



Evaluating the psychometric properties of the Chinese version of the modified Carolina Human Papillomavirus immunisation attitudes and beliefs scale among Chinese adolescent girls

Janita Pak Chun Chau, Suzanne Hoi Shan Lo^{*}, Laveeza Butt, Kai Chow Choi

The Nethersole School of Nursing, Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong

ABSTRACT

Human Papillomavirus (HPV) vaccine uptake among adolescents is influenced by their views and perceptions of the vaccination. The modified Carolina HPV Immunisation Attitudes and Beliefs Scale (CHIAS) is a well-established instrument to measure adolescents' views of HPV vaccination. However, there is currently no Chinese version available to inform HPV vaccination promotion efforts among Chinese adolescents. This study aimed to translate and validate the Chinese version of the modified CHIAS (CHIAS-C). A cross-sectional descriptive study was carried out with 212 female adolescents recruited from secondary schools. Internal consistency, convergent validity, and construct validity were examined. Cronbach's alpha of the five domains ranged from 0.60 to 0.89, suggesting acceptable internal consistency. Both positive and negative correlations were found between CHIAS-C domains and HPV vaccination intention, indicating convergent validity. Factorial validity was established through confirmatory factor analysis. Our findings suggest that adolescents had generally positive perceptions of HPV vaccination and were likely to accept vaccination if given more relevant information. It was found that most adolescents had neither attended any school talks about HPV nor spoken about the vaccination with healthcare providers. This illustrates that adolescents experience a lack of communication and education about HPV vaccination, both of which can be enhanced in order to persuade adolescents to receive the vaccination. The results suggest that the CHIAS-C is a reliable and valid tool to measure adolescents' views of HPV vaccination. The translated scale may therefore be used in future adolescent research and to inform the development of interventions to increase HPV vaccine uptake.

1. Introduction

Background.

Human papillomavirus (HPV)-associated cancers account for about 5.2% of all human cancers globally. All cervical cancers are attributable to HPV infection (Oh & Weiderpass, 2014). Cervical cancer is the fourth leading cancer in females worldwide, with 570,000 new cases in 2018 (World Health Organization, 2021). In Hong Kong, cervical cancer was the seventh leading cancer in females in 2018 and the eighth leading cause of female cancer deaths in 2019 (2.6% of all female cancer deaths) (Centre for Health Protection [CHP], 2021). A systematic review of 32 studies reported that women surviving cervical cancer had compromised health-related quality of life and sexual function compared with the matched general population (Ye et al., 2014).

Most infections by common types HPV are preventable by vaccination, including those caused by HPV types 16, 18, 31, 33, 45, 52, and 58, which are the primary cause of cervical cancer (CHP, 2020). Large epidemiological studies and reviews have consistently reported high efficacy of HPV vaccines in preventing both HPV infection and the development of associated diseases, a high degree of safety, and a

protection period of up to 10 years (Bergman et al., 2019; Harper and DeMars, 2017; Lee & Garland, 2017; Lehtinen et al., 2017). HPV vaccination has been recommended for all girls aged 9–26 years since 2007, and for all boys aged 11–26 years since 2011. However, despite the widespread endorsement and recommendations, an estimated global rate of HPV vaccination was only 39.7% among women aged 9–45 years. A much lower rate of 6.1% is reported among those aged 10–20 years (Bruni et al., 2016). Similarly in Hong Kong, a systematic review reported an extremely low uptake rate of HPV vaccine among adolescents, ranging from 2.4% to 9.1% (Loke et al., 2017). Conversely, recent statistics on seasonal influenza vaccination for targeted high risk groups show high vaccine acceptance, with over 65% of children aged 6–12 and nearly 40% of older adults aged 65 or above being vaccinated (CHP, 2022).

