v. 5, n. 17, 2025

International Journal of Health Science

Acceptance date: 22/04/2025

THERAPEUTIC RESULTS OF THE HPV VACCINE

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Abstract: Objective: To analyze the therapeutic results of the HPV vaccine, evaluating its efficacy in preventing infections, precancerous lesions and the impact on the incidence of cancers associated with the virus. Methodology: A bibliographic review was carried out in the PubMed - MEDLINE database, using the search terms "therapeutic", "HPV vaccines", "results" and their combinations. A total of 28 articles were selected for detailed analysis. Discussion: Large-scale vaccination is potentially associated with a reduction in HPV-related infections and lesions. Recent studies highlight immunotherapy combined with the quadrivalent vaccine as a promising advance in the treatment of recurrent or metastatic cervical cancer. In addition, challenges such as vaccine hesitancy and lack of knowledge about immunization remain significant barriers, often influenced by geographical and economic factors. The durability of the immune response induced by HPV vaccines has been a focus of new research, reinforcing their long-term efficacy. Final considerations: The importance of implementing awareness campaigns and community strategies, especially in low- and middle-income countries, to increase vaccination coverage is highlighted. However, it is essential to recognize the complexity of the issue and the need for further research to fully elucidate the benefits of vaccination and establish robust guidelines for the population.
Keywords: Therapeutic results, HPV vaccine, Prevention, Human papillomavirus.

INTRODUCTION

Human papillomavirus (HPV) infection is the most prevalent sexually transmitted disease in the world, with a high rate of transmission throughout life among men and women (Shamsi *et al.,* 2024). Studies show that the permanence of the virus is directly associated with the development of malignant neoplasms, cervical cancer being one of the most serious forms, as well as other anogenital and oropharyngeal neoplasms (Pergialiotis et al., 2024). Among the 218 subtypes identified, HPV-16 and HPV-18 are responsible for approximately 70% of cervical cancer cases, and infection with these types is prevented mainly through vaccination (Shamsi *et al.*, 2024).

Immunization against HPV represents the main primary prevention strategy against cervical cancer, significantly reducing the incidence of persistent infections and precancerous lesions, especially in populations with broad vaccination coverage (Cheema *et al.*, 2024). There are currently three formulations available: the bivalent vaccine, which protects against the oncogenic HPV-16 and HPV-18 subtypes; the quadrivalent, which includes additional protection against HPV-6 and HPV-11, which cause genital warts; and the nonavalent, which covers five additional subtypes, extending protection against lesions associated with the virus (Pergialiotis et al., 2024). Despite the effectiveness of vaccination, challenges such as vaccine hesitancy, barriers to access and gaps in the population's knowledge still limit its impact on reducing morbidity and mortality (Cheema *et al.*, 2024).

Cervical cancer remains one of the leading causes of female mortality, especially in low- and middle-income countries where access to immunization and screening programs is low (Aggarwal; Agarwal; Gupta, 2024). Successful experiences in countries such as Australia and China show that large-scale vaccination campaigns significantly reduce the incidence of HPV-associated infections and lesions (Chen *et al.*, 2024). However, in regions such as Qatar and Greece, vaccination uptake is still insufficient, reflecting distrust of the immunizer and a lack of organized public policies, resulting in late diagnosis and increased mortality (Cheema *et al.*, 2024; Shamsi *et al.*, 2024).

Studies conducted in the Colombian Amazon show that the prevalence of high-risk HPV remains high among indigenous women, with low vaccination coverage being a reflection of geographical and socioeconomic barriers, highlighting inequalities in cervical cancer prevention (Sarmiento-Medina *et al.*, 2024). This same pattern was observed among university students in Thailand, where knowledge about the relationship between HPV and cervical cancer is still limited, directly affecting acceptance of the vaccine (Sukrong *et al.*, 2024). This scenario reinforces the need for educational strategies to increase adherence to immunization.

The World Health Organization (WHO) currently recommends a single-dose vaccination schedule for healthy populations, guaranteeing the efficacy and economic viability of vaccination (Sukrong *et al.*, 2024). However, in immunosuppressed groups, such as transplant patients or those living with HIV, it is still necessary to administer three doses, which can compromise adherence due to logistical difficulties and the length of the vaccination schedule (Cheema *et al.*, 2024). In addition, research indicates that vaccine hesitancy among university students in China is strongly related to behavioral factors and lack of confidence in the safety of the immunizer, pointing to the need for awareness campaigns to improve vaccine acceptance (Chen *et al.*, 2024).

HPV vaccination represents a milestone in preventive oncology, reducing the incidence of neoplasms associated with the virus and significantly impacting mortality rates. However, its effectiveness depends on broad vaccination co-

International Journal of Health Science ISSN 2764-0159 DOI https://doi.org/10.22533/at.ed.1595172511042

verage, equitable access and the integration of early screening programs. Given this panorama, this study aims to analyze the main therapeutic results of the HPV vaccine, assessing its effectiveness in preventing infections, precancerous lesions and the impact on the incidence of cancers associated with the virus.

