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The impact of a comic book intervention on increasing East African-American adolescents' HPV vaccine-related knowledge, attitudes and intentions to receive vaccine

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Abstract

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Background: HPV vaccine uptake is low among East African-American (EAA) adolescents in the U.S. To improve HPV vaccine uptake in EAA communities, we developed a theory-based, community-informed comic book for adolescents as a part of an intervention targeting mothers and adolescents. We evaluated the impact on participating adolescents' HPV and HPV vaccine knowledge, attitudes and vaccination intentions.

Methods: The culture-specific comic book intervention was delivered to unvaccinated EAA adolescents who participated in ethno-linguistic-specific dinners with their mothers in Washington (8 dinners in Somali, 2 in Amharic) between 2017-2018. English-speaking adolescents aged 14-17 were assigned to complete a self-administered survey either before or after reading the comic book. Surveys were identical and assessed knowledge, barriers, communication with parents, and

intention. Responses between adolescents completing the pre- vs post-test were compared with chi-squared tests. We used generalized estimating equation (GEE) models to estimate relative risks (RRs) and 95% confidence intervals (CIs) to measure the magnitude of the impact of the intervention on each construct. We also stratified the GEE models by gender to enumerate gender-specific intervention effects and tested for the presence of interaction between the participants' gender and the assigned survey group (e.g., pre- or post-intervention).

Results: Among 136 (Pre-test=64, Post-test=72) participants, 90% were Somali and 54% female. Adolescents assigned to the post-test were more likely to correctly answer questions on HPV/HPV-vaccine knowledge than those assigned to the pre-test (correct responses ranged from 27%-67% on the pre-test vs. 66%-90% post-test). The differences were statistically significant ($p < .001$) for 10 of 11 questions. Overall, the adolescents in the post-intervention survey group were 1.87 (95% CI: 1.54-2.27) times and 1.74 (95% CI: 1.46-2.07) times more likely than adolescents in the pre-intervention group to correctly answer questions related to HPV and HPV vaccine knowledge, respectively. Significant pre/post differences were also observed for comfort talking with a parent (58% vs. 90% somewhat/very comfortable, RR: 1.55 [95% CI: 1.24-1.94]), willingness (38% vs. 83% probably/definitely willing, RR: 2.16 [95% CI: 1.55-3.01]) and intention to get vaccinated (34% vs. 86% very/somewhat likely, RR: 2.39 [95% CI: 1.69-3.37]). The impact of the comic book tended to be stronger in male versus female adolescents for all constructs (RR between the pre- and post-test groups ranged from 1.40-3.20 for males vs. 1.30-2.00 for females).

Conclusion: The comic book improved the EAA adolescents' HPV and HPV vaccine knowledge, attitudes and intentions to receive vaccine. This intervention could be adapted for other EAA and ethnic-minority communities.

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DEDICATION

I would like to dedicate this work to Paul, Althea, and Bear without whom this work would not have been possible.

Introduction

HPV causes virtually all cervical cancer, and is causally linked with cancers of the penis, vulva, vagina, anus and oropharynx.¹ At least 70% of cervical cancers are caused by high risk HPV types 16 and 18¹ and these two types are included in all prophylactic vaccines. The bivalent, quadrivalent, and nonavalent vaccines each have greater than 95% efficacy against HPV infections and cervical lesions caused by the types targeted by the vaccines.²⁻⁷ Despite being almost completely preventable with HPV vaccines, the vaccine uptake rate remains low in the U.S.⁸ In fact, in 2018, only 51% of the adolescents aged 13-17 years were up to date with their HPV vaccine series and 68% had received at least one dose,⁸ both of which are below the Healthy People 2020 goal of reaching 80% HPV vaccine series completion for all adolescents.⁹

A recent meta-analysis showed that ethnic minority adolescents (Black, Hispanic and Asian, or all minority groups combined) are 6.1% (95% CI: 3.3-8.8%) more likely to initiate the HPV vaccine series than their White counterparts; however, they are 8.6% (95% CI: 5.6-11.7%) less likely to complete the series.¹⁰ Furthermore, adolescents whose caregivers are foreign-born are less likely to receive HPV vaccine than adolescents with caregivers who were born in the U.S.¹¹ The 2012-2013 President's Cancer Panel Report highlighted the need for evidence-based, multi-level interventions to increase the knowledge about HPV vaccines that can overcome challenges that underserved racial/ethnic minorities face, such as language barriers, lack of awareness and culture-specific barriers.¹²

Preliminary research in King County, Washington State showed that adolescents in East African-American (EAA) communities are susceptible to many of the above stated challenges, such as limited awareness and misperceptions about HPV.¹³ From the 2014 American Community Survey that includes county- and Census-tract level data, it is estimated that there are ~1,800

Somali and ~1,280 Ethiopian adolescents between the ages of 11-17 years in King County. Although HPV vaccination data by race/ethnicity are not available, the majority of EAA adolescents reside in under-vaccinated Census tracts, which is defined as either having a lower initiation rate or completion rate than the national average in either gender.¹⁴ A prospective audit of immunization status among recently arrived East African children and adolescents in Australia showed that 97% (n=132) of participants had incomplete or unknown infant immunization status based on parent report and vaccination records.¹⁵ A study from another EAA community in the U.S. demonstrated that ethnically Somali girls were generally accepting of initiating the HPV vaccine series but less likely to complete it compared to White non-Hispanic girls of the same age.¹⁶

One approach to encourage the uptake of HPV vaccines among adolescents is the use of comic books. The comic book is a tool that is especially relevant in adolescent health promotion because the use of visual story with text improves comprehension and retention and can engage the reader.^{17,18} The comic book has been used successfully to improve health knowledge and behaviors in tobacco cessation and obesity prevention.^{19,20} Previously, Katz et al. developed and piloted a comic book related to HPV vaccines for 9-14 year old adolescents in rural Appalachian communities.¹⁸ However, no other studies have developed or evaluated the impact of a HPV vaccine comic book for East African adolescents.

Responding to the need for culturally tailored educational media to raise awareness and address misperceptions about HPV and HPV vaccines, our research team developed a comic book as a part of a multi-level intervention study involving mothers, adolescents, and healthcare providers in the EAA communities in King County, Washington. The comic book addressed HPV-related knowledge and beliefs such as perceived susceptibility and severity of HPV, perceived

benefits of vaccines and common adolescent barriers around HPV vaccination. The messages also addressed HPV-related attitudes such as social norms, using peers and family. In this study, we aimed to evaluate the impact of the comic book intervention on East African adolescents' knowledge of HPV and HPV vaccines, attitudes about and intention to receive HPV vaccination.

Methods

We developed and evaluated a comic book for 14-17 year old adolescents as part of a multi-level intervention study that involved mothers, adolescents and healthcare providers in the EAA communities in King County, Washington to promote HPV vaccine uptake. The comic book intervention was delivered between October 2017 and September 2018 via 10 ethno-linguistic-specific community dinners with mothers and their adolescent children in King County, Washington (8 in Somali and 2 in Amharic). The study was approved by the University of Washington Institutional Review Board.

Comic Book Development

The comic book was developed using a multi-step process that involved: 1) comic book mock-up based on the learnings from previous literature on vaccine barriers and facilitators, two behavioral theories (Health Belief Model and Theory of Reasoned Action);²¹⁻²⁴ 2) focus groups with ethnically Somali, Ethiopian, and Eritrean mothers in the King County area who reviewed the mock-up and gave additional feedback; 3) integration of the findings into the comic book messages; 4) assessment of acceptability among EAA adolescents; and 5) mapping the findings onto pertinent theoretical constructs such as HPV vaccine susceptibility and barriers.^{23,24} The comic book mock-up was vetted by the East African community members and our bilingual/bicultural research team to be culturally relevant to the target population.

