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Sexual Health Knowledge of Berlin Adolescents

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Abstract (English)

Background

Sexuality is an integral component of human existence. However, it can also endanger health, for example through unwanted pregnancy or sexually transmitted infections (STIs). Both can be prevented, but knowledge of the risk as well as of preventive methods is necessary. The internet could be an important source of knowledge, if adequate websites are used.

Adolescents are a group particularly at risk of adverse sexual health outcomes. Yet, little evidence is available on sexual health knowledge amongst adolescents in the German context, and on their preferences when looking for sexual health information online.

Objective

The objective of this study was to assess knowledge regarding emergency contraception (EC) and pregnancy risk, and regarding STIs among Berlin adolescents. Furthermore, preferences when looking for sexual health information online were evaluated.

Methods

A cross-sectional study was conducted among ninth-graders in Berlin schools. Students were asked to self-evaluate their knowledge on different aspects of EC, pregnancy risk, and STIs. Factual knowledge was assessed using test questions. Participants also evaluated the importance of different aspects of sexual health websites. Differences by gender, age, migrant background, and school type were calculated using bivariate and multivariable analyses.

Results

Of 1190 students present in class, 1177 elected to participate. The mean age was 14.6 years, 46.5% were female, and 52.9% listed at least one foreign-born parent. The vast majority of participants had heard of EC, but merely 12.7% knew the actual timeframe for usage. Most students could correctly evaluate pregnancy risk. While knowledge on HIV was widespread, 46.2% were unaware of chlamydia, and 92.2% were unfamiliar with the HPV vaccine. For online preferences, easily comprehensible wording and clear information layout were most frequently described as important. The reliability of a website's publisher was important to 79.3% of participants. Knowledge on EC and STIs, as well as the importance placed on website publisher reliability tended to be lower amongst male students, participants in the least academic school type, and children of immigrants.

Conclusion

Adolescents have suboptimal levels of knowledge, particularly regarding EC and STIs beyond HIV. A visible minority fails to recognise the crucial importance for sexual health websites to have a reliable publisher. Urgent efforts are called for to improve sexual health knowledge, and to disseminate eHealth literacy among adolescents.

Abstract (Deutsch)

Einleitung

Sexualität ist ein integraler Bestandteil der menschlichen Existenz, kann jedoch auch negative Auswirkungen auf die Gesundheit haben, beispielsweise durch ungewollte Schwangerschaft oder Geschlechtskrankheiten. Effektive Verhütung und Schutz vor Infektionen sind möglich, setzen jedoch ein Risikobewusstsein und Wissen über Präventionsmethoden voraus. Das Internet kann hierfür eine wichtige Wissensquelle sein, wenn Webseiten mit korrekten Informationen genutzt werden. Insbesondere Jugendliche und junge Erwachsene sind von ungewollter Schwangerschaft und Geschlechtskrankheiten betroffen. Dennoch ist bislang wenig bekannt über das sexualgesundheitliche Wissen von Jugendlichen in Deutschland und über ihre Präferenzen auf der Suche nach sexualgesundheitlichen Informationen im Internet.

Fragestellung

Das Ziel dieser Studie war die Erforschung des Wissens von Berliner Jugendlichen zu den Themen Notfallverhütung, Schwangerschaftsrisiko und Geschlechtskrankheiten. Weiterhin wurden die Wünsche und Präferenzen bei der Suche nach sexualgesundheitlichen Informationen im Internet erfragt.

Methodik

Daten wurden durch eine quantitative Befragung in den 9. Klassen Berliner Schulen erhoben. Die TeilnehmerInnen haben ihr Wissen zu verschiedenen Aspekten von Notfallverhütung, Schwangerschaftsrisiko und Geschlechtskrankheiten bewertet. Anschließend wurde das Wissen mit Testfragen überprüft. Weiterhin wurde die subjektive Wichtigkeit verschiedener Aspekte von sexualgesundheitlichen Webseiten erfragt. Mittels bivariater und multivariater Methoden wurden Unterschiede nach Geschlecht, Alter, Migrationshintergrund und Schultyp quantifiziert.

Ergebnisse

In den 9. Klassen der 13 teilnehmenden Schulen waren 1190 SchülerInnen während der Befragung anwesend, 1177 entschieden sich für eine Teilnahme. Das Durchschnittsalter lag bei 14,6 Jahren, 46,5% der TeilnehmerInnen waren weiblich und 52,9% hatten einen Migrationshintergrund. Notfallverhütung war der großen Mehrheit bekannt, aber nur 12,7% der Jugendlichen konnten das korrekte Zeitfenster für die Anwendung benennen. Das Schwangerschaftsrisiko in verschiedenen Szenarien wurde zumeist korrekt eingeschätzt. Während Wissen zu HIV weitverbreitet war, hatten 46,2% der Teilnehmenden noch nie von Chlamydien gehört, und die HPV-Impfung war 92,2% nicht bekannt. Bei den Online-Präferenzen wünschten die Jugendlichen am häufigsten eine einfach verständliche Sprache und eine übersichtliche Darstellung. Die Vertrauenswürdigkeit des Webseitenbetreibers wurde von 79,3% als wichtig erachtet. Das Wissen zu Notfallverhütung und Geschlechtskrankheiten, sowie die subjektive Wichtigkeit eines verlässlichen Webseitenbetreibers waren allgemein niedriger unter männlichen Schülern, TeilnehmerInnen mit Migrationshintergrund und an Schulen ohne gymnasiale Oberstufe.

