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Research Article

# Cervical cancer: A cross-sectional study of knowledge, attitudes, perceptions, and barriers to screening and prevention among female university students

Zahari Vlaykov[1], Joana Simeonova[2], Vidin Kirkov[2]

1 *Medical Faculty, Medical University of Sofia, Sofia, Bulgaria*

2 *Faculty of Public Health "Prof. Tzecomir Vodenitcharov, MD, DMSc," Medical University of Sofia, Sofia, Bulgaria*

Corresponding author: Vidin Kirkov (vkirkov@foz.mu-sofia.bg)

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## Abstract

A total of 277 female students from 11 specialties participated in an online cross-sectional survey at the Medical University of Sofia. Differences between specialties were observed in knowledge of human papillomavirus transmission, understanding of Pap smear results, testing practices, and vaccination. Despite generally satisfactory awareness, gaps in preventive knowledge and practices remained among some student groups. Lack of time, insufficient information, fear, and embarrassment were identified as the main barriers to screening. Regression analysis identified specialty, age, year of study, parental education, place of residence, and understanding of Pap smear results as factors associated with variations in knowledge and preventive practices. The findings indicate that health-related education alone does not ensure consistent preventive behavior. More targeted and comprehensive educational interventions addressing human papillomavirus, screening, and vaccination may strengthen preventive practices among future healthcare professionals.

## Keywords

health literacy, human papillomavirus, medical education, preventive behavior, vaccination

## Introduction

Cervical cancer (CC) is a major public health issue and ranks fourth worldwide in both incidence and mortality among cancers affecting women. The World Health Organization (WHO) reported more than 600,000 new cases annually, and deaths exceed 340,000 (World Health Organization 2026).

In Bulgaria, CC is a significant health concern, predominantly affecting women of working age. It has a substantial impact on their economic and psychosocial status and quality of life, while also resulting in considerable societal losses (Dsouza et al. 2022; Yordanov et al. 2023; National Statistical Institute, Republic of Bulgaria 2024). The lack of an effective screening program remains a challenge.

The primary cause of CC is persistent infection with high-risk types of human papillomavirus (HPV), mostly HPV-16 and HPV-18 (Fowler et al. 2023). Risk factors (RFs) associated with acquiring HPV include a high-

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er number of sexual partners, younger age at first intercourse, sexual activity before the age of 19, and higher parity (Wall et al. 2010).

Prevention plays a key role through HPV immunization (primary prevention) and screening (Pap test, HPV test) at the secondary prevention level, as well as early treatment of precancerous lesions (tertiary prevention). Unlike in many countries, where successfully implemented national screening programs are associated with a reduction in CC incidence and mortality rates (IARC Working Group on the Evaluation of Cancer-Preventive Interventions 2022; Jansen et al. 2020), screening coverage for CC in Bulgaria is still insufficient (45% in 2023 vs. 60–70% in developed countries), and the share of eligible girls who received the first dose of the HPV vaccine was only 8% in 2021, especially among high-risk groups (Shin et al. 2021; Todorova et al. 2026).

A number of potential personal and sociocultural barriers can prevent access to and use of screening services: knowledge and perceptions of CC, the Pap test, and pelvic examination (Wall et al. 2010; Dsouza et al. 2022; Fahrni et al. 2022; Arrivillaga et al. 2023; Pruski et al. 2023; Usman et al. 2023). These factors may also explain the attitudes and behaviors of Bulgarian women toward CC screening programs.

Young women are a priority group for health education and preventive activities due to their earlier sexual activity. The focus of this research is students at medical universities, as they have a dual role—participants in preventive initiatives and future healthcare workers who will motivate their patients to lead a healthy lifestyle.

The aim of this study was to assess and compare the levels of knowledge, attitudes, and behaviors toward CC and preventive care among female students from different specialties at the Medical University of Sofia. The study also aimed to identify prognostic predictors of perceptions, barriers, and practices toward CC. This is the first study in Bulgaria to investigate the barriers and opportunities in CC prevention services among students from many different university training programs.

