



## Review

# The awareness and acceptance of HPV vaccines among parents of primary and junior high school students in China: a meta-analysis



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## ABSTRACT

The awareness and acceptance of the human papillomavirus (HPV) vaccines among Chinese primary and junior high school students is limited. A meta-analysis was conducted to evaluate the awareness of HPV and HPV vaccines, as well as the acceptance of HPV vaccines, providing evidence-based strategies to promote HPV vaccination. Based on the databases of CNKI, Wanfang, VIP, PubMed, Embase, and Cochrane library, the literatures about the awareness of HPV and HPV vaccines, as well as the acceptance of HPV vaccines among parents of primary and junior high school students were collected from the inception to June 2023. Subgroup analysis was used to find the source of heterogeneity. Publication bias was evaluated using funnel plots and Egger's test. Fifteen literatures with 21,853 participants were included. The pooled HPV awareness, HPV vaccine awareness and acceptance rates among parents of primary and junior high school students in China were 42.90% (95% CI: 33.34%–52.47%), 28.11% (95% CI: 18.20%–43.41%), and 55.29% (95% CI: 45.85%–64.36%), respectively. The survey period and the proportion of female parents were the heterogeneity in awareness of HPV and HPV vaccines, as well as acceptance of HPV vaccines by subgroup analysis. Additionally, regional distribution emerged as another significant source of heterogeneity in HPV vaccine acceptance. The primary cause for parents' reluctance to vaccinate their children was their worries about the safety of the vaccines (66.21%). Though the awareness of HPV and its vaccines was low among parents of primary and junior high school students in China, the acceptance of HPV vaccines was relatively high. Strengthening health education and publicity was crucial to enhance awareness and acceptance, promoting HPV vaccination for effective cervical cancer prevention.

## 1. Introduction

Cervical cancer is the fourth most common cancers and the fourth leading cause of cancer death in women. In 2020, 604,000 new cases and 342,000 deaths of cervical cancer were reported worldwide, and China had the highest burden of cervical cancer [1,2]. Human papillomavirus (HPV) infection is closely related to cervical cancer, and persistent high-risk HPV (HR-HPV) infection is the main cause of cervical cancer [3,4]. Cervical cancer

is currently the only cancer with a definite etiology that can be prevented and treated either through early vaccination against HR-HPV, or by successful screening and management of precursors of cervical cancer [5,6].

With the development of preventive medicine research, preventive HPV vaccines have been successfully developed, introduced to the market, and concurrently used in clinical practice in many countries [7]. Currently, China has approved the marketing of bi-valent, quadrivalent, and 9-valent HPV vaccines. These vaccines are de-

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signed to target different types of HPV and have demonstrated the potential to effectively prevent HPV-related diseases [8]. Research indicates that the effectiveness of HPV vaccines is significantly influenced by the age at which the vaccine is had. Early vaccine against HPV is particularly crucial in preventing HPV infection and related diseases [9].

The World Health Organization recommends targeting girls aged 9–14 years who have not initiated sexual activity as the primary recipients for HPV vaccination, as this age group is considered the optimal time for vaccination [10]. The guidelines for comprehensive prevention and control of cervical cancer in China took girls aged 13–15 as the key target population [11]. However, vaccination is largely dependent on parents' awareness and acceptance of the HPV vaccines. Unfortunately, without sufficient information about HPV and cervical cancer, many parents may harbor doubts or misconceptions about the effectiveness of HPV vaccines. Consequently, these misunderstandings could lead some parents to hesitate about whether to have their children vaccinated against HPV. Therefore, increasing parental awareness and acceptance of HPV vaccines is critical to increase HPV vaccination among primary and junior high school students. However, there is inconsistency in the awareness and acceptance of HPV and HPV vaccines among parents of Chinese primary and junior high school students.

This study aimed to utilize a meta-analysis to analyze the awareness and acceptance of primary and junior high school students' parents towards HPV and the HPV vaccines in China, and explore the reasons behind parental vaccine hesitancy, providing evidence-based recommendations for promoting and advocating the HPV vaccines among Chinese primary and junior high school students.

## 2. Materials and methods

### 2.1. Search strategy and selection criteria

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) reporting guideline [12]. The corresponding checklists were shown in the Supplemental File. The study protocol was registered with the PROSPERO international prospective register of systematic reviews (CRD42023444453).

Literatures about the cross-sectional studies on parents' awareness and acceptance of HPV and HPV vaccines for primary and junior high school students in China from 6 electronic databases (CNKI, Wanfang, VIP, PubMed, Embase, and Cochrane library) were systematically searched. The research topics were as follow: HPV, vaccine, parent, acceptability. The study was conducted from the inception to June 2023. The language of the literature was confined to Chinese and English. Also, further relevant litera-

ture were added by tracing the references of the included literature.

Inclusion criteria: (1) A cross-sectional study was on the awareness and acceptance of HPV and HPV vaccines among parents of primary and junior high school students in China; (2) Original research; (3) The key terms simultaneously included a) Level of the awareness of HPV (Have you heard of HPV); b) Level of the awareness of HPV vaccines (Have you ever heard of the HPV vaccine); c) The acceptance of HPV vaccines; and (4) The language of the literature was English or Chinese.

Exclusion criteria: (1) Literature that did not provide underlying data or insufficient data to recalculate or combine; (2) Review, lecture, case reports and conference literature; (3) Literature with a quality score  $\leq 5$ ; and (4) Duplicated literature.

### 2.2. Data extraction

Two researchers (C.M.M. and W.Y.) independently conducted literature screening, data extraction, quality scoring, and cross checking. If there was any dispute, it was resolved through further discussion with the third researcher (Z.D.). The following information was extracted: the first author, publication year, survey area, sample size, sampling method, the proportion of female parents, the proportion of high school education or above, survey time, HPV awareness, HPV vaccines' awareness, HPV vaccines' acceptance, HPV awareness rate, HPV vaccines' acceptance rate, and literature quality score, etc.

### 2.3. Quality assessment

The quality of literatures was assessed by the Agency for Healthcare Research and Quality (AHRQ) checklist. The AHRQ cross-sectional evaluation scale was used to evaluate 11 items with a total score of 11. The higher the total score, the higher the quality of the literature. In this meta-analysis, a study with a score of 7–9 has good quality and low risk of bias, a score of 4–6 has a moderate quality and moderate risk of bias, and a score of 0–3 has low quality and high risk of bias.

