ORIGINAL ARTICLE

Validation of a Questionnaire for 18-45 Years of Females to Assess Social Media Usage, Knowledge, and Risk Perception Towards HPV Vaccination Acceptance in China

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ABSTRACT

Introduction: Social media usage, knowledge, and risk perception factors may play pivotal roles in shaping HPV vaccination acceptance. However, limited research has systematically evaluated the validation of questionnaire on these factors. Objective: This study aimed to assess the validity and reliability of a questionnaire designed to measure the impact of social media use, knowledge, and risk perception towards HPV vaccination acceptance in China. **Materials and methods:** To ensure rigorous validity and reliability analysis, the questionnaire underwent assessment using the Face Validity, Content Validity Index (CVI), Content Validity Ratio (CVR), and Cronbach's Alpha coefficient to evaluate validity and reliability as well as mitigate potential misinterpretation of results. **Results:** The final version of questionnaire comprised 78 items across five sections and underwent a rigorous evaluation to ensure both validity and reliability. The CVI, and CVR indicating that all items meet the minimum standards for content validity. Furthermore, in comparison to the initial version of the questionnaire, the Cronbach's Alpha values for each domain in the final version have shown improvement: HPV-related social media usage behavior [Cronbach's Alpha: 0.851 (item numbers: 10)], HPV knowledge [0.818 (25)], risk perception [0.888 (17)], and HPV vaccine acceptance [0.772 (7)]. These values surpass the minimum requirements of the inclusion criteria, signifying enhanced reliability of the revised questionnaire. **Conclusion:** The final version of questionnaire exhibited robust validity and reliability. This validated questionnaire serves as a valuable tool for future research endeavors, emphasizing the significance of meticulous instrument development and validation in yielding high-quality research outcomes in the domain of HPV-related factors.
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Keywords: HPV vaccine, Social media usage, Knowledge, Risk perception, HPV vaccination acceptance, Validation, Reliability

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INTRODUCTION

Human papillomavirus (HPV) is a common sexually transmitted infection that can cause serious health risks such as cervical, anal, and oropharyngeal cancers. Numerous data from World Health Organization (WHO) showed that if it cannot be treated in time, persistent HPV infection of the cervix may cause 95% of cervical cancer. Globally, it is estimated that 620,000 new cancer cases in women were caused by HPV in 2019 (1).

However, HPV infection and cervical cancer can be effectively prevented. WHO took action to eliminate cervical cancer in 2018, in China, the National Health Commission of the People's Republic of China (2023) implemented the "Action Plan to Accelerate the Elimination of Cervical Cancer (2023-2030)", screening and HPV vaccination are considered effective means to eliminate cervical cancer (2). At present, the HPV vaccine as a primary prevention measure for cervical

cancer is being implemented in many countries and regions around the world including China (3-6).

HPV vaccination before engaging in sexual activity is believed to be more effective in preventing HPV infections. In China, the HPV vaccine was introduced in 2016, followed by the launch of the nine-valent HPV vaccine in 2018, targeting females aged 16-26 (7). However, in 2022, the eligibility for the nine-valent vaccine was expanded to include females aged 9-45 (8). Despite its significance in disease prevention, several barriers hinder achieving high vaccination rates. Age, marital status, and income are the main factors that influence HPV vaccination uptake. Moreover, individuals' HPV knowledge, and risk perception also play crucial roles in vaccination decisions (9).

In recent years, social media platforms have emerged as influential channels for disseminating health information, significantly impacting individuals' knowledge, attitudes, and behaviors, including those related to HPV vaccination (10). Understanding the connection between social media usage and HPV vaccination is key to developing targeted interventions.

This pilot study aims to assess the validity and reliability of social media usage, knowledge, and perception towards vaccination acceptance questionnaire among females aged 18-45 in China.

MATERIALS AND METHODS

Study Population and sample size
This pilot study targeted 30 females aged 18-45 years in Xinxiang City, Henan Province, China. The selection of 30 participants as the sample size for this pilot study ensures a sufficient sample size to evaluate the internal consistency of the questionnaire. Online distribution and self-administration of questionnaires were facilitated to gather immediate feedback on the questionnaire content. Participation in the study was entirely voluntary, emphasizing the importance of individual consent.

The online distribution method eliminated geographical constraints, fostering a comprehensive understanding of social media usage, knowledge, risk perception and HPV vaccination acceptance among target population. This approach also minimized unnecessary interviewer interventions, contributing to the validity, reliability and authenticity of the obtained data and feedback. The data collection occurred in December 2023. Figure 1 shows the complete process of item validity and reliability testing.
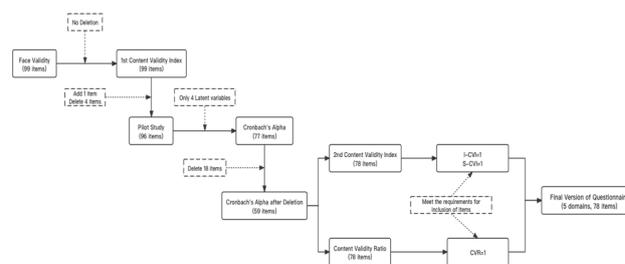

Figure 1: Items Validity and Reliability Testing Process

Questionnaire
Based on the foundation of the previous study, questionnaire entries related to this study were extensively searched through databases such as Web of Science, EBSCO, Scopus, PubMed, and CNKI (China National Knowledge Infrastructure). All items were adapted from published questionnaires. Additionally, a systematic review of factors influencing HPV vaccine acceptance among females in mainland China was conducted and was used to explore the potential questionnaire to be adopted (11).