Schlussfolgerung

Das Wissen der TeilnehmerInnen war suboptimal, besonders zu Notfallverhütung und Geschlechtskrankheiten jenseits von HIV. Eine bedeutende Minderheit scheint nicht in der Lage zu sein, die Verlässlichkeit von Online-Informationen kritisch einzuschätzen. Es ist dringend notwendig, das sexualgesundheitliche Wissen von Jugendlichen zu verbessern. Außerdem sollten Kompetenzen zur kritischen Evaluation von sexualgesundheitlichen Informationen im Internet vermittelt werden.

Introduction

Adolescent sexuality is a contentious issue, in academia as well as within society at large. There is no overarching consensus on whether adolescents should be sexually active in the first place, and on how they should be prepared for their sexual careers [1]. Either way, it has to be recognized that most adolescents are sexually active before they reach the legal age of majority, in Germany as well as in other developed countries [2]. For German youths, the mean age for first sexual intercourse is 15.1 years for boys and 14.9 years for girls [3].

Adolescence and young adulthood are periods of particular vulnerability to adverse sexual health outcomes due to more frequently changing sexual partners, and lower rates of correctly and consistently used contraception [4,5]. Adolescents overwhelmingly deem pregnancy as most undesirable [6], and are more likely to suffer from the long-term sequelae of sexually transmitted infections (STIs) [7].

In order to enable adolescents to make informed choices in sexual health, a certain level of sexual health knowledge is required. This has been explicitly recognized by the World Health Organization (WHO) Regional Office for Europe: It stipulates in its 2001 Regional Strategy on Sexual and Reproductive Health that the first objective in the field of adolescents' sexual and reproductive health should be "to inform and educate adolescents on all aspects of sexuality and reproduction and assist them in developing the life skills needed to deal with these issues in a satisfactory and responsible manner" [8].

In Germany, a myriad of preventive options exists in the realm of sexual health. For example, most methods of contraception are readily available for free or at nominal charge to all members of statutory health insurance aged 20 and below. Most instruments of STI screening and treatment are also covered by health insurance. However, as convincingly argued in the information-motivation-behavioural skills (IMB) model, information and motivation are key elements towards the uptake of preventive instruments in sexual health [9]. Most obviously, knowledge about their existence and availability is a prerequisite for the actual utilization of instruments of prevention. Indeed, research shows that non-usage of prevention is often linked to lack of knowledge: Studies on women undergoing induced abortion found that emergency contraception (EC) had not been sought either because women did not know about its availability, or because lack of sexual health knowledge precluded them from recognizing pregnancy risk [10–12]. A similar picture emerges regarding STI protection, with lack of knowledge likely to impede the uptake of prevention. For example most Germans have not

heard of any STI other than the Human Immunodeficiency Virus (HIV) [13], despite the latter's low prevalence compared to other STIs in Germany [14].

Whilst it is widely recognised that there is a lack of adolescents' knowledge regarding many sexual health topics, there is rather little evidence on what they actually know. This information is necessary to target public health campaigns to areas of need, rather than directing resources at topics for which information saturation has already been achieved.

In preparing the present study, we identified broad topics for which we set out to elucidate adolescent knowledge: STIs, pregnancy risk, and EC. Furthermore, we surveyed adolescents' preferences when looking for sexual health information online.

Knowledge on Emergency Contraception and Pregnancy Risk

Emergency contraception (EC) is a safe and effective method of lowering pregnancy risk following unprotected intercourse [15,16]. Given higher rates of unprotected intercourse and a predominantly negative evaluation of the potential outcome of pregnancy, adolescents can be regarded as a prime target audience for EC. For this, it is important that adolescents are equipped with sufficient knowledge to make informed choices regarding usage or non-usage.

To date, little research exists on adolescent knowledge regarding EC in Germany. The topic is particularly intriguing given the recent switch from prescriptive to over-the-counter status in Germany [17]. We assessed knowledge and awareness of EC, with issues ranging from awareness of EC's existence to testing students' knowledge on the effectiveness, sourcing, and timeframe for EC. Furthermore, it was tested to which extent students could correctly evaluate pregnancy risk in given scenarios, an essential skill to be able to make an informed choice on whether or not to use EC [18].

STI Knowledge

STIs pose a significant challenge to health systems and societies worldwide and can lead to a wide array of negative effects on the individual, ranging from physical discomfort to infertility, cancer, disability, and death [19]. With the higher rate of risky sexual behaviour described above, adolescents are particularly at risk of contracting STIs as well as to experience the long-term sequelae.

The incidence of several STIs in Germany has risen over the last decade: Syphilis and gonorrhoea are becoming more common, and the last five years have also seen an increase in

the numbers of new diagnoses of HIV [14]. Chlamydia as the most frequent cause of female infertility in developed countries [20] also occurs frequently in adolescents in Germany [21].

Despite the growing incidence of STIs, the various readily available methods of STI prevention are underused. Condoms are probably the most widely utilized instrument of STI prevention. However, research shows that condom use is predominantly with a contraceptive intention, rather than to prevent a possible infection [22,23]. Once pregnancy risk is controlled using other means such as hormonal contraceptives, the rate of condom use dwindles [24]. The Human Papillomavirus (HPV) vaccine is another widely available, yet underutilized means of STI prevention. Vaccination is endorsed by health authorities and medical bodies for all female adolescents in Germany, and is available free of charge on statutory health insurance [25]. Despite the explicit recommendation for the vaccine course to be completed at age 14, less than a third of girls in Germany have received a full course of HPV vaccination by the average age of sexual debut [25]. Low rates of uptake can also be observed for methods of secondary or tertiary prevention. For example in 2015, the nationally recommended and cost-free chlamydia screening for women under 25 was only used by 11.3% of the target population [14].

Improving knowledge on STIs and prevention methods can therefore be regarded as an important prerequisite to combating the recent rise in STIs. This holds especially true for adolescents as a group particularly at risk of contracting an STI. However, to improve the level of knowledge, data is needed on specific areas in which knowledge is particularly deficient. To this end, the study questionnaire assessed students' self-evaluated as well as objective knowledge regarding the most common viral and bacterial STIs.