### 2.4. Statistical analysis

A systematic analysis approach was used to calculate the pooled awareness of HPV/HPV vaccines and the acceptance of HPV vaccines from all eligible literature. The meta-analysis was conducted with the prevalence estimates that had been transformed using untransformed proportions, log-transformation and logit transformation to meet the requirement, which was tested using the Shapiro–Wilk test. The heterogeneity among studies was assessed using  $I^2$  statistic, which showed the percentage of variation across studies (with values of 25, 50, and

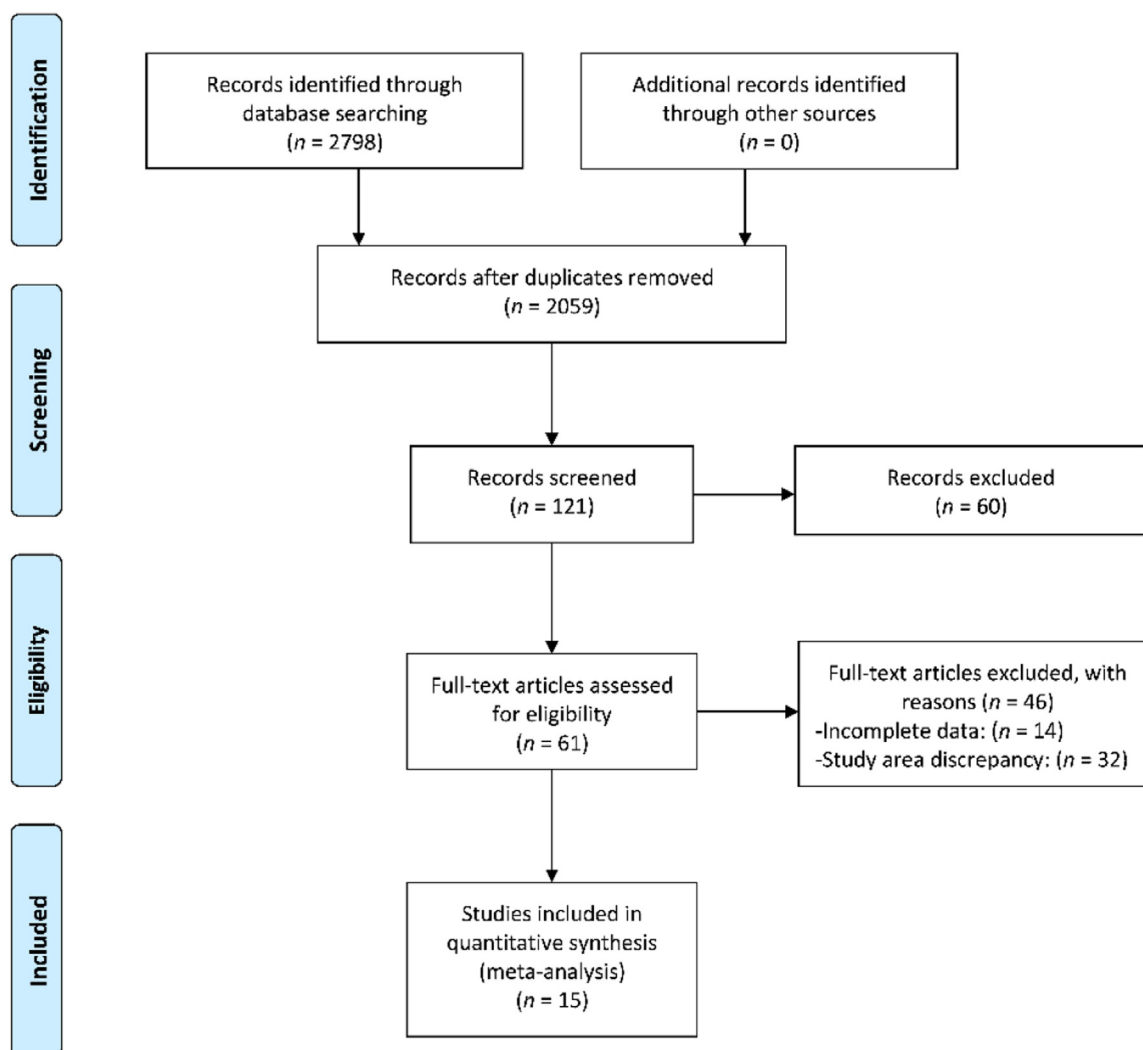


Fig. 1. PRISMA flow diagram of literatures selection by inclusion and exclusion.

75 indicating low, moderate, and high degrees of heterogeneity, respectively). If the data showed low or moderate heterogeneity ( $I^2 < 50\%$ ), a fixed-effect model was used; otherwise, a random-effect model was used [13,14]. Subgroup analysis by survey time, the proportion of female parents, the proportion of parents with a high school degree or above and regional distribution was used to find the source of heterogeneity. Finally, publication bias was evaluated using funnel plots and Egger's test. It was considered statistically significant if the  $P < 0.05$ . All statistical analyses were performed using R version 4.2.2 (Auckland, New Zealand: The University of Auckland) and Excel version 2016 (Microsoft).

### 3. Results

#### 3.1. Selection and characteristics

Following the search strategy, 2798 studies were identified, with 793 duplicates removed. Sixty-one of these studies were read in full-text, and 15 of them [15–29] met

the inclusion criteria in Fig. 1. The characteristics of the 15 included studies were shown in Table 1. The study included a wide-ranging sample of 4339 male and 17,237 female parents, hailing from at least 10 provinces, municipalities, and autonomous regions, and spanning 19 cities. Of the 15 studies, 13 were conducted in Chinese and the remaining 2 in English.

#### 3.2. Analysis of HPV awareness

To improve parents' awareness of HPV, we gained in-depth insights into the knowledge of HPV among the parents of Chinese primary and junior high school students. The analysis was based on the awareness of HPV included 10,042 participants. The overall random-effects pooled awareness rate of HPV was 42.90% (95% CI: 33.34%–52.47%) with a high level of heterogeneity ( $I^2 = 99.6\%$ ) as shown in Fig. 2. The sensitivity analysis showed that parent's awareness of HPV ranged from 40.25% (95% CI: 31.63%–48.88%) to 44.58% (95% CI: 34.92%–54.23%), indicating the results was stable. There were signs of pub-