Adolescents are frequently passive in the decision-making process of receiving vaccination (Herman et al., 2019), however, their attitudes towards and beliefs about HPV and its vaccine could affect their uptake of the vaccination. In a study which examined the predictors of HPV vaccination in low-income adolescents, the results showed that positive perceptions of vaccine safety and the receipt of written vaccination

^{*} Corresponding author at: ELB 826, 8/F, Esther Lee Building, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong.
E-mail address: suzannelo@cuhk.edu.hk (S. Hoi Shan Lo).

information from a health care provider were significantly associated with the adolescents' completion of the serial HPV vaccination (Gerend et al., 2019). On the contrary, negative views of HPV vaccination such as fear of side effects and poor knowledge of HPV infection were frequent causes of vaccine hesitancy (Anagnostou et al., 2017). Given the sub-optimal HPV vaccination coverage among female adolescents in Hong Kong, it is crucial to develop reliable and valid tools to evaluate their views regarding HPV and its vaccine. These tools will help provide useful evidence for developing tailored interventions to boost HPV vaccine uptake, and hence safeguard adolescent health.

The modified Carolina Human papillomavirus Immunisation Attitudes and Beliefs Scale (CHIAS) (Dempsey et al., 2014) has been developed to assess adolescents' attitudes and beliefs regarding HPV and HPV vaccination (Natipagon-Shah et al., 2021). However, no Chinese language version of the scale has been available to inform the development and evaluation of strategies aimed at improving attitudes and acceptance of HPV vaccination and increasing vaccine uptake among the Chinese population. This study aimed to address this gap by translating the modified CHIAS into Chinese and by examining its internal consistency, and factorial and convergent validity in a Chinese-speaking population.

2. Methods

2.1. Design

A cross-sectional study was conducted to examine the internal consistency, and factorial and convergent validity of the Chinese version of the modified CHIAS (CHIAS-C) in adolescents.

2.2. Translation

The modified CHIAS was first translated into Chinese by one post-doctoral fellow and two PhD students. The resulting versions of the modified CHIAS-C were compared and reviewed by bilingual research team members to resolve any discrepancies. Another PhD student then carried out the blinded back-translation of the modified CHIAS-C to ensure semantic equivalence (Chang et al., 2001). A review of the back-translation and original scale was conducted by a multi-disciplinary team of five experts in health, nursing, and paediatrics. To establish content validity, the second draft of the modified CHIAS-C was administered to eight bilingual PhD in nursing students who rated the appropriateness of the translation using a 4-point Likert scale (1 = very inappropriate to 4 = very appropriate). The scale achieved a satisfactory item-content validity index (CVI) and scale-CVI of 0.88, which is in line with the recommended value of 0.8 or above (Lynn, 1986). Minor language modifications were made and the CHIAS-C was finalised.

2.3. Sample

A convenience sample of 212 students was recruited from five secondary schools. The inclusion criteria included (1) 14 to 18 years old, and (2) female. The sample size was determined for examining the psychometric properties of the modified CHIAS-C, including factorial and convergent validity, and internal consistency. According to the rule of thumb as recommended by Everitt (1975) and Kline (1994), the number of subjects to items ratio should be at least 10 for performing factor analysis for evaluating factorial validity. By this standard, at least 170 adolescents would be adequate for conducting factor analysis of the 17-item modified CHIAS-C. Furthermore, a sample size of 170 participants would allow the study to detect a correlation coefficient of value as small as 0.21 with 80% power at a 5% level of significance. This would be sufficient for examining the convergent validity of the instrument by using correlational analysis. Such a sample size of 170 participants also fulfils the criterion of at least 30 participants for assessing internal consistency by using Cronbach's alpha as suggested by Yurdugül (2008).

2.4. Measures

2.4.1. Adolescents' attitudes and beliefs regarding HPV vaccination

The 17-item modified CHIAS (Dempsey et al., 2014) was used to measure adolescents' attitudes and beliefs about HPV vaccination. Participants were asked to rate each item on an 11-point scale, with higher values denoting less endorsement of HPV vaccination. The scale was validated in 139 college-aged women and yielded a factor structure similar to studies in which parents were assessed. Three of the factors (Barriers, Harms, and Effectiveness) show good internal consistency, with Cronbach's alpha from 0.74 to 0.90, whilst the other two factors (Uncertainty and Risk denial) have Cronbach's alpha of 0.43 to 0.49 (Dempsey et al., 2014). Overall, the scale was found to be reliable in assessing attitudes and beliefs about HPV vaccination.

