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Conflict of interest

None.

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# Evaluation of the knowledge of students concerning sexually transmitted infections in Bavaria/Germany (a cross-sectional study)

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## Summary

**Background and objectives:** Despite numerous information sources and campaigns on sexually transmitted infections (STIs), there has been an increase in STIs in Germany in recent years. The aim was to evaluate the awareness and knowledge level among young students in Bavaria/Germany for STIs with a focus on human papilloma viruses (HPV).

**Methods:** In a cross-sectional survey rendered completely and irreversibly anonymous, a total of 4,100 students from Bavaria between the ages of 12 and 17 were interviewed using a multiple choice questionnaire about their knowledge and awareness of STI, on the basis of gender, school education and preventive youth health examinations that had taken place.

**Results:** A total of 3,834 questionnaires were included in the data analysis. Interestingly, the awareness level for HPV is remarkably lower compared to other STIs. Girls and adolescents who had already taken preventive youth health examinations showed a higher knowledge of STIs on average. Additionally, we could show that adolescents of lower educational levels, such as secondary school students, had the least knowledge.

**Conclusions:** The cross-sectional study shows that many young people are still insufficiently informed about STIs. The gaps in information and lack of knowledge underline the necessity of intensive and long-term educational work.

## Introduction

Sexually transmitted infections (STIs) have been increasing significantly worldwide in recent years and represent a significant burden for people and health care systems. According to current data from the World Health Organization (WHO), more than one million people worldwide are infected with STIs every day [1]. These infections can generally be caused by bacteria, viruses, parasites or fungal pathogens [2–4].

Human immunodeficiency virus (HIV) infections have become treatable and pre-exposure prophylaxis (PrEP) for HIV has become available, leading to a decline of new HIV infections. In 2018, in Germany only about 2,400 people were newly infected. However, authors argue that the availability of these drugs led to an increased sexual risk behavior,

especially in the group of men who have sex with men. While PrEP prevents HIV transmission when condoms are not used, it does not protect against other STIs – as a consequence this presumably leads to an increase especially in hepatitis B and syphilis [5–10].

Vaccination rates and willingness of girls and boys to be vaccinated against human papilloma viruses (HPVs) are also worrying: In 2015, the rate was 31.1 % for 15 year-old girls with a fully completed vaccination series in Germany [11], although numerous current studies underpin the protective effect of this vaccination against cervical cancer and associated anogenital tumors [12–14]. The incidence of cervical cancer in women was 4,380 in Germany in 2016 (10.5 per 100,000) [15]. In countries with HPV vaccination programs, the rates of anogenital tumors have declined significantly. The global

incidence of genital warts is ranged from 160 to 289 cases per 100,000, due to recently installed vaccination programs for adolescents. The same literature also indicates STI screening of patients with anogenital warts is indicated, especially for HIV, syphilis and chlamydia [10].

Lack of knowledge about pathogens, transmission pathways or preventive measures contributes to the fact that young adults are frequently affected by STIs.

According to the *Centers of Disease Control and Prevention* (CDC), half of all newly diagnosed STIs in the United States of America (USA) occur in young people aged 15 to 24 [16].

By comparison, the proportion of 15- to 25-year-olds in Germany in 2017 amounted to about 8.7 million, which represented about 10 % of the total population of 82.7 million people [17]. This clearly shows why comprehensive information and intensive prevention work among young people is so important to counteract the trend of rising infection rates.

## Methods

From September 2018 to February 2019, we conducted a prospective cross-sectional survey rendered completely and irreversibly anonymous using a self-administered questionnaire in German language (translated version: Online supplementary file 1, original version: Online supplementary file 2). The recruitment took place in the context of prevention lectures for students from Bavaria/Germany, which were held in the lecture hall of the dermatological clinic of the university hospital of the Ludwig Maximilian University (LMU) Munich. In this nationwide-unique prevention project, school classes are informed about STIs and the possibilities of prevention. The objective of the present study was to determine young people's awareness and level of knowledge about the STIs. Metric variables were reported as mean values  $\pm$  standard deviation (SD). Reported percentages refer to the applicable cases. Group comparisons were made using chi-square tests for categorical variables and t-tests for metric variables. The study compared boys and girls, the different types of schools and students who had participated in at least one of two (J-group) or no (non-J-group) preventive youth examinations. The German curricula comprises the elementary and further educational sector. Elementary schools range from grade 1–4.