The comic book incorporated the constructs of Health Belief Model and Theory of Reasoned Action, and reflected the input from focus groups conducted in the three EAA communities in the King County area.^{23,24} The book graphically illustrated a personal story of a culturally appropriate adolescent female main character who is introduced to HPV vaccine at school in her health class and discusses HPV vaccines with diverse male and female peers, and finally with her family (mother and grandmother). The comic book was updated based on the focus group feedback. The story included dialogues between boys and girls, because the EAA mothers felt strongly that both boys and girls from diverse backgrounds should be included.²³ To enhance cultural relevance, two sets of graphic images were made to reflect characters from Somali, Ethiopian, and Eritrean communities.²³ For example, the main character was a girl wearing a hijab for the Somali comic book and non-hijab wearing character for Eritrean and Ethiopian comic books.²³ The book incorporated the constructs of perceived susceptibility to HPV infection (“HPV is so common that almost everyone will be infected at some point”), severity of the HPV infection (“HPV can cause diseases like cancer”), and benefits of the HPV vaccine (“The vaccine will protect you from cancer in the future”).²³ The book also addressed cues to action (“Talk to your parents about the vaccine”), self-efficacy to receive the vaccine (“I am sure I can get the HPV vaccine”), and barriers (“I’ve always hated shots because they hurt”).²³

Survey Development

Our research team’s experience working with the EAA and other immigrant communities and HPV vaccine research informed the development of the survey instrument.^{13,25-28} The items from previous studies were adapted or included when it was appropriate, and the survey instrument was reviewed by the representatives from the King County EAA communities for cultural acceptability and appropriateness. The survey instrument included simple item response options

instead of Likert-type scales, and was designed to be short in order to facilitate data collection before and after the dinner sessions.

The survey instrument was an 18-item questionnaire in English, and was designed to take 5-7 minutes. The questionnaire was designed to assess changes in seven theoretical constructs addressed in the comic book: adolescents' HPV knowledge and beliefs (5 questions), HPV vaccine knowledge and beliefs (6 questions), barriers to HPV vaccination (2 questions), relevant social norms and influences (2 questions), communication with parents about vaccination (1 question), willingness to be vaccinated (1 question), and vaccination intentions (1 question). The constructs were derived from the Health Belief Model and Theory of Reasoned Action).²¹⁻²³

Knowledge and beliefs related to HPV and HPV vaccine were measured by eleven questions in the survey. Of these, questions such as "HPV infection is rare" measured perceived susceptibility to HPV, "HPV vaccine prevents serious health problems" measured perceived benefits of vaccination, and "HPV infection can cause cancer" measured perceived severity of HPV. The barrier construct included two questions that measured the beliefs about the side effects and the pain of the HPV vaccine (e.g., "When thinking about getting the HPV vaccine, how concerned are you about side effects?"). Social norms and influence was measured by two questions that assessed HPV-related attitudes toward their peers and providers (e.g., "Doctors think it is very important that boys and girls get the HPV vaccine"). The communication construct was measured by the question, "How comfortable would you be talking with a parent about the HPV vaccine?" The willingness and intention constructs were each measured by the questions, "How willing would you be to get the HPV vaccine?" and "In the next 6 months, how likely is it that you will talk to a parent about getting the HPV vaccine?" respectively.

Recruitment, Screening, and Enrollment of Study Participants

Bilingual research staff recruited mothers with self-reported unvaccinated adolescents in East African communities in King County, Washington in two ways. First, the research staff recruited EAA women in central places of gathering such as community centers, places of worship and health fairs. The bilingual research staff spoke English and either Somali or Amharic. Second, community partners referred the research team to EAA women who might be interested in participating in the study by providing their names and phone numbers. The study staff called these individuals to assess interest and eligibility.

The female guardian (mother or female caregiver of the household, collectively called “mothers”) was eligible to participate if she spoke Somali or Amharic, had at least one 11-17 year old child, and reported that none of her children had received HPV vaccine. The written informed consent form was given in the mothers’ native language and was explained by the bilingual research staff. The mothers provided consent for their own participation and also their adolescents’ participation. The participating mothers completed a brief pre-intervention survey that included demographic information on the adolescents. The mothers were invited to bring their 14-17 year old children to the community dinner to participate in the comic book intervention. The adolescents were eligible to participate if they could speak and read English.

Study Procedures

The dinners were held in centrally located community centers vetted by the partners in King County’s East African communities. At each dinner, mother-adolescent dyad participants were served a culturally-appropriate meal. After dinner, the mothers participated in an educational forum intervention with a health care provider in an adjoining room (described in a separate paper), and the adolescents were divided into small groups by the research staff. The participating

adolescents were assigned to receive either the pre-intervention survey or an identical post-intervention survey. This data collection approach facilitated maintaining the adolescents' interest as well as time and resources for the research team. Research staff explained the study procedures to the adolescents and asked them whether they would like to participate in the study. If the adolescent agreed, verbal assent was documented and they received the comic book intervention. Each participating adolescent received a copy of a comic book to review and keep, either after the pre-intervention survey or before the post-intervention survey. Each adolescent received a small compensation of \$25 to thank them for their time.

Statistical methods

The questionnaires were administered and completed on paper. Redcap mobile iOS Application with offline iPad data collection was used for demographic data reported by mothers, which was uploaded to Redcap server after each dinner by the research team. Analysis was performed using R (version 3.6.1) and Stata (version 15.1) to conduct all statistical analyses.

Adolescents' demographic characteristics and responses to survey items were summarized by pre-/post- intervention group. For pre-/post-survey comparisons, each survey item was dichotomized (e.g., true or false), including the questions that had up to four response options. For example, the questions related to barriers to HPV vaccination (e.g., How concerned are you about the side effects of HPV vaccine?) had four options (e.g., very or somewhat concerned, not concerned, and not sure). These answers were dichotomized, grouping "very concerned" and "somewhat concerned" versus "not concerned" and "not sure". The question measuring the intention to be vaccinated (e.g., In the next 6 months, how likely is it that you will talk to a parent about getting the HPV vaccine?) was dichotomized by grouping "very likely" and "somewhat

likely” versus “likely” and “not likely”. The dichotomization is described along with the response result in Table 2.

The pre- and post- intervention survey responses to individual survey items were compared using chi-squared tests. To evaluate the impact of the comic book on adolescents’ knowledge of HPV and HPV vaccines, and attitudes about and intention to receive HPV vaccination, we calculated each participants’ proportion of correctly/positively answered questions for each construct in the pre- and post-intervention groups. Then, we calculated the mean and the standard deviation of the proportion correctly/positively answered questions for each construct.

To measure the magnitude of the impact of the intervention on each construct, we used generalized estimating equation (GEE) models to estimate relative risks (RRs) and 95% confidence intervals (CIs). The models used the count of correct answers per construct as the outcome, Poisson family (log link), exchangeable correlation structure, offset of the number of questions asked and were clustered on mother. Age, gender of the participant and the mother’s primary language were included as adjustment variables. A p-value of less than 0.05 was considered statistically significant. Within each construct, adolescents who did not answer one or more of the questions were excluded from the GEE analysis.

To enumerate gender-specific intervention effects, we stratified the multivariable GEE models by gender (controlling for the age of the participant and the mother’s primary language). We also formally tested for the presence of interaction between the participants’ gender and the assigned survey group (e.g., pre- or post-intervention).

Results

One hundred and thirty six adolescents (belonging to 84 mothers) who participated in an ethno-linguistic-specific community dinner were included in our analysis. 64 adolescents were

assigned to the pre-intervention group and 72 adolescents to the post-intervention group. Overall, about two-thirds were 14-15 years old (68.3%) and one-third 16-17 years old. Just over half (53.7%) were female, and almost half (47.8%) were born outside of the U.S. More than 90.0% of their mothers identified as Muslim and 60.0% of their mothers reported annual household income of less than \$25,000 (Table 1).

HPV knowledge and beliefs

Adolescents assigned to the post-intervention survey group were more likely to correctly answer questions about HPV knowledge and beliefs than those assigned to the pre-intervention survey group. At baseline, the proportion of correct responses across the five questions ranged from 36.7% to 61.3% in the pre-intervention group compared to 67.6% to 93.1% in the post-intervention group (Table 2). The difference between the pre- and post-intervention groups was statistically significant ($p < 0.001$) for all five questions.

The overall mean score of the students improved from 44.0% to 82.9% (Table 4), and the percentage of adolescents who correctly answered all five HPV knowledge questions increased from 6.7% in the pre-survey group to 52.9% in the post-survey group. The proportion of adolescents who correctly responded to “HPV infection is different from HIV” increased from 61.3% to 87.3%. 37.1% of the pre-intervention group answered correctly to “HPV infection is rare” compared to 67.6% in the post-intervention group. 39.7% of the pre-intervention group knew that HPV is spread through sexual contact and that most people with HPV infection know they have it, compared to 67.6% and 71.0%, respectively, in the post-intervention group. 36.7% of the pre-intervention group responded to the question “HPV can cause cancer” correctly compared to 93.1% in the post-intervention group. Overall, the adolescents in the post-intervention survey

group were 1.87 (95% CI: 1.54-2.27) times more likely to correctly answer questions related to HPV knowledge (<0.001, Table 4).