The full questionnaire was segmented into five domains comprising a total of 99 items. The first section focused on socio-demographic characteristics, encompassing 20 questions. Following this, the second section featured HPV-related social media use behaviors, through the setting of 14 items to evaluate participants' acquisition of HPV-related knowledge through social media. The third section comprised the HPV knowledge, the purpose is to measure participants' foundational understanding of HPV, HPV testing, and the HPV vaccine, with a total of 31 questions. The fourth part was the risk perception, examining participants' perceptions of risk related to HPV and HPV vaccination. Additionally, a dedicated dimension was included to assess participants' awareness of the safety of the HPV vaccine, resulting in a total of 27 questions. The final section investigated participants' acceptance of the HPV vaccination, comprising 8 questions. In the questionnaire, all items were closed-ended, except queries related to the "age of participant" and the "age of daughter" within the socio-demographic characteristics section.

Face Validity
Ten respondents from China were invited to conduct face validity on the items. Different from the expert assessment of content validity, the assessors of face validity should be the public who meet the survey inclusion criteria, rather than experts in the relevant field (12). Face validity is more concerned with measuring whether the items are expressed clearly and effectively,

avoiding the participant's confusion due to excessive professionalism or ambiguity.

The ten interviewees who participated in the face validity assessment all met the inclusion criteria for the target population of the formal study, and the educational level of the participants ranged from junior college to doctoral students. Face validity was conducted in a face-to-face format, with each participant invited one by one to review the questionnaire items and complete the face validity feedback form. According to the feedback results, there is no ambiguity in the understanding of the questionnaire content among the ten respondents.

Content Validity

To ensure the content validity of the research instrument, a panel of four experts was convened to evaluate the validity of the questionnaire entries before initiating the pilot study. The experts comprehensively reviewed all questionnaire entries to ensure that the content of the entry was highly relevant to the research topic and that the presentation was unambiguous. The experts consisted of one public health medicine specialist from Malaysia, and three experts from China: one gynecologist, one social scientist, and one public health specialist, who were engaged to conduct the content validity assessment in English and Chinese language accordingly. Given the study's context in China, the questionnaires were translated into Chinese for distribution. The back-to-back translation was done by native Chinese-speaking professionals who specialize in English language.

Expert panel members evaluated the questionnaires based on content assessment principles, assigning ratings to each item on a four-point scale (1 = The item is not relevant to the measured domain, 2 = The item is somewhat relevant to the measured domain, 3 = The item is quite relevant to the measured domain, 4 = The item is highly relevant to the measured domain) (13).

These ratings were utilized to calculate the Content Validity Index (CVI). Ratings of 1 and 2 indicate that the content is not relevant, while ratings of 3 and 4 indicate relevance. Additionally, experts were encouraged to provide comments on research items and suggest modifications during the review process.

The four experts systematically evaluated the questionnaire content following the Content Validity Index (CVI) assessment guidelines and provided insightful suggestions for modifications. After the revisions, the I-CVI values for each items met the required standards for content validity. These results indicate that the questionnaire scales achieved a satisfactory level of content validity after thorough evaluation and refinement.

Quantification of Content Validity

The initial version of the questionnaire for the CVI consist of a total of 99 items. 93 of the items received I-CVIs 1.00 from the experts on their relevance as shown in Table I. The remaining six items that did not receive I-CVIs 1.00 were; (1) "Do you educate your children about sex" (PF_10), (2)"Have you heard of HPV" (PF_16), (3) "Have you heard of the HPV vaccine"(PF_17), (4) "Using social media is my daily habit" (HRSMUS_4), (5) "I am nervous about the possible negative consequences of getting an HPV vaccine" (HRS_17), and (6) "I believe that contracting the HPV virus is serious and life-threatening" (HRS_27). In addition, it was suggested that the "I would recommend the HPV vaccine to other relatives" should be added in the "HPV vaccine acceptance" domain. Given that the acceptable CVI values for 3-5 experts should be (14). When the results were lower than 1, they should be deleted or modified. Therefore, based on the I-CVI findings and discussion among experts, four of the items were deleted, and the items structure of "Have you heard of HPV" and "Have you heard of the HPV vaccine" was modified. Meanwhile, the item "I would recommend the HPV vaccine to other relatives" was added in the HPV vaccine acceptance domain.

Table I: The I-CVI of all the items (items: 99)

Scale	Code Items (Annex A)	Relevant	Not relevant	I-CVIs *	Interpretation
Personal Factor	PF_1	4	0	1.00	Appropriate
	PF_2	4	0	1.00	Appropriate
	PF_3	4	0	1.00	Appropriate
	PF_4	4	0	1.00	Appropriate
	PF_5	4	0	1.00	Appropriate
	PF_6	4	0	1.00	Appropriate
	PF_7	4	0	1.00	Appropriate
	PF_8	4	0	1.00	Appropriate
	PF_9	4	0	1.00	Appropriate
	PF_10*	3	1	0.75	Eliminated
	PF_11	4	0	1.00	Appropriate
	PF_12	4	0	1.00	Appropriate
	PF_13	4	0	1.00	Appropriate
	PF_14	4	0	1.00	Appropriate

CONTINUE

Table I: The I-CVI of all the items (items: 99).(CONT.)

