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Assessing Cervical Cancer and HPV Awareness in Pakistan's Medical College Students Pursuing Healthcare Careers

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ABSTRACT

Background. Cervical cancer incidence is highest in low- and middle-income countries (LMICs), accounting for nearly 80% of cases worldwide. The circumstances in Pakistan are to a great extent obscure due to a lack of Human Papillomavirus (HPV) awareness and the lack of screening programs at population level. HPV screening is unavailable in many regions of Pakistan, and Pap smear testing is rarely performed even in gynecological clinics. Recently, the frequency of HPV has risen extensively in Pakistan.

Methods. This cross-sectional study aimed to evaluate the awareness level of HPV, the attitude towards HPV vaccine, and screening of HPV among students of ten medical colleges across Pakistan. The study was a self-administered questionnaire-based survey. A total of 4007 questionnaires were collected and analyzed from medical students studying at different colleges in Pakistan.

Results. The current study revealed a significant lack of knowledge and awareness concerning HPV among medical students in Pakistan as well as low screening rate of (11.1 %) due to many barriers. In the absence of cervical screening program, cancer of cervix remains a major health problem.

Conclusion. Education initiatives in Pakistani schools remain crucial to raise awareness on HPV and promote HPV screening, especially among medical students, who represent the country's future and healthcare system.
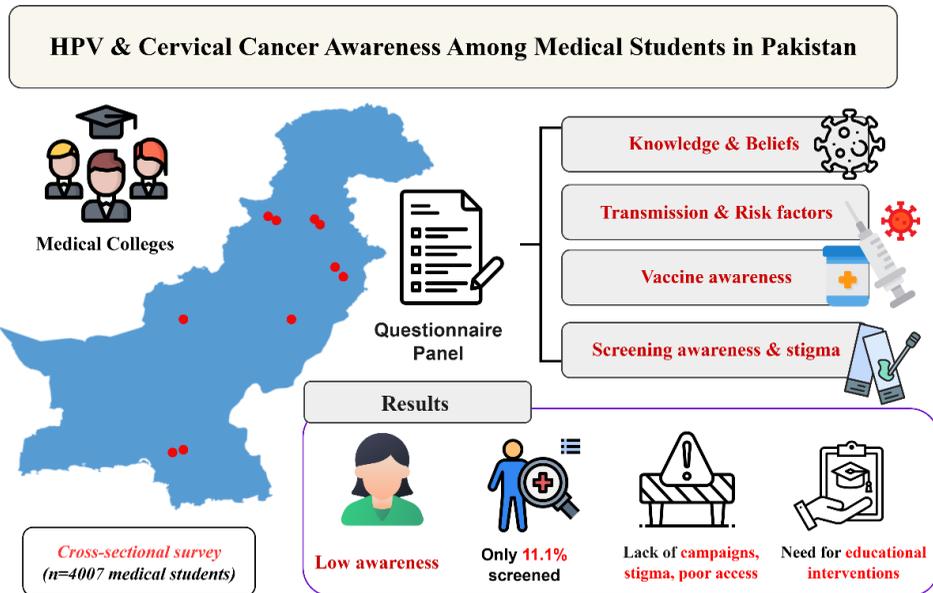
Keywords: awareness, cervical cancer, Human Papillomavirus (HPV), medical students, Pap smear, screening

Highlights

- Low awareness of HPV among future healthcare providers

- Barriers to screening and low uptake

- Need for educational interventions in medical schools

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GRAPHICAL ABSTRACT

HPV & Cervical Cancer Awareness Among Medical Students in Pakistan

Medical Colleges

Questionnaire Panel

Knowledge & Beliefs

Transmission & Risk factors

Vaccine awareness

Screening awareness & stigma

Results

Cross-sectional survey (n=4007 medical students)