HPV vaccine knowledge and beliefs

Statistically significant improvement in the percentage of correct responses were observed between the pre- and post-intervention survey groups for five of the six questions related to HPV vaccine knowledge and beliefs ($p < 0.001$, Table 2). Correct responses to the question “HPV vaccine prevents serious problems” did not differ significantly between groups (66.7% pre-intervention vs. 72.2% post-intervention, $p=0.48$). The largest difference (48.4%) was observed for the question “Adolescent boys do not need the HPV vaccine.” The overall mean score of the students improved from 42.8% to 75.4% (Table 4), and the percentage of adolescents who correctly answered all six HPV vaccine knowledge questions increased from 6.7% in the pre-survey group to 29.6% in the post-survey group. Overall, the adolescents in the post-intervention survey group were 1.74 (95% CI: 1.46-2.07) times more likely to correctly answer questions related to HPV vaccine knowledge ($p < 0.001$, Table 4).

Barriers

The proportion of adolescents who responded “not concerned” to the question “When thinking about getting the HPV vaccine, how concerned are you about the side effects?” significantly increased from 14.1% in the pre-intervention group to 29.2% in the post-intervention group ($p=0.034$, Table 2). Similar proportions of adolescents in the pre- and post-intervention groups responded “not concerned” to the question “When thinking about getting the HPV vaccine, how concerned are you about the shot being painful?” 39.1% and 40.3%, respectively ($p=1.00$). Post-intervention survey adolescents were 1.36 (95% CI: 0.93-2.01) more likely to be not

concerned about the side effects or the shot being painful compared to the pre-intervention survey adolescents; however, the result was not statistically significant ($p=0.112$, Table 4).

Social norms and influences

Adolescents who were assigned to the post-intervention survey group were more likely to assume positive social norms and influences towards receiving the HPV vaccine than those in the pre-intervention group. Both of the questions measuring positive social norm were statistically significant for change ($p < 0.001$). 20.7% of the pre-intervention group disagreed with the question “Other boys and girls would not think it is a good idea to get the HPV vaccine” compared to 59.5% of the post-intervention group. The proportion of adolescents who correctly responded to “Doctors think it is very important that boys and girls get the HPV vaccine” increased from 61.3% in the pre-intervention group compared to 88.1% in the post-intervention group. The overall mean of the positive responses of social influence increased from 36.3% to 70.1% (Table 4), and the percentage of adolescents who answered both questions positively increased from 9.7% in the pre-survey group to 50.0% in the post-survey group. Overall, the adolescents in the post-intervention survey group were 1.89 (95% CI: 1.48-2.41) times more likely to positively answer questions related to social norms and influences ($p < 0.001$, Table 4).

Communications

Adolescents who were assigned to the post-intervention survey group were more likely to feel comfortable talking to a parent about the HPV vaccine than those in the pre-intervention group. There were significantly more adolescents who felt very or somewhat comfortable talking with a parent in the post-intervention group (90.2%) compared to the pre-intervention group (57.8%, Table 2). Overall, the adolescents in the post-intervention survey group were 1.55 (95% CI: 1.24-

1.94) times more likely to feel comfortable talking to a parent about the HPV vaccine than those in the pre-intervention group ($p < 0.001$, Table 4).

Willingness

83.3% of the adolescents in the post-intervention group responded “definitely willing” or “probably willing” to the question, “How willing would you be to get the HPV vaccine?” compared to 37.5% in the pre-intervention group ($p < 0.001$, Table 2). The adolescents in the post-intervention group were 2.16 (95% CI: 1.55-3.01) times more likely to be willing to receive the vaccine than those in the pre-intervention group ($p < 0.001$, Table 4).

Intention

34.4% of the pre-intervention survey group responded, “very likely” or “somewhat likely” to the question, “In the next 6 months, how likely is it that you will talk to a parent about getting the HPV vaccine?” compared to 86.1% of the post-intervention survey group. The adolescents in the post-intervention group were 2.39 (95% CI: 1.69-3.37) times more likely express intention to receive the vaccine in the next 6 months ($p < 0.001$, Table 4).

Effect modification by gender

The proportion of correct responses to individual knowledge questions pre-intervention tended to be lower in males (range 18.2%-63.6%) than in females (range 32.3%-83.3%, Table 3). Testing for interaction between the participants’ gender and the intervention group showed marginal effect modification for the HPV vaccine knowledge and beliefs ($p=0.056$) and the willingness constructs ($p=0.083$, Table 5). For the HPV vaccine knowledge and beliefs construct, the male adolescents in post-intervention group were 2.13 (95% CI: 1.67-2.73) times more likely to correctly answer questions related to HPV vaccine knowledge compared to male adolescents in the pre-intervention group. On the other hand, female adolescents in the post-intervention group

were 1.48 (95% CI: 1.18-1.85) times more likely to correctly answer questions in this construct than female adolescents in the pre-intervention group. For the willingness construct, the male adolescents in the post-intervention group were 3.11 (95% CI: 1.75-5.52) times more likely to be willing to receive the HPV vaccine than male adolescents in the pre-intervention group. In contrast, the female adolescents in the post-intervention group were 1.67 (95% CI: 1.14-2.44) times more likely to be willing to receive the HPV vaccine than female adolescents in the pre-intervention group. In general, the magnitude of the impact on constructs other than HPV vaccine knowledge and beliefs and willingness was smaller for females; however, the interaction terms were not statistically significant.

Discussion

Overall, the comic book intervention had a significantly positive impact on the EAA adolescents' HPV and HPV vaccine knowledge (HPV-related knowledge), attitudes and intentions to receive vaccine. Specifically, the comic book improved HPV-related knowledge and beliefs, social norms, communication with parents, willingness and intention to receive the vaccine.

There have been several types of interventions evaluated that target adolescents to improve HPV vaccine knowledge and intentions. In their systematic review, Walling et al.²⁹ identified informational interventions such as community-level media campaigns and adolescent-targeted decision support such as informational videos narrated by a peer and an expert that successfully improved HPV vaccine knowledge in adolescents and uptake.^{30,31} They also identified some interventions that did not improve vaccine behavior, such as health message framing (e.g., gain versus loss- framed messages).³²

Other successful interventions targeted the target populations' environment to increase the vaccine uptake, such as text-message reminders. However, the inconsistent measurement and lack

of standardization of definitions of HPV vaccine related constructs such as knowledge, beliefs, susceptibility, and acceptance, as well as sparse long-term assessment of retention in knowledge and the actual vaccine status make it difficult to compare impact across intervention studies.

Comic books have been used for health promotion topics among diverse populations, particularly adolescents.^{18,33-35} For example, they have been used to decrease tobacco use among American Indian and Alaskan Native youth, for HIV/STD risk-reduction among South African adolescents, and to increase family planning among female Kenyan adolescents ages 15-19.²⁷⁻²⁹ The efficacy of the comic book medium as a behavioral intervention has been mixed and difficult to assess, as few studies have measured changes in knowledge or behavior.³³ For example, the study of tobacco prevention among American Indian and Alaskan Native Youth and HIV/STD risk-reduction among South African adolescents only measured acceptability, not changes in knowledge or behavior.^{33,35} The study of a comic book to increase family planning among female Kenyan adolescents found that ever being exposed to their intervention was associated with delayed first sex and first pregnancy/birth.³⁴ Moreover, the process of developing comic books for health promotion is not standardized, and each comic book goes through a unique process of operationalizing their central message. The current literature on the application of comic book interventions to increase HPV vaccine uptake is sparse and most educational interventions in general target the parents of adolescents or women.³⁶ A comic book was developed as a tool to increase HPV vaccine uptake in a community in the U.S.,¹⁸ and is planned for use in the low- and middle- income country setting.³⁷ A similar medium called “fotonovela” has been used to increase uptake in a Latino community.³⁸ Of these three comic books/fotonovela interventions, only two included impact evaluation. Katz et al. developed a comic book with similar constructs as our study, such as perceived susceptibility, severity and social norms.¹⁸ They described their process

of the comic book development using parental input. The comic book improved the mothers' knowledge and beliefs about HPV and HPV vaccine, but the impact on adolescents was not measured. Chan et al. used a slightly similar medium, called "fotonovela" to increase HPV vaccine knowledge, attitudes and intentions in a socioeconomically disadvantaged Hispanic community in California.²⁷ A fotonovela employs formatted photos instead of drawings, but text bubbles of dialogue between the characters like comic books.²⁷ However, the participants for this study were between ages of 18-26 years. Hence, there was content that does not apply to the EAA adolescent population, such as sexual practices among married couples.³⁸ Their fotonovela increased HPV-related knowledge and beliefs of their participants; however, only perceived susceptibility reached statistical significance.³⁸