After grade 4, students visit further education schools. Depending on the proficiency of the student, there are three types of schools: middle school (in Bavaria optionally +M-branch), grades 5 to 9 (10), secondary school, grades 5 to 10, and grammar school, grades 5 to 12 or 13 (depending on the curriculum). The grammar school belongs to the higher educational level; here, students are able to graduate with an A-level and apply for university. The middle and secondary school belong to the lower educational level.

The preventive youth examinations represent an extension of the preventive child examinations (U1–U9) in Germany. The first preventive youth examination (J1) takes place at the age of 12 to 15 years, while the second preventive examination (J2) takes place at the age of 16 to 17 years. These examinations serve the early detection and treatment of diseases that endanger the physical, mental or social development of the adolescent. Ideally, the doctor also deals with possible pubertal and sexually transmitted diseases – which is not always the case though. The aim is to detect behavior that is hazardous to health and to prevent it in the long term by means of preventive treatment or targeted education. The J group indicated that they had either received one (J1 or J2) or both (J1 and J2) preventive examinations, while the non-J group either had not received or was uncertain about having received them. The level of knowledge resulting from participation in these preventive examinations was the subject of our interest. Due to the high number of cases in the overall sample and the resulting high statistical power,  $p = 0.01$  was defined as the significance level for all analyses. Students, who were older than 17 years of age (legal age in Germany), who went to a vocational school or did not provide any information on age and/or type of school they are attending, were excluded. The data was evaluated descriptively. Due to the minute percentage of individuals, the gender specification “non-binary” was not considered separately in the gender comparison.

The study was approved by the local ethics committee of the LMU (project 18–524 UE).

## Results

### Study population

Overall, 4,100 questionnaires were collected. The final study population consisted of 3,834 (93.5 %) questionnaires. Fifty-five (1.3 %) did not provide information on their age, 140 (3.4 %) were already  $\geq 18$  years of age, 46 (1.1 %) were vocational students and 25 (0.6 %) lacked information on school education and were therefore excluded from the evaluation. We listed the main characteristics of the study population in Table 1 and the mean age and age-span for different groups in Table 2. Included adolescents had an almost equal gender distribution (50.4 % female vs. 47.9 % male) and the average age of all students was 15.26 years (SD: 0.856 years). The majority of participating schools were middle schools. In the J-group, the female gender predominated with 60.2 % (580/963) compared to the male gender with 39.8 % (383/963). In the school comparison, the grammar school students made up the largest part within the J-group with 41.8 % (413/987), followed by the secondary school students with 24.5 % (242/987) and the middle school students with 17.8 % (176/987), while the M-branch middle

**Table 1** Characteristics of the study population regarding gender, type of school and J-status (completion of preventive youth examination).

Total	n = 3,834 (100 %)	
	n	%
<b>Sex</b>		
Female	1,931	50.30 %
Male	1,836	47.90 %
Intersexual	49	1.30 %
No gender information	18	0.50 %
<b>Type of school</b>		
Middle school	1,180	30.80 %
Middle school M-branch	858	22.40 %
Secondary school	816	21.30 %
Grammar school	980	25.60 %
<b>J-group</b>		
Female	580	32.40 %
Male	383	22.60 %
Middle school	176	16.90 %
Middle school M-branch	156	19.60 %
Secondary school	242	31.50 %
Grammar school	413	44.00 %
<b>Non-J-group</b>		
Female	1,212	67.60 %
Male	1,308	77.40 %
Middle school	865	83.10 %
Middle school M-branch	640	80.40 %
Secondary school	526	68.50 %
Grammar school	526	56.00 %

**Table 2** Age distribution (n, mean and median age, standard deviation [SD] and age-span) of the different groups by school and J-group.

	Middle school	M-branch	Secondary school	Grammar school	Non-J-group	J-group	Unspecified J-status
n	1180	858	816	980	2557	987	290
Mean	14.78	15.44	15.52	15.48	15.24	15.33	15.19
Median	15.00	15.00	15.00	15.00	15.00	15.00	15.00
SD	0.840	0.880	0.711	0.711	0.864	0.802	0.947
Minimum	13	13	12	13	13	13	12
Maximum	17	17	17	17	17	17	17