Preferences in Sexual Health Websites

The internet has evolved into a main source of sexual health information, particularly for adolescents [24]. With its near-universal and low-cost availability, it bears the potential to improve sexual health knowledge, which in turn can contribute to healthy behaviour. This could be particularly important to groups relatively deprived of conventional sources of sexual health information, such as male adolescents, ethnic minorities, and the academically disadvantaged [24,26]. However, whilst reliable and comprehensive sexual health websites certainly exist, the internet also abounds in websites purveying information that is biased, misleading, or downright incorrect [27,28].

The vast majority of adolescents choose sexual health websites from search engine results, rather than based on external recommendations [29]. It is thus imperative that sexual health websites from reputable providers are found, and set up in accordance with the desires and preferences of their target audience. This could represent a significant competitive edge in the market for online patronage.

Surprisingly, little is known about the explicit sexual health website preferences of adolescents. As part of the wider study on adolescent sexual health, we therefore asked participants on their wishes and preferences when looking for sexual health information online.

Methods

Study Design

As described in more detail in the publications below [30–32], a cross-sectional study was conducted in schools to assess the sexual health knowledge and sexual health website preferences of Berlin adolescents. The study was approved by the Ethics Committee of the Charité – Universitätsmedizin Berlin, and by the Berlin Senate’s Department for Education, Youth and Science as the responsible school authority. A favourable vote by the parent-teacher-conference was made prerequisite for each school’s participation. As per state law, written parental consent was mandatory for participation for all students under 14 years of age.

Sampling and Data Collection

The head teachers and/or the heads of the biology departments of all Berlin state secondary schools were contacted by telephone and email with detailed information on the aim and scope of the study. Schools interested in participation received further information by post and/or in person. Subsequently, a member of the project team attended the school’s parent-teacher-conference to present the study and put it to the vote.

The study was conducted in the classroom setting. A member of the study team visited each class in a regular lesson. Students were informed of the background and aim of the study, and the range of topics covered. It was emphasised that participation was entirely voluntary, that the study did not represent a school assignment and was inconsequential towards school grades, and that questionnaires were anonymously collected and responses not disclosed to teaching staff. Subsequently, the study questionnaire was distributed in paper to all students

electing to participate. Classes were supervised by a member of the project team until all questionnaires had been collected. Students were then provided with the correct answers to all knowledge questions, and given the opportunity to ask further questions.

Questionnaire

The demographic variables assessed were age, gender, school type, and migrant background. School type was recorded at the school level by the conducting member of the project team to assess for differences between the main types of secondary schools in Berlin: academically-selective secondary schools qualifying for university access (Gymnasium), comprehensive secondary schools in which a certain proportion of students can qualify for university access (Integrierte Sekundarschule mit gymnasialer Oberstufe), and comprehensive secondary schools without this option (Integrierte Sekundarschule ohne gymnasiale Oberstufe). For brevity, the school types are reported in order of their academic selectiveness as “highest tier”, “intermediate tier”, and “lowest tier”. Furthermore, school and class membership were coded in order to allow for the statistical consideration of the impact of clustering by school and class, as described in the section on statistical methods below. To ensure that all questions were appropriate and comprehensible to the target population, the questionnaire was discussed with adolescents, and a pre-test in one school class was conducted, with comments from students leading to minor modifications.

Knowledge on Emergency Contraception and Pregnancy Risk

To assess the knowledge of adolescents about emergency contraception and pregnancy risk, questions were devised based on existing questionnaires, as described in more detail in the publication below [30]. Students were asked whether they had heard of EC, and if so, how they rate their knowledge. To evaluate factual knowledge, test questions were posed regarding the effectiveness, the timeframe, and the sources of EC. For timeframe, both 72 hours and 120 hours were taken to be correct, to account for the fact that both levonorgestrel- and ulipristal acetate-based EC is available in Germany [16]. Furthermore, students were asked to select sources of EC and/or EC prescriptions: gynaecologists, family planning centres, hospital emergency departments (all correct), and “from a pharmacy without prescription” (incorrect at the time of the study).

For pregnancy risk, participants were asked to evaluate whether a girl was reliably protected from pregnancy in six different scenarios. Three scenarios were offered in which contraceptive protection could be reasonably assumed: intercourse if the female partner is taking hormonal contraceptives, oral sex, and intercourse using a condom. Another three

scenarios were provided in which protection from pregnancy could not be presumed: first ever intercourse, intercourse if the condom breaks, and intercourse during period bleeding.

STI Knowledge

To assess STI knowledge, students were asked for an evaluation of their knowledge regarding the seven most frequent viral and bacterial STIs [33]: HIV, syphilis, genital herpes, hepatitis B, gonorrhoea, chlamydia, and HPV on a Likert-type scale. Participants could choose “good”, “rather good”, “mediocre”, “rather bad”, and “bad”, or state that they had never heard of the respective STI. Actual knowledge was tested by asking students to select STIs for which a reliable cure and/or a vaccination exists from the following list (correct responses in brackets, according to the Centers for Disease Control and Prevention (CDC) [34]): HIV (no cure, no vaccination), hepatitis B (no cure, vaccination exists), chlamydia (curable, no vaccination), HPV (no cure, vaccination exists), and genital herpes (no cure, no vaccination).

Preferences in Sexual Health Websites

Lacking existing instruments, the questionnaire section on adolescent preferences in sexual health websites was devised by the authors. Following discussion with students after the pre-test, the questions were phrased in the subjunctive (“How important would you find the following aspects when looking for sexual health information on the Internet?”). Importance was rated on a five-point Likert scale containing the options “important,” “somewhat important,” “neither important nor unimportant,” “rather unimportant,” and “unimportant”.

