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RESEARCH PAPER



The interdependent roles of the psychosocial predictors of human papillomavirus vaccination among Christian parents of unvaccinated adolescents

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ABSTRACT

Despite the availability of the human papillomavirus (HPV) vaccine, uptake has been sub-optimal among certain religious groups. Psychosocial factors (threat appraisal, coping appraisal, and attitudes) have been identified as independent determinants of HPV vaccination. However, their interdependent effects have not been tested. We examined the interdependency of these psychosocial factors in predicting HPV vaccination intention among Christian parents of unvaccinated adolescents (using a theory-driven conceptual model). A cross-sectional study of 342 participants showed that perceived self-efficacy ($\beta = 0.2, 0.11-0.29, p = <0.0001$) and perceived response efficacy of HPV vaccine ($\beta = 0.65, 0.53-0.77, p < .0001$) were positively associated with vaccination intention. Our mediation analysis (using the Preachers and Hayes' approach) shows that *attitudes toward HPV vaccination* mediated 59% of the relationship between perceived self-efficacy to vaccinate child and HPV vaccination intention; and 61% of the relationship between perceived response efficacy of HPV vaccine and HPV vaccination intention. Attitudes may be the psychosocial factor that drives the effects of coping appraisal. Therefore, designing an attitude-based intervention to address religious barrier beliefs among Christian parents may nullify the impact of low self-efficacy and response efficacy on HPV vaccination.

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HPV vaccination; vaccination intention; human papillomavirus; religiosity; psychosocial predictors

Introduction

Human Papillomavirus (HPV) is the most common sexually transmitted infection (STI) in the United States,¹ with an annual financial cost estimated to be 7 billion dollars.² However, a safe and effective HPV vaccine that protects against more than 90% of HPV-attributable cancers is available and is universally recommended at 11–12 years of age for boys and girls.³ Yet, HPV vaccination is particularly sub-optimal among some religious groups,^{4–11} including Christian and Muslim populations.

Vaccination is a complex process that is influenced by emotional, psychological, social, spiritual, political as well as cognitive factors.¹² For example, parents have reported hesitating on HPV vaccination for emotional reasons such as the fear of regret.¹³ This fear stems from the belief that parents are responsible for their child's health outcomes and a perception that vaccination could cause severe negative consequences to the child's well-being. Although parents are aware of the benefit and effectiveness of the vaccine, the decision to vaccinate a child may be emotionally challenging because of the anticipated harm from vaccination. Emotions could override critical reasoning such that vaccine hesitancy may be perceived as loss-aversion. Additionally, a number of studies have identified psychosocial predictors of HPV vaccine intention, including threat

appraisal (i.e., perceived vulnerability to HPV and perceived severity of HPV), coping appraisal (i.e., perceived self-efficacy to vaccinate a child and perceived response efficacy of HPV vaccine), and attitudes toward HPV.^{14–16} This work has largely considered these predictors to be independently associated with HPV vaccination intention. However, *attitude* has been theoretically identified as an underlying mechanism for threat appraisal and coping appraisal as well as other more distal psychosocial determinants.^{14,17–19}

In line with Integrated Behavioral Model- IBM¹⁸ and the Protection Motivation Theory- PMT,²⁰ our conceptual model (Figure 1) posits that threat appraisal (i.e., perceived vulnerability to HPV and perceived severity of HPV) and coping appraisal (i.e., perceived self-efficacy to vaccinate a child and perceived response efficacy of HPV vaccine) influence vaccine intention through attitude. For example, a religious parent with a high perceived vulnerability of child to HPV and response efficacy of the HPV vaccine may develop a positive attitude and report a high HPV vaccine intention. In line with our framework's hypothesized mediation pathways, past research has shown: 1) that threat appraisal and coping appraisal influence HPV attitudes;^{19,21–24} and 2), that attitudes are associated with higher vaccination intention.^{14,15,25} Yet, as noted above, there is a lack of literature that directly assesses if attitude mediates the relationship between threat appraisal, coping appraisal, and intention to vaccinate.