The participants in our study exhibited varying levels of baseline knowledge about HPV and HPV vaccine compared to adolescents surveyed in a few prior studies. We reviewed studies that assessed HPV-related knowledge among adolescent girls aged 13 to 21 in an urban setting in the U.S. published in 2017,³⁹ Ugandan female adolescents ages 12-17 who were surveyed in 2016,⁴⁰ unvaccinated Italian girls aged 13-20 years who were surveyed in 2009,⁴¹ and 13 year old female students in Malaysia who were surveyed in 2013.⁴² Notably, only 36.7% of the females in our study's pre-intervention group knew that HPV can cause cancer. In contrast, a survey of Ugandan female adolescents ages 12-17 found that the 70.0% of their respondents knew that HPV infections cause cervical cancer,⁴⁰ and 91.8% and 53.7% of unvaccinated girls in Italy and Malaysia, respectively, knew that cervical cancer was related to HPV infection.^{41,42} Of the pre-intervention participants (both males and females) in our study, 37.1% responded correctly that HPV infection is not rare. Similarly, 27.0% of the unvaccinated Malaysian students knew that HPV infections are common. Whereas 39.7% of our pre-intervention group responded correctly

that most people with HPV infection do not know they have it, 48.1% of the Malaysian adolescents and 87.0% of the U.S. adolescents knew that most people who become infected with HPV do not know that they have it.^{39,42} Lastly, 43.3% of our pre-intervention group females knew that HPV is spread through sexual contact, whereas 28.6% of the adolescents in the U.S. study knew that HPV is spread from person to person by skin to skin genital contact.³⁹ Since historical and current policy on HPV vaccination vary by location, it makes sense that there are differences in the baseline knowledge among unvaccinated adolescents in these settings. For example, HPV vaccine was introduced in Malaysia in 2010 targeting 13 year old girls, which is the current policy.⁴³ In the U.S., routine HPV vaccination began with females 9-26 in 2006, recommended to males in 2011.⁴⁴ In Uganda, HPV vaccine was introduced in 2013 and still targets girls ages 9-12.⁴⁵ The vaccine has been offered to girls 11 years and older since 2008 in Italy, and the country adopted a gender neutral HPV vaccination program in 2017.⁴⁶

Our comic book significantly improved the EAA adolescents' HPV-related knowledge. The adolescents in the post-intervention group had significantly higher knowledge than those in the pre-intervention group in questions that measured their perceived susceptibility, benefit of the vaccine, and barriers to vaccination.

Pain, distress, and/or fear about needle procedures is common among children and adolescents.⁴⁷ Particularly, HPV vaccine has received much negative attention from the media about reports of unusually high rates of pain and syncope.⁴⁸ A study that specifically compared pain related to HPV vaccine with another routine vaccination such as tetanus or meningococcal vaccine found that HPV vaccine pain was not any more painful than others, and that it didn't affect the vaccine regimen completion.⁴⁸ For the question "When thinking about getting the HPV vaccine, how concerned are you about the shot being painful?" similar proportions of adolescents

in the pre- and post-intervention groups reported being “not concerned.” This may be due to the adolescents being sensitized about the topic of pain, as the comic book discusses the potential negative consequences of HPV vaccination in detail. In contrast, the adolescents in the post-intervention group were significantly more likely to be not concerned about the side effects associated with the HPV vaccine compared to adolescents in the pre-intervention group. Our findings suggest that addressing the concerns about side effects can help adolescents to overcome the barriers to being vaccinated, including concerns related to pain.

While there was significant improvement in positive responses to questions related to health care provider and peer beliefs about HPV vaccines between pre- and post- intervention groups, only about half of the post-intervention survey group thought that other boys and girls would think it is a good idea to get the HPV vaccine. Social norms are shaped by culture and the environment, therefore, generalization is difficult from one group to another.⁴⁹ Very little information is available as to how the adolescents’ peer perception of HPV vaccine affects HPV vaccine behavior. For example, Rambout et al. stated they did not find any qualitative studies that solicited perspectives of the adolescent girls in their systematic review of self-reported barriers and facilitators to HPV vaccination among adolescent girls and young women aged 9-26 in North America.⁵⁰

Much of the literature and interventions to improve HPV vaccine uptake are focused on encouraging communication between the parents and the providers, or between mothers and daughters. Colón-López et al. found that feelings of embarrassment and focus on abstinence about sex-related-topics was a barrier to communication between parents and daughters of Puerto Rican ethnicity.⁵¹ Galbraith-Gyan et al. found that it was difficult to start the conversation around HPV vaccine for African-American mothers whose upbringing considered sexual health taboo.⁵²

Parental concern for sexual initiation or risky sexual behavior has been a barrier to initiation of communications about the HPV vaccine between parents and children and their vaccine behavior.⁵³ Our findings show that when HPV vaccination is approached with cultural sensitivity, it is possible to enhance the level of comfort for the adolescents to have a conversation about HPV vaccine with their parents.

There is growing evidence that while interventions based on Health Belief Models may positively influence intention to be vaccinated, their effect on behavior is inconsistent and minimal.²⁹ This may be because there are many factors that influence the adolescents' decision-making process around HPV vaccine, such as the parents' interest or willingness to have their adolescent child vaccinated. As the adolescents came to our intervention with their mothers, they may have perceived their environment as being vaccine friendly, which also could have influenced their intention to receive HPV vaccine.

The comic book intervention's impact was the greatest on intention to vaccinate among all constructs. This is likely derived from the strong impact of the comic book intervention across most constructs. The effects of interventions are often not evaluated longitudinally, which makes it difficult to measure their impact on vaccine behavior.⁴⁹ To address this gap, we plan to assess the impact of intention to vaccinate among post-intervention survey adolescents and their vaccine status 6-months after the dinner with future data.

The impact of the comic book tended to be stronger in male adolescents than females in our study. This may be explained by the fact that female adolescents generally had higher baseline knowledge prior to receiving the comic book. A similar trend was found in an international comparison of HPV-related knowledge among adults; women in the U.S. had higher awareness and general knowledge of HPV and HPV vaccine than men.⁵⁴ There have been many gender-

related barriers to HPV vaccination. The providers may be less likely to recommend HPV vaccine to boys than girls because the approval and introduction of HPV vaccines in the U.S. began with females 9-26 in 2006.⁴⁴ HPV vaccination for males ages 9-26 received permissive approval in 2009, and was not routinely recommended until 2011.⁴⁴ Myths or perception among providers that the vaccine is more effective among girls than boys,⁵⁵ and girls 11-12 are too young to be sexually active; therefore, should not be vaccinated, have been documented.⁵⁶ In addition, the focus of HPV vaccine outreach has been primarily on adolescent girls in the context of cervical cancer prevention in the U.S.⁵⁵ A national survey of parents of unvaccinated adolescent boys and girls reported that parents of boys were less likely to have received provider recommendation to receive HPV vaccination than parents of the girls.⁵⁵ The fear of earlier sexual debut, cultural and religious norm about sexual activity have been documented as barriers specifically for girls,⁵⁶ even though multiple studies have demonstrated that HPV vaccination does not increase sexual activity or hasten its debut.^{57,58}

To our knowledge, our study was the first that measured a comic book intervention impact on adolescents who are at a unique intersection of race, ethnicity, religion, culture and gender as EAA. Our study had many strengths. The comic book intervention was developed with the EAA communities' input through a multi-methods process involving focus groups with EAA mothers and measurement of acceptability by the EAA adolescents who are the target audience of the intervention. In addition, our study contributed toward the consistency of reporting on intervention impact on HPV vaccine. Our survey tool includes a comprehensive range of theoretical constructs derived from the Health Belief Model and Theory of Reasoned Action. While not applicable to every group, it provides a template of evaluation that can be adapted to different settings and audiences, which is a significant challenge in current literature.⁴⁹

One of the limitations of our study was sampling bias and its size. The adolescents who received the comic book intervention were essentially recruited through their mothers as dyads. Mothers who agreed to participate in the study, and their children, may be different from those who did not. For example, a participant mother may be more health conscious or motivated to learn about HPV vaccine. There may be circumstantial and relational differences between mothers who brought their children to dinner compared to a mother who was not able to participate because their children could not or were not willing to participate. In addition, our sample size was small. Most participants identified as Somali, so it was not possible to look at the effect differences by ethnicity. We reported the results of the stratified analysis, knowing that our sample size may not have enough power to detect presence of effect modification. Since our comic book was a part of a multi-level intervention that included the mothers and providers in the EAA community, we expect the impact of the comic book on social norms may have a synergistic effect on vaccination behavior. However, we did not have linked data on providers and adolescents and mothers who participated in the interventions; therefore, we could not measure this effect.