A total of nine aspects belonging to three principal groups were to be rated in importance: “who and for whom” (publisher and explicit target audience of a website), “information presentation” (visual style, clear layout of information, easily understandable language, and text shortness), and “website features” (facilities to ask individual questions, a section where people can report their own personal experiences, and advice provided by people of similar age). Aspects were chosen based on an in-depth analysis of the characteristics of different prominent German-language websites providing sexual health information, as described in more detail in the publication manuscript below [31].

Statistical Methods

IBM SPSS Statistics, Versions 23 and 25 (SPSS Inc., Chicago, IL, USA) were used for statistical analysis. Frequencies and descriptives were computed for all items. Two-sided chi-square tests were used to assess bivariate relationships between the demographic variables of age, gender, migrant background, and school type, and the outcome variables. The effect of

demographics on outcomes was further quantified using mixed multilevel regression models (SPSS GENLIMIXED). A mixed model was chosen to take into account the potential effect of clustering by class and school. “School” and “Class” were included in all regression models as random effects. Odds ratios and confidence intervals were calculated, for example to estimate gender differences in the odds of correct responses to STI knowledge questions.

Results

Participant Characteristics

A total of 287 schools were approached by email and/or telephone. The head teacher or the head of the biology or natural science department was successfully contacted in 142 cases, and the teaching bodies of 13 schools with a total of 61 classes agreed to participate. In all 13 schools the study received the approval of the parent-teacher-conference.

A total of 1190 students were present in the lessons allocated to the study by schools. Ten students were under 14 and failed to provide written parental consent. Two students elected not to participate, and one recently immigrated student lacked the required German language proficiency. Therefore, a total of 1177 students participated in the study.

Table 1. Population demographics.

Population characteristic	n (%)
Age in years	
13	23 (2.0%)
14	565 (48.0%)
15	480 (40.8%)
16	94 (8.0%)
<i>not provided</i>	15 (1.3%)
Gender	
Female	547 (46.5%)
Male	605 (51.4%)
<i>not provided</i>	25 (2.1%)
Parental place of birth	
Both parents born in Germany	544 (46.2%)
Only mother born abroad	127 (10.8%)
Only father born abroad	133 (11.3%)
Both parents born abroad	352 (29.9%)
<i>not provided</i>	21 (1.8%)
School type*	
Lowest tier	390 (33.1%)
Intermediate tier	395 (33.6%)
Highest tier	392 (33.3%)

*Coded for all participants at the school level.

Table 1 depicts the demographic composition of the study sample. The mean participant age was 14.6 years (standard deviation 0.7). Male students were slightly over-represented in the sample. The majority of students had at least one parent born abroad. Participants were almost equally distributed across the three school types.

Knowledge on Emergency Contraception and Pregnancy Risk

Most students were aware of EC, although only 32.8% described their knowledge as good or quite good. Table 2 gives an overview of correct responses to knowledge questions. Bivariate analyses of differences are presented in the publication below [30].

Table 2. Self-evaluated and factual knowledge of EC and pregnancy risk.

Self-evaluated knowledge	n (%) selected	n*
(rather) good knowledge	434 (38.7%)	1122
Never heard of EC	99 (8.8%)	1122
Correct responses to knowledge questions	n (%) correct	n*
Timing for EC (correct=72h or 120h)	144 (12.9%)	1114
Effectiveness of EC (correct=effective or rather effective)	428 (38.5%)	1112
Sources of EC:		
Gynaecologist (correct=yes)	989 (87.4%)	1132
Pharmacy without a prescription (correct=no**)	348 (31.4%)	1108
Hospital emergency department (correct=yes)	239 (21.9%)	1092
Family Planning Clinic (correct=yes)	159 (14.6%)	1088
Reliable protection from pregnancy in different scenarios:		
Intercourse using a condom (correct=yes)	974 (85.7%)	1137
Intercourse using oral contraceptives (correct=yes)	927 (82.0%)	1130
Oral sex (correct=yes)	885 (78.0%)	1135
First ever intercourse (correct=no)	888 (79.0%)	1124
If condom splits during intercourse (correct=no)	842 (74.6%)	1129
Sex during period bleeding (correct=no)	488 (43.5%)	1121

*number of responses included. **correct at the time of study.

In the multilevel regression model, female gender was significantly associated with higher odds of having heard of EC, of having a high level of self-professed knowledge, and to know the correct timeframe for EC. Neither migrant background nor school type had a significant effect on EC knowledge. For pregnancy risk, the association between gender and the odds of correct responses were less clear-cut. Female participants were significantly more likely to know that period bleeding does not provide contraceptive safety. However, female participants also tended to underestimate the contraceptive reliability of oral intercourse, with an odds ratio (OR) for correct responses to this question of 0.34 (95% confidence interval (CI) 0.26-0.45, reference=male). There was a general association between being of migrant background and attending a less academic school and lower odds of correct responses. For

example, the odds ratio for participants with at least one foreign-born parent to know that having intercourse for the first time does not provide contraceptive security was 0.41 (95% CI 0.30-0.58, reference=both parents born in Germany). Conversely, the odds ratio in students of the most academic school type for correct responses to this question was 3.25 (95% CI 2.26-4.68, reference=lowest tier).

STI Knowledge

Table 3 presents the self-evaluated and factual knowledge of participants regarding different STIs. HIV was known to virtually all participants. On the other side of the spectrum, chlamydia, despite being the most common bacterial STI, was unknown to 46.2% of participants. Factual knowledge is largely in line with self-evaluated knowledge of the different STIs. Most students were aware that to date, no vaccine or reliable cure exists for HIV, but knowledge particularly regarding genital herpes, HPV, and chlamydia was far less widespread. For example, the HPV vaccine was known to only 10.8% of participants, and only very few knew that HPV is not curable.