Scale	Code Items (Annex A)	Relevant	Not relevant	I-CVIs *	Interpretation
	PF_15	4	0	1.00	Appropriate
	PF_16*	3	1	0.75	Revised
	PF_17*	3	1	0.75	Revised
Personal Factor	PF_18	4	0	1.00	Appropriate
	PF_19	4	0	1.00	Appropriate
	PF_20	4	0	1.00	Appropriate
	HRSMUS_1	4	0	1.00	Appropriate
	HRSMUS_2	4	0	1.00	Appropriate
	HRSMUS_3	4	0	1.00	Appropriate
	HRSMUS_4*	3	1	0.75	Eliminated
	HRSMUS_5	4	0	1.00	Appropriate
	HRSMUS_6	4	0	1.00	Appropriate
HPV-related Social Media Use Behaviors	HRSMUS_7	4	0	1.00	Appropriate
	HRSMUS_8	4	0	1.00	Appropriate
	HRSMUS_9	4	0	1.00	Appropriate
	HRSMUS_10	4	0	1.00	Appropriate
	HRSMUS_11	4	0	1.00	Appropriate
	HRSMUS_12	4	0	1.00	Appropriate
	HRSMUS_13	4	0	1.00	Appropriate
	HRSMUS_14	4	0	1.00	Appropriate
	HKS_1	4	0	1.00	Appropriate
	HKS_2	4	0	1.00	Appropriate
	HKS_3	4	0	1.00	Appropriate
	HKS_4	4	0	1.00	Appropriate
	HKS_5	4	0	1.00	Appropriate
	HKS_6	4	0	1.00	Appropriate
	HKS_7	4	0	1.00	Appropriate
	HKS_8	4	0	1.00	Appropriate
	HKS_9	4	0	1.00	Appropriate
	HKS_10	4	0	1.00	Appropriate
	HKS_11	4	0	1.00	Appropriate
	HKS_12	4	0	1.00	Appropriate
	HKS_13	4	0	1.00	Appropriate
	HKS_14	4	0	1.00	Appropriate
	HKS_15	4	0	1.00	Appropriate
HPV Knowledge	HKS_16	4	0	1.00	Appropriate
	HKS_17	4	0	1.00	Appropriate
	HKS_18	4	0	1.00	Appropriate
	HKS_19	4	0	1.00	Appropriate
	HKS_20	4	0	1.00	Appropriate
	HKS_21	4	0	1.00	Appropriate
	HKS_22	4	0	1.00	Appropriate
	HKS_23	4	0	1.00	Appropriate
	HKS_24	4	0	1.00	Appropriate
	HKS_25	4	0	1.00	Appropriate
	HKS_26	4	0	1.00	Appropriate
	HKS_27	4	0	1.00	Appropriate
	HKS_28	4	0	1.00	Appropriate
	HKS_29	4	0	1.00	Appropriate
	HKS_30	4	0	1.00	Appropriate
	HKS_31	4	0	1.00	Appropriate
	HRS_1	4	0	1.00	Appropriate
	HRS_2	4	0	1.00	Appropriate
	HRS_3	4	0	1.00	Appropriate
Risk Perception	HRS_4	4	0	1.00	Appropriate
	HRS_5	4	0	1.00	Appropriate
	HRS_6	4	0	1.00	Appropriate
	HRS_7	4	0	1.00	Appropriate
	HRS_8	4	0	1.00	Appropriate

CONTINUE

Table I: The I-CVI of all the items (items: 99) (CONT.)

Scale	Code Items (Annex A)	Relevant	Not relevant	I-CVIs *	Interpretation
	HRS_9	4	0	1.00	Appropriate
	HRS_10	4	0	1.00	Appropriate
	HRS_11	4	0	1.00	Appropriate
	HRS_12	4	0	1.00	Appropriate
	HRS_13	4	0	1.00	Appropriate
	HRS_14	4	0	1.00	Appropriate
	HRS_15	4	0	1.00	Appropriate
	HRS_16	4	0	1.00	Appropriate
	HRS_17*	3	1	0.75	Eliminated
Risk Perception	HRS_18	4	0	1.00	Appropriate
	HRS_19	4	0	1.00	Appropriate
	HRS_20	4	0	1.00	Appropriate
	HRS_21	4	0	1.00	Appropriate
	HRS_22	4	0	1.00	Appropriate
	HRS_23	4	0	1.00	Appropriate
	HRS_24	4	0	1.00	Appropriate
	HRS_25	4	0	1.00	Appropriate
	HRS_26	4	0	1.00	Appropriate
	HRS_27*	3	1	0.75	Eliminated
	HVAS_1	4	0	1.00	Appropriate
	HVAS_2	4	0	1.00	Appropriate
	HVAS_3	4	0	1.00	Appropriate
	HVAS_4	4	0	1.00	Appropriate
HPV Vaccine Acceptance	HVAS_5	4	0	1.00	Appropriate
	HVAS_6	4	0	1.00	Appropriate
	HVAS_7	4	0	1.00	Appropriate
	HVAS_8	4	0	1.00	Appropriate

Note: * Eliminate items based on I-CVI results.