Low awareness

Only **11.1%** screened

Lack of **campaigns, stigma, poor access**

Need for **educational interventions**

1. INTRODUCTION

Cervical cancer is the 4th most communal cancer in women worldwide, after lung, breast, and colorectal cancers. There were estimated 604,000 new cases in 2020, with over 342,000 deaths of women. Approximately, 90% of all these cases occurred in low-and middle-income countries (LMICs). Women living with Human Immunodeficiency Virus (HIV) are six times more likely to develop cervical cancer. However, more than 95% of cervical cancer occurs due to Human Papillomavirus (HPV) [1, 2]. It is the most common type of Sexually transmitted disease (STD), infecting more than 30 million people every year. Likely, 80% of sexually active males and females would have been infected with HPV at some point in their lives. Approximately, all the women are at a risk of getting this infection regardless of socio-cultural and economic conditions [3]. HPVs are ubiquitous, small double-stranded DNA viruses (50-60nm in diameter), non-

enveloped viruses belonging to the Papillomaviridae family. A total of 200 viruses have been identified on the basis of the DNA sequence data, out of these, 85 HPV are well-characterized and 120 are partially-characterized as potential new genotype. Most of them affect human beings, with the ability to mask themselves from the immune system [4, 5]. HPVs are usually categorized into high-risk and low-risk HPVs. High-risk HPVs include 16, 18, 31, 33, 34, 35, 39, 45, 51, 52, 56, 58, 59, 66, 68, and 70. On the other hand, low-risk types include 6, 11, 42, 43, and 44 [6]. These types are associated with various kinds of clinical manifestations, from lesion to cancer. Similarly, low-risk HPVs are responsible for anogenital warts and cutaneous warts. Oropharyngeal and anogenital cancers, including penile, cervical, anal, vaginal, and vulvar are evident of high-risk HPV [7]. The pathogenesis comprises viral entry (HPV type 16 and 18) into metaplastic cells in the cervical transformation zone and integration of viral genome into host

genome. Consequently, this leads towards the inactivation of tumor suppressor genes p53 and Rb. Prolonged exposure to HPV infection is a pivotal cause of invasive cervical squamous cell carcinoma [6]. Furthermore, HPV is considered as a serious health problem worldwide. Furthermore, the infection has both physiological and psychological consequences. It has been marked as a leading driver of cervical cancer [8]. In 2020, the World Health Assembly formulated a global strategy to eliminate cervical cancer, with a comprehensive approach including primary prevention, secondary prevention, and tertiary prevention [9]. These levels are defined as the basis of age, disease prognosis, and possible available treatment [2]. In low-resource countries, such as Pakistan, women aged 15 or older are at a risk of developing cervical cancer. According to statistics, every year in Pakistan, nearly 5000 women are diagnosed with cervical cancer with 3197 deaths being recorded annually [10]. Approximately, 88.1% of invasive cervical cancers are linked to HPV types 16 and 18 [11]. The progression of pre-cancerous lesions (dysplasia) typically occurs slowly and early detection through Pap smear testing is straightforward, making these lesions fully treatable [12].

To prevent this invasive cancer and overall mortality rates, assessment of prior knowledge among healthcare workers regarding cervical cancer, their co-relationship with HPV, and associated risk factors is important [12, 13]. This is because healthcare professionals, especially medical physicians directly aware patients concerning various diseases on different mind levels. In developing countries, physicians can manipulate communities by helping them overcome the psychological barriers. Therefore, physicians play an effective role to control the overall state of any prevalent disease. By assessing medical students' knowledge and beliefs, the future prevalence of diseases a local community can be directly predicted. Therefore, the major impact of this study would be policy development at government level. Through the assessment of awareness level among medical students, the awareness among local communities can be directly concluded. In such context, descriptive questionnaire-based research was conducted in different medical colleges across Pakistan to identify knowledge and awareness of cervical cancer and its association with HPV. The questionnaire was specifically designed for medical college students (both male and female) excluding hospital staff so that their knowledge and perception concerning cervical cancer and HPV screening could be evaluated. Therefore, the objective of this study was to elevate the knowledge of medical students across different years of study. Eventually, it would be helpful to generate awareness about cancer among students as well as people who may save themselves from this deadly disease.

2. METHODOLOGY

2.1. Study Design and Setting

This cross-sectional descriptive study used a structured questionnaire to collect quantitative data in order to gain insights into participants' awareness, knowledge, and experience relating to cervical cancer and cervical cancer screening. This descriptive study employed structured questionnaire developed on web-based platform to collect data and some open-ended questions which were added to questionnaire in order to explore opinions of medical students about HPV screening. The authors designed the questionnaire based on the U.S. CDC HPV knowledge and screening guidelines (https://www.cdc.gov/).