## Materials and methods

A cross-sectional study was conducted in 2025, covering female students ($N = 277$) from 11 different specialties at the Medical University of Sofia, Bulgaria. Respondents completed an online questionnaire. Anonymity was ensured because no personally identifying information (name, faculty number, or email address) was collected.

The questionnaire collected data on the level of awareness of CC, HPV, and screening; attitudes toward preventive care; health-related behaviors (Pap test, HPV test, and HPV vaccination); and motivation and barriers to screening. Sociodemographic data (age, specialty, year of study, place of residence, and parental education) were also obtained. Specialty was the independent variable in the statistical model. The confounders were age, place of residence, parental education, and year of study.

Data were processed using SPSS v. 25.0. Descriptive analysis was applied. Categorical variables were presented as absolute and relative frequencies. The categorical variable representing RFs for CC was transformed into a continuous variable (number of RFs) and presented as the median (minimum–maximum). Pearson's chi-square and Kruskal–Wallis tests were used, and differences were considered statistically significant at $P \leq 0.05$. Multinomial logistic regression was performed to identify factors influencing knowledge, attitudes, and practices toward CC. The statistical model was considered significant if Sig. < 0.05.

## Results

### Sociodemographic characteristics of the participants

The distribution of the respondents according to different sociodemographic characteristics is presented in Table 1. Most students were studying Nursing (24.2%), Medicine (17.2%), and Public Health and Health Management (14.7%), and they were mostly second- and third-year students.

**Table 1.** Distribution of respondents according to sociodemographic characteristics (*n*, %).

| Variable | *N.* | % | Variable | *N.* | % |
|---|---|---|---|---|---|
| **Specialty** | | | **Year of study** | | |
| Medicine | 47 | 17.2 | First | 57 | 21.8 |
| Dental Medicine | 26 | 9.5 | Second | 82 | 31.3 |
| Pharmacy | 20 | 7.3 | Third | 53 | 20.2 |
| Nursing | 66 | 24.2 | Fourth | 27 | 10.3 |
| Midwifery | 38 | 13.9 | Fifth | 24 | 9.2 |
| Public Health and Health Management | 40 | 14.7 | Sixth | 19 | 7.3 |
| Health Care Management | 21 | 7.7 | Total | 262 | 100.0 |
| Other | 15 | 5.5 | | | |
| Total | 273 | 100.0 | | | |
| **Place of residence** | | | **Age** | | |
| City | 217 | 78.9 | <20 years | 8 | 2.9 |
| Town | 43 | 15.6 | 20–30 years | 145 | 52.9 |
| Village | 15 | 5.5 | 30–40 years | 47 | 17.2 |
| Total | 275 | 100.0 | >40 years | 74 | 27.0 |
| | | | Total | 274 | 100.0 |
| **Maternal education** | | | **Paternal education** | | |
| Primary education | 9 | 3.4 | Primary education | 8 | 3.0 |
| Secondary education | 113 | 41.5 | Secondary education | 148 | 54.6 |
| Higher education | 150 | 55.1 | Higher education | 115 | 42.4 |
| Total | 272 | 100.0 | Total | 271 | 100.0 |

Most respondents (52.9%) were between the ages of 20 and 30 years. Urban residents accounted for more than 90% of the respondents. Compared to nursing and midwifery students, most medical students came from highly educated families (their parents had university-level education).

## Awareness

### *Cervical cancer (CC)*

Approximately two-thirds of the students were fully informed about CC. A statistically significantly higher level of awareness ($\chi^2$ = 28.840, $N$ = 272, $P$ = 0.012) was observed among health care management (HCM) students (76.0%), midwifery (MW) students (71.1%), and medical (ME) students (68.1%) (Table 2).