Statistical analysis

A pilot study is an important part of developing a questionnaire and verifying its validity, and the results of the pilot study are important for improving the questionnaire design (15). This pilot study was conducted using a revised questionnaire. The revised questionnaire was divided into five sections: (i) Personal Factor (19 items), (ii) HPV-related Social Media Use Behaviors (13 items), (iii) HPV Knowledge (31 items), (iv) Risk Perception (25 items), and (V) HPV Vaccination Acceptance (8 items). In total, there were 96 items in the full questionnaire.

The questionnaires were collected online using WJX, and the complete dataset was exported and directly imported into the statistical software SPSS 29.0 for MacBook for analysis. Based on the objectives of this research, only the content validity and reliability analysis of the pilot study results was conducted, and no further descriptive analysis was carried out.

Alpha was developed by Lee Cronbach in 1951 to measure the internal consistency of a test or scale, using a number between 0 and 1. Cronbach's alpha changes with the number of test items, item correlation, and dimension (16). Acceptable alpha values mentioned in common studies range from 0.70 to 0.90 (17, 18). Alpha values that are too low may indicate poor correlation between internal items, while those that are too high may suggest redundancy and duplication of some items (19).

Ethical Clearance

Ethical approval was obtained from the Ethics Committee for Research Involving Human Subjects of Universiti Putra Malaysia (JKEUPM-2023-1146). In addition, this study was also reviewed and approved from the Ethics Committee of Xinxiang Medical University (XYLL-20230288). Consent from each participant was obtained using a consent form upon the agreement to participate in the study before answering the baseline questionnaire. No minors were involved in this study and participants are allowed to withdraw at any point without any penalty.

RESULTS

Validation of the questionnaire

There was no reliability testing for socio-demographic characteristics. For this pilot study, only four domains (latent variable) which are (i) HPV-related Social Media Use behaviors, (ii) HPV Knowledge, (iii) Risk Perception, and (iv) HPV Vaccine Acceptance were analyzed.

The initial Cronbach's alpha for the HPV-related Social Media Use behaviors, HPV Knowledge, Risk Perception, and HPV Vaccine Acceptance are shown in Figure 2 and Table II below. These results showed that the internal

consistency of the original questionnaire was satisfied except HPV testing knowledge and perceived safety of vaccine, although a higher Cronbach's alpha would have been obtained if certain items were deleted.

Table II: reliability analysis, item-total correlation, and variability of Cronbach's alpha if one item was deleted based on each dimension (items: 99).

Dimension	Item Code (Annex A)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
HPV-related Social Media Use Behaviors [0.821(13)]					
Contact Strengths [0.725(5)]	HRSMUS _1	14.67	6.92	0.575	0.631
	HRSMUS _2	14.43	7.633	0.462	0.679
	HRSMUS_3*	14.93	7.789	0.324	0.742
	HRSMUS_4	14.6	7.145	0.601	0.624
	HRSMUS_5*	14.43	8.047	0.469	0.678
Social Media Trust [0.830(3)]	HRSMUS_6	7.23	1.978	0.563	0.893
	HRSMUS_7	7.37	1.62	0.878	0.568
	HRSMUS_8	7.53	1.982	0.653	0.8
Social Media Information Satisfaction [0.671(5)]	HRSMUS_9	15.7	3.597	0.58	0.539
	HRSMUS_10	15.77	3.633	0.631	0.517
	HRSMUS_11	15.67	4.437	0.38	0.639
	HRSMUS_12*	15.73	4.685	0.222	0.712
	HRSMUS_13	15.67	4.782	0.35	0.651
HPV Knowledge [0.811(31)]					
HPV General Knowledge [0.708(15)]	HKS_1	9.17	6.557	0.218	0.708
	HKS_2	8.87	6.809	0.247	0.70
	HKS_3	8.87	6.189	0.62	0.662
	HKS_4	9	6.138	0.464	0.673
	HKS_5	8.9	6.783	0.227	0.702
	HKS_6	9.37	6.309	0.335	0.691
	HKS_7	8.77	7.22	0.124	0.708
	HKS_8*	9.73	7.375	0	0.711
	HKS_9	9.27	6.409	0.276	0.70
	HKS_10	9	6.207	0.431	0.678
	HKS_11	9.03	6.447	0.3	0.695
	HKS_12	8.80	6.648	0.506	0.682
	HKS_13	9.33	6.299	0.331	0.691
	HKS_14	8.90	6.576	0.337	0.69
	HKS_15	9.27	6.409	0.276	0.70
HPV Testing Knowledge [0.390(7)]	HKS_16*	2.27	1.995	0.172	0.357
	HKS_17	2.17	1.799	0.267	0.304
	HKS_18	1.90	1.403	0.551	0.098
	HKS_19	2.13	1.706	0.329	0.265
	HKS_20	2.00	1.931	0.098	0.397
	HKS_21	2.13	1.982	0.095	0.395
	HKS_22*	2.00	2.345	-0.179	0.539
HPV Vaccination Knowledge [0.689(9)]	HKS_23	6.43	3.082	0.275	0.682
	HKS_24	6.33	2.92	0.545	0.631
	HKS_25	6.47	2.878	0.395	0.656
	HKS_26	6.3	2.838	0.731	0.605
	HKS_27*	6.5	3.155	0.187	0.704
	HKS_28	6.37	2.792	0.59	0.617

CONTINUE

Table II: reliability analysis, item-total correlation, and variability of Cronbach's alpha if one item was deleted based on each dimension (items: 99). (CONT.)

