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Preference-Based Assessments

Preferences for Sexually Transmitted Infection and Cancer Vaccines in the United States and in China

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ABSTRACT

Objectives: This study assessed preferences for hypothetical vaccines for children in 2 large vaccine markets according to how the vaccine-preventable disease is transmitted via a discrete choice experiment.

Methods: Surveys in China (N = 1350) and the United States (N = 1413) were conducted from April to May 2021. The discrete choice experiment included attributes of cost, age at vaccination, transmission mode of the vaccine-preventable disease, and whether the vaccine prevents cancer. Preference utilities were modeled in a Bayesian, multinomial logistic regression model, and respondents were grouped by vaccine preference classification through a latent class analysis.

Results: Individuals favored vaccines against diseases with transmission modes other than sexual transmission (vaccine for sexually transmitted infection [STI] vs airborne disease, in the United States, odds ratio 0.71; 95% credible interval 0.64-0.78; in China, odds ratio 0.76; 95% credible interval 0.69-0.84). The latent class analysis revealed 6 classes: vaccine rejecters (19% in the United States and 8% in China), careful deciders (18% and 17%), preferring cancer vaccination (20% and 19%), preferring vaccinating children at older ages (10% and 11%), preferring vaccinating older ages, but indifferent about cancer vaccines (23% and 25%), and preferring vaccinating children at younger ages (10% and 19%). Vaccine rejection was higher with age in the United States versus more vaccine rejection among those at the age of 18 to 24 and ≥ 64 years in China.

Conclusion: The public had strong preferences against giving their child an STI vaccine, and the class preferring a cancer vaccine was less accepting of an STI vaccine. Overall, this study points to the need for more education about how some STI vaccines could also prevent cancers.

Keywords: conjoint analysis, human papillomavirus vaccines, immunization programs, latent class analysis, stated choice experiment, surveys and questionnaires.

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Introduction

In 1974, the World Health Organization recommended that countries publicly fund 4 vaccines: Bacillus Calmette-Guérin, diphtheria-tetanus-pertussis, polio, and measles vaccines. Since 2004, this recommendation has expanded to include 6 more vaccines (hepatitis B, *Haemophilus influenzae* type b, pneumococcal conjugate, rotavirus, rubella, and human papillomavirus [HPV] vaccines) that prevent acute and chronic diseases encompassing sexually transmitted (STI), bloodborne, and respiratory infections.¹

Each year, more than 2.7 million individuals die of acute diseases caused by common vaccine-preventable diseases (VPDs), and 762,000 die of cancers secondary to viral hepatitis and HPV.² Most of these deaths occur in low- and middle-income countries (LMICs), and the existing paradigm is that these deaths, along with the hundreds of millions of cases of VPDs, arise due to the lack of

vaccine access for families in these countries.^{3,4} Recently though, the United States has seen large outbreaks of VPDs for which vaccines have been readily available for decades such as pertussis⁵⁻⁷ and measles.^{5,8} The voluntary choice not to vaccinate is especially seen in the wealthier and more educated sectors of the population, whereas outbreaks of VPDs in middle-income countries such as China (such as a large mumps outbreak in 2011-2012)⁹ is due to a lack of access to vaccines. Nevertheless, middle-income countries are not immune to the consequences of vaccine hesitancy; after the dissolution of the Soviet Union, diphtheria-tetanus-pertussis uptake fell as parents became suspicious of the vaccine, and a large outbreak of more than 50,000 cases of diphtheria spread throughout eastern Europe.¹⁰ A study in 5 LMICs, including China, found substantial evidence of vaccine hesitancy, particularly over concerns about safety and newer vaccines.¹¹ Currently, there are still large outbreaks of VPDs in China—for example, more than 30,000 cases of pertussis and

rubella were reported in China in 2019; in the United States, there was also a high number of pertussis cases, with 15 609 reported in 2018.¹²