### *HPV transmission*

HPV is the most common sexually transmitted infection and is transmitted through skin-to-skin contact during vaginal, oral, and anal sexual activity. Respondents were considered "fully informed" if they chose all three options above, "partially informed" if only some of them were chosen, and "not informed" if none of the three correct options were chosen or if all seven suggested options were selected. Compared to the other students, ME students (58.7%) and MW students (42.1%) were better informed. Enhanced HPV education targeting DM students is warranted, as 23.1% were not informed about HPV transmission ($\chi^2$ = 44.326, $N$ = 271, $P$ = 0.001).

### *Risk factors (RFs) for CC*

RFs for CC include HPV infection (the most important and most frequently mentioned by respondents), early sexual activity, smoking, a weakened immune system, oral contraceptive use (>5 years), multiple pregnancies, family history of CC (mother, sister), socioeconomic status, obesity, nutritional factors, and age. Some of these RFs are modifiable (behavioral RFs), while non-modifiable RFs include age, ethnicity, and family history of CC.

Most of the RFs for CC were mentioned (open-ended question) by respondents. This variable was transformed into a continuous variable to determine how many RFs were mentioned correctly, which is also important for as-

**Table 2.** Awareness, attitudes, and practices toward cervical cancer (*n*, %).

| | ME | DM | PH | NS | MW | PHHM | HCM | Other |
|---|---|---|---|---|---|---|---|---|
| **Awareness of CC** | | | | | | | | |
| Fully informed | 32 (68.1) | 11 (42.4) | 8 (40.0) | 37 (56.9) | 27 (71.1) | 22 (55.0) | 16 (76.0) | 2 (13.3) |
| Partially informed | 14 (29.8) | 14 (53.8) | 12 (60.0) | 27 (41.6) | 11 (28.9) | 16 (40.0) | 5 (23.8) | 12 (80.0) |
| Not informed | 1 (2.1) | 1 (3.8) | 0 (0.0) | 1 (1.5) | 0 (0.0) | 2 (5.0) | 0 (0.0) | 1 (6.7) |
| Total | 47 (100.0) | 26 (100.0) | 20 (100.0) | 65 (100.0) | 38 (100.0) | 40 (100.0) | 21 (100.0) | 15 (100.0) |
| **Awareness of HPV transmission** | | | | | | | | |
| Fully informed | 27 (58.7) | 4 (15.4) | 4 (20.0) | 18 (27.7) | 16 (42.1) | 11 (27.5) | 7 (33.3) | 5 (33.3) |
| Partially informed | 16 (34.8) | 16 (61.5) | 14 (70.0) | 46 (70.8) | 22 (57.9) | 26 (65.0) | 13 (61.9) | 6 (40.0) |
| Not informed | 3 (6.5) | 6 (23.1) | 2 (10.0) | 1 (1.5) | 0 (0.0) | 3 (7.5) | 1 (4.8) | 4 (26.7) |
| Total | 46 (100.0) | 26 (100.0) | 20 (100.0) | 65 (100.0) | 38 (100.0) | 40 (100.0) | 21 (100.0) | 15 (100.0) |
| | 35 (74.5) | | | | | | | |
| | 3 (6.4) | | | | | | | |
| | 0 (0.0) | | | | | | | |
| | 9 (19.1) | | | | | | | |
| | 47 (100.0) | | | | | | | |
| **Pap test** | | | | | | | | |
| Last 12 months | 35 (74.5) | 14 (56.0) | 10 (52.6) | 46 (69.7) | 28 (73.7) | 28 (70.0) | 15 (71.4) | 11 (73.3) |
| 1–3 years ago | 3 (6.4) | 3 (12.0) | 5 (26.3) | 11 (16.7) | 4 (10.5) | 9 (22.5) | 5 (23.8) | 4 (26.7) |
| More than 3 years ago | 0 (0.0) | 0 (0.0) | 0 (0.0) | 3 (4.5) | 0 (0.0) | 2 (5.0) | 1 (4.8) | 0 (0.0) |
| Not performed | 9 (19.1) | 8 (32.0) | 4 (21.1) | 6 (9.1) | 6 (15.8) | 1 (2.5) | 0 (0.0) | 0 (0.0) |
| Total | 47 (100.0) | 25 (100.0) | 19 (100.0) | 66 (100.0) | 38 (100.0) | 40 (100.0) | 21 (100.0) | 15 (100.0) |
| **Understanding Pap smear** | | | | | | | | |
| Yes | 39 (83.0) | 13 (52.0) | 13 (72.2) | 47 (71.2) | 32 (86.5) | 29 (72.5) | 19 (90.5) | 10 (66.7) |
| No | 8 (17.0) | 12 (48.0) | 5 (27.8) | 19 (28.8) | 5 (13.5) | 11 (27.5) | 2 (9.5) | 5 (33.3) |
| Total | 47 (100.0) | 25 (100.0) | 18 (100.0) | 66 (100.0) | 37 (100.0) | 40 (100.0) | 21 (100.0) | 15 (100.0) |
| **HPV testing** | | | | | | | | |
| Yes | 15 (31.9) | 5 (19.2) | 9 (45.0) | 32 (49.2) | 12 (31.6) | 21 (52.5) | 14 (66.7) | 8 (53.3) |
| No | 32 (68.1) | 21 (80.8) | 11 (55.0) | 33 (50.8) | 26 (68.4) | 19 (47.5) | 7 (33.3) | 7 (46.7) |
| Total | 47 (100.0) | 26 (100.0) | 20 (100.0) | 65 (100.0) | 38 (100.0) | 40 (100.0) | 21 (100.0) | 15 (100.0) |
| **HPV vaccination** | | | | | | | | |
| Yes | 17 (37.0) | 0 (0.0) | 3 (15.0) | 4 (6.3) | 2 (5.3) | 6 (15.0) | 0 (0.0) | 1 (6.7) |
| No, I intend | 20 (43.5) | 21 (84.0) | 12 (60.0) | 24 (38.1) | 22 (57.9) | 22 (55.0) | 5 (25.0) | 3 (20.0) |
| No, I do not intend | 9 (19.6) | 4 (16.0) | 5 (25.0) | 35 (55.6) | 14 (36.8) | 12 (30.0) | 15 (75.0) | 11 (73.3) |
| Total | 46 (100.0) | 25 (100.0) | 20 (100.0) | 63 (100.0) | 38 (100.0) | 40 (100.0) | 20 (100.0) | 15 (100.0) |