Dimension	Item Code (Annex A)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
HPV Knowledge [0.811(31)]					
HPV Vaccination Knowledge [0.689(9)]	HKS_29*	6.43	3.289	0.134	0.711
	HKS_30*	6.5	3.086	0.232	0.695
	HKS_31	6.27	3.168	0.499	0.651
Risk Perception [0.852(25)]					
HPV Risk Perception [0.866(13)]	HRS_1	43.1	43.679	0.824	0.842
	HRS_2	43.1	42.024	0.802	0.84
	HRS_3	43.63	43.068	0.712	0.845
	HRS_4	43.23	43.082	0.784	0.842
	HRS_5	43.37	43.137	0.651	0.849
	HRS_6	42.97	43.757	0.739	0.845
	HRS_7	43.13	43.568	0.674	0.848
	HRS_8	43.03	42.447	0.77	0.842
	HRS_9	42.9	44.369	0.698	0.848
	HRS_10	44.6	49.421	0.085	0.891
	HRS_11	43.13	48.602	0.347	0.865
	HRS_12*	45.1	49.955	0.09	0.884
	HRS_13	44.7	48.493	0.21	0.876
HPV vaccination Risk Perception [0.748(8)]	HRS_14*	23.8	10.993	0.617	0.684
	HRS_15	23.7	10.217	0.661	0.671
	HRS_16	23.7	10.769	0.593	0.689
	HRS_17	22.97	12.792	0.501	0.713
	HRS_18	23.07	12.202	0.621	0.693
	HRS_19*	22.9	14.369	0.255	0.751
	HRS_20	22.93	13.995	0.334	0.74
	HRS_21*	22.9	15.61	-0.037	0.794
Perceived Safety of Vaccines* [0.033(4)]	HRS_22*	9.3333	1.402	0.319	-.386a
	HRS_23*	10.1333	1.982	-0.186	0.322
	HRS_24*	9.3667	1.275	0.399	-.544a
	HRS_25*	10.8667	1.637	-0.183	0.461
HPV Vaccine Acceptance [0.771(8)]					
HPV Vaccine Acceptance [0.771(8)]	HVAS_1	40.9	27.197	0.359	0.768
	HVAS _2	41.07	26.271	0.425	0.756
	HVAS _3	40.77	26.668	0.387	0.764
	HVAS _4	39.77	25.564	0.521	0.737
	HVAS _5	39.43	26.254	0.712	0.715
	HVAS _6	39.57	26.392	0.576	0.73
	HVAS _7	39.6	26.11	0.612	0.724
	HVAS _8*	39.5	29.914	0.295	0.772

Note: * Items deletion

Figure 2: Internal consistency of domain and dimension according to conceptual framework before deletion and modification.
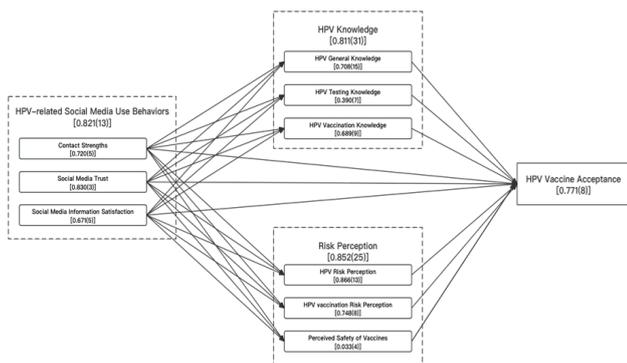

Figure 3: Internal consistency of domain and dimension according to conceptual framework after deletion and modification.

Modification of questionnaire items

Although Cronbach's alpha for the four domain of HPV-related social media use behaviors, HPV knowledge, risk perception, and HPV vaccination acceptance yielded more satisfactory results. However, considering the rigor of the questionnaire structure, we calculated separate Cronbach's alpha for the internal dimensions of each scale. According to the results of "Cronbach's Alpha if Item Deleted", the content of the scales was modified and screened based on the discussion with subject matter expert including supervisory committee during the pilot study.

In the HPV-related Social Media Use Behaviors, items HRSMUS _3, HRSMUS _5, and HRSMUS _12 were excluded; in the HPV Knowledge, items HKS_8, HKS_16, HKS_22, HKS_27, HKS_29, and HKS_30 were excluded; and in the HPV Vaccine Acceptance Scale, item HVAS_8 was excluded, while the original internal dimensions remained unchanged. The results show that Cronbach's Alpha of the dimension " Perceived Safety of Vaccines " is only 0.033, which means that this dimension may not be suitable for studying Risk Perception. Therefore, this dimension (items HRS_22, HRS_23, HRS_24, HRS_25) was deleted, and in addition, items HRS_12, HRS_14, HRS_19, and HRS_21 were also eliminated.