Since 2000, the United States has licensed 10 new vaccines,¹³ but research on vaccine hesitancy has not kept pace with vaccine development. The faltering rollout of the HPV vaccine in the United States is a cautionary tale on how not to inform the public about a vaccine. Before vaccine introduction, awareness of HPV was low.¹⁴ The Advisory Committee on Immunization Practices published its first set of recommendations in 2006; recommendations for routine use in males did not occur until 2011.^{15,16} Although the HPV vaccine protects against cervical, anal, oropharyngeal, and other cancers, early recommendations did not emphasize prevention of cancer as much as later recommendations.^{15,17} Programs that have attempted to promote HPV vaccination since its introduction in the United States have met with mixed success.¹⁸ In contrast, the hepatitis B vaccine—which protects against an infection spread not only through vertical transmission but also through injection drug use or sexual intercourse—has not had such a pushback from the public, likely due to being on the pediatric vaccination schedule and being marketed as a product that protects against the development of chronic infection.¹⁹ Nevertheless, some researchers have argued that “desexualizing” a vaccine could have inadvertent consequences in other areas of public health, such as reducing opportunities for health educators to communicate about safe sex practices.²⁰ A vaccine’s period of adoption into the national immunization program is a critical window for shaping public discourse about and uptake of the vaccine. As more vaccines are formulated, determination of how best to promote these vaccines to the public will become critical. Moreover, in China, the national government has set a goal of eliminating cervical cancer by 2047, and in response local governments are rapidly launching HPV vaccination programs targeting younger females.²¹

Multiple STI vaccines are currently in the clinical trial phase of development, with the most advanced candidates (targeting herpes simplex virus 2) projected to be licensed within 10 years.²² The future introduction of STI and other vaccines for adolescents into national immunization schedules will have to deal with a population of parents who may be skeptical about newer vaccines and for STI vaccines in particular. It will be important to understand how STI vaccines could be efficiently rolled out with parental preferences taken into consideration. Nevertheless, these preferences may vary across country. With samples taken from the United States and China, the most populous high-income and middle-income countries, respectively, this study (1) used a discrete choice experiment (DCE) to assess preferences for vaccines according to how the disease, against which the vaccine protects, is transmitted, and (2) classified individuals into preference classes using an exploratory latent class analysis (LCA). We hypothesized that there would be a strong dispreference for STI vaccines.

Methods

Study Population

This cross-sectional study enrolled both parent and nonparent adults at the age of ≥ 18 years in China and the United States. Data collection occurred in April and May 2021. Participants were recruited for the internet-based survey by the research firm Dynata (Shelton, CT) through social media and advertisements. Each wave used quota sampling to ensure that the numbers of participants invited were roughly proportional to the age/gender distribution of the adult population.

Table 1. List of attributes and attribute levels in a discrete choice experiment of vaccination preferences.

Attribute	Attribute levels
Age of vaccine administration	2 years 6 years 12 years 15 years
Transmission mode for vaccine-preventable disease	Airborne Foodborne Mosquito borne Sexually transmitted
Vaccine prevents cancer	Yes No
Cost	50 USD/RMB 100 USD/RMB 200 USD/RMB 400 USD/RMB

RMB indicates renminbi; USD, US dollar.

We aimed to obtain a sample of 1500 adult parents and non-parents from each country. This sample size was based on considerations for the DCE and the proportion in the sample who were parents (to ensure that we had enough sample for sensitivity analyses only including parents). In other research based on national panels, it has been found that approximately 63% of panelists are parents.²³ The sample size of parents within this survey (63% of 1500 is 945) was considered an adequate sample for statistical purposes. There is no standard methodology to calculate sample size for conjoint analysis studies such as DCEs,²⁴ but one formula for sample size is the following:²⁵

$$N > \frac{1000 \times (\text{largest number of attribute levels})}{(\text{number of choice tasks}) \times (\text{number of alternatives})}$$

This led to a simple random sample of 500 with 4 attribute levels, 4 choice tasks, and 2 alternatives. Our sample, of approximately 1500 in each country (or approximately 945 parents in each country), was sufficient for the purposes of the DCE.

Attributes and Study Design

The list of attributes is found in Table 1. Based on a review of the contrasts between HPV and hepatitis B vaccines, we selected the following attributes: cost, age at vaccine administration, transmission mode for disease that vaccine protects against, and whether the vaccine prevents cancer. We also allowed for an opt-out (ie, parents deciding not to vaccinate their child). Cost distributions were based on realistic values from the vaccines for children price list²⁶ and vaccine costs within China.²⁷ For ease of interpretation, we converted Chinese renminbi to US dollars using a purchasing power parity currency conversion of 4.186.²⁸ The ages at vaccination administration were chosen based on ages at which vaccines are commonly administered in the schedule recommended by the United States²⁹ and China Experts Advisory Committee on Immunization Practices.³⁰ The transmission modes spanned those of diseases that are currently vaccine preventable (eg, pertussis and measles being airborne/respiratory, hepatitis A being foodborne, Japanese encephalitis being mosquito borne, and hepatitis B and HPV being sexually transmitted).