2.4.2. Immunisation status and intention

(1) HPV vaccine uptake as determined by the proportion of female adolescents vaccinated; (2) Adolescents' intention to vaccinate on a 10-point Likert scale (1 = definitely not, 10 = definitely) (Hofman et al., 2013).

2.4.3. Socio-demographic and previous vaccinations

The following information was recorded: adolescents' age and immunisation history; receipt of influenza and HPV vaccine; attendance of school talks regarding HPV vaccination; receipt of HPV vaccine by other family members; and whether HPV vaccination has been discussed with healthcare professionals.

2.5. Data collection methods

Ethical approval was obtained from the Survey and Behavioural Research Ethics Committee of the University. Participants' rights and safety were protected in adherence to local laws, the Declaration of Helsinki, institutional policies and the ICH-GCP. Eligible participants received explanations of the study, potential risks or benefits, right to confidentiality, and right to withdraw from the study without negative consequences. Voluntary participation was emphasised. All participants were asked to sign informed consent forms. All information collected was kept confidential. A web-based mobile device with a user-friendly self-report system was developed to facilitate data collection.

2.6. Statistical analysis

Appropriate descriptive statistics were used to summarise and present the participants' characteristics. Normality of continuous variables, including the modified CHIAS-C domain scores and intention score of HPV vaccination (rated over 1 to 10) was assessed based on their skewness statistics and normal probability plots. Internal consistency, which indicates the reliability of different scale items in measuring the same construct, was assessed using Cronbach's alpha. Convergent validity, which assesses correlation between tests of the same construct, was evaluated by correlating the domain scores of the modified CHIAS-C with intention of HPV vaccination and assessed using Pearson correlation coefficient. Structural validity, which refers to the appropriate reflection of a construct's dimensionality in its factor structure, was examined using confirmatory factor analysis (CFA). Specifically, the five-factor structure as demonstrated by Dempsey et al. (2014), which includes the domains of barriers, harms, effectiveness, risk denial, and uncertainty, was examined by CFA. Several goodness-of-fit indices were adopted to assess the overall fit of the CFA model, including chi-square statistic to degree of freedom ratio (χ^2/df), the root-mean-square error of approximation (RMSEA), the standardised root-mean-square residual (SRMR), the non-normed fit index (NNFI), and the comparative fit index (CFI). An acceptable model fit was indicated by a χ^2/df value < 3 , a RMSEA value < 0.1 , a SRMR value < 0.1 , a NNFI ≥ 0.95 and a CFI value ≥ 0.9 (Bentler, 1990). The CFA was conducted using Lisrel 9.3

(Scientific Software International Inc.). All other statistical tests were performed using IBM SPSS 26 (IBM Corp., Armonk, NY). The statistical tests involved were all two-sided with the level of significance set at 0.05.

3. Results

3.1. Participants' characteristics

A total of 212 female secondary school students were recruited. The characteristics of the participants are presented in Table 1. Participants' mean age was 15.4 years (SD, 1.3). Over 70% of participants had received the influenza vaccine and the HPV vaccine uptake rate was 29.2%. The mean HPV vaccination intention score of unvaccinated participants was 6.0 (SD, 1.9) (ranging from 1 = definitely not to 10 = definitely). Among family members, the uptake of HPV vaccine was even lower at 15.1%. Nearly half of the adolescents (47.9%) had seen a doctor or health professional in the past year but only 3.3% of them had discussed the HPV vaccination in the visit. Only 17% had ever attended a talk about HPV vaccination.

3.2. Reliability

Internal consistency of the five domains of the modified CHIAS-C was determined using Cronbach's alpha. The translated instrument showed acceptable internal consistency with Cronbach's alpha of the five domains ranging from 0.60 to 0.89 (Table 2).