The total number of questions was adjusted from the original 96 to 78. Cronbach's alpha was recalculated after the adjustment, and the results are shown in Figure 3. The final version of questionnaire are shown in annex C.
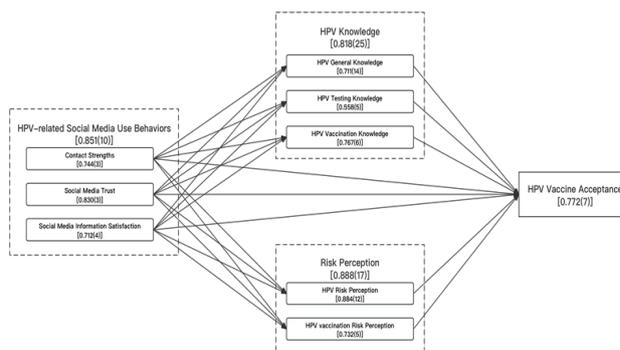
The results showed that the reliability of each domain and dimension after deletion and modification were satisfactory, and compared with the questionnaire before deletion, the reliability of the revised version was higher than the original version, which shows that the deletion and modification of the items is meaningful.

It is worth mentioning that Cronbach's Alpha of HPV testing knowledge in HPV Knowledge is not high, which means that the internal consistency of this dimension is low, indicating that there may be some heterogeneity in the item content. In the retest of the revised version questionnaire, this part should be focused on.

Quantification of Content Validity for Final Version

The final version of the questionnaire underwent significant changes compared to the original version. To ensure the validity of the questionnaire, a secondary content validity review was conducted, along with a content validity ratio analysis, focusing on the relevance and necessity of the questionnaire items.

To maintain the rigor of the content validity audit and facilitate comparisons with the initial audit, two new experts were added to the original expert review team, resulting in a total of six experts participating in the secondary review. The new experts included one social science expert from China and one public health expert from Malaysia. It's important to note that since the questionnaire is ultimately distributed in Chinese, any suggestions made by English-proficient experts for modifying item expressions should consider potential

ambiguities in the Chinese context.

The final version of the Content Validity Index (CVI) review questionnaire consisted of a total of 78 items. During the secondary CVI review, all 78 items obtained a perfect correlation of I-CVI 1.00, as depicted in Table III. Considering that the acceptable CVI value for six experts should be 0.83 (13,20), the revised questionnaire achieved satisfactory results during the expert review of CVI.

Table III: The I-CVI for final version of questionnaire (items: 78)

Scale	Items Code (Annex B)	Relevant	Not relevant	I-CVI	Interpretation
Personal Factor	PF_1	6	0	1.00	Appropriate
	PF_2	6	0	1.00	Appropriate
	PF_3	6	0	1.00	Appropriate
	PF_4	6	0	1.00	Appropriate
	PF_5	6	0	1.00	Appropriate
	PF_6	6	0	1.00	Appropriate
	PF_7	6	0	1.00	Appropriate
	PF_8	6	0	1.00	Appropriate
	PF_9	6	0	1.00	Appropriate
	PF_10	6	0	1.00	Appropriate
	PF_11	6	0	1.00	Appropriate
	PF_12	6	0	1.00	Appropriate
	PF_13	6	0	1.00	Appropriate
	PF_14	6	0	1.00	Appropriate
	PF_15	6	0	1.00	Appropriate
	PF_16	6	0	1.00	Appropriate
	PF_17	6	0	1.00	Appropriate
	PF_18	6	0	1.00	Appropriate
	PF_19	6	0	1.00	Appropriate
HPV-related Social Media Use Behaviors	HRSMUS_1	6	0	1.00	Appropriate
	HRSMUS_2	6	0	1.00	Appropriate
	HRSMUS_3	6	0	1.00	Appropriate
	HRSMUS_4	6	0	1.00	Appropriate
	HRSMUS_5	6	0	1.00	Appropriate
	HRSMUS_6	6	0	1.00	Appropriate
	HRSMUS_7	6	0	1.00	Appropriate
	HRSMUS_8	6	0	1.00	Appropriate
	HRSMUS_9	6	0	1.00	Appropriate
	HRSMUS_10	6	0	1.00	Appropriate
HPV Knowledge	HKS_1	6	0	1.00	Appropriate
	HKS_2	6	0	1.00	Appropriate
	HKS_3	6	0	1.00	Appropriate
	HKS_4	6	0	1.00	Appropriate
	HKS_5	6	0	1.00	Appropriate
	HKS_6	6	0	1.00	Appropriate
	HKS_7	6	0	1.00	Appropriate
	HKS_8	6	0	1.00	Appropriate
	HKS_9	6	0	1.00	Appropriate
	HKS_10	6	0	1.00	Appropriate
	HKS_11	6	0	1.00	Appropriate
	HKS_12	6	0	1.00	Appropriate
	HKS_13	6	0	1.00	Appropriate
	HKS_14	6	0	1.00	Appropriate
	HKS_15	6	0	1.00	Appropriate
	HKS_16	6	0	1.00	Appropriate
	HKS_17	6	0	1.00	Appropriate
	HKS_18	6	0	1.00	Appropriate
	HKS_19	6	0	1.00	Appropriate
	HKS_20	6	0	1.00	Appropriate
	HKS_21	6	0	1.00	Appropriate
	HKS_22	6	0	1.00	Appropriate

Table III: The I-CVI for final version of questionnaire (items: 78) (CONT.)

