor Analyses

We identified 4 factors and a possible fifth factor by examining factor eigenvalues in the exploratory factor analysis.

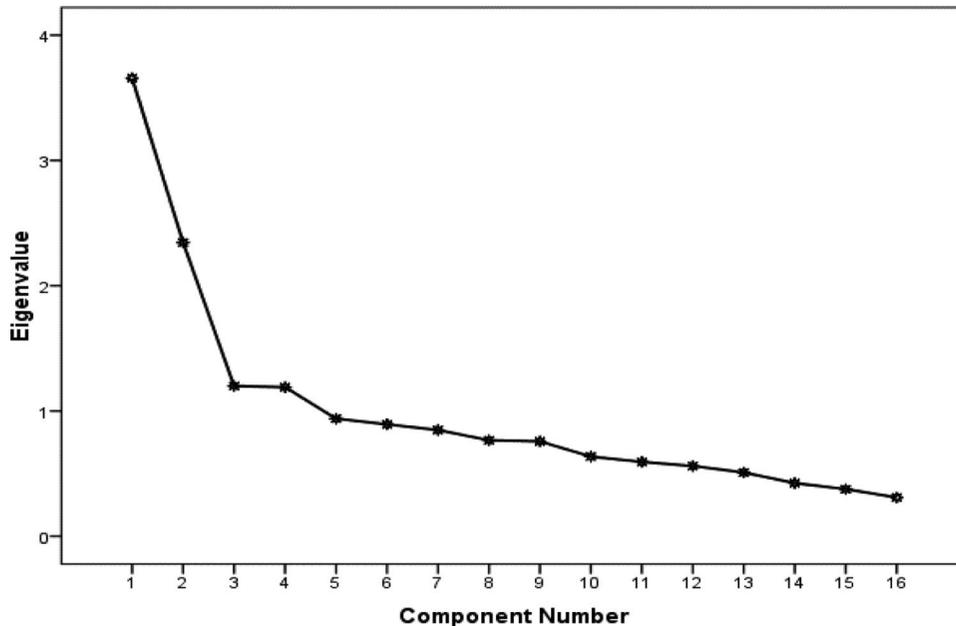


Figure 1. Scree plot. Factors above the “elbow” or break were retained resulting in a 4-factor solution.

Following an inspection of the scree plot (Fig. 1) and factor loadings, we adopted the 4 factor solution (Table 2) which was more robust and conceptually meaningful. Two items (“The HPV vaccine lasts a person’s entire life,” and “My daughter will get the most benefit from the HPV vaccine if she gets it sooner rather than later.”) were dropped from the analysis because they did not load acceptably onto any factor.

The first factor, which we labeled “Harms,” contained 6 items related to perceived potential harms from the vaccine including health problems and an increased likelihood of the daughter becoming sexually active. The second factor, labeled “Barriers,” contained 5 items about perceived barriers to HPV vaccination including cost and access to a healthcare provider. The third factor, “Effectiveness,” contained 2 items about the perceived effectiveness of HPV vaccine in protecting against genital warts and cervical cancer. The final factor, “Uncertainty,” consisted of 3 items including not having enough information about the HPV vaccine and perception of community vaccination norms. The possible range for all resulting factor scores was 1.0 to 4.0. All factors had acceptable internal consistency: perceived vaccination harms ( $\alpha = 0.69$ ), perceived barriers ( $\alpha = 0.69$ ), perceived vaccine effectiveness ( $\alpha = 0.61$ ), and uncertainty about the vaccine ( $\alpha = 0.66$ ).

The 4 factor solution fit the data well, as shown by generally acceptable fit indices in the confirmatory factor analysis (CFI = 0.949; RMSEA = 0.042;  $\chi^2 = 231.8$ ,  $df = 98$ ,  $P < 0.001$ ; relative  $\chi^2 = 2.265$ ). Although the significant chi-square statistic potentially indicates some level of model misfit, it is sensitive to sample size and model complexity.<sup>21</sup> More interpretable is the relative chi-square ratio ( $\chi^2/df$ ) which adjusts for these factors (<3.0 is desirable).<sup>22</sup>

Overall, parents perceived HPV vaccine to be moderately effective (mean = 2.42, SD = 0.60; Table 2). However, many had uncertainty about the vaccine (mean = 2.90, SD = 0.76) and believed it to have potential harms (mean = 2.21, SD = 0.53). Furthermore, though respondents perceived some barriers to vaccination (mean = 1.65, SD = 0.59), most parents

intended to get their daughter vaccinated within the next year (mean = 2.93, SD = 0.91).