We used a fractional factorial design and allowed respondents to opt out of the 2 choice profiles. Each respondent answered 4 different choice sets with the prompt: “in the following questions you will be presented with a table detailing 2 different vaccines for the same disease, vaccine A and vaccine B. Choose the vaccine

Table 2. Distribution of sociodemographic variables across US and China samples, April to May 2021.

Demographic characteristic	US sample (N = 1413)	Chinese sample (N = 1350)
Age		
18-24	273 (12)	239 (11)
25-34	317 (17)	367 (21)
35-44	320 (16)	334 (18)
45-54	130 (16)	207 (22)
55-65	147 (17)	116 (15)
≥ 64	226 (22)	87 (14)
Gender		
Female	763 (51)	681 (49)
Male	650 (49)	669 (51)
Educational attainment		
≤ High school	313 (19)	184 (20)
Vocational school or associate's degree	417 (29)	360 (27)
Bachelor's degree	683 (52)	806 (53)
Parent of daughter 5-17 years old		
No	1190 (86)	1164 (89)
Yes	223 (14)	186 (11)
Race/ethnicity		
Non-Hispanic black	195 (12)	-
Non-Hispanic white	944 (71)	-
Hispanic	128 (7)	-
Other	146 (11)	-
Religion		
None	398 (27)	-
Catholic	232 (17)	-
Evangelical Protestant	337 (23)	-
Mainline Protestant	128 (11)	-
Jewish	54 (4)	-
Other	264 (17)	-
Political affiliation		
Democrat	597 (40)	-
Independent	415 (30)	-
Republican	401 (30)	-

Note. Values are presented in the form of frequency (%).

that you would prefer be administered to your child." Before showing participants the choice profiles, we explained each attribute separately. After answering the questions, participants were asked how confident they were in responding to the DCE questions. We also collected standard demographic information from each participant. The surveys are available at <https://doi.org/10.6084/m9.figshare.16632343.v1>.

Covariates

Our demographic variables of interest were age, gender, education, and parenthood. For parenthood, we singled out parents of daughters at the age of 5 to 17 years to better understand the potential for gendered issues of STI vaccines. Within the United States, we also collected information on race/ethnicity, religion, and political affiliation.

Statistical Analysis

We conducted a Bayesian analysis of the DCE, with non-informative priors.³¹ We specified a multinomial logistic regression model with the data set situated as 3 observations per person (the choice of vaccine A or B or to opt out). This model yields odds

ratios (ORs) and 95% credible intervals (CrIs) (see [Appendix Table 1](#) in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.07.019>). We conducted a number of sensitivity analyses, including limiting the sample to those who indicated that they were confident in their responses and to those who were parents. Our main model includes cost of vaccine as a continuous variable, but supplementary analyses include it as a categorical variable following the original design of the conjoint analysis. These sensitivity analyses did not produce substantially different results (see [Appendix Tables 2 and 3](#) in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.07.019>). Our descriptive analyses are weighted, with raked weights³² developed based on age, gender, and region of country for both countries (and additionally race/ethnicity for the United States).

Subsequently, we conducted an LCA to classify individuals based on their preference characteristics; an individual is assigned to the class with the highest posterior probability. Our choice in the number of classes was based on model fit and interpretability of results.³³ We compared classes across demographic characteristics across the estimated classes using Rao-Scott chi-square tests. We named the preference classes based on the most preferred attribute levels in each class.

Ethical Approval

The study protocol was reviewed by the University of Michigan Health Sciences and Behavioral Sciences Review Board (#HUM00193501) and the Fudan University School of Public Health Ethical Review Committee (institutional review board #2021-03-0887). Participants read an electronic informed consent form earlier and had to click "I agree" before answering any questions.