Scale	Items Code (Annex B)	Relevant	Not relevant	I-CVI	Interpretation
HPV Knowledge	HKS_23	6	0	1.00	Appropriate
	HKS_24	6	0	1.00	Appropriate
	HKS_25	6	0	1.00	Appropriate
	HRS_1	6	0	1.00	Appropriate
	HRS_2	6	0	1.00	Appropriate
	HRS_3	6	0	1.00	Appropriate
	HRS_4	6	0	1.00	Appropriate
	HRS_5	6	0	1.00	Appropriate
	HRS_6	6	0	1.00	Appropriate
	HRS_7	6	0	1.00	Appropriate
	HRS_8	6	0	1.00	Appropriate
Risk Perception	HRS_9	6	0	1.00	Appropriate
	HRS_10	6	0	1.00	Appropriate
	HRS_11	6	0	1.00	Appropriate
	HRS_12	6	0	1.00	Appropriate
	HRS_13	6	0	1.00	Appropriate
	HRS_14	6	0	1.00	Appropriate
	HRS_15	6	0	1.00	Appropriate
	HRS_16	6	0	1.00	Appropriate
	HRS_17	6	0	1.00	Appropriate
	HVAS_1	6	0	1.00	Appropriate
	HVAS_2	6	0	1.00	Appropriate
	HVAS_3	6	0	1.00	Appropriate
HPV Vaccine Acceptance	HVAS_4	6	0	1.00	Appropriate
	HVAS_5	6	0	1.00	Appropriate
	HVAS_6	6	0	1.00	Appropriate
	HVAS_7	6	0	1.00	Appropriate

Content Validity Ratio

The content validity ratio (CVR) proposed by Lawshe (1975) is a linear transformation of a proportional level of agreement on how many "experts" within a panel rate an item "essential" (21,22). The CVR is a measure used to assess the essentiality of questionnaire items, with values ranging from -1 to +1. Experts rate each item on a three-point scale: 1 = not necessary, 2 = useful but not essential, and 3 = essential. The CVR is calculated by dividing the difference between the number of panelists indicating an item as "essential" and half the number of panelists, by half the number of panelists (CVR = (ne - N/2) / (N/2)). A higher CVR score indicates greater agreement among expert panelists regarding the necessity of the items. The minimum acceptable CVR value for the six panel experts involved in this study is 0.99 (21). The results of the CVR are shown in Table IV.

Table IV: The CVR for final version of questionnaire (items: 78)

Scale	Items code (Annex B)	Essential	Not Essential	CVR	Interpretation
	PF_1	6	0	1.00	Essential
	PF_2	6	0	1.00	Essential
	PF_3	6	0	1.00	Essential
	PF_4	6	0	1.00	Essential
	PF_5	6	0	1.00	Essential
	PF_6	6	0	1.00	Essential
	PF_7	6	0	1.00	Essential
	PF_8	6	0	1.00	Essential
	PF_9	6	0	1.00	Essential
Personal Factor	PF_10	6	0	1.00	Essential
	PF_11	6	0	1.00	Essential
	PF_12	6	0	1.00	Essential
	PF_13	6	0	1.00	Essential
	PF_14	6	0	1.00	Essential
	PF_15	6	0	1.00	Essential
	PF_16	6	0	1.00	Essential
	PF_17	6	0	1.00	Essential
	PF_18	6	0	1.00	Essential
	PF_19	6	0	1.00	Essential

Table IV: The CVR for final version of questionnaire (items: 78). (CONT.)

Scale	Items code (Annex B)	Essential	Not Essential	CVR	Interpretation
HPV-related Social Media Use Behaviors	HRSMUS_1	6	0	1.00	Essential
	HRSMUS_2	6	0	1.00	Essential
	HRSMUS_3	6	0	1.00	Essential
	HRSMUS_4	6	0	1.00	Essential
	HRSMUS_5	6	0	1.00	Essential
	HRSMUS_6	6	0	1.00	Essential
	HRSMUS_7	6	0	1.00	Essential
	HRSMUS_8	6	0	1.00	Essential
	HRSMUS_9	6	0	1.00	Essential
	HRSMUS_10	6	0	1.00	Essential
HPV Knowledge	HKS_1	6	0	1.00	Essential
	HKS_2	6	0	1.00	Essential
	HKS_3	6	0	1.00	Essential
	HKS_4	6	0	1.00	Essential
	HKS_5	6	0	1.00	Essential
	HKS_6	6	0	1.00	Essential
	HKS_7	6	0	1.00	Essential
	HKS_8	6	0	1.00	Essential
	HKS_9	6	0	1.00	Essential
	HKS_10	6	0	1.00	Essential
	HKS_11	6	0	1.00	Essential
	HKS_12	6	0	1.00	Essential
	HKS_13	6	0	1.00	Essential
	HKS_14	6	0	1.00	Essential
	HKS_15	6	0	1.00	Essential
	HKS_16	6	0	1.00	Essential
	HKS_17	6	0	1.00	Essential
	HKS_18	6	0	1.00	Essential
	HKS_19	6	0	1.00	Essential
	HKS_20	6	0	1.00	Essential
	HKS_21	6	0	1.00	Essential
	HKS_22	6	0	1.00	Essential
	HKS_23	6	0	1.00	Essential
	HKS_24	6	0	1.00	Essential
	HKS_25	6	0	1.00	Essential
Risk Perception	HRS_1	6	0	1.00	Essential
	HRS_2	6	0	1.00	Essential
	HRS_3	6	0	1.00	Essential
	HRS_4	6	0	1.00	Essential
	HRS_5	6	0	1.00	Essential
	HRS_6	6	0	1.00	Essential
	HRS_7	6	0	1.00	Essential
	HRS_8	6	0	1.00	Essential
	HRS_9	6	0	1.00	Essential
	HRS_10	6	0	1.00	Essential
	HRS_11	6	0	1.00	Essential
	HRS_12	6	0	1.00	Essential
	HRS_13	6	0	1.00	Essential
	HRS_14	6	0	1.00	Essential
	HRS_15	6	0	1.00	Essential
	HRS_16	6	0	1.00	Essential
	HRS_17	6	0	1.00	Essential
HPV Vaccine Acceptance	HVAS_1	6	0	1.00	Essential
	HVAS_2	6	0	1.00	Essential
	HVAS_3	6	0	1.00	Essential
	HVAS_4	6	0	1.00	Essential
	HVAS_5	6	0	1.00	Essential
	HVAS_6	6	0	1.00	Essential
	HVAS_7	6	0	1.00	Essential