More than 20% of parents responded “don’t know” to 6 scale items (Table 2 [see footnote]). Although this finding may reflect a general lack of knowledge about the vaccine in the first year after FDA approval, it could also potentially influence stability of the factor analysis. To address this potential limitation, we conducted extensive sensitivity analyses, for example dropping the 10% of parents who answered “don’t know” to half or more of the items, and dropping those who strongly or moderately agreed with the statement “I don’t have enough information about the HPV vaccine to decide whether to give it to [child’s name],” but we repeatedly found the same factor solution. These findings give us added confidence that the factor structure is stable.

### Association With Intentions to Vaccinate

All HPV vaccine attitude factor scores were associated with parents’ intentions to vaccinate their daughters against HPV in bivariate analyses ( $P \leq 0.001$ ), as shown in Table 3.

TABLE 3. Association of Parents’ HPV Vaccination Attitudes and Beliefs with Intentions to Vaccinate

	Bivariate $\beta$	Multivariate $\beta$
Factors		
Perceived harms of HPV vaccine	-0.59*	-0.49*
Perceived barriers to vaccination	0.16*	0.17*
Perceived HPV vaccine effectiveness	0.27*	0.06 <sup>†</sup>
Uncertainty about the vaccine	-0.43*	-0.21*

Standardized beta coefficients are reported. Multivariate model includes all factors in the table and controls for daughter’s age and household income which were associated with intentions in bivariate models ( $P \leq 0.10$ ).

\* $P \leq 0.001$ ; <sup>†</sup> $P \leq 0.05$ .

Higher levels of perceived vaccine harms ( $\beta = -0.59$ ) and uncertainty about the vaccine ( $\beta = -0.43$ ) were associated with lower parent intentions to have their daughters vaccinated. Conversely, parents who perceived HPV vaccine to be effective ( $\beta = 0.27$ ) and perceived more barriers to vaccination ( $\beta = 0.16$ ) reported greater intentions to vaccinate.

Associations between HPV vaccine attitude factors and parent intentions remained statistically significant in the multivariate model. Higher intentions to vaccinate remained associated with believing HPV vaccine has fewer harms ( $\beta = -0.49$ ) and having less uncertainty about the vaccine ( $\beta = -0.21$ ). Weaker associations were found for the other 2 factors, perceived effectiveness ( $\beta = 0.06$ ) and perceived barriers to access ( $\beta = 0.17$ ), as compared to bivariate models.

### One-Year Follow-up

The 3 CHIAS factors we were able to assess at both time points showed good internal consistency at follow-up (Harms,  $\alpha = 0.73$ ; Effectiveness,  $\alpha = 0.69$ ; Uncertainty,  $\alpha = 0.59$ ). The scales also showed good test-retest reliability, as shown by moderate size correlations of baseline and follow-up scale scores (Harms,  $r = 0.66$ ,  $P < 0.001$ ; Effectiveness,  $r = 0.42$ ,  $P < 0.001$ ; Uncertainty:  $r = 0.44$ ,  $P < 0.001$ ). Compared to baseline, parents perceived fewer vaccine harms (mean = 2.22, SD = 0.58,  $t(416) = 2.77$ ,  $P < 0.01$ ) and had less uncertainty about HPV vaccine (mean = 2.65, SD = 0.78,  $t(416) = 9.27$ ,  $P < 0.001$ ) at follow-up. Parents' perception of HPV vaccine effectiveness remained the same between interview waves (mean = 2.38, SD = 0.73, mean difference = 0.05,  $t(416) = 1.34$ ,  $P = 0.18$ ).