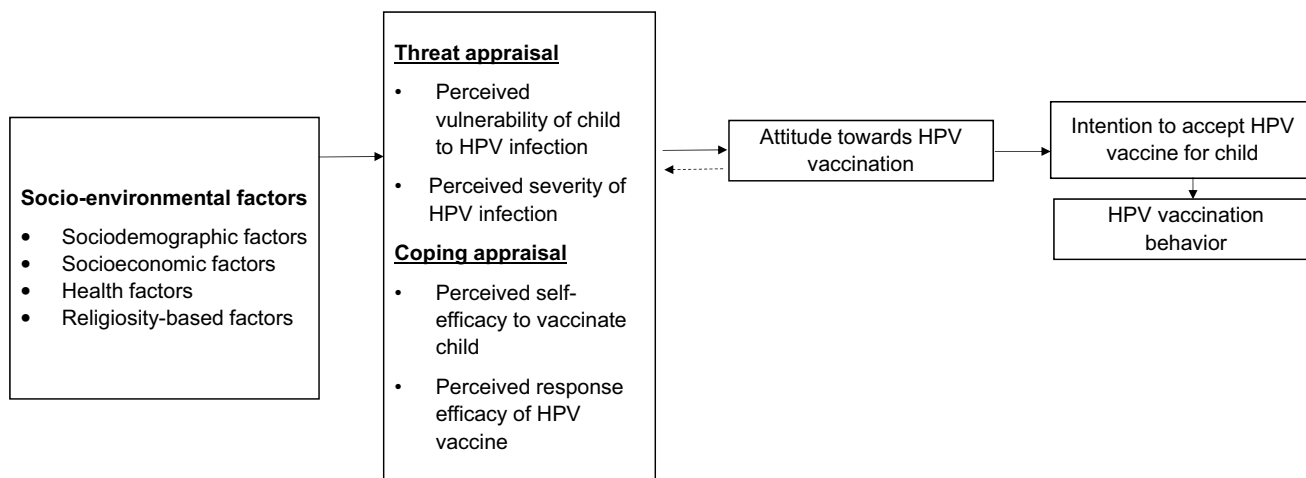


Figure 1. A conceptual model on the interdependent relationship between psychosocial predictors and HPV vaccination behavior.

This model may be particularly useful in general because past interventions have focused on populations' perceptions regarding diseases (i.e., threat appraisal) and public health solutions like vaccination (i.e., coping appraisal)^{15,26,27} – however, directly targeting attitudes may be more efficient, given it is the mechanism by which these more commonly targeted psychosocial predictors (threat appraisal and coping appraisal) influence vaccination intention and behaviors.

Current study

The purpose of this study was to test an integrated model of IBM and PMT in predicting HPV vaccination intentions. Specifically, we explored the mediating role of attitude in the relationship between threat appraisal, coping appraisal, and HPV vaccination intention.

Materials and methods

Study participants and design

We collected data using a cross-sectional online survey from September 28 to October 8, 2020. Participants were recruited through the Qualtrics Panel System (QPS; Qualtrics, Provo, Utah), a reliable and popular online survey research platform that offers access to a large and diverse pool of individuals across North America interested in contributing to research.^{28,29} We recruited participants (using the QPS aggregator) from diverse sources such as permission-based networks, member referrals, targeted e-mail lists, and social media. We used the background profile information provided by registered members to randomly select potential participants who are likely to meet the study eligibility criteria. Potential participants receive an e-mail invite from Qualtrics, inviting them to take the screening questions to assess their eligibility. The e-mail notifies them that the survey is for research purposes only; provides the estimated expected survey length; and the incentive for participation. Detailed specifications about the study are excluded from the e-mail to avoid selection biases.

For this study, we used a 2-step screening procedure to determine eligibility and ensure high data quality. First, participants were screened for being (i) over 18 years of age, (ii) parents or guardians of at least one child aged 11–17 years who has never been vaccinated for HPV, (iii) Christian, and (iv) residents of the United States. The QPS is configured to further enforce the eligibility screening criteria by activating the platform's fraud detection settings to prevent deceit using I.P. addresses. Participants who passed the first screening stage proceeded to an online informed consent form, which they completed before proceeding with the survey.