Conclusion

In conclusion, the comic book for adolescents is a useful tool to improve HPV vaccine uptake in the EAA communities. Although our intervention was developed based on preliminary input from the EAA communities in King County, there is potential to adapt the comic book intervention for other communities with low HPV vaccine uptake. The comic book benefitted from a sound theoretical framework and methods that can easily be adapted and replicated in other settings. With additional data, we plan to assess the impact of the intervention on the vaccination of the participating adolescents, which will enrich our knowledge about the benefits of the comic book intervention on HPV vaccine uptake.

Table 1. Demographic characteristics of the adolescents (N=136)

Characteristic	Pre-intervention survey (n=64)	Post-intervention survey (n=72)
Age (in years)	n (%)	n (%)
14	29 (45.3)	24 (33.3)
15	16 (25.0)	24 (33.3)
16	10 (15.6)	15 (20.8)
17	9 (14.1)	9 (12.5)
Gender		
Male	33 (51.6)	30 (41.7)
Female	31 (48.4)	42 (58.3)
Born outside of the U.S.^a		
No	22 (37.3)	37 (56.9)
Yes	37 (62.7)	28 (43.1)
Missing	5	7
Ethnicity^{ab}		
Somali	58 (92.1)	63 (88.7)
Oromo	0 (0.0)	1 (1.4)
Amhara	2 (3.2)	2 (2.8)
Tigre	1 (1.6)	5 (7.0)
Other	2 (3.2)	0 (0.0)
Missing	1	1
Language^{ab}		
Somali	59 (92.2)	64 (88.9)
Amharic	5 (7.8)	8 (11.1)
Religion^{ab}		
Christianity	5 (7.9)	8 (11.3)
Islam	58 (92.1)	63 (88.7)
Other	0 (0.0)	0 (0.0)
Missing	1	1
Annual household income^{ab}		
<\$25,000	36 (60.0)	41 (59.4)
\$25,000-50,000	16 (26.7)	18 (26.1)
>50,000	2 (3.3)	5 (7.2)
Do not know	6 (10.0)	5 (7.2)
Missing	4	3

^a Reported by the mother

^b Mother's demographic

Table 2. The impact of the comic book on adolescents' HPV and HPV vaccine knowledge/beliefs, barriers to HPV vaccination, relevant social norms/influences, communication with parents about vaccination, willingness to be vaccinated, and vaccination intentions

Constructs/ Survey Questions		Pre-intervention survey (n=64)	Post-intervention survey (n=72)	Chi-squared p- value±
HPV knowledge/ beliefs (5 questions)				
HPV infection is different than HIV infection.		n (%)	n (%)	0.001
Correct	True	38 (61.3)	62 (87.3)	
Incorrect	False	3 (4.8)	2 (2.8)	
	Not sure	21 (33.9)	7 (9.9)	
HPV infection is rare.*				<0.001
Correct	False	23 (37.1)	48 (67.6)	
Incorrect	True	20 (32.3)	13 (18.3)	
	Not sure	19 (30.6)	10 (14.1)	
HPV is spread through sexual contact.				<0.001
Correct	True	25 (39.7)	62 (89.9)	
Incorrect	False	8 (12.7)	2 (2.9)	
	Not sure	30 (47.6)	5 (7.2)	
Most people with HPV infection know they have it.				<0.001
Correct	False	25 (39.7)	49 (71)	
Incorrect	True	8 (12.7)	10 (14.5)	
	Not sure	30 (47.6)	10 (14.5)	
HPV can cause cancer.**				<0.001
Correct	True	22 (36.7)	67 (93.1)	
Incorrect	False	9 (15.0)	2 (2.8)	
	Not sure	29 (48.3)	3 (4.2)	
HPV vaccine knowledge / beliefs (6 questions)				
The HPV vaccine prevents serious health problems.***				
Correct	True	42 (66.7)	52 (72.2)	
Incorrect	False	11 (17.5)	12 (16.7)	
	Not sure	10 (15.9)	8 (11.1)	
The HPV vaccine is unsafe.****				<0.001
Correct	False	27 (42.9)	53 (73.6)	

Incorrect	True	20 (31.7)	9 (12.5)	
	Not sure	16 (25.4)	10 (13.9)	
The HPV vaccine contains pork gelatin.****				
Correct	False	27 (42.9)	61 (84.7)	<0.001
Incorrect	True	5 (7.9)	2 (2.8)	
	Not sure	31 (49.2)	9 (12.5)	
All adolescent girls should get the HPV vaccine.				
Correct	True	17 (27.0)	47 (66.2)	<0.001
Incorrect	False	12 (19.0)	16 (22.5)	
	Not sure	34 (54.0)	8 (11.3)	
Adolescent boys do not need the HPV vaccine.				
Correct	False	17 (26.6)	54 (75.0)	<0.001
Incorrect	True	12 (18.8)	9 (12.5)	
	Not sure	35 (54.7)	9 (12.5)	
HPV vaccination involves more than one shot.				
Correct	True	28 (44.4)	57 (79.2)	<0.001
Incorrect	False	8 (12.7)	10 (13.9)	
	Not sure	27 (42.9)	5 (6.9)	
Social Norms/Influences (2 questions)				
Other boys and girls would not think it is a good idea to get the HPV vaccine.				
Positive	False	11 (17.7)	38 (52.8)	<0.001
Negative	True	14 (22.6)	22 (30.6)	
	Not sure	37 (59.7)	12 (16.7)	
Doctors think it is very important that boys and girls get the HPV vaccine.				
Positive	True	35 (54.7)	63 (87.5)	<0.001
Negative	False	9 (14.1)	5 (6.9)	
	Not sure	20 (31.2)	4 (5.6)	
Barriers (2 questions)				
When thinking about getting the HPV vaccine, how concerned are you about side effects?				
Positive	Not concerned	9 (14.1)	21 (29.2)	0.034
Negative	Not sure	16 (25.0)	8 (11.1)	

	Very concerned	14 (21.9)	19 (26.4)	
	Somewhat concerned	25 (39.1)	24 (33.3)	
When thinking about getting the HPV vaccine, how concerned are you about the shot being painful?				0.885
Positive	Not concerned	25 (39.1)	29 (40.3)	
Negative	Not sure	12 (18.8)	6 (8.3)	
	Very concerned	11 (17.2)	16 (22.2)	
	Somewhat concerned	16 (25)	21 (29.2)	
Communication (1 question)				
How comfortable would you be talking with a parent about the HPV vaccine?				<0.001
Positive	Very comfortable	14 (21.9)	42 (58.3)	
	Somewhat comfortable	23 (35.9)	23 (31.9)	
Negative	Not sure	15 (23.4)	2 (2.8)	
	Not comfortable	12 (18.8)	5 (6.9)	
Willingness (1 question)				
How willing would you be to get the HPV vaccine?				<0.001
Positive	Definitely willing	10 (15.6)	28 (38.9)	
	Probably willing	14 (21.9)	32 (44.4)	
Negative	Not sure	25 (39.1)	6 (8.3)	
	Not willing	15 (23.4)	6 (8.3)	
Intention (1 question)				
In the next 6 months, how likely is it that you will talk to a parent about getting the HPV vaccine? †				<0.001
Positive	Very likely	7 (10.9)	29 (40.3)	
	Somewhat likely	15 (23.4)	33 (45.8)	
Negative	Not sure	29 (45.3)	5 (6.9)	
	Not likely	13 (20.3)	5 (6.9)	

^a Percent of correct/positive answers in each category

* Perceived susceptibility measure

** Perceived severity measure

*** Perceived benefit measure

**** Barrier measure

† 6-month period was used because the state immunization records will be accessed after an interval of 6 months.

± All responses were dichotomized prior to conducting the chi-squared test.