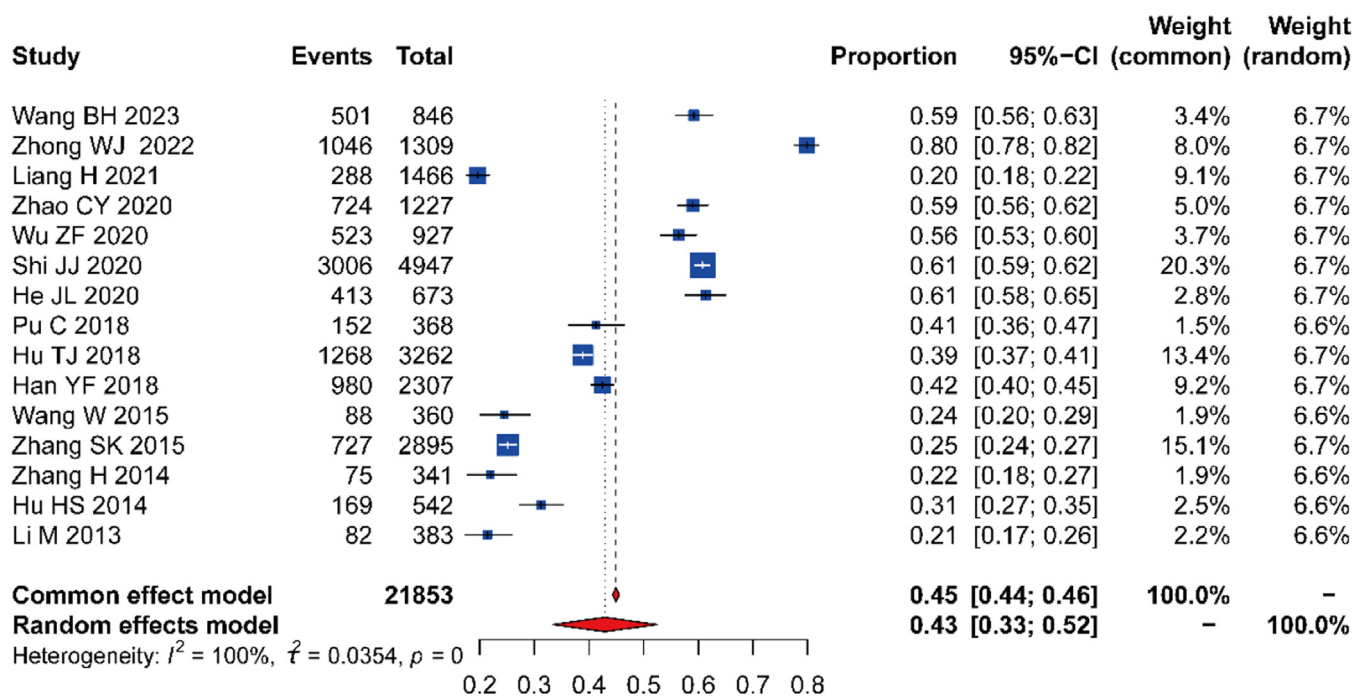


Fig. 2. Forest plot of HPV awareness among parents of primary and junior high school students in China [15–29].

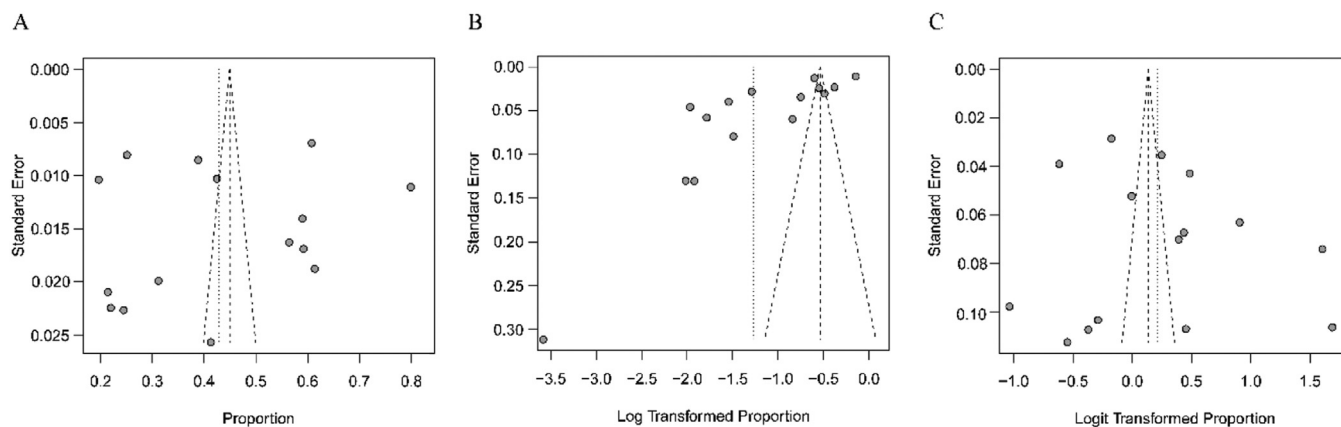


Fig. 3. Funnel chart depicting the rate of awareness and acceptance of HPV and HPV vaccines among parents of primary and junior high school students in China. HPV awareness rate (A), HPV vaccines' awareness rate (B) and HPV vaccines' acceptance rate (C).

lication bias when the funnel plot was examined visually, but Egger's test indicated otherwise ( $P = 0.73$ ) as seen in Figs. 3A and 4A.

### 3.3. Analysis of HPV vaccines' awareness

To understand the parents' awareness of the HPV vaccines can determine the demand for promoting vaccination, we conducted the analysis of HPV vaccines' awareness including 8,424 participants. The overall random-effects pooled awareness rate of HPV vaccines was 28.11% (95% CI: 18.20%–43.41%) with a high level of heterogeneity ( $I^2 = 99.7\%$ ) as shown in Fig. 5. The sensitivity analysis showed that parent's awareness of HPV vaccines ranged from 25.95% (95% CI: 16.81%–40.06%) to 32.62% (95% CI: 23.11%–46.04%), indicating the re-

sult was stable. The funnel plot was asymmetric, and there was publication bias, Egger test  $P < 0.05$ , indicating that the bias was statistically significant as shown in Figs. 3B and 4B.

### 3.4. Analysis of HPV vaccines' acceptance

To understand parents' willingness and attitude towards having their children receive the HPV vaccines, we conducted the analysis of HPV vaccines' acceptance including 11,161 participants, the overall random-effects pooled acceptance rate of HPV vaccines was 55.29% (95% CI: 45.85%–64.36%) with a high level of heterogeneity ( $I^2 = 99.1\%$ ) as shown in Fig. 6. The sensitivity analysis showed that parent's awareness of HPV vaccines ranged from 52.70% (95% CI: 44.09%–61.14%) to 57.47% (95%

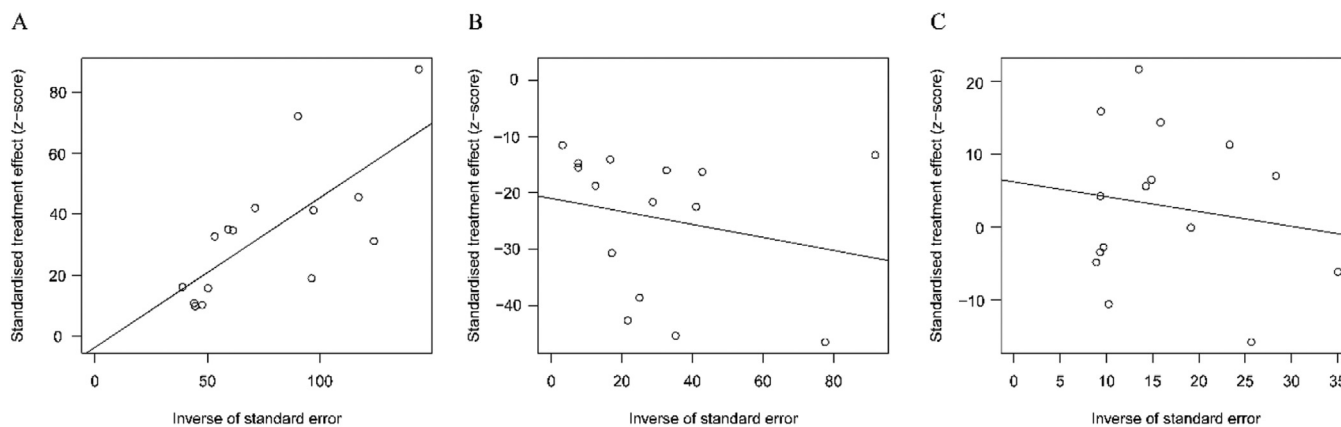


Fig. 4. Egger test depicting the rate of awareness and acceptance of HPV and HPV vaccines among parents of primary and junior high school students in China. HPV awareness rate (A), HPV vaccines' awareness rate (B) and HPV vaccines' acceptance rate (C).