2.2. Study Procedure

The questionnaire consisted of six parts. The first part comprised socio demographic characteristics of study participants. The second part consisted of twelve questions on general knowledge and beliefs of medical students about HPV. The third one was based on eight questions regarding students' knowledge about HPV transmission ways and predisposing factors. The fourth part consisted of again twelve questions about awareness and attitudes of medical students towards HPV vaccine. The fifth part comprised four questions about awareness and attitudes of medical students towards cervical cancer screening. Finally, the sixth part consisted of three questions about HPV stigma scale of medical students.

2.3. Study Participants

The inclusion criteria of the current study were major medical colleges across Pakistan. Ten different medical colleges were selected from all four provinces including, Ayub Medical College (AMC); Frontier Medical College (FMC); Khyber Medical College (KMC); GU (Gandhara University); Ziauddin University (ZU); Nishtar Medical College (NMC); Bolan Medical College (BMC); Punjab Medical College (PMC); Isra University (IU); King Edward Medical University (KEMU). The exclusion criteria were non-medical students, doctors, and other hospital staff, such as nurses and paramedics. Data was collected between January and April 2023. Questionnaires were distributed electronically through class representatives using institutional mailing lists. A total of 4,120 forms were sent and 4,007 complete responses were received (response rate: 82%). Incomplete forms (n=113) were excluded from analysis.

2.4. Convenience Sampling and Email Surveys

A convenience sampling technique was used for this study. The questionnaire was sent by email via class representative to all eligible students which included electronic consent form and explanation of research background.

2.5. Data Handling and Variables

The number of participants was presented as counts and percentages. Responses of a categorical type (for example, Yes/No or multiple-choice items) were summarized as frequencies and percentages. Likert-type items were coded from 1 (strongly disagree/incorrect) to 5 (strongly agree/correct). These are usually described as the percentage frequency of each coded response; when summarized numerically, we report the median [IQR] and, where relevant, the mean $\pm$ SD, with the coding scheme explained in the table notes.

2.6. Data Analysis

Data was entered in Microsoft Excel 2021 and analyzed using IBM SPSS Statistics version 22. Firstly, descriptive analysis was performed (frequencies, percentages, means, standard deviations, medians, and interquartile ranges) for all variables. Categorical variables (for example, sex, year of study, college, and Yes/No or multiple-choice responses) were compared using Pearson's chi-square test; Fisher's exact test was used when any expected cell count was <5. Ordinal (Likert-scale) data and composite scores were analyzed using the Mann–Whitney U test for comparisons between two groups and the Kruskal–Wallis test for comparisons across more than two groups, with Bonferroni correction applied for multiple pairwise comparisons where relevant. Continuous variables (such as age) were summarized as mean $\pm$ SD or

median [IQR] according to distribution, which was assessed using the Shapiro–Wilk test. Statistical significance was defined as $p < 0.05$; $p < 0.01$ and $p < 0.001$ were interpreted as highly and very highly significant, respectively, and are indicated in the tables.
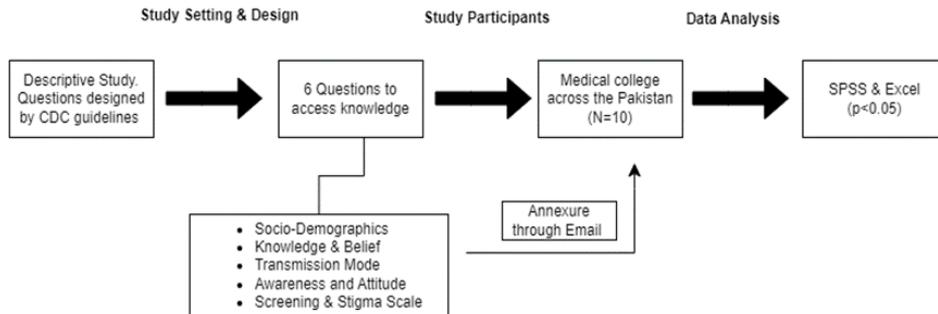

Figure 1. Basic Methodology Steps were Followed During Data Collection and Analysis

Initially, questionnaire was designed based on guidelines provided by CDC. This included socio-demographics, knowledge and belief on HPV and cervical cancer, transmission mode, and awareness.