ME = medicine; DM = dental medicine; PH = pharmacy; NS = nursing; MW = midwifery; PHHM = public health and health management; HCM = health care management; CC = cervical cancer; HPV = human papillomavirus.

sessing the level of awareness. The values ranged from 0 to 10 (Table 2), and the median number of RFs for CC was higher among HCM students (3, 0–10), but the differences between groups were not statistically significant ($P > 0.05$).

## Pap test

### *Knowledge of the first Pap smear and understanding results from the test*

According to current medical recommendations, the first Pap smear is recommended after the onset of sexual activity or at the age of 21, followed by testing every 3 years for women aged 21–29 years and annually for women aged 30 years and older (Al-Naggar and Isa 2010). Despite greater variability in responses among PH students and PHHM students, the differences between groups were not statistically significant ($P > 0.05$).

The ability to correctly read and interpret Pap test results is crucial for appropriate subsequent behavior. Statistically significant differences ($\chi^2 = 15.240$, $N = 269$, $P = 0.033$) were found between students from different specialties—the proportion of students unable to understand Pap smear results was higher among DM students (48.0%) than among HCM students (9.5%).

### *Pap test*

DM students (32%) and PH students (21.1%) reported never having been screened for CC, compared with approximately 70% of students from other specialties ($\chi^2 = 35.281$, $N = 271$, $P = 0.026$).

### *Barriers and attitudes toward CC screening*

The common barriers to cytological screening for CC identified in this study were lack of time, insufficient information, and psychological issues (shame, discomfort, and fear); no statistically significant differences were found between groups ($P > 0.05$).