## DISCUSSION

Our study is the first, to our knowledge, to develop a scale measuring attitudes and beliefs toward HPV vaccination. We identified 4 underlying factors to the CHIAS which are largely consistent with Health Belief Model constructs.<sup>23</sup> All CHIAS factors showed good test-retest reliability and had acceptable internal consistency. Perceived HPV vaccine harms and effectiveness, barriers to vaccination, and uncertainty about the vaccine were associated with parents' HPV vaccination intentions in multivariate models. In line with the research to date on HPV vaccination, most parents in this study had positive attitudes about the HPV vaccine and intended to vaccinate their adolescent daughters against HPV.<sup>9,13,14,24</sup>

Contrary to a recent systematic review of the literature,<sup>5</sup> perceived effectiveness and barriers played a relatively small role in HPV vaccination intentions in this study. Beliefs about harms and uncertainty were more important factors, in keeping with the findings of the previous review. The positive association of perceived barriers with HPV vaccination intention was unexpected and in contrast to previous research on vaccine acceptability.<sup>25</sup> This finding may reflect greater awareness of barriers among those planning to vaccinate, who may have explored health care systems and their limitations in greater depth, although we acknowledge that are other potential explanations for the association.

Parents in this sample had a high degree of uncertainty about the HPV vaccine, although uncertainty decreased by the follow-up interview. Consistent with previous research,<sup>26</sup> many respondents believed they did not have enough information to make a decision about giving the HPV vaccine to their daughters. Our finding that parents were uncertain about HPV vaccination norms (i.e., whether other parents were vaccinating

their children) is not surprising given that our survey was conducted only 1 year after vaccine licensing.

Our results have implications for future HPV vaccine research. The CHIAS may be useful in studying HPV vaccine attitudes among populations beyond parents, though the generalizability of the scale has yet to be established. The association between HPV vaccination intentions and specific attitudes identified with the CHIAS point to potential strategies for intervention. Specifically, interventions that seek to reduce concerns about perceived vaccine harms and increase perceptions of HPV vaccine effectiveness may increase parents' intentions to vaccinate their adolescent daughters. Furthermore, because knowledge about HPV has been associated with HPV vaccination attitudes,<sup>11</sup> interventions that provide education and information about the severity of HPV infection and the benefits of HPV vaccination to parents may decrease uncertainty about the vaccine.<sup>27</sup> We caution, however, that results of this study are insufficient on their own to identify what will be an effective intervention to increase vaccine uptake.

Strengths of our study include a large sample of parents who reside in an area with high cervical cancer rates and an examination of multiple attitudes covering a wide range of HPV vaccine topics. However, our study also has several limitations. First, while understanding the HPV vaccination attitudes and intentions of populations at most risk of cervical cancer will be especially important in assuring that these populations receive the vaccine, our sample was drawn from one geographical area of North Carolina. Generalizability of findings to parents in other areas and to other populations will need to be established. Second, while parents are the key health care decision-makers for many adolescents, some youth may make HPV vaccination decisions on their own, and our study does not examine the attitudes and beliefs of adolescents themselves. Third, limited understanding of HPV vaccine may have affected some participants' responses. However, we provided several informational statements on HPV vaccine before assessing beliefs. Sensitivity analyses showed that the CHIAS factor structure and associations with vaccination intentions are stable for parents with lower knowledge. Two CHIAS factors (Uncertainty and Effectiveness) are comprised of relatively few items which may make them unstable and result in lower measures of internal consistency because Cronbach's coefficient  $\alpha$  is influenced not only by the magnitude of correlation among items, but also by the number of items being assessed. The cross-sectional nature of the study design precludes making causal inferences about the association of attitudes and vaccination intentions. Lastly, parents' intentions to vaccinate may overstate actual vaccine uptake as intent does not always translate into health behavior.<sup>28,29</sup>

The findings of our study suggest that parent attitudes about HPV vaccine are important to their intentions to vaccinate their adolescent daughters against HPV. The CHIAS offers researchers a compact, standardized measure of important HPV vaccine attitudes and beliefs. Further research is needed to determine if these attitudes and the CHIAS predict vaccination behavior in longitudinal studies and whether interventions to change the vaccine attitudes and beliefs we identified can increase HPV vaccine uptake.

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