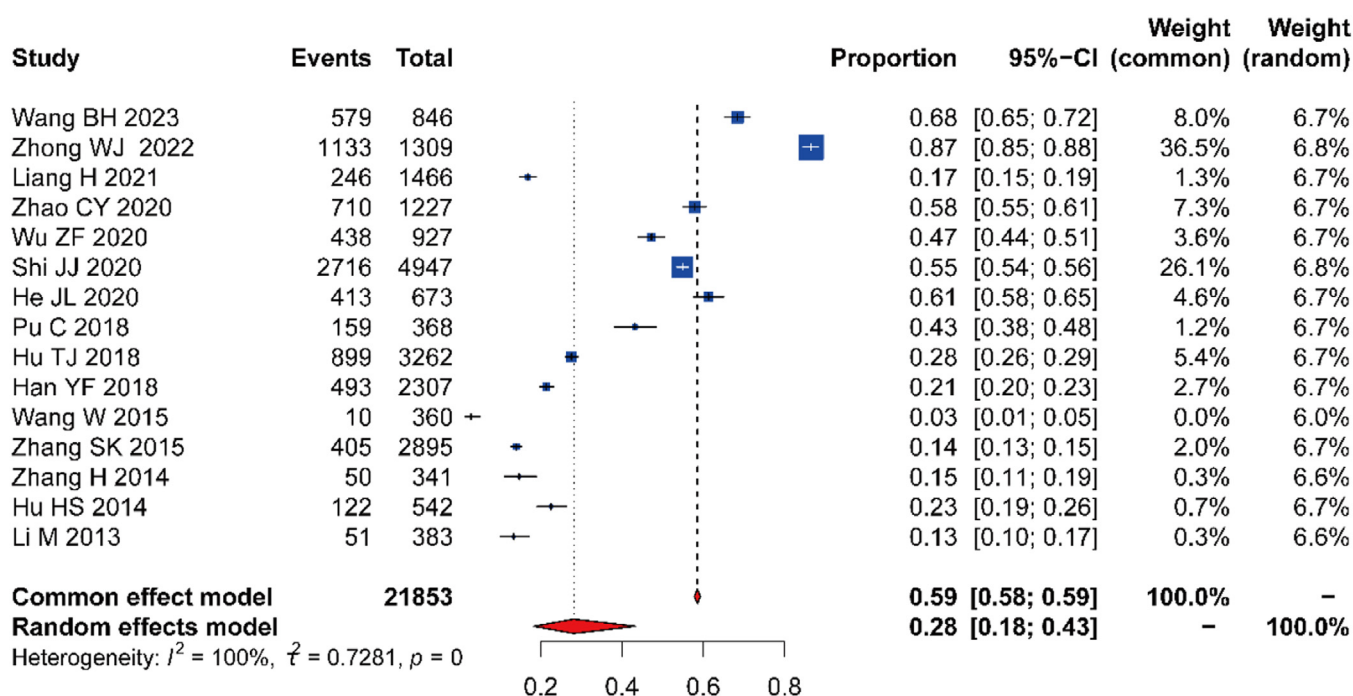


Fig. 5. Forest plot of HPV vaccines' awareness among parents of primary and junior high school students in China [15–29].

CI: 48.44%–66.02%), indicating the result was stable. The funnel plot was symmetrical, and Egger's test ( $P = 0.35$ ), did not indicate publication bias as shown in Figs. 3C and 4C.

### 3.5. Subgroup analysis

We conducted subgroup analysis to explore the sources of heterogeneity. The survey period (around 2016) and the proportion of female parents were the heterogeneity in awareness of HPV and HPV vaccines, as well as acceptance of HPV vaccines by subgroup analysis. Additionally, regional distribution emerged as another significant source of heterogeneity in HPV vaccine acceptance, as shown in Table 2.

### 3.6. Reasons why parents were reluctant to vaccinate their children against HPV

In order to explore the reasons for the parents were reluctant to vaccinate their children against HPV, we conducted an analysis of 15 included studies and found that 12 of them investigated parents' unwillingness to have their children vaccinated with the HPV vaccines. Parents worried about the safety of vaccines (66.21%; 95% CI: 59.68%–73.46%,  $I^2 = 97.7\%$ ), the effectiveness of vaccines (45.03%; 95% CI: 35.15%–55.33%,  $I^2 = 95.7\%$ ), their children were too young (40.24%; 95% CI: 34.90%–46.39%,  $I^2 = 88.8\%$ ), and vaccines were not widely used in China (36.21%; 95% CI: 30.82%–42.53%,  $I^2 = 98.0\%$ ). In addition, it was partly due to absence of aware-