METHODOLOGY

A literature review was carried out according to the criteria of the PVO strategy, which stands for: population or research problem, variables and outcome. This strategy was used to develop the research question "What are the main therapeutic results of the HPV vaccine in terms of reducing infections, precancerous lesions and cancers associated with the virus?". The searches were carried out using the PubMed - MEDLINE (Medical Literature Analysis and Retrieval System Online) databases. The search terms were used in combination with the Boolean terms "AND" and "OR", using the following search strategy: ((("therapeutical"[All Fields] OR "therapeutically"[All Fields] OR "therapeuticals"[All Fields] OR "therapeutics"[MeSH Terms] OR "therapeutics"[All Fields] OR "therapeutic"[All Fields]) AND ("result"[All Fields] OR "resultant"[All Fields] OR "resultants"[All Fields] OR "resulted"[All Fields] OR "resulting"[All Fields] OR "results"[All Fields]) AND ("papillomavirus vaccines"[MeSH Terms] OR ("papillomavirus"[All Fields] AND "vaccines"[All Fields]) OR "papillomavirus vaccines"[All Fields] OR ("hpv"[All Fields] AND "vaccine"[All Fields]) OR "hpv vaccine"[All Fields])). From this search, 249 articles were found, which were then submitted to the selection criteria. The inclusion criteria were: articles in English; free full text; published between 2024 and 2025, which addressed the themes proposed for this research and review, meta-analysis, observational or experimental studies. The exclusion criteria were: duplicate articles, articles available in abstract form, articles that did not directly address the proposal studied and articles that did not meet the other inclusion criteria. After applying the inclusion and exclusion criteria, 28 articles were selected from the PubMed database to make up the collection of this study.

DISCUSSION

Vaccination against HPV represents a significant advance in the prevention of infections, precancerous lesions and cancers associated with the virus. Numerous studies reinforce its efficacy both in reducing viral load and in reducing the incidence of related diseases. According to Wang et al. (2024), the potential of immunotherapy combined with the quadrivalent HPV vaccine was analyzed in the treatment of recurrent or metastatic cervical cancer. The overall response rate of 53.8% and disease control in 76.9% of cases indicate promising potential, especially for patients who do not respond to conventional therapies. A comparison between pembrolizumab and sintilimab revealed that the latter, in combination with the vaccine, showed promising efficacy, reinforcing the need for larger-scale studies to confirm the findings. However, the small sample size limits the generalizability of the results, highlighting the importance of large-scale randomized clinical trials to validate the results.

In addition to therapeutic advances, awareness of HPV vaccination plays a fundamental role in population adherence. Garg et al. (2024) analyzed the impact of social networks on vaccine acceptance and found that the dissemination of medical information online has positively influenced the decision to vaccinate. However, Solis-Torres et al. (2024) point out that, despite this progress, medical students still have gaps in their knowledge about HPV, which suggests the need for curriculum improvement and educational campaigns aimed at health professionals on the subject.

HPV awareness and vaccination remains a global challenge, especially in populations where cervical cancer screening is still underutilized. Alrefai et al. (2024) reviewed the prevalence of HPV and the population's level of knowledge about the infection, highlighting a worrying lack of awareness among both the general public and health professionals. The study revealed that although cervical cancer is the fourth most prevalent type in women globally, its incidence in certain regions, such as Saudi Arabia, remains relatively low due to the absence of systematic screening programs and limited vaccination uptake. Furthermore, misinformation about the safety of the HPV vaccine and vaccine hesitancy are additional barriers to its widespread implementation. The authors emphasize that educational strategies and public policies aimed at disseminating knowledge are essential to improve acceptance and adherence to immunization, ensuring greater protection against infection and its complications.

The implementation of vaccination has also been associated with a reduction in the incidence of cervical cancer. Grieger et al. (2024) observed that, in Germany, the introduction of the vaccine in 2007 led to a significant drop in cases of carcinoma in situ of the uterine cervix, especially in young women. Similar results were reported by Na et al. (2024), who analysed the effectiveness of vaccination in South Korean women infected with the HPV-16 and HPV-18 subtypes between 2010 and 2021, showing that immunization significantly reduced viral load and the duration of infection, especially for HPV-16. However, the authors highlight the need to expand vaccination coverage to the 18-26 age group and to implement strategies to encourage vaccination in less informed populations.

The durability of the immune response induced by HPV vaccines has also been the subject of research. The Costa Rica HPV Vaccine Trial (Porras et al., 2024) revealed that after 16 years of administration of a single dose of the bivalent vaccine, the production of antibodies against HPV-16 and HPV-18 remained high, without the need for boosters. Similar results were obtained by Malvi et al. (2024), who compared the efficacy of one, two and three doses of the quadrivalent vaccine, indicating that immunogenicity was sustained for 12 years, regardless of the number of doses.