Early detection of CC and individual health responsibility were found to be the leading motives for proactive behavior among most students, although the differences between groups were not statistically significant ($P > 0.05$).

## HPV testing and vaccination

### *HPV awareness*

HPV testing has better predictive values than cytology-based screening. It is essential for detecting infections caused by high-risk oncogenic HPV types and identifying early cervical cellular changes. One-third of students from other specialties in this study were not aware of HPV testing. Although statistically significant differences were observed between groups, the chi-square test was not considered reliable.

The proportion of students who had not been tested for HPV was significantly higher ($\chi^2 = 18.384$, $N = 272$, $P = 0.010$) among DM students (80.8%), MW students (68.4%), and ME students (68.1%).

### *HPV vaccination*

The HPV vaccine prevents infection with high-risk HPV types, reducing CC incidence by 90%. Nevertheless, barriers to HPV vaccination vary across cultures. In this sample, the proportion of unvaccinated women was lower in most groups, with the exception of medical students (37.0%). The differences between groups were statistically significant ($\chi^2 = 18.384$, $N = 272$, $P = 0.010$).

### *Statistical modeling of cervical cancer knowledge, attitudes, and practices*

Multinomial logistic regression models (main effects) were constructed to identify prognostic markers of knowledge, attitudes, and practices regarding CC among female university students from different specialties.

### *Models 1a and 1b (awareness of CC and HPV transmission, reference category: fully informed)*

Independent variables included in both models were specialty, year of study, age, parental education, and place of residence (Fig. 1a, b).

Specialty was the only variable inversely associated with awareness of CC (Fig. 1a). A one-unit increase in the predictor made the target category "partially informed" less likely than the reference category "fully informed" for the following specialties: ME (B = –2.271, $P = 0.016$, Exp(B) = 0.103, CI = 0.016–0.654), NS (B = –2.044, $P = 0.016$, Exp(B) = 0.129, CI = 0.025–0.681), MW (B = –3.002, $P = 0.001$, Exp(B) = 0.050, CI = 0.008–0.298), PHHM (B = –2.224, $P = 0.013$, Exp(B) = 0.108, CI = 0.019–0.629), and HCM (B = –2.943, $P = 0.003$, Exp(B) = 0.053, CI = 0.008–0.361).

NS students were less likely to be uninformed about HPV transmission (B = –2.876, $P = 0.036$, Exp(B) = 0.056, CI = 0.004–0.834) compared with the reference category ("fully informed") of the dependent variable (Fig. 1b).

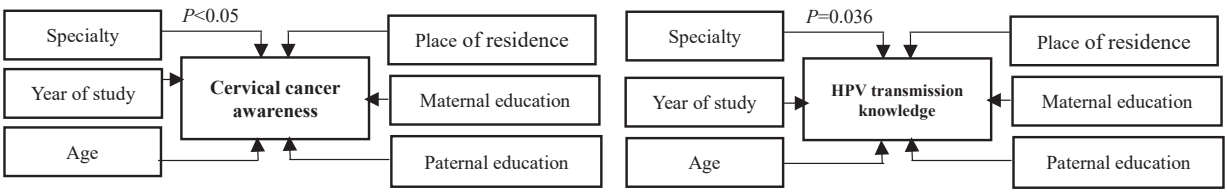


**Figure 1. a, b.** Multinomial logistic regression models of cervical cancer knowledge and its prognostic markers.

### *Models 2a, b, and c (Pap test, HPV testing, and HPV vaccination)*

Fig. 2a presents the results from the multinomial logistic regression of the Pap test. In addition to the sociodemographic characteristics, "cervical cancer awareness," "HPV transmission knowledge," and "understanding Pap smear results" were added to the statistical model.