3. RESULTS

The demographic section of the questionnaire profiled all participants (both males and females). Of the 4,007 respondents, 45.5% were females and 54.5% were males, with a mean age of 21.3 years. Figure 2 outlines the summary of demographic information of participants. In total, 4007 participants, that is, 45.5% were female students and 54.5% were male students, having mean age, that is, 21.32 year of both participants.
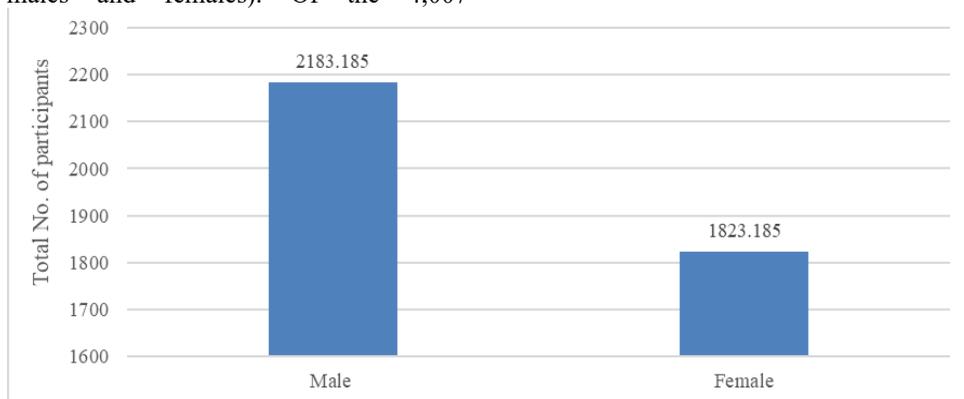

Figure 2. Participant Ratio Across Different Medical Colleges of Pakistan

Unfortunately, the overall awareness level among female students was less than the male students.

3.1. Frequency of Participants Across Different Medical Colleges

Over the total of 4007, frequency

across different medical colleges varied. A total of 4 out of 10 medical colleges of Khyber Pakhtunkhwa (KPK) contributed 1,766.1 participants, followed by Punjab (1,166.037), Sindh (913.596), and Baluchistan (160.28), respectively as shown in Table 1.

Table 1. Numerical Data of Participants Across Various Medical Colleges

Medical Colleges	Count	%Age
Ayub Medical College - Khyber Pakhtunkhwa (KP)	564	14.1
Frontier Medical College - Khyber Pakhtunkhwa (KP)	208	5.2
Khyber Medical College - Khyber Pakhtunkhwa (KP)	749	18.7
Gandhara University - Khyber Pakhtunkhwa (KP)	245	6.1
Ziauddin University - Sindh	677	16.9
Nishtar Medical College - Punjab	453	11.3
Bolan Medical College - Balochistan	160	4
Punjab Medical College - Punjab	289	7.2
Isra University - Sindh	237	5.9
King Edward Medical University - Punjab	425	10.6

This data is believed to be a rough sketch of the level of awareness among different provinces.

3.2. Number of Participants in Different Years of Study

A total of 4007 students (Figure 3) were selected from class 1st year, 2nd year, 3rd year, and 4th year. The number of students from 1st year was 365 (9.1); 829 (20.7%) students were selected from 2nd year, 1495 (37.3 %) students were selected from 3rd year, and 1318 (32.9) students were selected from 4th year.
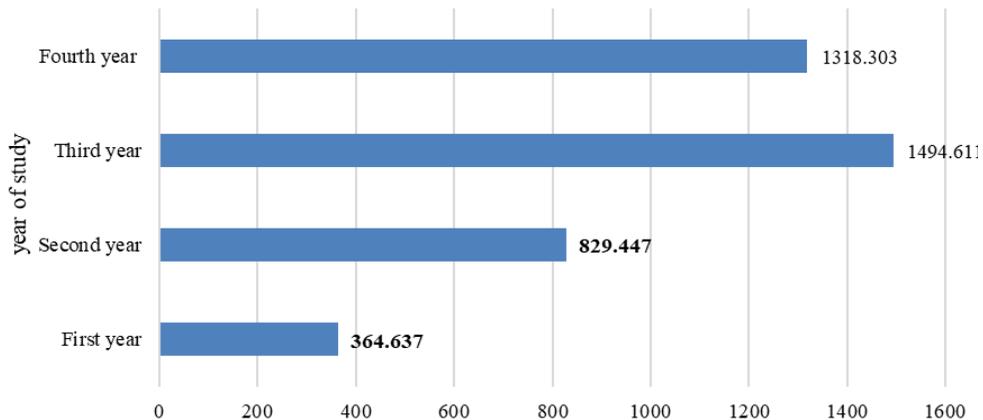

