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Self-sampling for cervical cancer screening: preferences, acceptability, convenience and cost-effectiveness

Sedigheh Damavandi Kamali [1], Iliad Moradi [2], Abdolvahab Moradi [1]*

1. Department of Microbiology, Faculty of Medicine, Golestan University of Medical Sciences, Gorgan, Iran
2. Department of Laboratory Sciences, School of Allied Medical Sciences, Iran University of Medical Sciences, Tehran, Iran
* Correspondence: Abdolvahab Moradi. Department of Microbiology, Faculty of Medicine, Golestan University of Medical Sciences, Gorgan, Iran.
Tel: +989111772107; Email: abmoradi@gmail.com

Abstract

Background: Human papillomaviruses (HPVs) are DNA viruses from the *Papillomaviridae* family. These viruses are linked to about 5% of human cancers, with a significant association with cervical cancer. Infection with this virus can be screened in women to prevent cervical cancer.

Methods: This review analyzes articles published over the last two decades regarding self-sampling, papillomavirus, and cervical cancer. The search for articles was conducted using various scientific databases, with selections based on their relevance to the topic and their contribution to understanding and comparing methods. Key results were examined, focusing on social aspects, economic savings, and participants' satisfaction with the self-sampling method.

Results: One of the most common and effective methods for HPV screening is sampling from the cervix using the Pap smear method and molecular techniques, widely used in various countries. Currently, HPV screening methods in different countries are primarily limited to clinical sampling, which cannot cover all urban and rural populations. The World Health Organization has recommended and supported self-sampling for HPV screening as a new strategy.

Conclusion: This mini-review discusses the self-sampling method for HPV screening, its advantages, and its application in different countries. As self-sampling can address the needs of both rural and urban areas, it is more economically viable and helps minimize cultural barriers and public opinion challenges compared to clinical sampling. The HPV self-sampling strategy offers an effective and efficient method for HPV screening, aiming to cervical cancer caused by the HPV virus in various countries.

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Introduction

Cervical cancer is the fourth most common cancer among women, with 570,000 new cases reported annually, mostly affecting women between the ages of 30 and 49 (1-3). According to the World Health Organization (WHO), the incidence and mortality rates of cervical cancer are predicted to increase in the coming years (4).

In humans, approximately 5% of all cancers are caused by human papillomavirus (HPV) infection, with cervical cancer being one of the most significant from a global perspective. Papillomaviruses are a widespread group of non-enveloped epitheliotropic viruses that cause hyperproliferative lesions of the skin and mucous membranes. Rarely, the viral life cycle of these viruses can deviate, leading to various epithelial malignancies, including uterine cervical cancer, as well as other cancers in the anogenital tract and upper airway (5). Cervical cancer can be caused by specific types of HPV, with HPV-16 and HPV-18 responsible for 70% of cervical cancers and lesions (1,6).

In developing countries, cervical cancer accounts for over 90% of HPV-related cancers (7). Widespread cervical cancer screening has significantly reduced the global incidence of the disease, with the Pap smear being the most commonly used screening method. This technique involves the harvest of cervical cells for examination by a cytopathologist (8).

HPV screening methods can be categorized into clinical sampling and self-sampling. Clinical sampling, the most widely used method worldwide, requires the patient's attendance, experienced personnel, and substantial financial resources.

Alternatively, HPV samples can be collected by patients themselves, a process known as self-sampling. Self-sampling for HPV is independent of location, time, and direct involvement of healthcare personnel, making it feasible in low-resource settings and potentially increasing screening uptake (8). Additionally, self-sampling methods have demonstrated high accessibility and acceptability for cervical cancer screening compared to clinician-administered sampling. Self-sampling is less invasive, which can make it more appealing and help overcome cultural and social barriers to screening (9). Research shows that self-sampling methods are well-received, significantly increasing screening uptake compared to traditional clinical methods (2,10).

A meta-analysis has shown that women with the option of self-sampling were more likely to participate in cervical cancer screening programs, with a reported risk ratio of 2.27 for increased participation. Although concerns exist regarding the accuracy of self-sampling and women's confidence in performing it, clear instructions and support are necessary (4). Studies have demonstrated that the accuracy of HPV self-sampling for cervical cancer screening is comparable to samples collected by healthcare professionals (11). Thus, self-sampling can serve as an effective alternative method with the potential to increase participation in cervical cancer screening (12,13). However, while self-sampling has shown promise, both types of testing methods should be evaluated to ensure optimal women's health outcomes (12).

This mini-review aims to discuss the choice between clinical sampling and self-sampling for HPV testing, focusing on their accessibility, comfort, and effectiveness. As the healthcare system evolves, understanding these methods is essential to improve screening rates and reduce the incidence of cervical cancer.