Table 3. The impact of the comic book on adolescents' HPV and HPV vaccine knowledge/beliefs, barriers to HPV vaccination, relevant social norms/influences, communication with parents about vaccination, willingness to be vaccinated, and vaccination intentions stratified by gender

Constructs/ Survey Questions		Stratification by Gender ^a					
		Female			Male		
		Pre-intervention survey (n=31)	Post-intervention survey (n=42)	Chi-squared p-value	Pre-intervention survey (n=33)	Post-intervention survey (n=30)	Chi-squared p-value
HPV knowledge/ beliefs (5 questions)							
HPV infection is different than HIV infection.		n (%)	n (%)		n (%)	n (%)	
Correct	True	17 (58.6)	37 (88.1)	0.004	21 (63.6)	25 (86.2)	0.043
Incorrect	False	1 (3.4)	2 (4.8)		2 (6.1)	0 (0.0)	
	Not sure	11 (37.9)	3 (7.1)		10 (30.3)	4 (13.8)	
HPV infection is rare.*							
Correct	False	15 (51.7)	26 (61.9)	0.393	8 (24.2)	22 (75.9)	<0.001
Incorrect	True	6 (20.7)	10 (23.8)		14 (42.4)	3 (10.3)	
	Not sure	8 (27.6)	6 (14.3)		11 (33.3)	4 (13.8)	
HPV is spread through sexual contact.							
Correct	True	13 (43.3)	38 (92.7)	<0.001	12 (36.4)	24 (85.7)	<0.001
Incorrect	False	5 (16.7)	1 (2.4)		3 (9.1)	1 (3.6)	
	Not sure	12 (40.0)	2 (4.9)		18 (54.5)	3 (10.7)	
Most people with HPV infection know they have it.							
Correct	False	13 (43.3)	28 (68.3)	0.036	12 (36.4)	21 (75)	0.003
Incorrect	True	7 (23.3)	6 (14.6)		1 (3)	4 (14.3)	
	Not sure	10 (33.3)	7 (17.1)		20 (60.6)	3 (10.7)	
HPV can cause cancer.**							
Correct	True	11 (37.9)	39 (92.9)	<0.001	11 (35.5)	28 (93.3)	<0.001
Incorrect	False	5 (17.2)	2 (4.8)		4 (12.9)	0 (0.0)	
	Not sure	13 (44.8)	1 (2.4)		16 (51.6)	2 (6.7)	
HPV vaccine knowledge / beliefs (6 questions)							

The HPV vaccine prevents serious health problems.***							
Correct	True	25 (83.3)	31 (73.8)	0.338	17 (51.5)	21 (70.0)	0.134
Incorrect	False	2 (6.7)	8 (19.0)		9 (27.3)	4 (13.3)	
	Not sure	3 (10.0)	3 (7.1)		7 (21.2)	5 (16.7)	
The HPV vaccine is unsafe.****							
Correct	False	16 (53.3)	30 (71.4)	0.115	11 (33.3)	23 (76.7)	0.001
Incorrect	True	5 (16.7)	5 (11.9)		15 (45.5)	4 (13.3)	
	Not sure	9 (30.0)	7 (16.7)		7 (21.2)	3 (10.0)	
The HPV vaccine contains pork gelatin.****							
Correct	False	14 (46.7)	35 (83.3)	0.001	13 (39.4)	26 (86.7)	<0.001
Incorrect	True	2 (6.7)	2 (4.8)		3 (9.1)	0 (0.0)	
	Not sure	14 (46.7)	5 (11.9)		17 (51.5)	4 (13.3)	
All adolescent girls should get the HPV vaccine.							
Correct	True	11 (36.7)	27 (65.9)	0.015	6 (18.2)	20 (66.7)	<0.001
Incorrect	False	5 (16.7)	10 (24.4)		7 (21.2)	6 (20)	
	Not sure	14 (46.7)	4 (9.8)		20 (60.6)	4 (13.3)	
Adolescent boys do not need the HPV vaccine.							
Correct	False	10 (32.3)	34 (81.0)	<0.001	7 (21.2)	20 (66.7)	<0.001
Incorrect	True	6 (19.4)	2 (4.8)		6 (18.2)	7 (23.3)	
	Not sure	15 (48.4)	6 (14.3)		20 (60.6)	3 (10)	
HPV vaccination involves more than one shot.							
Correct	True	14 (45.2)	33 (78.6)	0.003	14 (43.8)	24 (80.0)	0.003
Incorrect	False	3 (9.7)	5 (11.9)		5 (15.6)	5 (16.7)	
	Not sure	14 (45.2)	4 (9.5)		13 (40.6)	1 (3.3)	
Social Norms/Influences (2 questions)							
Other boys and girls would not think it is a good idea to get the HPV vaccine.							
Correct	False	6 (20.7)	25 (59.5)	0.001	5 (15.2)	13 (43.3)	0.013
Incorrect	True	5 (17.2)	11 (26.2)		9 (27.3)	11 (36.7)	
	Not sure	18 (62.1)	6 (14.3)		19 (57.6)	6 (20.0)	
Doctors think it is very important that boys and girls get the HPV vaccine.							
Correct	True	19 (61.3)	37 (88.1)	0.007	16 (48.5)	26 (86.7)	0.001

Incorrect	False	4 (12.9)	3 (7.1)		5 (15.2)	2 (6.7)	
	Not sure	8 (25.8)	2 (4.8)		12 (36.4)	2 (6.7)	
Barriers (2 questions)							
When thinking about getting the HPV vaccine, how concerned are you about side effects?							
Positive	Not concerned	2 (6.5)	11 (26.2)	0.029	7 (21.2)	10 (33.3)	0.279
Negative	Not sure	10 (32.3)	5 (11.9)		6 (18.2)	3 (10.0)	
	Very concerned	8 (25.8)	10 (23.8)		6 (18.2)	9 (30.0)	
	Somewhat concerned	11 (35.5)	16 (38.1)		14 (42.4)	8 (26.7)	
When thinking about getting the HPV vaccine, how concerned are you about the shot being painful?							
Positive	Not concerned	10 (32.3)	11 (26.2)	0.571	15 (45.5)	18 (60)	0.248
Negative	Not sure	6 (19.4)	4 (9.5)		6 (18.2)	2 (6.7)	
	Very concerned	7 (22.6)	14 (33.3)		4 (12.1)	2 (6.7)	
	Somewhat concerned	8 (25.8)	13 (31.0)		8 (24.2)	8 (26.7)	
Communication (1 question)							
How comfortable would you be talking with a parent about the HPV vaccine?							
Positive	Very comfortable	7 (22.6)	26 (61.9)	0.003	7 (21.2)	16 (53.3)	0.002
	Somewhat comfortable	12 (38.7)	12 (28.6)		11 (33.3)	11 (36.7)	
Negative	Not sure	8 (25.8)	1 (2.4)		7 (21.2)	1 (3.3)	
	Not comfortable	4 (12.9)	3 (7.1)		8 (24.2)	2 (6.7)	
Willingness (1 question)							
How willing would you be to get the HPV vaccine?							
Positive	Definitely willing	9 (29)	15 (35.7)	<0.001	1 (3.0)	13 (43.3)	0.002
	Probably willing	6 (19.4)	20 (47.6)		8 (24.2)	12 (40.0)	
Negative	Not sure	13 (41.9)	5 (11.9)		12 (36.4)	1 (3.3)	
	Not willing	3 (9.7)	2 (4.8)		12 (36.4)	4 (13.3)	
Intention (1 question)							
In the next 6 months, how likely is it that you will talk to a parent about getting the HPV vaccine? †							
Positive	Very likely	4 (12.9)	21 (50)	<0.001	3 (9.1)	8 (26.7)	<0.001
	Somewhat likely	10 (32.3)	18 (42.9)		5 (15.2)	15 (50.0)	

Negative	Not sure	14 (45.2)	3 (7.1)		15 (45.5)	2 (6.7)	
	Not likely	3 (9.7)	0 (0.0)		10 (30.3)	5 (16.7)	

^a Percent of correct/positive answers in each category

* Perceived susceptibility measure

** Perceived severity measure

*** Perceived benefit measure

**** Barrier measure

† 6-month period was used because the state immunization records will be accessed after an interval of 6 months.

± All responses were dichotomized prior to conducting the chi-squared test.