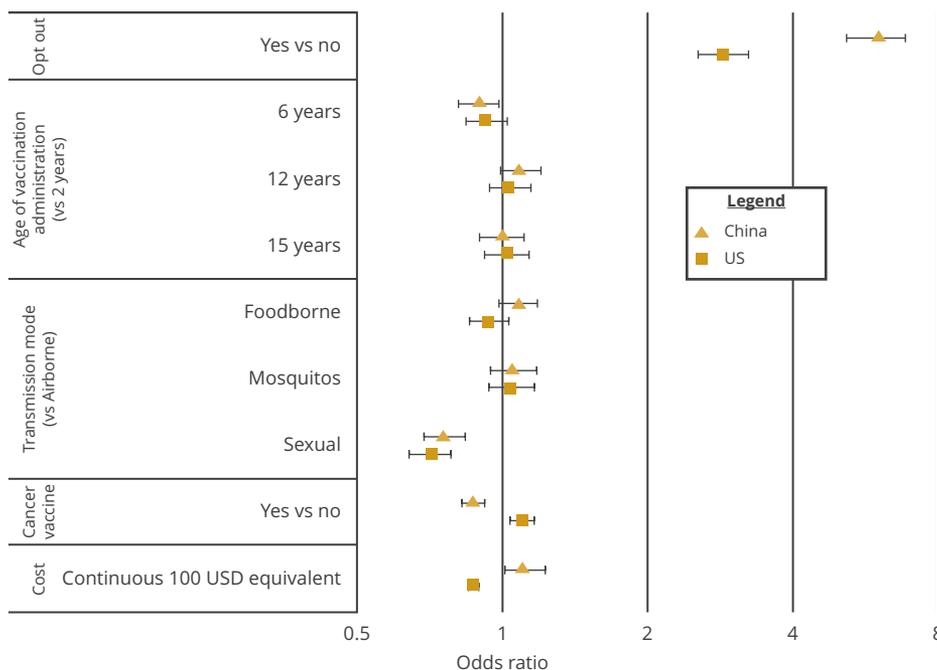
Results

In total, the online questionnaire database captured responses from 2371 individuals in the United States and 1830 individuals in China. After excluding those who did not agree to the informed consent, we had a final sample of 1413 from the United States and 1350 from China. The distribution of demographic variables is presented in [Table 2](#). The US and Chinese samples were relatively comparable in the proportion of individuals with a high school education or less (19% in United States and 20% in China) and the proportion with a bachelor's degree (52% in the United States and 53% in China). In both countries, a small proportion were parents of a daughter at the age of 5 to 17 years: 14% in the United States and 11% in China.

[Figure 1](#) graphically displays results from the DCE (which is also presented, along with willingness to pay estimates, within [Appendix Table 1](#) in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.07.019>). Overall, individuals in the United States and in China preferred other vaccines over STI vaccines (reference level: vaccine for airborne disease, in the United States, OR 0.71; 95% CrI 0.64-0.78; in China, OR 0.76; 95% CrI 0.69-0.84). In the United States, individuals expressed stronger preference for a vaccine protecting against cancer (OR 1.10; 95% CrI 1.04-1.17), whereas in China the opposite association was observed (OR 0.87; 95% CrI 0.83-0.92). There were no major differences in preferences for the age at vaccination administration in China or the United States.

Models fit for different numbers of classes are presented in [Appendix Table 4](#) in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.07.019> for the United States and [Appendix Table 5](#) in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.07.019> for China. We chose 6 classes for each country as a balance between increased fit as the number of

Figure 1. Preferences for pediatric vaccines of various characteristics in China (n = 1350) and the United States (n = 1413); results are obtained from a Bayesian multinomial logistic regression model.



USD indicates US dollar.

classes increased with interpretability of the results (Appendix Table 6 in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.07.019> shows alternative results from a 5-class LCA). The composition of each class varies slightly between countries, but we were able to describe classes within each country in a similar fashion (see Appendix Tables 7 and 8 in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.07.019>). Vaccine rejecters (19% in the United States and 8% in China) were those who tended to opt out of the DCE. Another class included those we describe as careful deciders (18% in the United States and 17% in China), meaning that one attribute in particular did not drive their decision making. Those with strong preferences for a cancer vaccine made up 20% of the US sample and 19% of the China sample. There were individuals grouped into classes based on whether they preferred vaccinating their child at younger ages (10% in the United States and 19% in China), at older ages (10% in the United States and 11% in China), or at older ages, but being indifferent about cancer vaccines (23% in the United States and 25% in China). Notably, the class with preferences for vaccinating at younger ages also preferred not receiving a cancer vaccine. Overall, vaccines for an STI were strongly not preferred except in the careful decider class and the class preferring cancer vaccines.