Methods

This review is based on the analysis of articles published in the last two decades. For this purpose, scientific databases such as PubMed, Scopus, Web of Science, and Google Scholar were used. Searches were conducted using keywords such as self-sampling, papillomavirus, and cervical cancer. The selected articles were chosen based on their relevance to the topic and their role in better understanding and comparing the methods. Key findings were combined and categorized, focusing on social insights, cost-effectiveness, and participant satisfaction with the self-sampling method.

Self-sampling for HPV detection

The use of new technologies to detect HPV, the necessary cause of cervical cancer, has created new opportunities by allowing women to self-collect cervical cells at home and mail the samples for HPV testing (14). The accuracy and reliability of HPV self-sampling methods have been the subject of multiple studies. A meta-analysis has shown that self-collected samples can be as accurate as clinical samples, providing a reliable alternative for cervical cancer screening. HPV self-sampling can enhance cervical cancer screening uptake, especially in low- and middle-income countries, where 89% of cervical cancer cases occur (4).

Although WHO recommends HPV self-sampling as an additional screening method for early detection in women aged 30 years and older (1), HPV self-sampling has been effective in reaching women who otherwise delay or opt out (15). Self-sampling tests have been recommended as an alternative way to improve cervical cancer screening uptake and reduce the disease burden (4).

Many studies have shown that self-sampling is highly accepted by women. Using a standard practice in cervical cancer screening programs is minimally invasive and associated with very low discomfort for women (16). Due to the

physical and psychological discomfort associated with physician-collected samples, self-sampling can be an acceptable alternative, which is also supported by WHO recommendations on self-care interventions (13). Cervical cancer screening presents an opportunity to prevent this invasive cancer, contributing to significant reductions in the global burden of cervical cancer (14).

Humanity has always sought easier, better, and more cost-effective strategies than traditional methods while ensuring accuracy, efficiency, and convenience. Self-sampling for HPV to screen for cervical cancer is one such strategy that has been used in various communities.

What people particularly liked about HPV self-sampling was the level of privacy, convenience, and overall comfort, especially compared to a Pap smear. The ability to collect a sample in the comfort of their own home and at any time of their choice reassures some providers about concerns related to access to healthcare (e.g., wait time, appointment scheduling, transportation) (17). However, it is noteworthy that self-sampling is recommended in 17 countries, primarily to target under-screened populations (4). Figure 1 shows the procedure of self-sampling.

HPV self-sampling's help in increasing cervical cancer screening coverage

The HPV self-sampling can significantly improve cervical cancer screening uptake, particularly among women who are under-screened or never screened (18).

Self-sampling for HPV testing is one of the most cost-effective methods and has been evaluated in several European populations as well (19). HPV self-sampling has shown efficient and significant improvements in cervical cancer screening rates among women (15). To achieve significant improvements in screening rates, it is essential to develop public health strategies that promote self-sampling as an effective alternative to traditional clinical methods (20). Local public health campaigns can also increase awareness and acceptance of self-sampling methods (21).

Countries, including Australia, Denmark, Malaysia, and the Netherlands, are moving toward self-sampling as a screening option (4). In the Netherlands, an observational study has shown that high-risk HPV (hrHPV) testing on self-collected samples performs well in routine primary screening programs, suggesting that self-sampling could be an effective primary screening option (22). Australia was one of the first countries to introduce a national HPV vaccination program in 2007, and it has since achieved high vaccination coverage across both men and women. If the situation is maintained, cervical cancer could be considered eliminated as a public health problem in Australia within the next 20 years (1).

Preferences, acceptability, and economic aspects of HPV self-sampling compared to healthcare provider-collected samples

It is essential to ensure that self-sampling methods are accessible and acceptable to women in low- and middle-income countries. Studies have shown that self-sampling is an acceptable alternative, with women often preferring it because of the privacy and convenience it offers (7). Economic considerations also play a vital role. A systematic review and meta-analysis revealed that HPV self-sampling has the potential to be cost-effective compared to healthcare provider-collected samples (4). However, there are several common concerns and misconceptions about HPV self-sampling. One major concern is the accuracy and reliability of self-collected samples (10). With proper information and effective educational programs, these issues can be resolved.

HPV self-sampling is widely accepted; however, awareness, experience, and preferences need to improve. It is considered acceptable and easy to use (2). Acceptability exists in both developing and developed countries, and women prefer self-sampling over attending screenings with cervical cytology when both methods are available (23). Participants rated the positive test characteristics of self-sampling more favorably compared to cervical cytology (24). Self-sampling tests represent a valid alternative for HPV testing and are widely accepted. Cost-effectiveness is also improved by reducing the cost of HPV self-sampling and attracting never-tested and long-term under-tested women (19).