As a second screening measure, we further ensured data quality by excluding participants who may have been inattentive and sped through the survey by completing it in less than half the median completion time (7.96 minutes). In addition, we took a response validity check measure by subtracting the child's reported age from the parents'. Participants whose *parent-child* age difference showed that they were 8–14 years old at the time of birth were excluded from the study. Finally, we embedded three instructional manipulation checks (i.e., participants were asked to skip some questions) into various survey sections to check participants' attentiveness to the survey questions. Respondents were informed at the start of the survey that their attention would be checked, and inattentive participants would be discontinued from proceeding.³⁰ If participants have more than one child between 11–17 years old, they were asked to think of the oldest eligible child when answering the questions.

In total, we assessed 969 potential participants for eligibility. Of them, 502 met the initial eligibility criteria. Participants were excluded for failing the attention check question (130; 26%), incomplete survey (11; 2%), speeding through the survey, and failing the response validity check (19; 4%). We had a final analytic sample of 342 participants. The University of Illinois Chicago Institution Review Board approved all study activities (IRB Protocol #2020–1033).

Measures

Dependent variable

We assessed *HPV vaccine intention* with a two-item measure ($\alpha = 0.90$)³¹ on a Likert scale ranging from 1 = Definitely false to 5 = Definitely true. Participants were asked if they (i) *intended* and (ii) *wished to vaccinate their children against HPV in the next one year*. The mean of the responses was analyzed for each participant, thereby ranging from 1–5.

Independent variables

Threat appraisal. Perceived vulnerability of child to HPV infection was assessed with three items ($\alpha = 0.93$)³¹ on a 5-point response scale ranging from 1 = Strongly disagree to 5 = Strongly agree. Items started with the stem statement “Thinking about the possibility of my child getting HPV infection when he/she grows up makes me feel” and is followed by the endpoints (a) Anxious, (b) Fearful, and (c) Worried. The mean scores of the items were analyzed for each participant.

Perceived severity of HPV was measured with three items; $\alpha = (0.85)$ ³² on a 5-point response scale from 1 = Strongly disagree to 5 = Strongly agree. This measure was adapted to assess participants’ perception of the seriousness of their child being infected with HPV or HPV-related disease. An example of an item is “HPV is a serious infection for my child to contract.” The scores of the three items were averaged and analyzed for each participant.

Coping appraisal. Perceived self-efficacy to vaccinate a child was assessed using a 1-item measure.³³ Participants were asked, “If I wanted to, I could take my child for HPV vaccination in the next 1 year.” Response options ranged from 1 = Definitely yes to 5 = Definitely no. Responses were reversely coded and averaged for each participant such that higher mean scores represented higher perceived self-efficacy to vaccinate a child.

Perceived response efficacy of HPV vaccine was measured with three items ($\alpha = 0.92$)¹⁵ assessing the participants’ perception of the HPV vaccine’s effectiveness. An example of an item is “I believe HPV vaccination leads to reassurance about my child’s health.” Responses ranged from 1 = Strongly agree to 5 = Strongly disagree. Items were reversely coded for analysis, with higher scores representing higher perceived response efficacy.

Mediating variable

Attitude was measured with five items ($\alpha = 0.95$)³⁴ assessing the participants’ underlying belief about HPV vaccination on a 5-point scale. Participants were presented with the statement: “Vaccinating my child against HPV will be” (a) Extremely bad to Extremely good (b) Extremely unnecessary to Extremely necessary (c) Extremely immoral to Extremely moral (d) Extremely risky to Extremely safe (e) Extremely harmful to Extremely beneficial. Mean responses were summed up to range from 1 to 5 for each participant.

Sociodemographic, socioeconomic, health-related and religiosity-based covariates

Sociodemographic characteristics reported included parent’s age (continuous variable), child’s age, parent’s sex (female, male), sex of the (eldest eligible) child; race/ethnicity; and

marital status (married, divorced, separated, widowed, or single). *Socioeconomic* status (SES) characteristics reported were household income (<\$20,000, \$20,000 – <\$35,000, \$35,000 – <\$50,000, \$50,000 – <\$75,000, and \$75,000 or more); employment status, and education (less than high school, high school graduate, some college, college graduate or more). *Health-related factors* were measured using two items that measured HPV-related family medical history and general vaccine beliefs.³¹ Specifically, participants were asked: 1) if they or their family members have been diagnosed with HPV-related infections like cervical cancer, penile cancer, genital warts, anal cancer (Yes or No), and 2) if they had a personal belief against vaccine in general (Yes or No). *Religiosity-based* characteristics included religious affiliation (Catholic, Baptist, Pentecostal, Protestant, Adventist, Jehovah’s Witness, Mormon) and organizational religiosity (2 items) through the frequency of online/in-person attendance at religious services before and during the covid-19 pandemic, non-organizational religiosity (1 item), and intrinsic religiosity (3 items).³⁵