Additional data reinforces the importance of early vaccination for maintaining immunity against HPV. A study by Davis et al. (2024) followed Alaskan Native children who received the quadrivalent vaccine between the ages of 9 and 14 and assessed antibody levels over five years after immunization. The results showed that all participants maintained detectable antibodies against the four types of HPV included in the vaccine (HPV-6, HPV-11, HPV-16 and HPV-18), even with a gradual decline over the years. In addition, children vaccinated at a younger age showed higher levels of antibodies at five years of follow-up, suggesting that the immune response is more robust when vaccination occurs early. These findings corroborate the guidelines that recommend administering the HPV vaccine before sexual activity begins, ensuring sustained protection against persistent infections and cancers associated with the virus.

These findings reinforce the recommendation of the World Health Organization (WHO) to use a single-dose vaccine schedule. However, Zaman et al. (2024) emphasize that the safety and immunogenicity of the vaccine may vary according to the population profile. In a study involving girls aged 9 to 14, it was observed that the seroconversion rate reached 100% one month after the second dose, and remained high at six months. However, the study highlighted limitations such as the short follow-up time and the restriction of the sample to specific ethnic groups, suggesting the need for new clinical trials with greater population diversity.

Despite the documented benefits, challenges in implementing vaccination in vulnerable populations still persist. Waters et al. (2024) analyzed the barriers faced in recommending and administering the vaccine in oncology settings, highlighting that vaccine hesitancy, lack of knowledge among health professionals and difficulties in accessing the immunizer represent significant obstacles. The study reinforces the need for integrated strategies that include training professionals, improving distribution infrastructure and expanding policies to encourage vaccination.

The interaction between vaccination and cervical cancer screening programs has also been widely studied. Grimes (2024) analyzed how HPV prevalence in different age groups and vaccination levels affect the interpretation of screening tests, highlighting that large-scale immunization can alter the epidemiological patterns of infection. The study suggests that adjustments to screening protocols are needed to optimize the early detection of precancerous lesions, especially as vaccination becomes more widespread.

In relation to inequalities in access to the vaccine, studies indicate that socioeconomic and educational factors have a direct influence on vaccination coverage. Gong et al. (2024) identified disparities in China, where middle- and lower-class women have lower adherence to immunization due to a lack of knowledge about its importance and the absence of effective public policies. A similar situation was observed in Canada, where the COVID-19 pandemic negatively impacted school vaccination programs, reducing adherence and increasing cases of cervical cancer (Perez et al., 2024). To mitigate these inequalities, Tai et al. (2024) point out that the implementation of educational campaigns and community vaccination strategies can significantly increase vaccination coverage, especially among children and adolescents.

The impact of vaccination on reducing HPV-related cancers has also been documented in longitudinal studies. Lehtinen et al. (2024) compared the efficacy of the bivalent and quadrivalent vaccines in preventing stage 3 carcinoma in situ and adenocarcinoma, showing that both confer significant protection, although the quadrivalent vaccine showed a slight superiority in the range of protection. Mo et al. (2024) analyzed the prevalence and genotypic distribution of HPV in Chinese women between 2019 and 2023, finding that subtypes not included in current vaccines, such as HPV-35, HPV-51 and HPV-68, continue to circulate with significant frequency, indicating the need to develop vaccines with a broader spectrum.

Another relevant aspect is the acceptance of the vaccine among parents and guardians. Heyde et al. (2024) analyzed the global perception of HPV vaccination and found that acceptance rates vary between regions, being highest in Africa (79.6%) and lowest in North America (56.7%). Among the main factors influencing this acceptance are concerns about the safety of the vaccine and a lack of knowledge about its benefits. Arroyo et al. (2024) reinforce that, as vaccination coverage increases, the accuracy of HPV screening tests improves, optimizing the early detection of cervical lesions and reducing the need for more invasive tests.

Dull et al. (2024) argue that in order to achieve the elimination of cervical cancer, it is essential to combine vaccination strategies with effective screening and innovative therapeutic measures. In addition, Cai et al. (2024) suggest expanding vaccination coverage to high-risk populations, such as men who have sex with men and immunosuppressed patients, as well as developing therapeutic vaccines to treat established infections.

FINAL CONSIDERATIONS

Immunization against HPV is essential for the prevention of infections, cancer precursor lesions and neoplasms associated with the virus, with proven efficacy of the bivalent and quadrivalent vaccines, including a single-dose regimen. The combination with immunotherapy has shown potential in the treatment of advanced cervical cancer, while effective screening favors the early detection of lesions. However, challenges such as vaccine hesitancy, lack of knowledge and access barriers still limit population adherence, highlighting the need for public policies that encourage vaccination and raise awareness. In addition, more robust clinical studies, with diverse populations and prolonged follow-up, are essential to assess the durability of the immune response and develop vaccines with a greater spectrum of protection. Increasing vaccination coverage, combined with educational strategies and improved medical training, is fundamental to reducing the incidence of HPV-related neoplasms and optimizing screening and prevention programs.

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