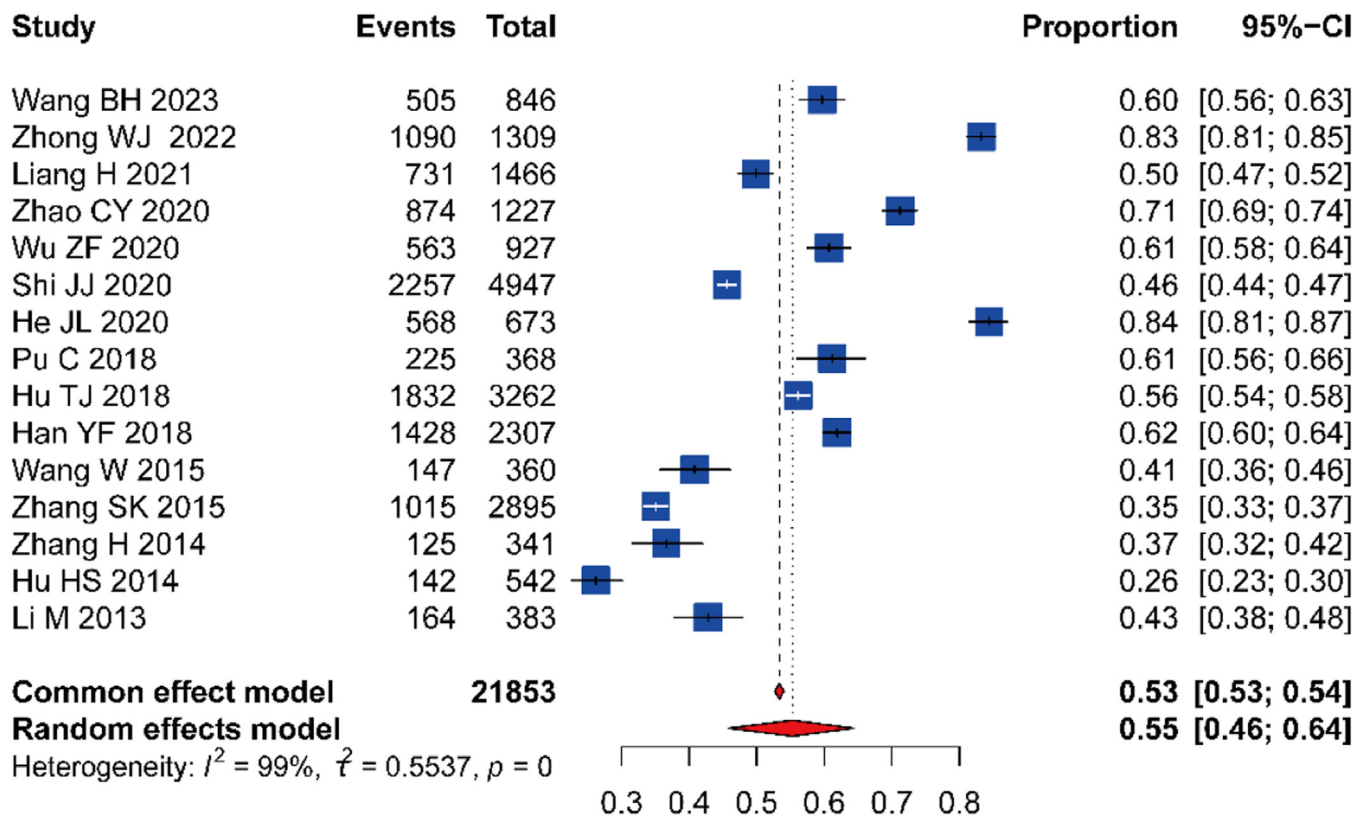


Fig. 6. Forest plot of HPV vaccines' acceptance rate among parents of primary and junior high school students in China [15–29].

ness of HPV vaccines (28.20%; 95% CI: 2.07%–54.34%,  $I^2 = 99.9\%$ ).

#### 4. Discussion

Cervical cancer is the only cancer in the world that can be prevented by HPV vaccination [30,31]. Studies have shown that persistent infection with HR-HPV is the main cause of cervical cancer [32,33]. The incidence of cervical cancer can be reduced by 70% after HPV vaccination in school-age girls [34], and as of June 2020, 107 (55%) of the 194 WHO Member States have introduced HPV vaccination [35]. According to a paper published by WHO in 2018 [36], the primary prevention target of cervical cancer were to vaccinate girls aged 9–13 before they start having sex, and it was crucial to protect school-age girls from HPV infection in order to prevent cervical cancer. As part of China's plan to eliminate cervical cancer, 15 cities were selected in 2021 as the first pilot cities for comprehensive cervical cancer prevention, and introduced a free HPV vaccination program for school-aged girls [37]. Parental awareness and acceptance of HPV vaccines played a significant role in HPV vaccination among junior high school students, and the low awareness of HPV vaccines among parents might affect the future promotion of the vaccination against HPV in China. In this study, fifteen cross-sectional studies of parents' awareness on HPV, HPV vaccines and accep-

tance of HPV vaccines for primary and junior high school students in China between 2013 and 2023 was evaluated. Fifteen literatures all included 3 indicators: HPV awareness rate, HPV vaccines' awareness rate, and HPV vaccines' acceptance rate, which could reflect the cognition of HPV and HPV vaccines since they were from the same population. This study revealed that the awareness and acceptance rates of HPV and HPV vaccines among parents of primary and junior high school students in China stood at 42.90%, 28.11% and 55.29%, respectively. Compared to the study done in 2019, these figures showed an increase of 28.21%, 18.91%, and 41.35% [38], this could be due to the emphasis on a younger age group, particularly those girls aged 15 or younger, who have been prioritized for HPV vaccination within the national government immunization program. Additionally, this may have been influenced by the National Health Commission's initiative to provide free HPV vaccination for girls aged 9–14 in pilot areas since 2021 [39]. With the publicity and promotion of vaccine, parents' awareness and acceptance rates of HPV vaccines are increasing, but they were still relatively low compared to other countries [40–44]. For example, the coverage rates of the 3-dose HPV vaccines among female students in Tanzania were 84.7%, 81.4%, and 76.1%, respectively [45]; the HPV awareness among parents of adolescent girls in Nigeria was 53.5%, and the HPV vaccine awareness and acceptance rates were 62.1% and 79.2%, respectively [46].

**Table 1**  
Characteristics of included literature.

Author & survey year	Surveyed area	Sample size	Sampling method	Female parents (%)	Parents with high school or above education (%)	Surveyed time	Awareness of HPV (%)	Awareness of HPV vaccines (%)	Acceptance of HPV vaccines (%)	Quality score
Wang et al., 2023 [15]	Zhejiang	846	Convenience sampling	82.15	51.65	2021	59.22	68.43	87.22	8
Zhong et al., 2022 [16]	Shanghai	1309	Proportionate to population size	73.64	61.96	2021	79.91	86.55	83.27	8
Liang et al., 2021 [17]	Zhejiang	1466	Multi-stage stratified cluster sampling	78.65	28.38	2019	19.65	16.81	49.86	8
Zhao et al., 2020 [18]	Beijing	1227	Multi-stage stratified cluster random sampling	100.00	59.90	2020	59.01	57.86	71.23	9
Wu et al., 2020 [19]	Shanghai	927	Cluster non-random sampling	100.00	40.34	2019	56.42	47.25	60.73	7
Shi et al., 2020 [20]	4 provinces	4947	Convenience sampling method	86.05	21.20	2019	60.76	54.90	45.62	6
He et al., 2020 [21]	Hangzhou	673	Multi-stage stratified cluster random sampling	75.93	47.40	2018	61.37	61.37	84.40	7
Pu et al., 2018 [22]	Chengdu	368	Easy sampling	65.20	12.00	2015–2016	41.30	43.20	61.10	6
Hu et al., 2018 [23]	Shanghai	3262	Random stratified cluster sampling	66.71	35.84	2017	38.87	27.56	56.16	9
Han et al., 2018 [24]	Xiamen	2307	Multistage cluster random sampling	100.00	25.30	2018	42.50	21.40	61.90	8
Wang et al., 2015 [25]	Jinan	360	Cluster sampling	52.22	74.58	2013	22.63	10.20	40.80	8
Zhang et al., 2015 [26]	7 cities	2895	Multistage nonrandomized cluster sampling	62.80	42.40	2011–2012	25.10	14.00	36.20	8
Zhang et al., 2014 [27]	Wuhan	341	Cluster sampling	63.34	27.14	2013	21.99	14.66	36.66	8
Hu et al., 2014 [28]	Guangzhou	542	Stratified sampling	68.50	46.80	2013	32.10	22.90	26.70	6
Li et al., 2013 [29]	Beijing	383	Convenience and Multi-stage sampling	55.35	21.67	2011–2012	21.41	13.32	48.42	7