We describe how the different classes vary by demographic composition in Table 3 (for the United States) and Table 4 (for China). The largest trends were observed in differences between being classified as a vaccine rejecter or not. For the United States, there was a strong monotonic relationship between being a vaccine rejecter and age, with 13% of those at the age of 18 to 24 years rejecting vaccines versus 30% in those at the age of ≥ 64 years ($P < .001$). In China, this was a U-shaped relationship, with the lowest levels of classification as a vaccine rejecter in those at the age of 35 to 44 years (4%), but classification as a vaccine rejecter relatively high for those at the age of 18 to 24 and ≥ 64 years ($P < .001$). In

the United States, there were not significant differences in class assignment by gender, education, and whether the participant was a parent of a daughter at the age of 5 to 17 years. In China, there was a significant difference ($P = .006$), with lower numbers in the vaccine rejection class who were parents of daughters (4%) than those who were not (9%). In the United States, we also examined differences across race/ethnicity, religion, and political affiliation. Across race/ethnicity, the highest proportion in the vaccine rejection group was found among non-Hispanic white Americans (23%) and was relatively low among Hispanic Americans (12%). By political affiliation, vaccine rejection was highest among independents (28%) and lowest among Democrats (15%). There were no significant differences by religion.

Discussion

The introduction of the HPV vaccine in the United States and in China has led to a need for new communication techniques and framing for parents compared with other childhood vaccines. After the HPV vaccine, numerous STI vaccine candidates will likely achieve licensing in the foreseeable future,³⁴ and this study highlights potential pitfalls to STI vaccine promotion. Using internet-based samples in China and the United States, we sought to understand preferences in the general population for STI versus non-STI vaccines using a DCE. We found that individuals had a weaker preference for a vaccine against STI. Overall, our study highlights some challenges in introducing an STI vaccine into a population in the presence of strong preferences against STI vaccines.

We found somewhat similar results for China and the United States in terms of opt-out, age, and transmission mode preferences. Nevertheless, there were opposite trends for preferences for a cancer vaccine and cost of the vaccine. In the United States,

Table 3. Demographic characteristics based on pediatric vaccine preference from a latent class analysis, United States, April to May 2021.

Demographic characteristic	Vaccine rejecters, %	Prefer cancer vaccines, %	Prefer vaccinating older ages, %	Careful deciders, %	Prefer vaccinating younger ages, %	Prefer vaccinating older ages, indifferent about cancer vaccines, %
Age						
<i>P</i> < .001						
18-24	13	20	12	21	10	23
25-34	14	23	11	19	11	23
35-44	14	21	11	19	11	24
45-54	26	18	9	16	9	21
55-65	28	18	10	16	8	20
≥ 64	30	16	9	15	9	20
Gender						
<i>P</i> = .247						
Female	23	20	10	17	9	21
Male	20	19	10	18	10	23
Educational attainment						
<i>P</i> = .121						
≤ High school	24	18	9	18	10	22
Vocational school or associate's degree	23	18	10	19	9	21
Bachelor's degree	20	21	11	17	10	22
Parent of daughter 5-17 years old						
<i>P</i> = .309						
No	22	19	10	17	10	22
Yes	18	20	10	19	11	23
Race/ethnicity						
<i>P</i> = .031						
Non-Hispanic black	18	20	11	19	10	22
Non-Hispanic white	23	19	10	17	10	21
Hispanic	12	21	11	20	11	26
Other	20	19	10	17	10	24
Religion						
<i>P</i> = .846						
None	22	21	10	16	9	21
Catholic	21	19	10	17	10	23
Evangelical Protestant	20	18	11	19	10	22
Mainline Protestant	26	20	9	17	9	19
Jewish	19	19	14	19	8	21
Other	22	19	9	18	10	23
Political affiliation						
<i>P</i> < .001						
Democrat	15	22	11	18	10	24
Independent	28	17	10	16	9	20
Republican	24	18	9	19	10	21