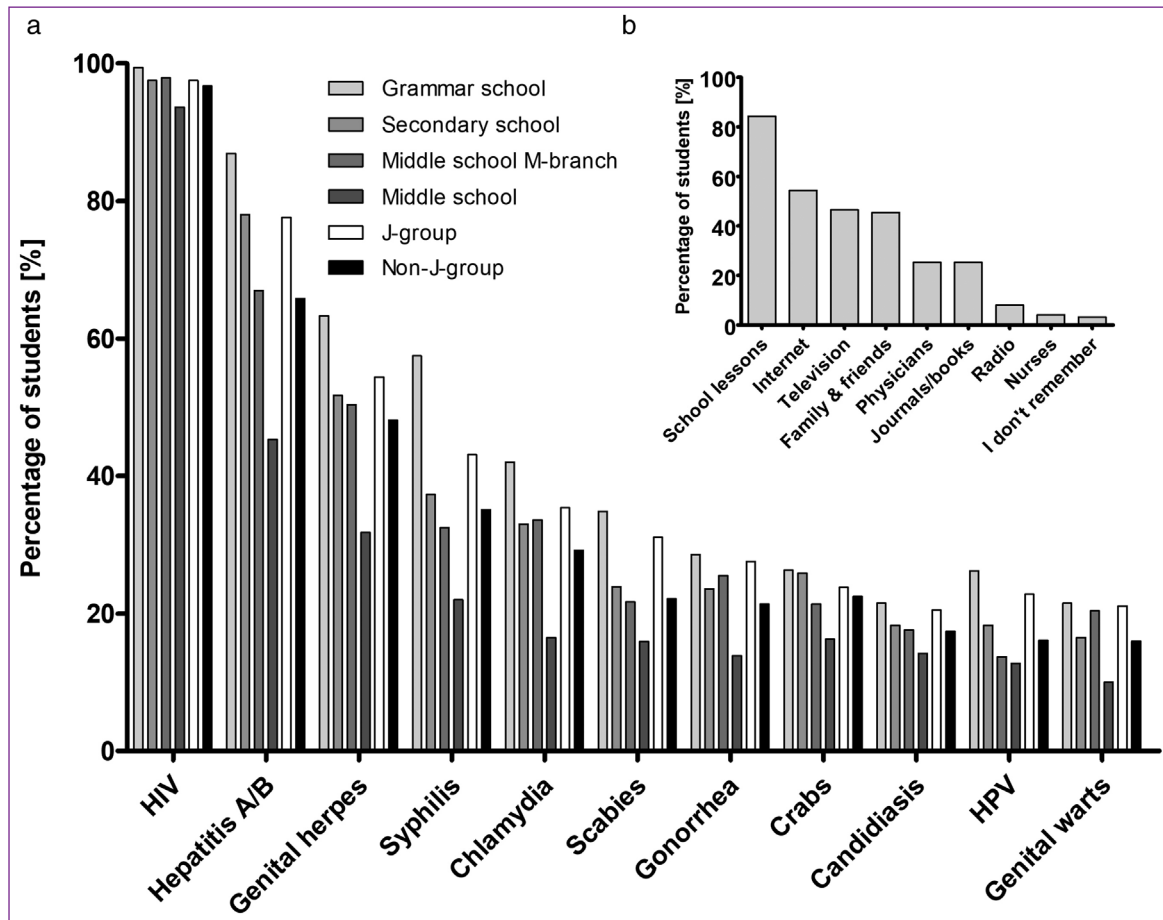
school students made up the smallest share with 15.8 % (156/987). In the non-J-group, the male gender was found to be 51.9 % (1,308/2,520), while the female gender was 48.1 % (1,212/2,520). The largest percentage of students in the non-J-group was represented by the middle school with 33.8 % (865/2,557) and by the middle school M-branch with 25.0 % (640/2,557). The secondary and the grammar school followed with a proportion of 20.6 % (526/2,557).

## Questionnaire

Almost all (98.2 %; 3,755/3,822) of the students answered “yes” to the question whether they had heard of STIs before, while 1.8 % (67/3,822) answered “no”. In gender comparison, girls with 98.8 % (1906/1929) and boys with 97.7 % (1786/1828) had similar results ( $p = 0.009$ ). There were significant differences in the information provided by the students in view of the school level attended. Only 95.8 % (1,125/1,174) of middle school students stated that they had already heard of STIs. In contrast, the values of the M-branch middle school were 99.3 % (852/858), the secondary school 99.3 % (808/814) and the grammar school 99.4 % (970/976) ( $p < 0.001$ ).