The acceptance of HPV and HPV vaccines by parents of adolescent boys in Portugal were 69.5% and 84.5%, respectively [47]; a Spanish study concluded that HPV awareness and parental occupation were associated with HPV vaccines' acceptance [48]. In addition, the acceptance of HPV vaccines among parents of Australian children was 80.1% [49]. The awareness, vaccine price, vaccine safety and effectiveness were related to parents' willingness to vaccinate their children with HPV vaccines in Nigeria [46]; our study found that the main factors affecting the acceptance of parental HPV vaccines were vaccine safety, vaccine effectiveness, parental awareness and children's age in China. However, given the vast territory of China and the disparity in economic growth, parents had different levels of knowledge regarding HPV and HPV vaccines. The subgroup analysis was also scheduled to investigate the underlying sources of the heterogeneity. It showed that the publication bias of the publications was small, suggesting the results was stable and reliable, and which could provide a theoretical basis for the promotion of HPV vaccines.

At present, most parents have a relatively low awareness rate of HPV and HPV vaccines. HPV vaccines are most effective way to prevent cervical cancer before their first sex behavior. Parents tend to underestimate the moment when their children will exhibit their first sexual behavior. A study has indicated that the median age of first sexual intercourse among urban women in China is 22 years, while in rural areas it is 21 years. Furthermore, more than 10% of females aged 15–19 have engaged in sexual activity [50]. Research on domestically produced bivalent HPV vaccines has demonstrated that 2 doses administered to females aged 9–14 provide equivalent immunogenicity to the standard 3-dose regimen. The benefits of administering HPV vaccines to females aged 13–15 prior to their first sexual encounter can be maximized [51,52]. It is essential for public health officials to provide education on the knowledge of HPV and HPV vaccines, and to increase parents' understanding, recognition, and approval of the HPV vaccines, especially before girls graduate from junior high school (before the age of 16). The government should expedite the approval process of domestic HPV vaccines through centralized procurement to promote HPV vaccine supply enterprises with reasonable prices. Additionally, they should explore various channels to ensure the vaccination of school-aged students in poverty-stricken areas, which will be beneficial in significantly increasing the HPV vaccination rate and protecting the healthy development of young people, ultimately aiming to eliminate cervical cancer in China as soon as possible.

The limitations of this study: As a single rate meta-analysis, the high heterogeneity was observed during data integration. The subgroup analyses was employed to address this issue. Due to the high heterogeneity, interpret-

**Table 2**  
Subgroup analysis on awareness and acceptance rates of HPV and HPV vaccines.

Subgroup	No. of studies	No. of subjects	No. with awareness /acceptance	HR (95%CI)	P
<b>HPV awareness</b>					
Survey time					
≥2016	9	16,964	8749	0.5306 (0.4181; 0.6431)	<0.0001
<2016	6	4889	1293	0.2748 (0.2159; 0.3336)	
Proportion of female					
>70%	8	13,702	7481	0.5484 (0.4271; 0.6697)	0.0002
≤70%	7	8151	2561	0.2920 (0.2322; 0.3517)	
Proportion of parents with high school or above education					
>50%	4	3742	2359	0.5570 (0.3320; 0.7820)	0.1606
≤50%	11	18,111	1683	0.3825 (0.2887; 0.4763)	
Regional distribution					
Eastern region	11	13,302	6082	0.4537 (0.4458; 0.4615)	0.4993
Midwest region	2	709	227	0.3161 (0.1269; 0.5053)	
Mixed region	2	7842	3733	0.4294 (0.0800; 0.7788)	
<b>Awareness of HPV vaccine</b>					
Survey time					
≥2016	9	16,964	7627	0.4339 (0.3001; 0.6275)	0.0057
<2016	6	4889	797	0.1440 (0.0722; 0.2872)	
Proportion of female					
>70%	8	13,702	6728	0.4593 (0.3083; 0.6843)	0.0040
≤70%	7	8151	1696	0.1588 (0.0868; 0.2905)	
Proportion of parents with high school or above education					
>50%	4	3742	2432	0.3195 (0.0672; 1.0000)	0.8170
≤50%	11	18,111	5992	0.2647 (0.1883; 0.3720)	
Regional distribution					
Eastern region	11	13,302	5094	0.2860 (0.1636; 0.5000)	0.9804
Midwest region	2	709	209	0.2533 (0.0878; 0.7303)	
Mixed region	2	7842	3121	0.2773 (0.0726; 1.0000)	
<b>HPV vaccination willingness</b>					
Survey time					
≥2016	9	16,964	9848	0.6495 (0.5531; 0.7351)	0.0002
<2016	6	4889	1818	0.4003 (0.3179; 0.4887)	
Proportion of female					
>70%	8	13,702	8016	0.6601 (0.5546; 0.7518)	0.0008
≤70%	7	8151	3650	0.4236 (0.3407; 0.5111)	
Proportion of parents with high school or above education					
>50%	4	3742	2616	0.6540 (0.4827; 0.7930)	0.1648
≤50%	11	18,111	9050	0.5145 (0.4126; 0.6151)	
Regional distribution					
Eastern region	11	13,302	8044	0.5915 (0.4777; 0.6963)	0.0239
Midwest region	2	709	350	0.4885 (0.3228; 0.6568)	
Mixed region	2	7842	3272	0.4026 (0.3318; 0.4778)	

ing the meta-analysis results requires caution. The investigation mainly focused on provincial capitals, which may not fully represent all parents' willingness to vaccinate their children with HPV vaccines in China. To ensure comprehensive insights, more large-scale, high-quality studies are needed to reflect the awareness and acceptance of HPV vaccines among parents of primary and junior high school students in China.

### 5. Conclusion

The parents of primary and junior high school students in China are now more likely to vaccinate their children against HPV than before, although the awareness and acceptance of HPV and HPV vaccines are not so high. To understand why parents were initially hesitant to vaccinate their children is essential for creating and executing public health strategies. Medical institutions, schools, and



communities should promote social awareness and health education to increase parents' knowledge of HPV and HPV vaccines to prevent cervical cancer.

### Declaration of competing interest

No potential conflict of interest was reported by the author(s).

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### Author contributions

M.C., Y.W., and L.L. conceived, designed the review. Z.L., C.L. and T.N. did the data collection. D.Z., M.Z., M.Z. and J.J. did the analysis for the study. The manuscript was drafted by M.C. and Y.W. L.M.L. reviewed the manuscript originally submitted and revised it following the reviewer's comments. The authors read and approved the final manuscript.

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### Data available statement

The data that support the findings of this study are available from the corresponding author, LM Luo, upon reasonable request.

### Ethics statement

Not Applicable.

### Informed consent

No informed consent is required for this review article.

### Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.imj.2023.11.003.