Table 3. Self-evaluated and factual STI knowledge.

Question	n (%) selected/correct	n*
HIV		
(Rather) good knowledge	817 (71.2%)	1148
Never heard of the disease	17 (1.5%)	1148
Factual question: cure (correct=no reliable cure)	946 (83.6%)	1131
Factual question: vaccination (correct=no vaccine)	716 (63.2%)	1133
Hepatitis B		
(Rather) good knowledge	312 (27.5%)	1136
Never heard of the disease	151 (13.3%)	1136
Factual question: cure (correct=no reliable cure)	245 (21.8%)	1122
Factual question: vaccination (correct=vaccine exists)	552 (48.7%)	1134
Genital herpes		
(Rather) good knowledge	238 (21.1%)	1130
Never heard of disease	266 (23.5%)	1130
Factual question: cure (correct=no reliable cure)	88 (7.9%)	1121
Factual question: vaccination (correct=no vaccine)	200 (17.8%)	1125
HPV		
(Rather) good knowledge	146 (12.9%)	1129
Never heard of the disease	422 (37.4%)	1129
Factual question: cure (correct=no reliable cure)	25 (2.2%)	1126
Factual question: vaccination (correct=vaccine exists)	122 (10.8%)	1133
Chlamydia		
(Rather) good knowledge	134 (11.8%)	1134
Never heard of the disease	524 (46.2%)	1134
Factual question: cure (correct=curable)	212 (18.8%)	1125
Factual question: vaccination (correct=no vaccine)	113 (10.0%)	1130

*number of responses included.

In bivariate analysis, there was a significant gender difference for all STIs but hepatitis B and chlamydia, with female participants less likely to claim good knowledge and more likely to select “never heard” for all STIs except for chlamydia. Students from the intermediate tier of schools were most likely to have at least some awareness of all listed STIs, and students with a migrant background were more likely to have never heard of all STIs but hepatitis B. For the factual knowledge questions, there was no general knowledge superiority of either gender. Notably, male participants were significantly more likely to be aware of the HPV vaccine. Bivariate data is presented in detail in the publication below [32]. In multivariate analysis, again female gender was associated with significantly lower rates of good self-evaluated knowledge regarding HIV, genital herpes, and HPV, and with significantly higher odds of non-awareness of HPV. Students from a migrant background had higher odds of lack of awareness for all STIs, although results were statistically significant only for genital herpes. Students from the highest academic tier had the lowest self-evaluated levels of knowledge for hepatitis B, HPV, and chlamydia.

In the regression model on factual knowledge, there was again no clear association between gender and knowledge, although as was the case in bivariate analysis, female gender was associated with lower rates of awareness of the HPV vaccine (OR 0.60, 95% CI 0.41-0.88, reference=male). Migrant background was significant as a factor only for knowledge of the non-curability of HPV and the lack of an HIV vaccine. Students with a migrant background were significantly more likely to know the former and less likely to know the latter. Students from the intermediate tier of schools tended to have higher odds of correct responses.

Preferences in Sexual Health Websites

Table 4. Website preferences.

Question	n (%) (rather) important	n*
Language easily understandable	971 (88.2%)	1101
Information clearly laid out	880 (80.4%)	1094
Reputable publisher	867 (79.3%)	1094
Possibility to ask questions	794 (72.7%)	1092
Section with personal experiences	751 (68.7%)	1093
Advice by other adolescents	719 (66.3%)	1085
Explicitly addressed at adolescents	686 (62.3%)	1101
Texts short and concise	570 (52.0%)	1097
Visual style/design attractive	384 (35.3%)	1088

*Number of responses included.

Table 4 shows the numbers and percentages of participants selecting “important” or “rather important” for each website aspect. Easily comprehensible language was the website aspect most frequently described as (rather) important by participants in the sample, followed by clear information layout and a reputable publisher. The visual style was least frequently deemed (rather) important. Amongst female participants, 84.9% found publisher reliability (rather) important, compared to 74.2% of male participants (P from chi-squared test <.001). The proportion considering this aspect as (rather) important was also significantly lower amongst students with a migrant background, and students from the least academic school type. On the other hand, the visual style was much more frequently described as (rather) important by boys: 40.5% of boys selected this aspect, whereas amongst girls the percentage was 29.2% (P from chi-squared test <.001). In multivariable analysis, male students were shown to be approximately half as likely as female students to attribute importance to a website’s publisher (OR 0.50, 95% CI 0.37-0.69, reference=female). Migrant background was associated with lower odds of considering publisher reliability (rather) important (OR 0.64, 95% CI 0.50-0.81). The higher the school type, the higher the odds ratio of finding this aspect important. Being of female gender also increased the odds of preferring a website explicitly addressed at adolescents by more than twofold. The odds ratio of attributing importance to an easily comprehensible language was significantly higher amongst students without migrant background, and of students in the most academic school type.

Discussion

We conducted a cross-sectional study amongst Berlin ninth-graders to assess adolescent knowledge regarding emergency contraception and sexually transmitted infections, and to elucidate adolescent preferences in sexual health websites. Although it was emphasised that participation was entirely voluntary, only two out of 1179 students decided not to partake. It can be assumed that this demonstrates the interest and curiosity evoked by the topic of sexuality, particularly in this age bracket. With a mean age of 14.6, population-level data suggests that most participants in our sample were yet to experience their sexual debut in the near future, but had already engaged in some form of intimate contact [24].

Knowledge on Emergency Contraception and Pregnancy Risk

The vast majority of students in our sample were aware of the existence of EC. This is much in line with previous studies both in Germany [24] and in other industrialized countries [35,36]. The majority of students had a positive evaluation of their own knowledge regarding

EC. However, when put to the test, factual knowledge was patchy. For example, only 12.7% of participants were familiar with the timeframe for EC usage, a percentage much lower than that found in other European settings [35,37].