DISCUSSION

After completing the sorting of previous research items, an initial item pool was established, followed by a face validity assessment and an expert-invited content validity review. Based on the results of the Content Validity Index (CVI), modifications, eliminations, and necessary additions were made to the item pool, which was then subjected to a pilot study. The Cronbach's Alpha values of the initial questionnaire are as follows: HPV-related social media use behaviors [0.821 (13)], HPV knowledge [0.811 (31)], risk perception [0.852 (25)], and HPV vaccine acceptance [0.771(8)]. However, specific dimensions such as "HPV testing knowledge" within HPV knowledge and "perceived safety of vaccines" within risk perception exhibited significant reliability issues, indicating potential weaknesses in these dimensions' reliability and the need for further refinement.

To address these concerns, targeted adjustments were made based on empirical research findings and expert suggestions, including the deletion of the "perceived safety of vaccines" dimension within risk perception and editing, revising, and eliminating other items to enhance the questionnaire's overall effectiveness, reliability, and validity. This revision aimed to elevate the questionnaire's quality and suitability for assessing HPV-related social media usage behavior, HPV knowledge, risk perception, and HPV vaccine acceptance among the target population.

The revised final questionnaire comprised a total of 78 items across five domains and underwent comprehensive evaluation through CVI, CVR, and Cronbach's Alpha review to ensure its reliability and validity. The results demonstrated that all items met or exceeded minimum content validity standards and surpassed the threshold for expert consensus. Furthermore, the Cronbach's Alpha values for each domain of the final questionnaire exhibited significantly improved reliability compared to the preliminary version, exceeding the minimum requirements of the inclusion criteria.

Recommendations
Conduct Large-Sample Surveys Across Different Regions and Populations: While the current study has established the reliability and validity of the final questionnaire version, future research should prioritize conducting large-sample surveys across diverse regions and populations. This approach will enhance the universality and practicality of the questionnaire, ensuring its applicability across various cultural backgrounds and demographic groups.

Implement Longitudinal Research Methods: While the current study adopted a cross-sectional design, future research could benefit from employing longitudinal research methods to track changes in HPV-related knowledge, attitudes, and behaviors over time. By using validated questionnaires in longitudinal studies, researchers can gain valuable insights into the dynamic nature of HPV-related factors, facilitating a deeper understanding of intervention effects and trends in vaccine acceptance.

Integrate the Validated Questionnaire into Health Service Management Programs: The validated questionnaire holds potential utility in health service management programs aimed at promoting HPV vaccination. By integrating the questionnaire into routine assessments and surveys conducted by healthcare providers and public health agencies, valuable data can be collected to inform targeted interventions and strategies aimed at increasing HPV vaccination rates. This integration will facilitate the collection of real-time data to monitor vaccination trends and assess the effectiveness of intervention efforts.

Strength and limitation
This study adopted a rigorous and comprehensive validation process to ensure the reliability and validity of the questionnaire through face validity, CVI, CVR, and Cronbach's Alpha review. The resulting validated questionnaire encompasses a broad spectrum of factors pertinent to HPV vaccine acceptance, furnishing researchers and healthcare professionals with a comprehensive tool for evaluating HPV vaccine acceptance within target populations. Moreover, the validated questionnaire enables the identification of barriers to HPV vaccination among the target population, offering tailored insights to inform the development of interventions aimed at augmenting vaccination rates.

However, certain limitations should be acknowledged. Firstly, the study's limited sample size and regional focus may curtail its generalizability. Future research endeavors should endeavor to validate the questionnaire across larger and more diverse populations spanning various geographical regions to enhance its applicability across different contexts. Additionally, the reliance on self-administered questionnaires may introduce self-report bias, potentially stemming from participants' cognitive biases or imperfect recall. Subsequent research should explore avenues to mitigate self-report bias and enhance the questionnaire's validity, perhaps by integrating objective measures where feasible.

CONCLUSION

These findings underscore the critical importance of methodological rigor in questionnaire development, ensuring the creation of robust research instruments. The validated questionnaire holds promise as a valuable resource for future studies aimed at identifying and addressing barriers to HPV vaccine uptake, thereby contributing to enhanced public health outcomes in HPV prevention and vaccination efforts.

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