### References

[1] H Sung, J Ferlay, RL Siegel, et al., Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries, *CA Cancer J. Clin.* 71 (3) (2021) 209–249, doi:10.3322/caac.21660.  
 [2] X Shen, Y Cheng, F Ren, et al., The burden of cervical cancer in China, *Front. Oncol.* 12 (2022) 979809, doi:10.3389/fonc.2022.979809.

[3] KT Simms, J Steinberg, M Caruana, et al., Impact of scaled up human papillomavirus vaccination and cervical screening and the potential for global elimination of cervical cancer in 181 countries, 2020–99: a modelling study, *Lancet Oncol.* 20 (3) (2019) 394–407, doi:10.1016/S1470-2045(18)30836-2.  
 [4] L Rahangdale, C Mungo, S O'Connor, et al., Human papillomavirus vaccination and cervical cancer risk, *BMJ* 379 (2022) e070115, doi:10.1136/bmj-2022-070115.  
 [5] S Feldman, Screening options for preventing cervical cancer, *JAMA Intern Med* 179 (7) (2019) 879–880, doi:10.1001/jamainternmed.2019.0298.  
 [6] S Wilailak, M Kengsakul, S Kehoe, Worldwide initiatives to eliminate cervical cancer, *Int. J. Gynaecol. Obstet.* 155 (suppl 1) (2021) 102–106, doi:10.1002/ijgo.13879.  
 [7] X.Q. Xu, F.H. Zhao. Efficacy, immunogenicity and population-level impact of human papillomavirus vaccine and roll-out study in China. Peking Union Medical College. (2021). doi: 10.27648/d.cnki.gzxhu.2021.000401.AU: Please provide complete details (Journal title/book title, volume and pages) in reference 7.  
 [8] XM Yang, RR Jin, HL Zhou, et al., Progress in research of HPV vaccine and influencing factors in process of promotion and vaccination, China, *J. Clin. Electron. Ed.* 15 (3) (2021) 218–223.  
 [9] DA Sealy, N Modeste, P Dyett, Barriers and facilitators to the HPV vaccine among mothers of adolescent girls: a qualitative study conducted in Trinidad and Tobago, *Women Health* 61 (3) (2021) 235–243, doi:10.1080/03630242.2020.1856295.  
 [10] Y Ueda, E Miyagi, Importance of education about cervical cancer and its preventive measures for the promotion of HPV vaccine according to the WHO strategies, *Vaccines* 9 (10) (2021) 1199, doi:10.3390/vaccines9101199.  
 [11] L.H. Wang, G.L. Zhao, Guidelines for comprehensive prevention and control of cervical cancer in China, *Chin. J. Woman Child Health Res.* 29 (1) (2018) 1–3, doi:10.3969/j.issn.1673-5293.2018.01.001.  
 [12] D Moher, A Liberati, J Tetzlaff, et al., Reprint: preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement, *Phys. Ther.* 89 (9) (2009) 873–880.  
 [13] J.P. Higgins, S. Green, *Cochrane Handbook for Systematic Reviews of Interventions*, The Cochrane Collaboration, Oxford, 2008, pp. i–xxi. version 5.0.2 [updated September 2009].  
 [14] JJ Barendregt, SA Doi, YY Lee, et al., Meta-analysis of prevalence, *J. Epidemiol. Community Health* 67 (11) (2013) 974–978, doi:10.1136/jech-2013-203104.  
 [15] BH Wang, SY Yan, SY Wang, et al., Awareness of HPV and HPV vaccine and willingness to be vaccinated among parents of children aged 9–14, *J. Public Health Prev. Med.* 34 (1) (2023) 39–43.  
 [16] WJ Zhong, JF Duan, ZY Wang, et al., Perception of HPV and the willingness of HPV vaccine among parents of female pupils in Qingpu District, Shanghai City, China, *J. Public Health. Manag.* 38 (1) (2022) 68–72.  
 [17] H Liang, TT Tang, HK Lü, et al., Awareness and willingness to vaccinate daughters with human papillomavirus vaccines among parents of primary and middle school students, *Prev. Med.* 33 (9) (2021) 884–888.  
 [18] C.Y. Zhao, J. Shi, GF Zhang, et al., Mothers of primary and secondary school girls in Tongzhou district, Beijing receiving HPV vaccine from daughters and its influencing factors, *Chin. J. Sch. Health* 41 (04) (2020) 597–600, doi:10.16835/j.cnki.1000-9817.2020.04.031.  
 [19] Z.F. Wu, X.H. Qian, J.Y. Hu, Willingness of mothers to vaccinate their primary-school-age girls with human papillomavirus vaccine and factors influencing willingness in a district of Shanghai, *Chin. J. Vaccines Immun.* 26 (06) (2020) 634–638.  
 [20] J.J. Shi, W.Z. Yu, H. Zheng, Acceptability of Human Papillomavirus Vaccine for 9–14-Year-Old Girls Among Parents in Four Provinces of China, *Chinese Center for Disease Control and Prevention*, 2020, doi:10.27511/d.cnki.gzyyy.2020.000028.  
 [21] JL He, LJ Hong, YX Liu, et al., Knowledge about human papillomavirus (HPV) and HPV vaccine and willingness for their children's vaccination among parents of 9–14 years old girls in Hangzhou city, *Chin. J. Public Health.* 36 (10) (2020) 1478–1481.  
 [22] C Pu, CR Liu, X Zhang, et al., Knowledge and attitudes toward HPV and its vaccines among parents of middle school students in Chengdu, *Mod. Prev. Med.* 45 (2) (2018) 299–302 347.  
 [23] TJ Hu, Q Zhu, WH Chen, et al., Survey on knowledge of HPV and HPV vaccine, acceptance for vaccination and its influence factors among parents of elementary and middle school students in Songjiang district of Shanghai city, *Chin. J. Viral Dis.* 8 (3) (2018) 216–222.  
 [24] YF Han, YN Zhuang, Y Li, et al., Analysis of mothers' acceptance of HPV vaccination of adolescent girls in Xiamen, *Zhonghua Yu Fang Yi Xue Za Zhi* 52 (1) (2018) 38–42, doi:10.3760/cma.j.issn.0253-9624.2018.01.008.  
 [25] W Wang, Y Ma, X Wang, et al., Acceptability of human papillomavirus vaccine among parents of junior middle school students in Jinan, China, *Vaccine* 33 (22) (2015) 2570–2576, doi:10.1016/j.vaccine.2015.04.010.  
 [26] SK Zhang, XF Pan, SM Wang, et al., Knowledge of human papillomavirus vaccination and related factors among parents of young adolescents: a nationwide survey in China, *Ann. Epidemiol.* 25 (4) (2015) 231–235, doi:10.1016/j.annepidem.2014.12.009.  
 [27] H Zhang, DX Yu, ZX Liu, et al., Parental acceptance of junior high school students for human papillomavirus vaccination: a survey at one school in Wuhan, *J. Public Health Prev. Med.* 25 (1) (2014) 49–52.  
 [28] HS Hu, XL Wei, ZF Ren, et al., Investigation on acceptance of HPV vaccination and its determinants among the parents of junior high school students in Guangzhou city, *Chin. J. Dis. Contr. Prev.* 18 (7) (2014) 659–662.  
 [29] M. Li, L.R. Ju, B.L. Li, et al., Survey of the cognition on human papillomavirus and its preventive vaccine of junior school students' parents and university students in Beijing, *Chin. J. Woman Child Health Res.* 24 (1) (2013) 14–17 60, doi:10.3969/j.issn.1673-5293.2013.01.006.  
 [30] M Brisson, JJ Kim, K Canfell, et al., Impact of HPV vaccination and cervical screen-