3.3. Convergent validity

Pearson's correlation coefficient was used to assess the strength of the relationship between the modified CHIAS-C and intention of HPV vaccination. Significant negative correlations were found between the domain scores of "Harms" ($r = -0.378, p < 0.001$) and "Risk denial" ($r = -0.405, p < 0.001$), and the intention score of HPV vaccination (Table 3). Significant positive correlations were found between domain scores of "Effectiveness" ($r = 0.219, p = 0.001$) and "Uncertainty" ($r = 0.389, p < 0.001$), and the intention score of HPV vaccination (Table 3). Convergent validity of the modified CHIAS-C was therefore indicated.

Table 1
Characteristics of the study sample (Students, N = 212).

	Mean (SD)/n (%)
Age (years) †	15.4 (1.3)
Had ever had an uptake of influenza vaccine	
No	61 (29.6%)
Yes	145 (70.4%)
Had ever had an uptake of HPV vaccine	
No	150 (70.8%)
Yes	62 (29.2%)
Your family member had ever had an uptake of HPV vaccine	
No/Don't know	180 (84.9%)
Yes	32 (15.1%)
Had seen a doctor or health professional in the past year	
No	110 (52.1%)
Yes	101 (47.9%)
Ever discussed with a health professional about HPV vaccination in the past year	
No	203 (96.7%)
Yes	7 (3.3%)
Had ever had attended a school talk about HPV vaccination	
No	175 (82.9%)
Yes	36 (17.1%)
Intention of HPV vaccination among unvaccinated participants [From 1: certainly not to 10: certainly yes] †	6.0 (1.9)

Data marked with † are presented as mean (standard deviation), all others are presented as frequency (%).

Table 2
Internal consistency of the 17-item modified CHIAS-C.

Chinese version of the 17-item modified CHIAS	Score	Internal consistency
Domains	Mean (SD)	Cronbach's alpha
Barriers [possible score range: 0–50]	25.2 (9.4)	0.89
Harms [possible score range: 0–50]	20.9 (8.3)	0.81
Effectiveness [possible score range: 0–20]	12.2 (2.8)	0.74
Risk denial [possible score range: 0–30]	11.2 (4.7)	0.60
Uncertainty [possible score range: 0–20]	7.9 (4.5)	0.67

Table 3
Correlations between modified CHIAS-C scores and intention of HPV vaccination.

Chinese version of the 17-item modified CHIAS	Pearson correlation coefficient
Domains	
Barriers [possible score range: 0–50]	-0.005 ($p = 0.947$)
Harms [possible score range: 0–50]	-0.378 ($p < 0.001$)
Effectiveness [possible score range: 0–20]	0.219 ($p = 0.001$)
Risk denial [possible score range: 0–30]	-0.405 ($p < 0.001$)
Uncertainty [possible score range: 0–20]	0.389 ($p < 0.001$)

3.4. Structural validity

The structural validity of the modified CHIAS-C was evaluated through CFA. The results suggest that the five-factor structure identified in the original version was an acceptable fit to the data, with $\chi^2/df = 2.55$, RMSEA = 0.086, SRMR = 0.068, NNFI = 0.92, and CFI = 0.94 (Fig. 1).

4. Discussion

This study established some desirable psychometric properties of the modified CHIAS-C tool among a group of female adolescents in Hong Kong. In line with the original English scale, the results of the CFA support the 5-factor structure of the modified CHIAS-C. In terms of reliability, our study found that the translated tool has acceptable internal consistency, reflecting results from the development of the original scale which was validated in a group of 139 college-aged women (McRee et al., 2010). In the study, three factors ("Barriers", "Harms", and "Effectiveness") were found to have Cronbach's alphas ranging from 0.74 – 0.91, demonstrating good reliability. In contrast, the internal consistency of the remaining two factors ("Risk denial" and "Uncertainty") was notably better in the translated scale, with Cronbach's alphas ranging from 0.60 – 0.67, as compared to a range of 0.43–0.49 in the original scale.