Note. *P* values from Rao-Scott chi-square tests.

there was a preference for a cancer vaccine, whereas in China there was a preference for a noncancer vaccine. We will note that this could be due to low knowledge of specific cancer vaccines, such as the HPV vaccine in China. Knowledge about the vaccine and its related infection was greatly related to vaccination choices in a previous DCE of HPV vaccination preferences in Zhejiang province, China.³⁵ Hepatitis B vaccines have been publicly funded in China since 2002,³⁰ but the HPV vaccine has only recently been introduced into the private market in China; this lack of long-term use of multiple anticancer vaccines may indicate a lack of familiarity with these vaccines in China and accordingly less strong preferences for them. We also found that in the United States, as

expected, there was a dispreference for a more costly vaccine, whereas in China the opposite association was found. Similar trends were found in previous studies.^{36,37} Sensitivity analyses within a previous article suggested that trends in the overall population were being driven by higher income individuals valuing higher cost vaccines (perhaps out of a conflation between cost and quality), whereas individuals of lower socioeconomic status had dispreferences for higher cost vaccines, as expected.³⁶

We found a substantial dispreference for STI vaccines, with little difference across comparisons with other vaccines (for airborne, mosquito-borne, or foodborne illnesses). Within the United States, there has been stated concern that vaccinating

Table 4. Demographic characteristics by pediatric vaccine preference from a latent class analysis, China, April to May 2021.

Demographic characteristic	Vaccine rejecters, %	Prefer cancer vaccines, %	Prefer vaccinating older ages, %	Careful deciders	Prefer vaccinating younger ages, %	Prefer vaccinating older ages, indifferent about cancer vaccines, %
Age						
<i>P</i> < .001						
18-24	13	20	11	17	16	23
25-34	8	20	11	16	18	27
35-44	4	19	11	20	21	26
45-54	5	21	12	18	20	25
55-65	10	19	12	16	20	22
≥ 64	14	18	11	15	17	25
Gender						
<i>P</i> = .165						
Female	7	20	12	17	19	25
Male	10	19	11	17	19	25
Educational attainment						
<i>P</i> = .095						
≤ High school	11	20	9	17	19	25
Vocational school or associate's degree	9	20	13	16	18	24
Bachelor's degree	7	19	11	18	19	26
Parent of daughter						
5-17 years old						
<i>P</i> = .012						
No	9	20	11	17	19	25
Yes	4	20	12	18	19	27

Note. *P* values from Rao-Scott chi-square tests.

adolescents against an STI could negatively influence sexual behaviors,³⁸ although empirical evidence has shown this to be an unfounded concern.³⁹ A previous qualitative study also noted that for some parents, knowing that the HPV vaccine protected against an STI was important for their decision making, but for other parents it was not as important.⁴⁰ It is also possible that preferences differ by gender of the child, and we note that only approximately 1 in 3 HPV vaccination programs worldwide vaccinate both girls and boys.⁴¹ As vaccine candidates for herpes simplex virus 2, chlamydia, and other STIs progress through clinical trial development, it will be important for industry and public health stakeholders to strategize about how to effectively increase vaccine uptake. There are other possible reasons for differences in preferences across transmission modality; it is possible that the COVID-19 pandemic has increased the relative salience of vaccines for airborne transmitted infections. It is also possible that the lower preference for STI vaccines could be due to beliefs that the infection could be prevented through other means, such as safer sex practices. Nevertheless, it is also likely that many vaccine-preventable illnesses could also be prevented through nonpharmaceutical interventions, including safer food preparation and mask wearing.

In our LCAs, we found similar classifications for China and the United States, although the proportions varied slightly. For instance, there were more vaccine rejecters in the United States (19%) than in China (8%). Direct comparisons of vaccine attitudes across different countries are limited in the scientific literature. Nevertheless, a recent global study actually found higher proportions of individuals in the United States believing that vaccines are effective, important, and safe than in China.⁴² Attitudes toward vaccines in China may be shaped by some recent safety and

quality scandals.⁴³ In contrast, coverage of mandatory pediatric vaccines in China is relatively high.⁴⁴ In line with the results of our study, this may suggest individuals in China may have concerns about vaccines but still are willing to obtain vaccines for their children or may be strongly influenced by the presence of vaccine mandates.