- ing on cervical cancer elimination: a comparative modelling analysis in 78 low-income and lower-middle-income countries, *Lancet* 395 (10224) (2020) 575–590, doi:10.1016/S0140-6736(20)30068-4.
- [31] HCW Choi, K Leung, KKL Chan, et al., Maximizing the cost-effectiveness of cervical screening in the context of routine HPV vaccination by optimizing screening strategies with respect to vaccine uptake: a modeling analysis, *BMC Med.* 21 (1) (2023) 48, doi:10.1186/s12916-023-02748-3.
- [32] GK Shapiro, HPV vaccination: an underused strategy for the prevention of cancer, *Curr. Oncol.* 29 (5) (2022) 3780–3792, doi:10.3390/curroncol29050303.
- [33] F Wang, R Liu, Y Ma, et al., Case report: noninvasive clinical intervention of REBAC-IN® on histologic regression of high grade cervical intraepithelial neoplasia, *Front. Med.* 8 (2021) 627355, doi:10.3389/fmed.2021.627355.
- [34] X.J. Xu, X. Tang, X.M. Li, et al., Health economic evaluation of different immunization strategies for HPV vaccine among the age-appropriate population in Guangdong Province, China, *Cancer* 31 (02) (2022) 139–145.
- [35] L Bruni, A Saura-Lázaro, A Montoliu, et al., HPV vaccination introduction worldwide and WHO and UNICEF estimates of national HPV immunization coverage 2010–2019, *Prev. Med.* 144 (2021) 106399, doi:10.1016/j.ypmed.2020.106399.
- [36] New WHO guidelines for the prevention and control of cervical cancer 2018. Available from: <https://www.who.int/zh/news/item/03-12-2014-new-who-guide-to-prevent-and-control-cervical-cancer> (accessed on 15 July 2023).
- [37] S Minhas, M Kashif, Z Rehman, et al., Distribution of high-risk human papillomavirus genotypes in cervical secretions in Punjab, *J. Coll. Physicians Surg. Pak.* 30 (7) (2021) 786–791, doi:10.29271/jcpsp.2021.07.786.
- [38] JJ Shi, XX Zhang, H Zheng, et al., Awareness and acceptance of human papillomavirus vaccine among parents of adolescents in Chinese mainland: a meta-analysis, *Chin. J. Vaccines Immun.* 25 (4) (2019) 464–470.
- [39] KA Rabiou, TG Alausa, FM Akinlusi, et al., Parental acceptance of human papillomavirus vaccination for adolescent girls in Lagos, Nigeria, *J. Family Med. Prim. Care* 9 (6) (2020) 2950–2957, doi:10.4103/jfmpc.jfmpc\_102\_20.
- [40] JY Zhang, Y Han, RJ Wang, et al., Analysis on the KAP related to human papillomavirus and HPV vaccine among different populations, *Chin. J. Health. Educ.* 36 (2) (2020) 147–152.
- [41] X. Zhang, Z. Su, H.F. Xu, et al., Summary and analysis of women's awareness and willingness to receive HPV vaccine in Chinese Mainland from 2009 to 2016, *Chin. J. Public Health* 37 (12) (2021) 1726–1730.
- [42] H.J. Yan, Z. Su, S.J. Liu, et al., Investigation on the cognition and promotion attitude of HPV vaccine in China after COVID-19, *Chin J Public Health* 37 (12) (2021) 1731–1736.
- [43] N. Di, Y.N. Liu, J.X. Zhang, et al., Research progress on questionnaire survey of HPV awareness and HPV vaccine acceptance, *Chin. Gen. Pract.* 23 (13) (2020) 1675–1679.
- [44] Q. Wang, M.Z. Li, W.J. Cheng, et al., Investigation on the recognition of common gynecological malignant tumors in Chinese women, *Chin. J. Clin. Obstet. Gynecol.* 21 (04) (2020) 420–422, doi:10.13390/j.issn.1672-1861.2020.04.025.
- [45] D Watson-Jones, K Baisley, R Ponsiano, et al., Human papillomavirus vaccination in Tanzanian schoolgirls: cluster-randomized trial comparing 2 vaccine-delivery strategies, *J. Infect. Dis.* 206 (5) (2012) 678–686, doi:10.1093/infdis/jis407.
- [46] HW Akinleye, OJ Kanma-Okafor, IP Okafor, et al., Parental willingness to vaccinate adolescent daughters against human papilloma virus for cervical cancer prevention in Western Nigeria, *Pan Afr. Med. J.* 36 (2020) 112, doi:10.11604/pamj.2020.36.112.19007.
- [47] I. Azevedo, R. Covas, C. Carvalho, et al., Human papillomavirus (HPV) and the HPV vaccination in teenage boys: parental knowledge and acceptance, *Cogent Med.* 5 (1) (2018) 29–30, doi:10.1080/2331205X.2018.1544190.
- [48] N López, I Salamanca de la Cueva, E Vergés, et al., Factors influencing HPV knowledge and vaccine acceptability in parents of adolescent children: results from a survey-based study (KAPPAS study), *Hum. Vaccin. Immunother.* 18 (1) (2022) 2024065, doi:10.1080/21645515.2021.2024065.
- [49] KE Wijayanti, H Schütze, C MacPhail, et al., Parents' knowledge, beliefs, acceptance and uptake of the HPV vaccine in members of The Association of Southeast Asian Nations (ASEAN): a systematic review of quantitative and qualitative studies, *Vaccine* 39 (17) (2021) 2335–2343, doi:10.1016/j.vaccine.2021.03.049.
- [50] SL Fu, YQ Yu, HF Xu, et al., Knowledge and attitudes toward prophylactic human papillomavirus vaccines among the mainland Chinese population, *Chin. J. Clin. Oncol.* 45 (23) (2018) 1220–1224.
- [51] S.Q. Zhang, K. Wang, Y.L. Zhang, Application status of HPV vaccine in China, *Chin. J. Clin. Obstet. Gynecol.* 35 (10) (2019) 1090–1095, doi:10.19538/j.fk.2019100105.
- [52] J Lei, A Ploner, KM Elfström, et al., HPV vaccination and the risk of invasive cervical cancer, *N. Engl. J. Med.* 383 (14) (2020) 1340–1348, doi:10.1056/NEJMoa1917338.