Table 4. Generalized estimating equations (GEE) models for measuring the impact of the comic book on the adolescents' HPV and HPV vaccine knowledge/beliefs, barriers to HPV vaccination, relevant social norms/influences, communication with parents about vaccination, willingness to be vaccinated, and vaccination intentions

Construct	Mean (%) and the standard deviation of the proportion of correct/positive answers		Unadjusted RR (95% CI)	P-value	Adjusted RR ^a (95% CI)	P-value
	Pre-survey	Post-survey				
HPV knowledge / beliefs (5 questions)	44.0 (32.1)	82.9 (23.3)	1.89 (1.55-2.29)	<0.001	1.87 (1.54-2.27)	< 0.001
HPV vaccine knowledge / beliefs (6 questions)	42.8 (27.7)	75.4 (22.5)	1.76 (1.48-2.10)	<0.001	1.74 (1.46-2.07)	<0.001
Social norms / influence (2 questions)	36.3 (31.6)	70.1 (33.2)	1.93 (1.52-2.46)	<0.001	1.89 (1.48-2.41)	<0.001
Barriers (2 question)	26.6 (34.5)	34.7 (36.2)	1.31 (0.88-1.95)	0.186	1.36 (0.93-2.01)	0.112
Communication (1 question)	57.8 (49.8)	90.3 (29.8)	1.56 (1.25-1.95)	<0.001	1.55 (1.24-1.94)	<0.001
Willingness (1 question)	37.5 (48.8)	83.3 (37.5)	2.22 (1.59-3.10)	<0.001	2.16 (1.55-3.01)	<0.001
Intention (1 question)	34.4 (47.9)	86.1 (34.8)	2.51 (1.76-3.56)	<0.001	2.39 (1.69-3.37)	<0.001

^a Adjusted for age, gender, and mother's primary language

Table 5. Generalized estimating equations (GEE) models for measuring the impact of the comic book on the adolescents' HPV and HPV vaccine knowledge/beliefs, barriers to HPV vaccination, relevant social norms/influences, communication with parents about vaccination, willingness to be vaccinated, and vaccination intentions stratified by gender

Construct	Stratification by Gender								Interaction p-value
	Female				Male				
	Correct/positive answers (Mean/SD)		Unadjusted RR (95% CI)	Adjusted RR ^a (95% CI)	Correct/positive answers (Mean/SD)		Unadjusted RR (95% CI)	Adjusted RR ^a (95% CI)	
	Pre-intervention survey (n=31)	Post-intervention survey (n=42)			Pre-intervention survey (n=33)	Post-intervention survey (n=30)			
HPV knowledge / beliefs (5 questions)	47.6 (34.0)	82.5 (22.7)	1.73 (1.32-2.27)	1.73 (1.33-2.24)	40.7 (30.3)	83.6 (24.4)	2.06 (1.55-2.73)	2.07 (1.56-2.75)	0.406
HPV vaccine knowledge / beliefs (6 questions)	51.8 (30.2)	76.0 (24.2)	1.47 (1.16-1.86)	1.48 (1.18-1.85)	34.9 (22.9)	74.4 (20.4)	2.13 (1.67-2.73)	2.13 (1.67-2.73)	0.056
Social norms / influence (2 questions)	41.9 (32.9)	73.8 (33.6)	1.78 (1.30-2.45)	1.79 (1.29-2.47)	31.8 (30.2)	65.0 (32.6)	2.04 (1.42-2.95)	2.08 (1.45-2.98)	0.473
Barriers (2 question)	19.4 (30.8)	26.2 (33.6)	1.35 (0.69-2.66)	1.30 (0.68-2.47)	33.3 (36.8)	46.7 (37.0)	1.40 (0.88-2.24)	1.40 (0.87-2.23)	0.447
Communication (1 question)	61.3 (49.5)	90.5 (29.7)	1.48 (1.10-1.99)	1.44 (1.07-1.94)	54.6 (50.6)	90.0 (30.5)	1.65 (1.18-2.31)	1.63(1.17-2.27)	0.599
Willingness (1 question)	48.4 (50.8)	83.3 (37.7)	1.72 (1.16-2.55)	1.67 (1.14-2.44)	27.3 (45.2)	83.3 (37.9)	3.06 (1.70-5.48)	3.11 (1.75-5.52)	0.083
Intention (1 question)	45.2 (50.6)	92.9 (26.1)	2.06 (1.38-3.07)	2.00 (1.35-2.95)	24.2 (43.5)	76.7 (43.0)	3.16 (1.67-6.00)	3.20 (1.70-6.04)	0.222

^a Adjusted for age and mother's primary language

References

1. Muñoz N, Castellsagué X, de González AB, Gissmann L. Chapter 1: HPV in the etiology of human cancer. *Vaccine*. 2006;24 Suppl 3:S3/1-10.
2. Paavonen J, Naud P, Salmeron J, et al. Efficacy of human papillomavirus (HPV)-16/18 AS04-adjuvanted vaccine against cervical infection and precancer caused by oncogenic HPV types (PATRICIA): final analysis of a double-blind, randomised study in young women. *Lancet (London, England)*. 2009;374(9686):301-314.
3. Apter D, Wheeler CM, Paavonen J, et al. Efficacy of human papillomavirus 16 and 18 (HPV-16/18) AS04-adjuvanted vaccine against cervical infection and precancer in young women: final event-driven analysis of the randomized, double-blind PATRICIA trial. *Clinical and vaccine immunology : CVI*. 2015;22(4):361-373.
4. Garland SM, Hernandez-Avila M, Wheeler CM, et al. Quadrivalent vaccine against human papillomavirus to prevent anogenital diseases. *The New England journal of medicine*. 2007;356(19):1928-1943.
5. FUTURE II Study Group. Quadrivalent vaccine against human papillomavirus to prevent high-grade cervical lesions. *The New England journal of medicine*. 2007;356(19):1915-1927.
6. Huh WK, Jaura EA, Giuliano AR, et al. Final efficacy, immunogenicity, and safety analyses of a nine-valent human papillomavirus vaccine in women aged 16-26 years: a randomised, double-blind trial. *Lancet (London, England)*. 2017;390(10108):2143-2159.
7. Jaura EA, Giuliano AR, Iversen OE, et al. A 9-valent HPV vaccine against infection and intraepithelial neoplasia in women. *The New England journal of medicine*. 2015;372(8):711-723.
8. Walker TY, Elam-Evans LD, Yankey D, et al. National, Regional, State, and Selected Local Area Vaccination Coverage Among Adolescents Aged 13-17 Years - United States, 2018. *MMWR Morb Mortal Wkly Rep*. 2019;68(33):718-723.
9. Office of Disease Prevention and Health Promotion. HealthyPeople.gov: Immunization and Infectious Diseases. <https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases/objectives>. Published 2016. Accessed 6/16, 2020.
10. Spencer JC, Calo WA, Brewer NT. Disparities and reverse disparities in HPV vaccination: A systematic review and meta-analysis. *Preventive medicine*. 2019;123:197-203.
11. Kepka D, Bodson J, Lai D, et al. Factors Associated with Human Papillomavirus Vaccination Among Diverse Adolescents in a Region with Low Human Papillomavirus Vaccination Rates. *Health Equity*. 2018;2(1):223-232.
12. The President's Cancer Panel. *Accelerating HPV Vaccine Uptake: Urgency for Action to Prevent Cancer: A Report to the President of the United States*. U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute;2014.
13. Greenfield LS, Page LC, Kay M, Li-Vollmer M, Breuner CC, Duchin JS. Strategies for increasing adolescent immunizations in diverse ethnic communities. *The Journal of adolescent health : official publication of the Society for Adolescent Medicine*. 2015;56(5 Suppl):S47-53.

14. King County Motion 15507 Signature Report. In: July 17, 2019.
15. Paxton GA, Rice J, Davie G, Carapetis JR, Skull SA. East African immigrant children in Australia have poor immunisation coverage. *J Paediatr Child Health*. 2011;47(12):888-892.
16. Pruitt CN, Reese CS, Grossardt BR, Shire AM, Creedon DJ. Completion of the human papillomavirus vaccination series lags in Somali adolescents. *J Low Genit Tract Dis*. 2013;17(3):280-288.
17. Hosler J, Boomer KB. Are comic books an effective way to engage nonmajors in learning and appreciating science? *CBE Life Sci Educ*. 2011;10(3):309-317.
18. Katz ML, Oldach BR, Goodwin J, Reiter PL, Ruffin MT, Paskett ED. Development and initial feedback about a human papillomavirus (HPV) vaccine comic book for adolescents. *J Cancer Educ*. 2014;29(2):318-324.
19. Prokhorov AV, Hudmon KS, Marani SK, et al. Eliminating second-hand smoke from Mexican-American households: outcomes from Project Clean Air-Safe Air (CASA). *Addict Behav*. 2013;38(1):1485-1492.
20. Branscum P, Sharma M, Wang LL, Wilson BR, Rojas-Guyler L. A true challenge for any superhero: an evaluation of a comic book obesity prevention program. *Fam Community Health*. 2013;36(1):63-76.
21. Madden TJ, Ellen PS, Ajzen I. A comparison of the theory of planned behavior and the theory of reasoned action. *Personality and social psychology Bulletin*. 1992;18(1):3-9.
22. Glanz K, Rimer BK, Viswanath K. *Health behavior and health education: Theory, research, and practice, 4th ed*. San Francisco, CA, US: Jossey-Bass; 2008.
23. Celentano I. Development and Production of a Theory- Based, Audience Centric HPV Vaccine Promotion Comic Book for East African Adolescents (Master's thesis)2018.
24. Ko LK, Taylor VM, Mohamed FB, et al. "We brought our culture here with us": A qualitative study of perceptions of HPV vaccine and vaccine uptake among East African immigrant mothers. *Papillomavirus Res*. 2019;7:21-25.
25. Bastani R, Glenn BA, Tsui J, et al. Understanding suboptimal human papillomavirus vaccine uptake among ethnic minority girls. *Cancer epidemiology, biomarkers & prevention : a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology*. 2011;20(7):1463-1472.
26. Glenn BA, Tsui J, Coronado GD, et al. Understanding HPV vaccination among Latino adolescent girls in three U.S. regions. *Journal of immigrant and minority health*. 2015;17(1):96-103.
27. McRee AL, Brewer, N. T., Reiter, P. L., Gottlieb, S. L., & Smith, J. S. The Carolina HPV Immunization Attitudes and Beliefs Scale (CHIAS): Scale development and associations with intentions to vaccinate. *Sexually Transmitted Diseases*. 2010;37:234-239.
28. Taylor VM, Burke N, Do H, Liu Q, Yasui Y, Bastani R. HPV vaccination uptake among Cambodian mothers. *Journal of cancer education : the official journal of the American Association for Cancer Education*. 2012;27(1):145-148.
29. Walling EB, Benzoni N, Dornfeld J, et al. Interventions to Improve HPV Vaccine Uptake: A Systematic Review. *Pediatrics*. 2016;138(1):e20153863.
30. Cates JR, Diehl SJ, Crandell JL, Coyne-Beasley T. Intervention effects from a social marketing campaign to promote HPV vaccination in preteen boys. *Vaccine*. 2014;32(33):4171-4178.