Analytical strategy

We summarized participants’ characteristics by using descriptive statistics to report means, standard deviations, frequencies, and percentages. We conducted multivariate linear regression models to examine associations between the independent (threat appraisal and coping appraisal) and dependent (intention to vaccinate) variables. We included all predictor variables and controlled for sociodemographic, socioeconomic, religiosity, and health-related covariates. Including all threat appraisal and coping appraisal into the model concurrently allowed me to identify each predictor’s independent association with the outcome. The covariates’ inclusion explains what other factors may jointly predict the association between threat appraisal and coping appraisal and HPV vaccination as described in the theoretical model. Finally, we assessed whether attitude partially mediated the relationship between the significant threat appraisal and coping appraisal variables from the multivariate analysis and HPV vaccination intention. We used Preacher and Hayes’ approach of calculating standard errors and 95% confidence intervals to test the significance of the mediation effect of threat and coping appraisal with vaccination intention through attitude.^{36,37} This method used 5,000 bootstrapped samples to estimate the bias-corrected confidence interval. We confirmed our analysis using the traditional mediation Sobel’s test (an independent test of the indirect effects treated similarly as a z-test) to assess the full mediated pathways.^{38,39}

Results

Sample characteristics

Table 1 provides the sociodemographic, socioeconomic, and psychosocial characteristics of our sample (N = 342). The average parents’ age was 41.33 ± 5.47 years, and the child’s age was 14.08 ± 2.04 years. Participants were mostly male (54%). Most respondents reported having male children (66%), being White (87%), married (89%), with a college

Table 1. Frequency distribution of patients' characteristics (n = 342)^a.

Participants' characteristics	Mean (SD)/ N (%)
Sociodemographic characteristics	
Parent's age	41.33 (5.47)
Child's age	14.08 (2.04)
Parent's Sex	
Female	157 (46%)
Male	185 (54%)
Child's Sex	
Female	117 (34%)
Male	225 (66%)
Race ^a	
White	298 (87%)
Nonwhite	44 (13%)
Marital status ^a	
Not Married	38 (11%)
Married	304 (89%)
Denomination	
Catholic	136 (40%)
Non-Catholic	206 (60%)
Socioeconomic status characteristics	
Highest education ^a	
Less than a college degree	86 (25%)
College or more	256 (75%)
Household income ^a	
Less than \$75,000	105 (31%)
Over \$75,000	235 (69%)
Employment status ^a	
Employed	285 (83%)
Unemployed/retired/disabled/others	57 (17%)
Health-related factors	
Personal belief against vaccines in general	
Yes/Not sure	121 (35%)
No	221 (64%)
History of HPV-related infections [†]	
Yes	25 (7%)
No	317 (93%)
Religiosity domains	
Organizational religiosity	3.09 (0.93)
Non-organizational religiosity	3.46 (1.35)
Intrinsic religiosity	4.25 (0.78)
Outcome variables	
Intention to vaccinate against HPV	3.02 (1.32)
Psychosocial factors	
Perceived vulnerability to HPV	3.71 (1.14)
Perceived severity of HPV	4.32 (0.82)
Perceived self-efficacy to vaccinate a child	3.98 (1.16)
Perceived response efficacy of HPV vaccine	3.6 (1.14)
Attitude	3.47 (1.09)

^aResults from this group should be interpreted with caution due to the small n.

education or more (75%), employed (83%), and household income over \$75,000 (69%). Participants had a mean organizational religiosity of 3.09 ± 0.93 (ranged from 1–5.5). The mean scores for the threat appraisal predictors were 3.71 ± 1.14 (ranged from 1–5) for perceived vulnerability to HPV and 4.32 ± 0.82 (ranged from 1–5) for the perceived severity of HPV. For coping appraisal, there was 3.98 ± 1.16 (ranged from 1–5) for perceived self-efficacy to vaccinate a child and 3.6 ± 1.14 (ranged from 1–5) for perceived response efficacy of HPV vaccine. The mean attitude was 3.47 ± 1.09 (ranged from 1–5). The mean intention to vaccinate a child against HPV in the next year was 3.02 ± 1.32 (ranged from 1–5).