## STI knowledge

We asked students about their current level of knowledge concerning STIs, with a pre-selection of eleven STIs to choose from. The information is shown in Figure 1a, broken down to school type and J-group comparison. The differences between the schools were significant ( $p < 0.001$ ), while in the J-group comparison a few values did not reach the significance level of  $p = 0.01$ . Since the pathogenesis of genital warts in relation to HPV in detail cannot be expected by students, HPV and genital warts were investigated as separate entities [18]. The grammar school students were more familiar with all STIs listed in comparison to the students of the other schools. Furthermore, the middle school M-branch students



**Figure 1** STI student knowledge. Overview of the level of awareness of individual STIs (HIV, hepatitis A/B, genital herpes, syphilis, chlamydia, scabies, gonorrhoea, crabs, candidiasis, HPV, genital warts) in terms of school and J-group comparisons (a). Percentage distribution of STI information sources among students (b).

achieved significantly better results than the middle school students and consequently their results were comparable to those of secondary school students. The results of the J-group comparisons showed, that more STI entities were already known in the J-group than the non-J-group.

### Sources of information

The most frequent sources of information about STIs were school lessons with 84.3 % (3,164/3,755; male 81.2 % 1,451/1,786, female 87.4 % 1,665/1,906). Other important sources were the internet with 54.4 % (2,044/3,755; male 54.3 % 970/1,785, female 54.6 % 1,041/1,906), followed by television with 46.5 % (1,747/3,755; male 48.3 % 863/1,786, female 45.1 % 859/1,906). Of lesser importance were family and friends with 45.4 % (1,703/3,755; male 42.2 % 750/1,786, female 48.7 % 929/1,906), physicians with 25.3 % (950/3,755; male 18.4 % 328/1,796, female 31.8 % 606/1,906) and also journals and books

with 25.3 % (950/3,755; male 22.5 % 401/1,786, female 28.1 % 535/1,906). The radio was in second last place with 8.0 % (299/3,755; male 10.1 % 181/1,786, female 6.0 % 114/1,906). Nurses ranked last with 4.1 % (154/3,755; male 2.7 % 49/1,786, female 5.1 % 97/1,906). The entire evaluation is shown in Figure 1b.

### HPV etiology

We asked the adolescents what kind of pathogen the HPV vaccination is directed against. The choices offered were “bacteria”, “viruses”, “fungus” and the option “I don't know”. Overall, only 37.2 % (327/879) of the girls and 34.4 % (127/369) of the boys knew that this was a vaccination against a virus. The lack of knowledge is illustrated by the fact that 49.0 % (431/879) of the girls and 52.6 % (194/369) of the boys responded “I don't know”. With 39.2 % (155/395) correct answers, students in the J-group were better informed about the etiology than students in

the non-J-group with 35.9 % (282/786). However, in both groups almost half of the adolescents answered the question with “I do not know” (46.1 % vs. 50.8 %). Results in detail are shown in Figure 2a.

### Vaccination status

When asked whether students have already been vaccinated against HPV, 30.3 % (286/945) of girls answered in the affirmative, compared to only 19.4 % (78/403) of boys. Furthermore, 45.3 % (428/945) of the girls and 62.3 % (251/403) of the boys were unaware of their own status ( $p < 0.001$ ).

Beyond that, it is shown that the vaccination level of the grammar school students, at 33.8 % (136/402), is significantly ( $p < 0.001$ ) higher than in the other schools. The greatest ignorance regarding their own vaccination status was shown by the students of the middle school with 62.5 % (255/408). This is also reflected in the J-group comparison, with 36.7 % (158/431) vaccinated adolescents in the J-group and 22.3 % (190/852) vaccinated in the non-J-group ( $p < 0.001$ ). The results are shown in Figure 2b, grouped by school type and J-status.