31. Hopfer S. Effects of a narrative HPV vaccination intervention aimed at reaching college women: a randomized controlled trial. *Prevention science : the official journal of the Society for Prevention Research*. 2012;13(2):173-182.
32. Rickert VI, Auslander BA, Cox DS, Rosenthal SL, Rupp RE, Zimet GD. School-based HPV immunization of young adolescents: effects of two brief health interventions. *Human vaccines & immunotherapeutics*. 2015;11(2):315-321.
33. Montgomery M, Manuelito B, Nass C, Chock T, Buchwald D. The Native Comic Book Project: native youth making comics and healthy decisions. *Journal of cancer education : the official journal of the American Association for Cancer Education*. 2012;27(1 Suppl):S41-S46.
34. Speizer IS, Calhoun LM, Guilkey DK. Reaching Urban Female Adolescents at Key Points of Sexual and Reproductive Health Transitions: Evidence from a Longitudinal Study from Kenya. *Afr J Reprod Health*. 2018;22(1):47-59.
35. Jemmott LS, Jemmott JB, 3rd, Ngwane Z, et al. 'Let Us Protect Our Future' a culturally congruent evidenced-based HIV/STD risk-reduction intervention for young South African adolescents. *Health Educ Res*. 2014;29(1):166-181.
36. Furgurson KF, Sandberg JC, Hsu FC, Mora DC, Quandt SA, Arcury TA. HPV Knowledge and Vaccine Initiation Among Mexican-Born Farmworkers in North Carolina. *Health promotion practice*. 2019;20(3):445-454.
37. Goldman B. Comic book aimed at cutting cervical cancer rates hits the stands. <https://scopeblog.stanford.edu/2018/12/03/comic-book-aimed-at-cutting-cervical-cancer-rates-hits-the-stands/>. Published 2018. Accessed June 1, 2020.
38. Chan A, Brown B, Sepulveda E, Teran-Clayton L. Evaluation of fotonovela to increase human papillomavirus vaccine knowledge, attitudes, and intentions in a low-income Hispanic community. *BMC research notes*. 2015;8:615.
39. Rosen BL, Shew ML, Zimet GD, Ding L, Mullins TLK, Kahn JA. Human Papillomavirus Vaccine Sources of Information and Adolescents' Knowledge and Perceptions. *Global pediatric health*. 2017;4:2333794x17743405.
40. Kisaakye E, Namakula J, Kihembo C, Kisakye A, Nsubuga P, Babirye JN. Level and factors associated with uptake of human papillomavirus infection vaccine among female adolescents in Lira District, Uganda. *Pan Afr Med J*. 2018;31:184-184.
41. Sopracordevole F, Cigolot F, Manciola F, Agarossi A, Boselli F, Ciavattini A. Knowledge of HPV infection and vaccination among vaccinated and unvaccinated teenaged girls. *International Journal of Gynecology & Obstetrics*. 2013;122(1):48-51.
42. Wong LP, Alias H, Sam IC, Zimet GD. A Nationwide Study Comparing Knowledge and Beliefs about HPV among Female Students before and after HPV Vaccination. *Journal of pediatric and adolescent gynecology*. 2019;32(2):158-164.
43. Bruni L, Albero G, Serrano B, et al. *Human Papillomavirus and Related Diseases in Malaysia. Summary Report 17 June 2019*. ICO/IARC Information Centre on HPV and Cancer (HPV Information Centre);2019.
44. Daley EM, Vamos CA, Thompson EL, et al. The feminization of HPV: How science, politics, economics and gender norms shaped U.S. HPV vaccine implementation. *Papillomavirus research (Amsterdam, Netherlands)*. 2017;3:142-148.

45. Bruni L, Albero G, Serrano B, et al. *Human Papillomavirus and Related Diseases in Uganda. Summary Report 17 June 2019*. ICO/IARC Information Centre on HPV and Cancer (HPV Information Centre);2019.
46. Colamesta V, Grossi A, Barbará A, et al. Human Papilloma Virus (HPV) vaccination in Italy: towards new perspectives and new challenges. *Epidemiology, biostatistics, and public health*. 2018;15.
47. Lee VY, Caillaud C, Fong J, Edwards KM. Improving vaccine-related pain, distress or fear in healthy children and adolescents-a systematic search of patient-focused interventions. *Human vaccines & immunotherapeutics*. 2018;14(11):2737-2747.
48. Reiter PL, Brewer NT, Gottlieb SL, McRee A-L, Smith JS. How much will it hurt? HPV vaccine side effects and influence on completion of the three-dose regimen. *Vaccine*. 2009;27(49):6840-6844.
49. Fu LY, Bonhomme LA, Cooper SC, Joseph JG, Zimet GD. Educational interventions to increase HPV vaccination acceptance: a systematic review. *Vaccine*. 2014;32(17):1901-1920.
50. Rambout L, Tashkandi M, Hopkins L, Tricco AC. Self-reported barriers and facilitators to preventive human papillomavirus vaccination among adolescent girls and young women: a systematic review. *Preventive medicine*. 2014;58:22-32.
51. Colón-López V, Fernández-Espada N, Vélez C, et al. Communication about sex and HPV among Puerto Rican mothers and daughters. *Ethnicity & health*. 2017;22(4):348-360.
52. Galbraith-Gyan KV, Lechuga J, Jenerette CM, Palmer MH, Moore AD, Hamilton JB. HPV vaccine acceptance among African-American mothers and their daughters: an inquiry grounded in culture. *Ethnicity & health*. 2019;24(3):323-340.
53. Holman DM, Benard V, Roland KB, Watson M, Liddon N, Stokley S. Barriers to human papillomavirus vaccination among US adolescents: a systematic review of the literature. *JAMA pediatrics*. 2014;168(1):76-82.
54. Marlow LAV, Zimet GD, McCaffery KJ, Ostini R, Waller J. Knowledge of human papillomavirus (HPV) and HPV vaccination: An international comparison. *Vaccine*. 2013;31(5):763-769.
55. Lindley MC, Jeyarajah J, Yankey D, Curtis CR, Markowitz LE, Stokley S. Comparing human papillomavirus vaccine knowledge and intentions among parents of boys and girls. *Human vaccines & immunotherapeutics*. 2016;12(6):1519-1527.
56. Ferrer HB, Trotter C, Hickman M, Audrey S. Barriers and facilitators to HPV vaccination of young women in high-income countries: a qualitative systematic review and evidence synthesis. *BMC Public Health*. 2014;14:700-700.
57. Brouwer AF, Delinger RL, Eisenberg MC, et al. HPV vaccination has not increased sexual activity or accelerated sexual debut in a college-aged cohort of men and women. *BMC Public Health*. 2019;19(1):821-821.
58. Aujo JC, Bakeera-Kitaka S, Kiguli S, Mirembe F. No difference in sexual behavior of adolescent girls following Human Papilloma Virus vaccination: a case study two districts in Uganda; Nakasongola and Luwero. *BMC Public Health*. 2014;14:155-155.