Figure 3. The Frequency of Participants Across Various Years of Study

The chi-square test revealed a significant difference in the distribution of participants across the years of study ($p<0.001$), indicating that the number of participants was not uniformly distributed across the four years.

3.3. Knowledge and Beliefs about HPV

A total of 12 questions were asked

from medical students to assess their knowledge and beliefs about HPV as shown in Table 2. This section evaluated the overall knowledge and beliefs of students regarding cancer and HPV. Major beliefs included risk factor, infertility correlation, prognosis of disease, relationship with smoking and alcohol, as well as types and responsible strain for anogenital. Moreover, these beliefs also included the use of antibiotics for HPV, genital warts, transmission mode, relationship between cervical cancer and HPV as well as general knowledge about cancer. The results indicated that medical students had transitional knowledge regarding cancer and HPV. A large proportion of students did not answer, concluding the lack of awareness and knowledge.

Table 2. General Knowledge and Beliefs of Medical Students about HPV

Questions	Yes n (%)	No n (%)	Don't Know n (%)	Correct Answer n (%)
Q1. Can we prevent any cancer? ***	3429 (85.6)	328 (8.2)	249 (6.2)	3429 (85.6)
Q2. Does HPV cause cervical cancer? ***	1134 (28.3)	737 (18.4)	2135 (53.3)	1134 (28.3)
Q3. How many types of HPV are there? ***	1654 (41.3)	569 (14.2)	1783 (44.5)	1654 (41.3)*
Q4. Is HPV infection sexually transmitted? ***	1414 (35.3)	633 (15.8)	1959 (48.9)	1414 (35.3)
Q5. Does HPV cause genital warts? ***	1190 (29.7)	617 (15.4)	2199 (55.1)	1190 (29.7)
Q6. Can HPV cause cancer in men? ***	1190 (29.7)	785 (19.6)	2031 (50.7)	1190 (29.7)
Q7. Can HPV be cured with antibiotics? ***	785 (19.6)	1438 (35.9)	1783 (44.5)	1438 (35.9) (No)
Q8. Are HPV6/11 responsible for >90% of anogenital warts? ***	801 (20.0)	913 (22.8)	2292 (57.1)	801 (20.0) (Yes)
Q9. Do smoking and alcohol contribute to cervical cancer risk? ***	1462 (36.5)	993 (24.8)	1551 (38.7)	1462 (36.5)
Q10. Is HPV infection curable? ***	1366 (34.1)	801 (20.0)	1839 (45.9)	801 (20.0) (No)
Q11. Can HPV cause infertility? ***	1326 (33.1)	769 (19.2)	1911 (47.7)	†
Q12. What is the main risk factor for HPV infection? ***	2472 (61.7%)	417 (10.4%)	1117 (27.9%)	‡

The significance value defined as **$p<0.005$ and ***$p<0.001$
† Evidence for direct infertility from HPV is limited; if you keyed this as No, set "Correct answer n (%)" to 769 (19.2%). If you treated "can contribute indirectly" as Yes, keep 1326 (33.1%)-but explain the rationale in methods/discussion. ‡ "Main risk factor" is inherently multiple-choice (e.g., unprotected sex, multiple partners). If you dichotomized it, state the coding and the specific option(s) classed as "correct" in the table note and methods.