With regard to convergent validity, positive correlations were observed between HPV vaccination intention and the domains of "Effectiveness" and "Uncertainty". This is consistent with previous studies which show that higher perceived vaccine efficacy and more certainty regarding the vaccination are linked to better uptake of HPV vaccination (Yuen et al., 2018). In contrast, significant negative correlations were found between vaccine intention and the remaining two domains of "Harms" and "Risk denial". This is in line with past studies which suggest that a fear of negative side effects and poor understanding of the infection and disease risk contribute significantly to vaccine refusal (Bonnani et al., 2018). Encouragingly however, our sample demonstrated relatively low risk denial with a mean score of 11.2 out of 30, while that of perceived harms was slightly higher at 20.9 out of 50. These figures suggest that adolescents' views towards the vaccine lean positive and that further education regarding vaccine safety and HPV infection risk factors would likely improve vaccine intention and uptake.

Our results also highlight areas of improvement for HPV vaccine promotion efforts. In a concerning finding, only seven adolescents (3.3%) had spoken to a health professional about HPV vaccination in the

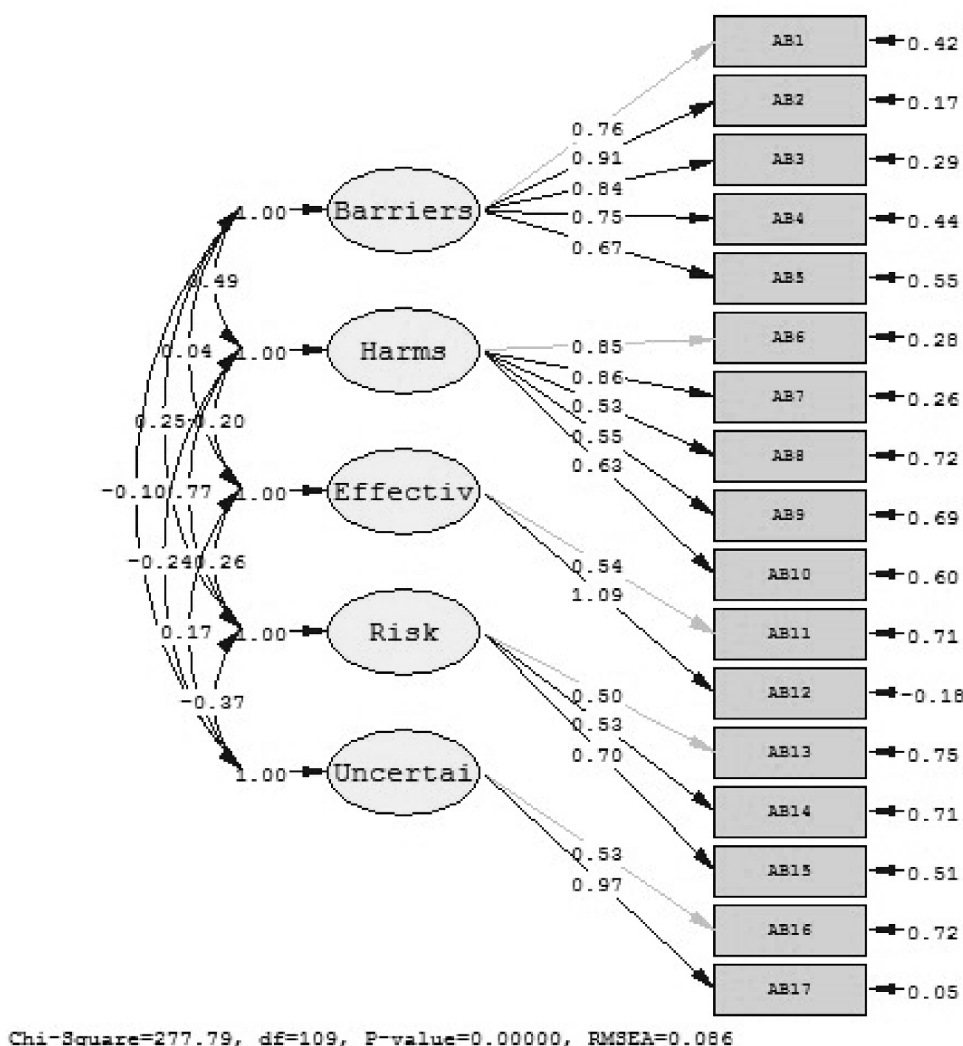


Fig. 1. Confirmatory factor analysis of the 17-item modified CHIAS-C.