Pregnancy risk in the provided scenarios was correctly evaluated in most cases. However, less than 40% of students correctly identified that period bleeding alone did not offer reliable contraceptive safety. Also, there was a notable minority, particularly amongst girls, that overestimated pregnancy risk in intercourse using a condom, and in oral sex. It is likely that the recent over-the-counter switch of emergency contraception in Germany leads to a development similar to other countries that have previously liberalized access: with the option of direct pharmacy access, very few women elect to seek medical counselling before usage [38,39]. This makes a correct evaluation of pregnancy risk yet more important. EC is a viable option in situations of significant pregnancy risk. Conversely, EC should be eschewed when pregnancy risk is so low that the financial expenses and potential side effects are unwarranted, for example, if contact is limited to oral sexual intercourse.

Emergency contraception is a safe and effective method to prevent a large proportion of pregnancies that would have otherwise occurred [16]. This should make it a particularly viable second-line option for adolescents. They are more prone to engage in unprotected intercourse, but are also significantly more likely to deem a potential pregnancy as strongly undesirable [6]. However, for EC to be accessed and used, a certain basic level of knowledge regarding EC and pregnancy risk is necessary. Our results could aid schools, parents, sexual health educators, and public health agencies to address specific areas of information poverty.

STI Knowledge

HIV was known to virtually all adolescents, and most students knew that to date, no reliable cure or vaccination exist for HIV. Knowledge on all other STIs was much lower. This was particularly visible for HPV and chlamydia, despite these being the most common bacterial and viral STIs [33]. More than 46% of participants had not heard of chlamydia and 37% had not heard of HPV. Factual knowledge was similarly dire. For example, the HPV vaccine was known to less than 11% of students, with numbers yet lower amongst female participants.

In terms of the information-motivation-behavioural skills model, it is likely that this lack of knowledge impedes the uptake of preventive options in two ways: Preventive options largely unknown to the target audience – for example, the HPV vaccine – are unlikely to be widely accessed. Furthermore, it is likely that motivation to employ condoms as the mainstay of

primary STI prevention would be increased with better awareness of the risk of contracting different STIs, some of which are widespread, are not curable and/or can cause neoplasia, infertility or other undesired sequelae.

Our results show that lack of knowledge on most non-HIV STIs is common even in subpopulations usually associated with better sexual health knowledge, such as female participants, students without migrant background, and more academic youths [24,40]. This demonstrates that sexual health educators such as schools and public health authorities fail to communicate even basic knowledge on STIs to even the most accessible target audiences, let alone groups more difficult to reach with sexual health information. This failure is reflected in the current Berlin school curriculum on sexual health. It includes condoms as the sole instrument of prevention, and lists HIV/AIDS as the only STI that must be covered in school-based sexual health tuition [41]. In the light of the recent increase in STI incidence in Germany, and the widespread lack of knowledge demonstrated in our study, it is important that school boards and public health authorities increase their efforts to propagate at least a basic body of knowledge on a range of STIs. The recent launch by the German Federal Centre for Health Education of its first campaign explicitly focussed on STIs beyond HIV is a late, but laudable, step in this direction.

Preferences in Sexual Health Websites

The three website aspects most frequently considered important in our sample were an easily comprehensible language, a clear information layout, and a reputable publisher. The design/visual style of a website was least frequently deemed important.

While correct, adequate and well-presented sexual health information is certainly available online, many websites also contain highly unreliable information [27,28]. Given that most adolescents look for sexual health information starting with search engine queries [29], it is imperative that the explicit preferences of the target audience are taken into account: Successful user-centricity can be the deciding factor on whether a website is actually used for information, or whether potential users immediately “bounce” back to search results [42]. Therefore, public health agencies and other reputable providers of online sexual health information should make sure that the preferences of adolescents are taken into account when setting up sexual health websites.

Furthermore, it is of paramount importance that adolescents learn to critically assess the validity of online (sexual) health information, as an integral part of “eHealth literacy” [43]. In

our results, most students recognised the importance of the reputability of a website's publisher. However, a visible minority failed to consider this aspect of a website as important. Higher proportions of male students, participants with migrant background, and the academically disadvantaged neglected the importance of publisher reliability. This is particularly problematic given the fact that precisely these subpopulations have been shown to possess inferior sexual health knowledge and are more likely to engage in risky sexual behaviour [24,44]. Given Germany's compulsory schooling, schools could act as an important vector to reach virtually all adolescents and strive to provide them with the necessary eHealth-literacy to find correct information online.

Conclusion

Sexuality is an integral and enriching part of human existence and can contribute to a healthy life. Yet, sexuality can also endanger physical and mental health, for example through unwanted pregnancy and sexually transmitted infections. Modern contraceptives make it possible to minimize pregnancy risk. For STIs, a plethora of instruments exists to lower the risk of infections, to detect and treat existing infections, and to prevent long-term sequelae. However, knowledge in the target audience is necessary for the diverse methods of prevention to be utilized. Our results show that in Berlin adolescents, the level of knowledge is suboptimal regarding STIs and emergency contraception. Whilst the internet could mitigate information poverty, this requires that users critically evaluate online resources. Our results show that this skill cannot be taken for granted, particularly amongst groups already shown as relatively deficient in knowledge: male adolescents, the academically disadvantaged, and students with an immigrant background. Schools, parents, sexual health educators, and public health agencies are called upon to improve the sexual health knowledge and the eHealth literacy of adolescents.