3.4. Awareness of the Predisposing Variables and Modes of HPV Transmission

In the second part of questionnaire, total 8 questions were asked to determine the level of students' knowledge about HPV transmission, ways, and predisposing factors (Table 3). Only (39.7%) students believed that HPV can be transmitted by toilet seats. A total of (46.3%) students responded that HPV infection can be transmitted by exchange of body fluids. A total of (42.2%) believed that HPV can be transferred through sharing underwear and towels. A total of (34.3%) students answered that HPV infection is most common among women aged 23-30 years who are sexually active. Only (29.1%) students responded that HPV can cause oral cancer. Most of the students (62.5%) believed that cervical cancer may lead to death if not treated early. A total of (39.3%) students responded that 50% sexually active people acquire HPV infection. A total of (52.7%) students expressed that using condoms may prevent the spread of infection.

Table 3. Knowledge on HPV Transmission

Questions	Yes n (%)	No n (%)	Don't Know n (%)	Correct Answer n (%)
Q1. Can HPV be transmitted through toilet seats? ***	1590 (39.7)	841 (21.0)	1575 (39.3)	841 (21.0)
Q2. Can HPV be transmitted by exchange of body fluids? ***	1855 (46.3)	881 (22.0)	1270 (31.7)	881 (22.0)
Q3. Can HPV be transmitted by sharing underwear and towels? ***	1695 (42.3)	689 (17.2)	1622 (40.5)	689 (17.2)
Q4. Is HPV infection most common among women aged 23–30 years? ***	1374 (34.3)	977 (24.4)	1655 (41.3)	977 (24.4)
Q5. Can HPV cause oral cancer? ***	1164 (29.1)	1109 (27.7)	1733 (43.2)	1164 (29.1)
Q6. Can cervical cancer lead to death if not treated early? ***	2504 (62.5)	529 (13.2)	973 (24.3)	2504 (62.5)
Q7. Do 50% of sexually active people acquire HPV infection? ***	1573 (39.3)	1021 (25.5)	1412 (35.2)	1573 (39.3)
Q8. Can using condoms prevent the spread of infection? ***	2111 (52.7)	809 (20.2)	1086 (27.1)	2111 (52.7)

Significance value defined as **$p<0.005$ and ***$p<0.001$

3.5. Awareness and Attitudes towards HPV Vaccine

The third part of questionnaire focused on vaccination. A total of 12 questions were formulated to determine the awareness and attitudes of medical students towards HPV vaccine (Table 4). Only (33.7%) students thought that vaccine is available for the prevention of diseases. A total of (37.3%) students responded that HPV vaccine may cause HPV infection. Unfortunately, (58.9%) students did not know who is eligible for HPV vaccine. A total of (50.3%) students suggested that people with 10-30

years age group should get 2 doses of HPV vaccine. A total of (44.9%) students responded that protection provided by HPV vaccine is 50%, while (39.1%) thought that vaccine protection could last for 7 years. Furthermore, (41.9%) students did not think that vaccine can cure an infected person. A total of (34.7%) students were unaware of vaccine safety. A total of (38.9%) did not know that vaccine has any live viruses. A total of (44.7%) students did not know about the protection of vaccine. A total of (41.3%) students suggested that people should not get screened after getting vaccine.

Table 4. Awareness and Attitudes of Medical Students towards HPV Vaccine

Questions	Yes n (%)	No n (%)	Don't Know n (%)	Correct Answer n (%)
Q1. Is there any vaccine available for the prevention of disease? ***	1349 (33.7)	1045 (26.1)	1612 (40.2)	1349 (33.7)
Q2. Can HPV vaccine cause HPV infection? ***	1149 (28.7)	1493 (37.3)	1364 (34.0)	1493 (37.3)
Q3. Who is eligible for HPV vaccine? ***	722 (18.0)	922 (23.0)	2362 (59.0)	-
Q4. Which age group should receive HPV vaccine? ***	1158 (28.9)	2015 (50.3)	833 (20.8)	-
Q5. How many doses are required for protection against HPV? ***	889 (22.2)	1598 (39.9)	1519 (37.9)	-
Q6. Does HPV vaccine provide protection? ***	1799 (44.9)	1590 (39.7)	617 (15.4)	-
Q7. How long does vaccine protection last? ***	1349 (33.7)	1565 (39.1)	1092 (27.2)	-
Q8. Can HPV vaccine cure an HPV-infected person? ***	1084 (27.1)	1678 (41.9)	1244 (31.0)	1678 (41.9)
Q9. Are HPV vaccines safe in your opinion? ***	1325 (33.1)	1293 (32.3)	1388 (34.6)	1325 (33.1)
Q10. Does the vaccine contain HPV or any live virus? ***	1389 (34.7)	1061 (26.5)	1556 (38.8)	1061 (26.5)
Q11. Does HPV vaccine provide protection against all types of HPVs? ***	745 (18.6)	1470 (36.7)	1791 (44.7)	1470 (36.7)
Q12. Once vaccinated, a person no longer has to be screened. ***	777 (19.4)	1654 (41.3)	1575 (39.3)	1654 (41.3)