past year. This potentially illustrates the reluctance of healthcare professionals in discussing or recommending HPV vaccination, suggesting that they may encounter significant barriers in initiating conversations about the vaccination. As there is substantial evidence on the positive influence of provider recommendations on improving HPV vaccine uptake (Oh et al., 2021), it is vital for healthcare professionals to strengthen communication about HPV vaccination with adolescents and their parents. Moreover, further research may also be conducted to understand health professionals' views regarding HPV vaccination, and help identify areas of concern in their communication with adolescents and parents.

Our findings also reveal that only 17.1% of adolescents had ever attended an HPV talk, suggesting that current HPV vaccination promotion in schools was also suboptimal. As there is evidence that school-based educational interventions can effectively raise adolescent knowledge levels (Mbulawa et al., 2021; Zhang et al., 2020), school talks on HPV could be an impactful and more targeted method for raising awareness and illustrating the value of HPV vaccination. Therefore, more efforts should be directed to supporting schools, such as supplying them with specialised educational resources to ensure that adolescents are provided with essential health information in an effective and timely manner (Chau et al., 2020).

Nearly one-third of the sample (29.2%) have already been vaccinated for HPV, demonstrating an increased vaccine uptake compared to earlier studies which found that only 2.4–9.1% of schoolgirls in Hong

Kong had been vaccinated (Choi et al., 2013). This is a positive finding which implies that existing vaccination promotion efforts in the past years such government and healthcare provider recommendations as well as advertisement campaigns have been effective in raising awareness and encouraging HPV vaccine uptake among the target population (Leung & Law, 2017). Yet, as the goal is to reach full coverage among female adolescents, it is necessary to develop further measures to persuade the remaining hesitant groups and further boost vaccine uptake. In particular, this scale was validated in a younger population as compared to previous studies as earlier intervention to improve adolescent attitudes and raise awareness regarding HPV could potentially lead to corresponding action towards timely vaccination, which may be more beneficial than attempts to encourage vaccination at a later age. As such, our findings suggest that the scale can be effectively administered to younger populations to facilitate the design of targeted HPV vaccine promotion initiatives which could convince adolescents to get vaccinated and protect their health in the long term.

5. Limitations

As the sample size was relatively small and participants were recruited in a small geographic area, the generalisability of the findings may be limited. Moreover, as the participants were recruited by convenience sampling, the representativeness of the sample may be affected, particularly as minimal sociodemographic data were collected.

Also, there may be shortcomings in participant vaccine uptake data as adolescents may be subject to recall bias and misremember their own or their family members' vaccine uptake. Additionally, the study could have benefitted from additional data collection regarding adolescent HPV vaccine uptake in order to assess whether the scale could encourage vaccination.

6. Conclusion

The modified CHIAS-C demonstrates some desirable psychometric properties which support it as a reliable and valid tool to measure Chinese adolescents' attitudes and beliefs about HPV and HPV vaccination. As HPV vaccine uptake rates in Chinese adolescent populations remain suboptimal, this scale could be beneficial in the development and evaluation of measures to enhance vaccine uptake and protect adolescent health.

Ethics.

This study was granted ethical approval by the Survey and Behavioural Research Ethics Committee (CUHK) (Reference no: CV-1804).

Role of the study sponsor.

The funder has no role in study design, in the collection, analysis, and interpretation of data, in the writing of the report, and in the decision to submit the paper for publication.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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