Predictors (threat appraisal and coping appraisal) of HPV vaccination intention among religious parents

Table 2 shows the associations between threat appraisal and coping appraisal and vaccination intention where all predictor variables and covariates were included perceived self-efficacy

Table 2. Multivariable linear regression models of threat appraisal and coping appraisal on vaccination intentions.

Psychosocial predictors	β (95% CI) ^a	P-value
Threat appraisal predictors		
Perceived vulnerability to HPV	0.1 (0.01–0.21)	0.06
Perceived severity of HPV	–0.01 (–0.13–0.14)	0.98
Coping appraisal predictors		
Perceived self-efficacy to vaccinate a child	0.2 (0.11–0.29)	<0.0001
Perceived response efficacy of HPV vaccine	0.65 (0.53–0.77)	<0.0001

^a95% CI = 95% confidence interval.

Table 3. Analysis of attitude as a mediator of threat appraisal, coping appraisal, and vaccination intention.

Coping appraisal predictors	Mediation effect (95% CI) ^a	% Mediated
Perceived self-efficacy to vaccinate a child	0.12 (0.06–0.19)	59%
Perceived response efficacy of HPV vaccine	0.39 (0.29–0.51)	61%

^a95% bias-corrected confidence interval (95% CI) with 5,000 bootstrap resamples.

($\beta = 0.2, 0.11–0.29, p = <0.0001$) and perceived response efficacy of HPV vaccine ($\beta = 0.65, 0.53–0.77, p < .0001$) were positively associated with vaccination intention.

The mediating role of attitude

Standardized mediation tests using the Preachers and Hayes methods (Table 3) show that attitudes mediated 59% of the relationship between perceived self-efficacy to vaccinate a child and HPV vaccination intention (Table 3). This association yielded a mediation effect of 0.12, and 95% bias-corrected confidence interval (95% CI) = 0.06–0.19. In our second mediation model, attitudes mediated 61% of the relationship between perceived response efficacy of HPV vaccine and HPV vaccination intention with a significant partial mediation effect of 0.39, 0.29–0.51.

Discussion

This study used a theory-driven analytic approach to quantify the interdependent effects of threat appraisal and coping appraisal of HPV vaccine intention. We specifically found that attitude mediated the relationship coping appraisal- perceived self-efficacy to vaccinate a child and perceived response efficacy of HPV vaccine – had with HPV vaccination intention among religious parents of unvaccinated adolescents.

Our conceptual model tests a potential mechanism for how coping appraisal might be associated with vaccine intention through *attitude*. In both mediating models, attitude mediated more than half of the different coping appraisal predictors' total effect on vaccine intention. Thus, this novel approach clarifies the mediating role of attitude. Existing work has identified attitude as a proximal predictor of vaccination intention but has not tested its role as a mediator between threat appraisal and coping appraisal and vaccination intention.^{14,17–19} Our findings suggest that individuals with higher self-efficacy to vaccinate their children and those who perceive the HPV vaccine as effective may report higher vaccine intention

because of a more positive attitude. Programs/efforts that aim to increase HPV vaccination among religious populations should thus consider focusing directly on parental attitudes toward the vaccine. This will attenuate any adverse effects of coping appraisal on vaccination intention.

Furthermore, this study confirmed the direct and indirect association of coping appraisal with HPV vaccination intention but did not confirm the association of threat appraisal (operationalized as a perceived vulnerability of child to HPV and perceived severity of HPV) with vaccination intention either directly or indirectly. This is similar to past findings that tested the independent and direct associations of psychosocial variables (threat appraisal, coping appraisal, and attitude) with vaccination intention.^{14,15} Threat appraisal was not significantly associated with vaccination intention once coping appraisal was accounted for.^{15,40,41} These findings suggest that offering information on the threat appraisal of HPV alone may not increase vaccination intention if it is not combined with information on coping appraisal. Presenting parents with information regarding their child's vulnerability to HPV without addressing their perceived self-efficacy to vaccinate their child may not change their vaccination decision. This is especially possible in the context of parents who practice intrinsic religiosity who are more likely to neutralize potential threats with their beliefs and their perceived closeness to God.