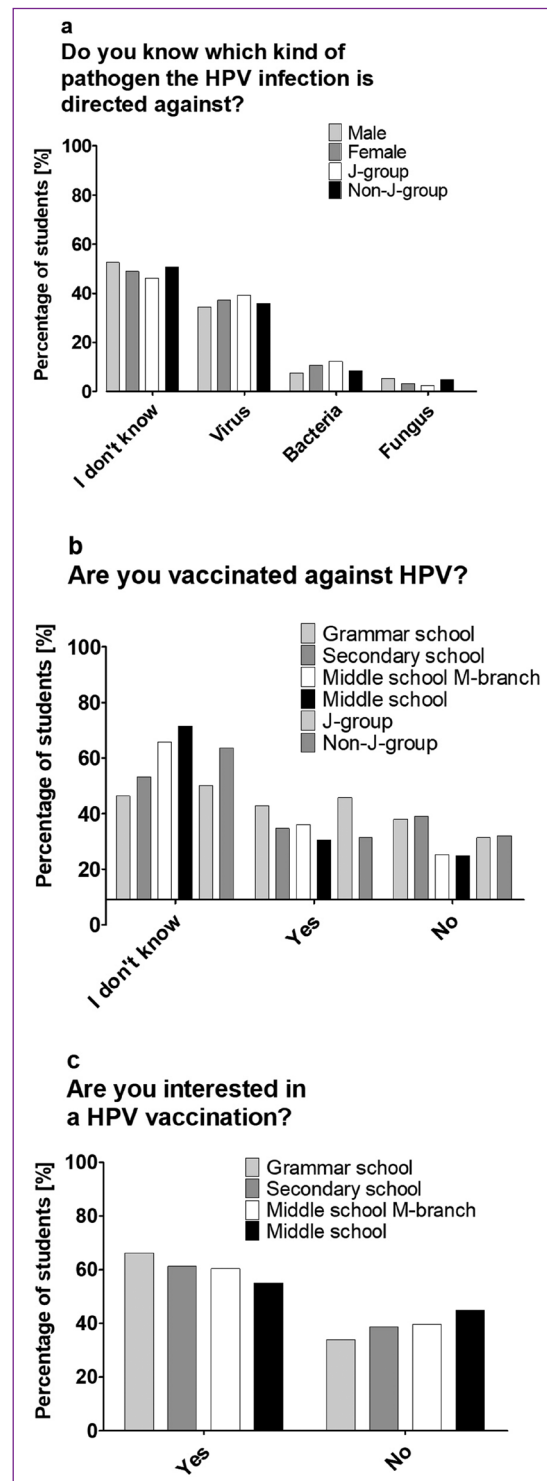
### Interest in HPV vaccination

We evaluated the data of students who had not yet received HPV vaccination or were unaware of their vaccination status with regard to the question of whether they would have a general interest in such vaccination. More than half (60.5 %; 543/898) answered the question in the affirmative, while 39.5 % (355/898) answered the question in the negative. The girls with 66.1 % (395/598) showed a clearer interest in HPV vaccination than the boys, in whom only 49.3 % (140/284) were interested ( $p < 0.001$ ).

Secondary school students were the least interested population with 55.0 % (153/278) compared to the students of other schools. The middle school M-branch 60.4 % (116/192) and the secondary school 61.3 % (119/194) showed a similar interest. With 66.2 % (155/234) the grammar school students formed the collective with the most interest. The results are shown in Figure 2c ( $p = 0.080$ ). The results of the J-group comparison are not significant ( $p = 0.282$ ).

### Vaccination counterarguments

The reasons of the 355 young people who were not interested in HPV vaccination, were: primarily a lack of knowledge of the actual vaccination (40.0 %; 142/355). Additionally, 32.1 % (114/355) of the students felt that they did not need this vaccination and 24.5 % (87/355) stated that they were sexually inactive. Table 3 shows all arguments in hierarchical order.



**Figure 2** HPV awareness. Knowledge of HPV pathogenesis in gender ( $p = 0.073$ ) and J-group comparisons ( $p = 0.030$ ) (a). Statements on HPV vaccination status in school type comparison ( $p < 0.001$ ) and J-group comparison ( $p < 0.001$ ) (b). Interest in HPV vaccination of not yet vaccinated students in school type comparison ( $p = 0.080$ ) (c).

**Table 3** Arguments against HPV vaccination.

Arguments against HPV vaccination	n = 355	
	n	%
I don't know enough about the vaccination	142	40.0 %
I don't need a vaccination	114	32.1 %
I am not sexually active	87	24.5 %
I do have concerns about side effects	56	15.8 %
I am afraid of pain during the process of inoculating	29	8.2 %
My parents are against the vaccine	20	5.6 %
No details provided	39	11.0 %

## Discussion

We evaluated data from a total of 3,834 students, with an average age of 15.26 years. According to recent literature, German teenagers in this age segment have prior knowledge of sexuality, prevention and partnership [19]. The results regarding HIV are encouraging. Here, more than 90 % of all students stated that they had already heard of this disease, although the knowledge about other STIs was decidedly lower. On average, only about 18 % of young people stated that they had ever heard of HPV. Even though the prevention of HPV infection is crucial as it may cause neoplasias, such as genital warts, cervical cancer and squamous cell cancers, and the treatment is challenging [3, 20–24], STIs such as syphilis, gonorrhea or chlamydia infections were completely unknown to more than two thirds of teenagers. The findings of this study are consistent with those of other studies [25, 26].