References

1. Bay-Cheng LY. The Trouble of Teen Sex: The construction of adolescent sexuality through school-based sexuality education. *Sex Educ* 2003 Apr 1;3(1):61–74.
2. Darroch JE, Singh S, Frost JJ. Differences in teenage pregnancy rates among five developed countries: the roles of sexual activity and contraceptive use. *Fam Plann Perspect* 2001 Dec;33(6):244–250, 281.
3. Jugendsexualität. Wiederholungsbefragung von 14- bis 17-Jährigen und ihren Eltern. Cologne: Bundeszentrale für Gesundheitliche Aufklärung, 2010. (Accessed December 17, 2017, at <https://publikationen.sexualaufklaerung.de/index.php?docid=227>).
4. Kan ML, Cheng YA, Landale NS, McHale SM. Longitudinal Predictors of Change in Number of Sexual Partners across Adolescence and Early Adulthood. *J Adolesc Health* 2010 Jan;46(1):25–31.
5. Santelli JS, Brener ND, Lowry R, Bhatt A, Zabin LS. Multiple sexual partners among U.S. adolescents and young adults. *Fam Plann Perspect* 1998 Dec;30(6):271–275.
6. Alford SM, Lappin RE, Wells K, Barone AR, Dalton VK. Adolescent and Young Adult Women's Use of Emergency Contraception. *J Pediatr Adolesc Gynecol* 2010 Oct;23(5):279–284.
7. Land JA, van Bergen JE, Morr e SA, Postma MJ. Epidemiology of Chlamydia trachomatis infection in women and the cost-effectiveness of screening. *Hum Reprod Update* 2010 Apr;16(2):189–204.
8. WHO regional strategy on sexual and reproductive health. Copenhagen: WHO Regional Office for Europe, 2001 (Accessed May 19, 2018, at <http://www.euro.who.int/en/health-topics/Life-stages/sexual-and-reproductive-health/publications/pre-2007/who-regional-strategy-on-sexual-and-reproductive-health>).
9. Fisher JD, Fisher WA. Changing AIDS-risk behavior. *Psychol Bull* 1992 May;111(3):455–474.
10. Matthiesen S, Block K, Mix S, et al. Schwangerschaft und Schwangerschaftsabbruch bei minderj hrigen Frauen: eine Studie. Cologne: Bundeszentrale f r Gesundheitliche Aufkl rung (BZgA), 2009.
11. Aneblom G, Larsson M, Odland V, Tyd n T. Knowledge, use and attitudes towards emergency contraceptive pills among swedish women presenting for induced abortion. *BJOG Int J Obstet Gynaecol* 2002 Feb 1;109(2):155–160.
12. S rensen MB, Pedersen BL, Nyrnberg LE. Differences between users and non-users of emergency contraception after a recognized unprotected intercourse. *Contraception* 2000 Jul;62(1):1–3.
13. AIDS im  ffentlichen Bewusstsein der Bundesrepublik Deutschland 2016. Cologne: Bundeszentrale f r Gesundheitliche Aufkl rung, 2016. (Accessed September 27, 2017, at <https://www.infodienst.bzga.de/?id=teaserext2.13&idx=7018>).
14. Bremer V, Dudareva-Vizule S, Buder S, an der Heiden M, Jansen K. Sexuell  bertragbare Infektionen in Deutschland. *Bundesgesundheitsblatt - Gesundheitsforschung - Gesundheitsschutz* 2017 Sep 1;60(9):948–957.

15. Task Force on Postovulatory Methods of Fertility Regulation. Randomised controlled trial of levonorgestrel versus the Yuzpe regimen of combined oral contraceptives for emergency contraception. *The Lancet* 1998 Aug 8;352(9126):428–433.
16. Glasier AF, Cameron ST, Fine PM, Logan SJS, Casale W, Van Horn J, Sogor L, Blithe DL, Scherrer B, Mathe H, Jaspert A, Ulmann A, Gainer E. Ulipristal acetate versus levonorgestrel for emergency contraception: a randomised non-inferiority trial and meta-analysis. *Lancet* 2010 Feb 13;375(9714):555–562.
17. Segerer S. Notfallkontrazeptiva — Bilanz nach Wegfall der Verschreibungspflicht. *Gynäkol Geburtshilfe* 2017 Oct 1;22(5):34–38.
18. Moreau C, Bouyer J, Goulard H, Bajos N. The remaining barriers to the use of emergency contraception: perception of pregnancy risk by women undergoing induced abortions. *Contraception* 2005 Mar;71(3):202–207.
19. Global health sector strategy on Sexually Transmitted Infections, 2016-2021. Geneva: WHO, 2016. (Accessed September 20, 2017, at <http://www.who.int/reproductivehealth/publications/rtis/ghss-stis/en/>).
20. Westrom LV. Chlamydia and its effect on reproduction. *J Br Fertil Soc* 1996;1(1):23–30.
21. Griesinger G, Gille G, Klapp C, von Otte S, Diedrich K. Sexual behaviour and Chlamydia trachomatis infections in German female urban adolescents, 2004. *Clin Microbiol Infect* 2007 Apr 1;13(4):436–439.
22. Garside R, Ayres R, Owen M, Pearson VAH, Roizen J. “They never tell you about the consequences”: young people’s awareness of sexually transmitted infections. *Int J STD AIDS* 2001;12(9):582–588.
23. de Visser R. One size fits all? Promoting condom use for sexually transmitted infection prevention among heterosexual young adults. *Health Educ Res* 2005 Oct 1;20(5):557–566.
24. Heßling A. Youth Sexuality 2010: Repeat Survey of 14 to 17-year-olds and their parents. Cologne: Bundeszentrale für Gesundheitliche Aufklärung (BZgA); 2010.
25. Rieck T, Feig M, Wichmann O, Siedler A. Aktuelles aus der KV-Impfsurveillance – Impfquoten der Rotavirus-, Masern-, HPV- und Influenza-Impfung in Deutschland. *Epid Bull* 2017;1:1–12.
26. Borzekowski DG, Rickert VI. Adolescent cybersurfing for health information: A new resource that crosses barriers. *Arch Pediatr Adolesc Med* 2001 Jul 1;155(7):813–817.
27. Kanuga M, Rosenfeld WD. Adolescent sexuality and the internet: the good, the bad, and the URL. *J Pediatr Adolesc Gynecol* 2004 Apr;17(2):117–124.
28. Madden T, Cortez S, Kuzemchak M, Kaphingst KA, Politi MC. Accuracy of information about the intrauterine device on the Internet. *Am J Obstet Gynecol* 2016 Apr;214(4):499.e1–6.
29. Buhi ER, Daley EM, Fuhrmann HJ, Smith SA. An Observational Study of How Young People Search for Online Sexual Health Information. *J Am Coll Health* 2009 Sep 30;58(2):101–111.
30. von Rosen FT, von Rosen AJ, Müller-Riemenschneider F, Tinnemann P. Awareness and knowledge regarding emergency contraception in Berlin adolescents. *Eur J Contracept Reprod Health Care Off J Eur Soc Contracept* 2017 Feb;22(1):45–52.