Interventions should seek to increase vaccination intention by targeting parents' attitudes. For example, intervention messages can be designed to 1) alleviate the fears about the emotional consequence of vaccination (such as the fear of needles or long-term side effects.⁴² 2) boost parents' perceived self-efficacy to vaccinate a child by emphasizing that parents, though close to God, should take the responsibility of protecting their children from harm instead of shifting the responsibility solely to an external divine being. Such interventions may challenge the attitude that HPV vaccination is unnecessary since protection comes from God. This viewpoint may increase the perceived response efficacy of HPV vaccine among parents who hold such religious beliefs. These findings, therefore, indicate that interventions can be tailored toward effective psychosocial predictors of HPV vaccination.

Furthermore, our sample is predominantly White and Christians, suggesting an intersection between religion and race. Previous studies have shown that this complex mix could influence normative assumptions that may impact vaccination decisions.^{13,43} Therefore, it is important to investigate the unique social and emotional barriers that these embedded sociodemographic constructs may introduce to HPV vaccination decisions.

Our study is not without its limitations. First, we acknowledge that the mediating factor between the threat appraisal, coping appraisal and vaccination intention may look different across frameworks. Hence, more research is needed to explore other frameworks, psychosocial variables, and how they indirectly influence vaccination intention. Second, our study is a cross-sectional design; hence, we could not establish a causal ordering. Since predictors, outcomes, and mediators were assessed concurrently, reverse causality cannot be ruled out (i.e., attitude may influence a person's coping appraisal). A

more longitudinal approach is needed to confirm the cause-and-effect likelihood of our conceptual model. Third, we could not measure the actual HPV vaccination behavior as an outcome. Since intention does not always translate to behavior change, it is important to assess HPV vaccination behavior as an outcome. Finally, our participants identified with the Christian religion and mostly had a college degree. Hence our findings may not be generalizable across all religions and across individuals with lower education. Future studies should explore the possible variations of our conceptual model across religions.

Conclusion

We tested an integrated conceptual model on the mediating role of attitude in the relationship between the psychosocial predictors of HPV vaccination and vaccination intention among religious parents of unvaccinated adolescents. Our findings show that coping appraisal- perceived self-efficacy to vaccinate a child and the perceived response efficacy of the HPV vaccine is higher among parents with high vaccine intention. These associations are mediated by attitude.

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References

1. Facts CDCSTD. Human papillomavirus (HPV) [Internet]; 2019 [accessed 2020 Jul 28]. <https://www.cdc.gov/std/hpv/stdfact-hpv.htm>
2. Perkins RB, Zisblatt L, Legler A, Trucks E, Hanchate A, Gorin SS. Effectiveness of a provider-focused intervention to improve HPV vaccination rates in boys and girls. *Vaccine*. 2015;33(9):1223–29. doi:10.1016/j.vaccine.2014.11.021.
3. What Everyone CDC. Should know | human papillomavirus (HPV) vaccination | vaccination and immunization | cdc [internet]; 2020 [accessed 2021 Mar 4]. <https://www.cdc.gov/vaccines/vpd/hpv/public/index.html>
4. Bodson J, Wilson A, Warner EL, Religion KD. and HPV vaccine-related awareness, knowledge, and receipt among insured women aged 18–26 in Utah. *PloS One*. 2017;12(8):e0183725. doi:10.1371/journal.pone.0183725.
5. Castle PE, Rausa A, Walls T, Gravitt PE, Partridge EE, Olivo V, Niwa S, Morrissey KG, Tucker L, Katki H, et al. Comparative community outreach to increase cervical cancer screening in the Mississippi Delta. *Prev Med*. 2011;52(6):452–55. doi:10.1016/j.ypmed.2011.03.018.
6. Hirth J. Disparities in HPV vaccination rates and HPV prevalence in the United States: a review of the literature. *Human Vacc Immun*. 2019;15(1):146–55. doi:10.1080/21645515.2018.1512453.