There were similar proportions of individuals in the class preferring cancer vaccines in China (19%) and in the United States (20%). Interestingly for both China and the United States, individuals in this class were more willing to consider STI vaccines than other classes. Accordingly, pushing forward a message that STI vaccines, such as HPV and hepatitis B, also protect against cancer could be motivating for vaccine acceptance, but might be less impactful among individuals of other vaccine preference classes. In the initial rollout of the vaccine, there was a large backlash over sex-related concerns. Succinct messages that frame HPV vaccine as both an STI and a cancer vaccine could be useful and be in line with public health goals to promote healthy sexual activity and to reduce rates of HPV related cancer.^{20,45} In fact, it is important to highlight that clear communication between parents and vaccination providers is essential to increase uptake of the vaccine.⁴⁶

Within the United States, age, race/ethnicity, and political affiliation were all associated with LCA classification. For all these, the most substantial differentiation was between vaccine rejecters and other categories, with little difference across the other 4 categories. This could indicate that the relationship between demographic status and vaccine attitudes is more tied to whether an individual accepts or rejects a vaccine, but not on shades of how they accept vaccines or what specific vaccines they prefer. Previous studies have also shown vaccine hesitancy to be relatively

high in white Americans, with low levels of vaccination in black Americans more tied to access and affordability issues than hesitancy.⁴⁷ Similarly, a study in Australia found lowest vaccination coverage in the most affluent areas.⁴⁸ Although some studies have identified some more concerns among black Americans about side effects,⁴⁹ much of this can be tied to racial discrimination.⁵⁰ We also note that we did not find a difference in class assignment across religion within the United States. Previous studies have found this relationship⁵¹ (although another study actually found the reverse association).⁵² Discrepancies across previous studies and our studies in the relationship between religion and vaccination could be due to differences in location, time, or how variables were assessed.

Fewer studies in China have studied vaccine hesitancy patterns. A recent scoping review of this literature found that most studies position vaccine hesitancy as a result of medical misconduct or vaccine safety concerns.⁵³ China does have high vaccination rates, although coverage for mandatory vaccines is higher than for voluntary vaccines,⁴⁴ and some vaccines, such as rotavirus, *Haemophilus influenzae* type b, pneumococcal, and HPV vaccines, are voluntary in China and thus have low coverage.

Among LMICs, several populous countries, including Turkmenistan, Zambia, Uzbekistan, Mexico, and Rwanda, are reported to have more than 90% first dose coverage of the HPV vaccine.⁴¹ Evaluation of projects in LMICs has highlighted the needs to integrate HPV vaccination with other community health programs, including vaccination, to distribute the vaccine at schools and other locations, and to involve multiple stakeholders.^{54,55} The examples speak to the ability to successfully promote STI vaccines in diverse settings. Vaccination coverage could also be increased through vaccine mandates.⁵⁶

Strengths and Limitations

There are several limitations to this study. It is an opt-in study, such that our sample is not probability based and is biased toward those with internet access. The probability of internet access also varies between the countries. Therefore, our results need to be explored in more robust samples. We note that our sample is more educated in the general population—for example, in our study in China, 27% had a 2-year postsecondary degree, and 53% had a bachelor's degree. The National Bureau of Statistics of China estimates these numbers to be 36% and 18%, respectively, for adults at the age of 25 to 34 years in 2020.⁵⁷ The US Census estimates that 35% of adults in 2020 had a bachelor's degree and 10% had an associate's degree⁵⁸ compared with 52% and 29%, respectively, in our sample. We purposefully asked about preferences for broad groupings of VPD by transmission modality, but we acknowledge that individuals could have varied preferences for vaccines within group (eg, for an influenza vs COVID-19 vaccine or for an HIV vs gonorrhea vaccine). A strength is the similar study design in the United States and in China, which results in us being able to make direct comparisons across countries.

Conclusions

In this DCE, jointly conducted in the United States and in China, we found that the public, when asked about childhood vaccines, had relatively low preferences for STI vaccines versus vaccines for airborne, foodborne, or mosquito-borne infections. With an LCA, the class preferring a cancer vaccine did not accept an STI vaccine. Overall, this study points to the need for more education about how some STI vaccines can also prevent cancers and that doctors should be open in their communication with parents.

Supplemental Material

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.jval.2022.07.019>.

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