As almost 85 % of students draw their knowledge of STIs from school lessons, schools have a special role, the internet (54.4 %) and television (46.5 %) are also cited by many students as sources of information. There was no difference in the rank order between male and female gender. The enormous influence of the schools and therefore of the teachers reflects how important this component is in terms of sexual education. The data is consistent with data from the Federal Center for Health Education (Bundeszentrale für gesundheitliche Aufklärung, BZgA) from the Sexual Report 2015, in which more than 80 % of young people also stated that they obtain their knowledge about sexuality, reproduction and prevention from school lessons. Furthermore, the study revealed that 27 % of the 14 to 25 year olds do not use condoms for contraception during first sexual intercourse with a heterosexual partner [19]. In the future, the discussion of topics such as prevention of STIs and especially beyond HIV/AIDS (acquired immunodeficiency syndrome), must be

given a higher priority in sex education lessons. In the guidelines for sexual and family education in Bavarian schools, it is regulated that sex education must be taught in a cross-curricular way, beyond biology lessons [27]. This means that teachers of subjects such as religion, ethics, German language and social sciences are also involved. All teachers should be equally familiar with these topics; hence sex education needs to find its way into the curricula of all German universities for teacher training. It is important to train teachers in this respect already during their academic studies, so that a confident handling is guaranteed later on [28].

Grammar school students are more familiar with STIs in general, but also specifically with HPV, and have more knowledge compared to students with lower levels of education. The HPV vaccination rate (33.8 %) and interest in such a vaccination (66.2 %) are also higher among grammar school students. However, these results are extremely multifactorial and therefore do not allow conclusions to be drawn about individuals or groups, since socioeconomic aspects, the willingness to learn, commitment and initiative as well as the ability to reflect what has been learned play a major role.

Physicians are only mentioned as a source of information by about 25.3 % of adolescents. In this context, it seems to be very important that especially pediatricians and general practitioners actively address and inform their young patients about topics related to sexuality. The ability and active willingness to interact with young patients, including on sensitive topics such as sexuality, should be promoted even more during medical school.

Specifically with regard to the HPV vaccination, 50.4 % of the girls stated that they had already heard about the vaccination. For boys, this number was only 22.7 %. In 2015, the HPV vaccination rate for the complete vaccination series of 15-year-old girls in Germany was 31.1 % nationwide. Compared to other German states, Bavaria had the lowest vaccination rate with 22.4 % [5]. The results reflect the national average with 30.3 % vaccinated girls. Only 19.4 % of the male students stated that they were vaccinated – however, one has to keep in mind that HPV vaccination for boys is only recommended since 2018 in Germany [29]. It should be mentioned that a look into the vaccination card should be a matter of course for every doctor, to point out missed vaccinations or vaccinations that need to be supplemented. With regard to vaccination interest, it is also shown that girls (66.1 %) show an increased interest in vaccination in contrast to their male classmates (49.3 %). Similar results were obtained in a Brazilian study from 2018, which examined 301 university students and also showed that girls have increased knowledge, higher vaccination rates and increased interest in vaccination against HPV compared to boys [30]. The implementation of these multi-layered approaches could contribute to a decisive improvement in the knowledge of adolescents

and thus have an ongoing positive effect on their future health behavior, in order to reduce STI prevalence. Limitations of this study could be the peer influence of opinions between classmates and the issue of the reliability of the answers.

Despite numerous existing sources of information, such as school lessons, public education campaigns, preventive medical checkups or the internet, many young people are still insufficiently informed about STIs. In contrast to the high prevalence of HPV in Germany and worldwide, the teenagers display the lowest awareness levels of all assessed STIs. The gaps in information and lack of knowledge are reflected in this study and show the need for intensive and extensive educational work. Special focus should be set on male teenagers and students of lower educational levels, such as middle school students who had the least knowledge. In the long term, it is important to promote protective behavior through knowledge, especially in school lessons, during visits to the doctor and through sustained campaigns to minimize the risk of infection and thereby reduce the overall incidence of STIs.

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