7. Lahijani AY, King AR, Gullatte MM, Hennink M, Bednarczyk RA. HPV vaccine promotion: the church as an agent of change. *Soc Sci Med.* 2021;268:113375. doi:10.1016/j.socscimed.2020.113375.
8. Lipka M, Wormald B. How religious is your state? Pew Research Center. 2016.
9. Pratt R, Njau SW, Ndagire C, Chaisson N, Toor S, Ahmed N, Mohamed S, Dirks J. “We are Muslims and these diseases don’t happen to us”: a qualitative study of the views of young Somali men and women concerning HPV immunization. *Vaccine.* 2019;37(15):2043–50. doi:10.1016/j.vaccine.2019.03.006.
10. Touyz SJ, Touyz LZ. The kiss of death: HPV rejected by religion. *Curr Oncol.* 2013;20(1):e52. doi:10.3747/co.20.1186.
11. Walker TY, Elam-Evans LD, Yankey D, Markowitz LE, Williams CL, Fredua B, Singleton JA, Stokley S. National, regional, state, and selected local area vaccination coverage among adolescents aged 13–17 years—United States, 2018. *Morbidity Mortality Weekly Rep* 2019;68:718.
12. Kumar D, Chandra R, Mathur M, Samdariya S, Kapoor N. Vaccine hesitancy: understanding better to address better. *Israel J Health Policy Res.* 2016;5(1):1–8. doi:10.1186/s13584-016-0062-y.
13. Argyris YA, Kim Y, Roscizewski A, Song W. The mediating role of vaccine hesitancy between maternal engagement with anti- and pro-vaccine social media posts and adolescent HPV-vaccine uptake rates in the US: the perspective of loss aversion in emotion-laden decision circumstances. *Social Sci Med.* 2021;282:114043. doi:10.1016/j.socscimed.2021.114043.
14. Catalano HP, Knowlden AP, Birch DA, Leeper JD, Paschal AM, Usdan SL. Using the theory of planned behavior to predict HPV vaccination intentions of college men. *J Am College Health.* 2017;65(3):197–207. doi:10.1080/07448481.2016.1269771.
15. Gainforth HL, Cao W, Latimer-Cheung AE. Determinants of human papillomavirus (HPV) vaccination intent among three Canadian target groups. *J Cancer Educ.* 2012;27(4):717–24. doi:10.1007/s13187-012-0389-1.
16. Mupandawana ET, Cross R. Attitudes towards human papillomavirus vaccination among African parents in a city in the north of England: a qualitative study. *Reprod Health.* 2016;13(1):97. doi:10.1186/s12978-016-0209-x.
17. Maddux JE, Rogers RW. Protection motivation and self-efficacy: a revised theory of fear appeals and attitude change. *J Exp Soc Psychol.* 1983;19(5):469–79. doi:10.1016/0022-1031(83)90023-9.
18. Montañó DE, Kasprzyk D. Theory of reasoned action, theory of planned behavior, and the integrated behavioral model. *Health Behav Theory Res Prac.* 2015;70:231.
19. Xiao X. Follow the heart or the mind? Examining cognitive and affective attitude on HPV vaccination intention. *Atlantic J Comm.* 2019;29(2):93–105.
20. Rogers RW, and Prentice-Dunn S. 1997. Protection motivation theory. In: *Handbook of health behavior research 1: Personal and social determinants.* chman, D. S. (Ed.). (Plenum Press): (pp. 113–132).
21. Catalano HP, Knowlden AP, Sharma M, Franzidis A. A pilot study applying social cognitive theory to predict HPV vaccination intentions of unvaccinated college women. *Am J Sex Educ.* 2016;11(4):287–305. doi:10.1080/15546128.2016.1231648.
22. Glanz K, Rimer BK, and Viswanath K. *Health behavior: theory, research, and practice.* Hoboken, New Jersey: John Wiley & Sons; 2015.
23. Grandahl M, Chun Paek S, Grisurapong S, Sherer P, Tyden T, Lundberg P. Parents’ knowledge, beliefs, and acceptance of the HPV vaccination in relation to their socio-demographics and religious beliefs: a cross-sectional study in Thailand. *PloS One.* 2018;13:e0193054. doi:10.1371/journal.pone.0193054.
24. Hamilton K, van Dongen A, Hagger MS. Theory of planned behavior meta-analysis for parent-for-child behaviors; 2020.