A systematic review and meta-analysis focusing on low- and middle-income countries highlighted the potential of HPV self-sampling in improving screening uptake (4). A study on African-American women in the Mississippi Delta region of the United States examined the cost-effectiveness of HPV self-sampling. The findings suggest that self-sampling could be a very effective strategy for reducing cervical cancer in high-risk populations by making screening more accessible and affordable (25). Insights from federally qualified health centers in the United States have reported that while the costs of setting up self-sampling programs might be higher, the long-term savings from increased screening coverage and early detection could be much greater (26). A cost-effectiveness analysis compared repeated HPV self-sampling with traditional Pap smear cytology. The study reported that HPV self-sampling could enhance participation rates, thereby identifying more women at risk of developing cervical cancer. This increase in participation is likely to reduce the overall costs (19). This is particularly important for women who live in remote or underserved areas, where they may face logistical and financial barriers to accessing traditional cervical cancer screening methods (12).

Furthermore, Indian women continue to be hesitant and shy about taking a pelvic exam due to cultural reasons (3). Studies on women's views regarding HPV self-sampling have indicated that, in Western countries, most women are receptive to HPV self-sampling as part of future screening (27).

Studies show that the acceptability of HPV self-sampling was very positive among both women aged 25 to 35 and those older than 45, indicating that it could be a solution to overcome the barrier of the Pap smear and is feasible as an alternative cervical cancer screening method (28). A four-year project in Nicaragua, Guatemala, and Honduras showed high acceptability of HPV self-sampling among nearly a quarter-million women (29). In Peru, high levels of satisfaction with HPV self-sampling have been documented in the Loreto province, where 74.2% of users reported feeling at least satisfied with the program, and 68.0% preferred self-sampling compared to healthcare provider sampling (29).

These results can help adjust public health strategies for the early inclusion of HPV self-sampling as a screening method to prevent cervical cancer in its early stages. Self-collected samples also have high efficiency and acceptability, which can reduce socioeconomic and cultural barriers to increase the screening rate. Currently, primary cervical screening programs in many nations, such as Norway, Denmark, and the United Kingdom, involve self-sampling (2). Table 1 shows the summary of self-sampling studies in some countries.

Figure 1. Procedure of self-sampling

Table 1. Summary of self-sampling studies in countries and comparison with clinician collection sampling

Country	Participants	Brief result	Ref.
Denmark	23632	Women participating in self-sampling had a higher XCIN2 (OR = 1.83, 95% CI: 1.21–2.77) and routine screening (OR = 1.03, 95% CI: 0.75–1.40)	(30)
Japan	7653	By sending the HPV test kit to 1,674 women, 953 of them returned the kit, and 89 HPV-positive cases were found.	(31)
Botswana	104	Women living with HIV found self-sampling to be comfortable and easy more than 90% of the time, and 95% were willing to try it again.	(32)
Mexico	110	A large proportion of women (42.7%) preferred both methods equally. There was also a strong willingness to use self-sampling and recommend it.	(24)
Nigeria	9406	Overall acceptability of self-sampling was very high, with 81.2% of women preferring self-sampling over clinician collection.	(33)
Cameroon	540	Participants expressed a high level of acceptance of HPV self-sampling as a screening method. Acceptance of the method did not correlate with education level, knowledge, age, or socio-professional class.	(27)
China	1793	Approximately 88.8% of participants rated the acceptability of self-sampling methods as "high," and 64.2% preferred self-sampling for cervical cancer screening.	(2)
Italy	482271	Self-sampling methods have nearly doubled the likelihood of using cervical cancer screening and show higher rates compared to samples collected by doctors.	(6)

Results and Discussion

Considering the analysis conducted regarding HPVs and the infections it causes, particularly cervical cancer, as well as the importance of early detection and complications arising from this virus for prevention and treatment, it is expected that all countries, especially developing ones, would adopt measures for self-sampling to increase the coverage of HPV screening in both rural and urban areas, particularly for women who do not participate in regular screening programs or have never been screened.

Conclusion

To minimize the barriers and challenges of sampling by healthcare workers compared to self-sampling for HPV, this method can serve as a highly acceptable and cost-efficient alternative, effective across various countries.

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Ethical statement

This study, as a review article based solely on the research of others, does not require any special ethical approval.

Conflicts of interest

There are no conflicts of interest.

Author contributions

AM, SDK, and IM contributed to the study conception, data analysis, revision, reading, and confirmation of the final version of the manuscript.

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