Younger females (aged <20 years: B = 4.434, $P$ = 0.050, Exp(B) = 84.255, CI = 0.967–7337.9; and aged 20–30 years: B = 3.814, $P$ = 0.018, Exp(B) = 45.338, CI = 1.926–1067.0) and females whose mothers had lower educational attainment (secondary education: B = 2.485, $P$ = 0.013, Exp(B) = 12.002, CI = 1.688–85.329) were more likely to report never having had a Pap test compared with the reference group (last 12 months). Conversely, lower paternal education (B = –2.620, $P$ = 0.007, Exp(B) = 0.073, CI = 0.011–0.475) and the ability to interpret Pap smear results (B = –4.504, $P$ = 0.001, Exp(B) = 0.011, CI = 0.002–0.075) were inversely associated with the target category (not performed) compared with the reference category (last 12 months).

As shown in Fig. 2b, female DM students (B = 1.783, $P$ = 0.034, Exp(B) = 5.946, CI = 1.149–30.759) and university students from lower socioeconomic backgrounds (maternal primary education: B = 17.480, $P$ = 0.001, Exp(B) = 39046815, CI = 6553702–23260082) were more likely to report not having undergone HPV testing compared with the reference category (yes, performed).

## Discussion

Early cervical cancer prevention (HPV vaccination, Pap smear, HPV DNA tests, and visual inspection with acetic acid (VIA) and Lugol's iodine—VIA-VILI) has great potential to improve the chances of survival, prognosis, and quality of life for many girls and women. Along with administrative barriers to accessing health services, sociocultural norms and a number of personal characteristics of women (limited knowledge, lack of awareness, low perceived risk, beliefs, fear and embarrassment, lack of time, and financial constraints) prevent them from participating in CC prevention programs. These factors often coincide with early-onset sexual activity and increasing sexual experience among university students (Shin et al. 2021; Arrivillaga et al. 2023).

The results of this study confirm and enrich the knowledge accumulated so far in medical research about CC-related awareness, attitudes, and prevention among 277 female students from different specialties at the Medical University of Sofia. Although most respondents reported that they were well informed about CC, gaps in knowledge about HPV transmission and how to interpret Pap smear results were found among a significant proportion of DM students. This can partly explain their nonparticipation in CC screening; similar results have been reported previously (Lee et al. 2021; Shin et al. 2021; Gari et al. 2023; Pruski et al. 2023). The proportions of students who underwent HPV testing and received HPV vaccination in this sample were relatively low (0–37%) and correspond to the results reported by Hristamyan (2026) and Wojewoda et al. (2025). These results highlight the need for more information campaigns and measures to address structural, sociocultural, and psychological barriers (Wojewoda et al. 2025). A previous study among Bulgarian university students revealed that HPV vaccination rates correlated positively with nationality (international students), sexual activity (five or more sexual partners), and year of study (third year) (Hristamyan et al. 2025).

On the other hand, university students are not only current and potential beneficiaries of preventive services but will also become health educators. Therefore, good health literacy is crucial for both groups: users and healthcare providers (Fahrni et al. 2022; Pruski et al. 2023). More health education activities should be introduced and systematically integrated into the curricula of different medical specialties, covering different CC-related topics such as HPV transmission and RFs for CC, screening recommendations and screening barriers, interpretation of screening results, and HPV vaccination. The training should be comprehensive, engaging, and modern, building and improving health literacy and confidence, developing professional competence, and maintaining students' interest.

Beyond the university environment and curricular differences between specialties, personal and sociocultural barriers (younger age and lower parental education) were found to be predictors of a lack of awareness and risky behavior. The decision to have a Pap smear or to participate in screening programs is also influenced by gender roles, religious norms, education, self-care behavior, the appearance of symptoms, prior experience, family history of cancer, opinions of other people (intimate partners, peers),