Significance value defined as **$p<0.005$ and ***$p<0.001$

3.6. Awareness of Cervical Cancer Screening and Stigma Scale

The last part of questionnaire was about awareness regarding the screening of cervical cancer and stigma scale of the population as illustrated in Table 5 and 6. In study population, (47.5%) did not know about screening tests for cervical cancer. Overall, they had very less knowledge about Pap smear test for screening cervical cancer. A total of (46.9%) students suggested that HPV infected people should not be ashamed, and their freedom should not be restricted. A total of (39.5%) study

population think that the lack of HPV awareness campaigns is the main reason of lack of HPV awareness in medical students in Pakistan.

Table 5. Awareness and Attitudes of Medical Students towards Cervical Cancer

Questions	Yes n (%)	No n (%)	Don't Know n (%)	Correct answer n (%)
Q1. What screening test should be done for HPV, in your opinion?	481 (12.0)	1622 (40.5)	1903 (47.5)	1622 (40.5)
Q2. Conventional Pap test has 75% sensitivity.	1118 (27.9)	857 (21.4)	2031 (50.7)	857 (21.4)
Q3. Regular screening must be done in less than 3 years.	1220 (30.5)	1029 (25.7)	1757 (43.8)	1029 (25.7)
Q4. Pap smear is a special test to detect abnormal cervical cells.	1430 (35.7)	977 (24.4)	1599 (39.9)	1430 (35.7)

Significance value defined as **$p<0.005$ and ***$p<0.001$

Table 6. HPV Stigma Scale of Medical Students

Questions	Yes n (%)	No n (%)	Don't Know n (%)
Q1. HPV-infected persons should not be ashamed. ***	1879 (46.9)	921 (23.0)	1206 (30.1)
Q2. Freedom of HPV-infected persons should not be restricted. ***	1654 (41.3)	953 (23.8)	1399 (34.9)
Q3. Main reason for lack of HPV awareness in Pakistan? (single yes) ***	1581 (39.5)	1053 (26.3)	1372 (34.2)

Significance value defined as **$p<0.005$ and ***$p<0.001$

4. DISCUSSION

This is the first study in Pakistan to assess the medical students' knowledge and awareness of HPV infection and vaccination. For control of HPV infections in countries, the current study is important. This is because future doctors are responsible for providing awareness to their patients.

The research demonstrated a low level of awareness among college students pertaining to the risk factors and symptoms of STIs including HPV [14, 15]. Cervical cancer is responsible for the deaths of a greater number of females in developing nations, regardless of the evidence-based fact that females are less familiar than males. It was discovered that many females do not go to screening programs and are not aware of risk associated with cervical cancer, advantages of screening, early detection, and prevention [16]. A few studies conducted in different South Asian nations have demonstrated that 50-85% of females were proficient or aware of cervical cancer [17]. Degree to which females are actually well-educated about cancer and screening can be judged simply by questioning their level of knowledge [12].

On socio-demographic analysis, KPK and Punjab showed a higher rate of participants, indicating the awareness level among students. Around 37.6% of respondents knew about cervical cancer, while 26.0% of them knew about cervical screening and only 11.1% (445/4007) of respondents had ever undergone screening in this

investigation level of awareness found in the current study, which was less than 82.45% as reported in a study published in India [18]. In a similar manner, most students were not familiar with different strains of HPV which are causative agents of cervical cancer and other complications. Still, the majority of students (44%) were not aware about the impact of antibiotics in treating HPV infection. Usually, physicians do not recommend antibiotics to treat HPV, except in secondary bacterial infections [19]. In this study, only 29% of the participants reported that HPV also affects men. According to statistics, in 4 out of 10 cases men are infected with HPV or develop cancer (oropharyngeal region, penis, and anus) [20].