25. Fernandes R, Potter BK, Little J. Attitudes of undergraduate university women towards HPV vaccination: a cross-sectional study in Ottawa, Canada. *BMC Women’s Health.* 2018;18(1):1–9. doi:10.1186/s12905-018-0622-0.
26. Porter RM, Amin AB, Bednarczyk RA, Omer SB. Cancer-salient messaging for human papillomavirus vaccine uptake: a randomized controlled trial. *Vaccine.* 2018;36(18):2494–500. doi:10.1016/j.vaccine.2018.01.040.
27. Weinstein JE, Ananth A, Brunner JP, Nelson RE, Bateman ME, Carter JM, Buell JF, Friedlander PL. Efficacy of a human papillomavirus vaccination educational platform in a diverse urban population. *JAMA Otolaryngol–Head Neck Surg.* 2016;142(6):590–95. doi:10.1001/jamaoto.2016.0433.
28. Bryan CJ, Bryan AO, Baker JC. Associations among state-level physical distancing measures and suicidal thoughts and behaviors among US adults during the early COVID-19 pandemic. *Suicide Life-Threatening Behav.* 2020;50(6):1223–29. doi:10.1111/sltb.12653.
29. Hamm J, Yun J. Influence of physical activity on the health-related quality of life of young adults with and without autism spectrum disorder. *Disability Rehab.* 2019;41(7):763–69. doi:10.1080/09638288.2017.1408708.
30. Paas LJ, Morren M. Please do not answer if you are reading this: respondent attention in online panels. *Mark Lett.* 2018;29(1):13–21. doi:10.1007/s11002-018-9448-7.
31. Abhyankar P, O’connor DB, Lawton R. The role of message framing in promoting MMR vaccination: evidence of a loss-frame advantage. *Psychol Health Med.* 2008;13(1):1–16. doi:10.1080/13548500701235732.
32. Courneya KS, Hellsten L-A. Cancer prevention as a source of exercise motivation: an experimental test using protection motivation theory. *Psychol Health Med.* 2001;6(1):59–64. doi:10.1080/13548500125267.
33. Hess TR, Tracey TJ. Psychological help-seeking intention among college students across three problem areas. *J Counsel Dev.* 2013;91(3):321–30. doi:10.1002/j.1556-6676.2013.00100.x.
34. Ajzen I. Constructing a TPB questionnaire: conceptual and methodological considerations; 2002.
35. Koenig HG, Büssing A. The Duke University Religion Index (DUREL): a five-item measure for use in epidemiological studies. *Religions.* 2010;1(1):78–85. doi:10.3390/rel1010078.
36. Hayes AF, Baron B. Kenny: statistical mediation analysis in the new millennium. *Communication Monographs.* 2009;76(4):408–20. doi:10.1080/03637750903310360.
37. Preacher KJ, Hayes AF. Assessing mediation in communication research. *The Sage sourcebook of advanced data analysis methods for communication;* 2008.
38. MacKinnon DP, Lockwood CM, Hoffman JM, West SG, Sheets V. A comparison of methods to test mediation and other intervening variable effects. *Psychol Method.* 2002;7(1):83. doi:10.1037/1082-989X.7.1.83.
39. Sobel ME. Asymptotic confidence intervals for indirect effects in structural equation models. *Sociol Method.* 1982;13:290–312. doi:10.2307/270723.
40. Kothe EJ, Ling M, North M, Klas A, Mullan BA, Novoradovskaya L. Protection motivation theory and pro-environmental behaviour: a systematic mapping review. *Aus J Psychol.* 2019;71(4):411–32. doi:10.1111/ajpy.12271.
41. Yeung NC, Lu Q, Wong CC, Huynh HC. The roles of needs satisfaction, cognitive appraisals, and coping strategies in promoting posttraumatic growth: a stress and coping perspective. *Psychol Trauma: Theory Res Prac Policy.* 2016;8(3):284. doi:10.1037/tra0000091.
42. Marshall S, Sahn LJ, Moore AC, Fleming A. A systematic approach to map the adolescent human papillomavirus vaccine decision and identify intervention strategies to address vaccine hesitancy. *Public Health.* 2019;177:71–79. doi:10.1016/j.puhe.2019.07.009.
43. Boddie SC, Park JZ. Racializing the religious during the COVID-19 pandemic. *Religions.* 2021;12(5):341. doi:10.3390/rel12050341.