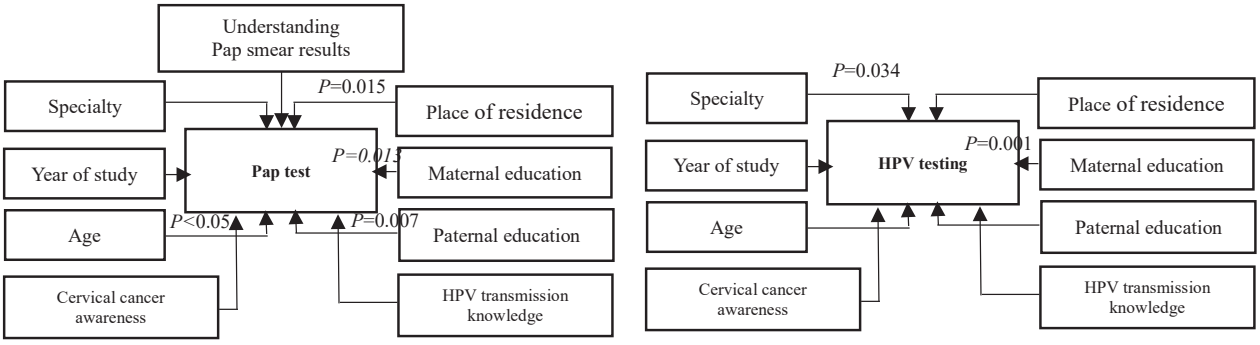


**Figure 2. a, b.** Multinomial logistic regression models of the Pap test and HPV testing and their prognostic markers.

and level of acculturation (Al-Naggar and Isa 2010; Teng et al. 2014; Shin et al. 2021; Dsouza et al. 2022; Arrivillaga et al. 2023; Usman et al. 2023). Although lack of time, insufficient information, and negative attitudes were confirmed as common barriers to Pap smear participation, there were no statistically significant differences between university students from different specialties.

The study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design does not allow causal relationships to be established. Second, the study was conducted among students from a single medical university, which may limit the generalizability of the findings to students from other universities or to the wider population. Third, the data were collected using a self-administered online questionnaire, and therefore, some responses may have been influenced by recall or social desirability bias. Finally, the number of participants differed between some analyses because of missing responses, which should also be taken into account when interpreting the statistical findings.

Overall, the study highlights that awareness of CC among future healthcare professionals should not be considered equivalent to effective preventive behavior. Differences between specialties and the presence of informational, psychological, and practical barriers indicate a need for more targeted and comprehensive preventive education. Strengthening knowledge and communication skills related to HPV, screening, and vaccination during university education may contribute not only to better personal preventive practices among students but also to their future role in promoting CC prevention among patients.

## Conclusion

The findings of this study indicate that although most female university students demonstrated a satisfactory level of awareness of CC, important gaps remained in knowledge of HPV transmission and interpretation of Pap smear results. Preventive practices, particularly HPV testing and vaccination, were relatively limited, and differences were observed between students from different specialties. Informational, psychological, and practical barriers were also identified as factors affecting participation in CC screening. These findings suggest that awareness of CC does not necessarily translate into appropriate preventive behavior. Comprehensive and targeted education on HPV transmission, CC screening, interpretation of screening results, and HPV vaccination should therefore be integrated into the curricula of future healthcare professionals to strengthen health literacy and support effective CC prevention.

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# Additional information

### Conflict of interest

The authors have declared that no competing interests exist.

### Ethical statements

The authors declared that no clinical trials were used in the present study.

The authors declared that no experiments on humans or human tissues were performed for the present study.

The authors declared that no informed consent was obtained from the humans, donors or donors' representatives participating in the study.

The authors declared that no experiments on animals were performed for the present study.

The authors declared that no commercially available immortalised human and animal cell lines were used in the present study.

### Artificial Intelligence (AI) use

The authors accept full responsibility for the content of the manuscript, including the disclosure of any use of AI.

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### Author contributions

All authors have contributed equally.

### Author ORCIDs

V. Kirkov https://orcid.org/0000-0001-8596-5677

### Data availability

All of the data that support the findings of this study are available in the main text.