In this study, the awareness level of the transmission and vaccination among students was still not significant. Different types of vaccines have been licensed including Gardasil, Gardasil 9, and Cervarix, administered in the form of 2-3 shots. According to World Health Organization (WHO), HPV vaccine can be administered in girls between the age of 9-13 years, with successive interval of six months. Immunocompromised individuals and females with age 15 or older should also receive the vaccine shots to be fully protected [21]. Only 7.9% of students were aware of the link, and many were unfamiliar with local screening initiatives. The association between HPV and cervical cancer was only acknowledged by 7.9% (317/4007) of respondents. Lack of knowledge, lack of Pap screening to analyze cancer [22–24], concerns about what people would think [25], and lack of information about how to get screening services done [26] were the main obstacles. Only over half of women thought they were at danger, indicating that they saw the benefits of screening [27]. Few screening indications were given to women. In bivariate analyses, three parameters were adversely associated with screening, that is, the belief that the Pap smear test is uncomfortable, the lack of belief in cervical screening, and the analysis of cancer.

This study revealed that there is limited information about cervical cancer, risk factors, and cervical screening among medical college's students matching to the results of studies carried out in 2021 in Jordan and Lebanon [28, 29]. Likewise, outcomes proposed poor dissemination of data. Students stated lack of awareness campaigns as the main barrier to screening. The cervical screening initiative should target those students who have never undergone a Pap smear.

In low-resource countries, such as Pakistan, there is still no policy for the prevention and awareness of HPV and their association with cervical cancer [30]. There are some key points that are needed to address this issue and to provide awareness to society at community level. These are mentioned as follows:

- Development of proper official national policy or recommendations for cervical cancer screening including starting age, active invitation to screening, screening frequency, and intervals.
- Establishment of infrastructure for increasing out-reach of Pap smear testing and nucleic acid (DNA and RNA) testing, in every district hospital. For distant areas, mobile facilities could be a good option.
- Development of proper vaccination programs for females and males aged 15 or older. Targeting males must be necessary since most of them are considered the carriers for HPV. Therefore, to attain immunity, we must

immunize every individual of community in order to minimize the spread of virus.

- Government must introduce incentives to promote awareness and knowledge of HPV through different platforms, such as social media, electronic media or print media. Different influencers must engage community towards the HPV infection and cervical cancer.

4.1. Limitations

There are some limitations of this study including sample size and biases which might not be the representatives of the entire medical college students, affecting the generalizability of the findings. The cross-sectional design limits the ability to observe temporal changes or causality. The reliance on ten medical colleges restricts the applicability of the results to the country level. Despite these limitations, this study provided valuable insights that could serve as a central point for more comprehensive research or study in the future.

4.2. Conclusion

Pakistani medical students' knowledge has fundamental gaps in the understanding of HPV and vaccines and the screening behavior among the subgroups is different. The medical colleges can seal these loopholes by incorporating standard HPV preventive modules, conducting on-campus screening and vaccination awareness programs, as well as training medical students on short-term counseling. Making curricula consistent with national screening and vaccination pathways would enhance early detection and eventually health outcomes of women.

Authors' Contribution

Sadia Bibi: conceptualization, data curation, formal analysis, investigation, writing-original draft. **Farakh Javed:** supervision, conceptualization, writing-original draft, writing-review & editing. **Muhammad Fozan:** validation, visualization. **Ehtisham Shafique:** validation, visualization. **Afsheen Tajummal:** validation, visualization. **Mustafeez Mujtaba Babar:** writing-original draft. **Shehzad Usman:** writing-original draft. **Usman Ayub Awan:** writing-original draft

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This article highlights the most significant clinical and scientific advances in cervical cancer research from the past year. It covers updates in screening, prevention, novel therapeutics, and ongoing clinical trials. The paper is especially useful for staying current with rapidly evolving treatment and management strategies.