31. von Rosen AJ, von Rosen FT, Tinnemann P, Müller-Riemenschneider F. Sexual Health and the Internet: Cross-Sectional Study of Online Preferences Among Adolescents. *J Med Internet Res* 2017 Nov 8;19(11):e379.
32. von Rosen FT, von Rosen AJ, Müller-Riemenschneider F, Damberg I, Tinnemann P. STI Knowledge in Berlin Adolescents. *Int J Environ Res Public Health* 2018 Jan 10;15(1):110.
33. Incidence, Prevalence, and Cost of Sexually Transmitted Infections in the United States. Atlanta, GA: National Prevention Information Network, 2013. (Accessed September 20, 2017, at <https://npin.cdc.gov/publication/incidence-prevalence-and-cost-sexually-transmitted-infections-united-states>).
34. Center for Disease Control and Prevention. Sexually Transmitted Diseases Treatment Guidelines, 2015. *MMWR Recomm. Rep.* 2015, 64, 1–137.
35. Graham A, Green L, Glasier AF. Teenagers' knowledge of emergency contraception: questionnaire survey in south east Scotland. *BMJ* 1996 Jun 22;312(7046):1567–1569.
36. Hobbs MK, Taft AJ, Amir LH, Stewart K, Shelley JM, Smith AM, Chapman CB, Hussainy SY. Pharmacy access to the emergency contraceptive pill: a national survey of a random sample of Australian women. *Contraception* 2011 Feb;83(2):151–158.
37. Pedersen W. Emergency contraception: why the absent effect on abortion rates? *Acta Obstet Gynecol Scand* 2008 Feb 1;87(2):132–133.
38. Marston C, Meltzer H, Majeed A. Impact on contraceptive practice of making emergency hormonal contraception available over the counter in Great Britain: repeated cross sectional surveys. *BMJ* 2005 Jul 30;331(7511):271.
39. Glasier A, Manners R, Loudon JC, Muir A. Community pharmacists providing emergency contraception give little advice about future contraceptive use: a mystery shopper study. *Contraception* 2010 Dec;82(6):538–542.
40. Samkange-Zeeb F, Mikolajczyk RT, Zeeb H. Awareness and Knowledge of Sexually Transmitted Diseases Among Secondary School Students in Two German Cities. *J Community Health* 2013 Apr;38(2):293–300.
41. Allgemeine Hinweise zu den Rahmenplänen für Unterricht und Erziehung in der Berliner Schule AV 27: Sexualerziehung. Berlin: Senatsverwaltung für Bildung, Jugend und Familie, 2001. (Accessed September 17, 2017, at https://www.berlin.de/sen/bildung/unterricht/faecher-rahmenlehrplaene/rahmenlehrplaene/mdb-sen-bildung-schulorganisation-lehrplaene-av27_2001.pdf).
42. van Gemert-Pijnen JE, Nijland N, van Limburg M, Ossebaard HC, Kelders SM, Eysenbach G, Seydel ER. A holistic framework to improve the uptake and impact of eHealth technologies. *J Med Internet Res* 2011 Dec 5;13(4):e111.
43. Norman CD, Skinner HA. eHealth Literacy: Essential Skills for Consumer Health in a Networked World. *J Med Internet Res* 2006 Jun 16;8(2):e9.
44. de Graaf H, Vanwesenbeeck I, Meijer S. Educational Differences in Adolescents' Sexual Health: A Pervasive Phenomenon in a National Dutch Sample. *J Sex Res* 2015 Sep 2;52(7):747–757.

Eidesstattliche Versicherung

„Ich, Frederik von Rosen, versichere an Eides statt durch meine eigenhändige Unterschrift, dass ich die vorgelegte Dissertation mit dem Thema „Sexual Health Knowledge of Berlin Adolescents“ selbstständig und ohne nicht offengelegte Hilfe Dritter verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel genutzt habe.

Alle Stellen, die wörtlich oder dem Sinne nach auf Publikationen oder Vorträgen anderer Autoren beruhen, sind als solche in korrekter Zitierung (siehe „Uniform Requirements for Manuscripts (URM)“ des ICMJE -www.icmje.org) kenntlich gemacht. Die Abschnitte zu Methodik (insbesondere praktische Arbeiten, Laborbestimmungen, statistische Aufarbeitung) und Resultaten (insbesondere Abbildungen, Graphiken und Tabellen) entsprechen den URM (s.o) und werden von mir verantwortet.

Meine Anteile an den ausgewählten Publikationen entsprechen denen, die in der untenstehenden gemeinsamen Erklärung mit dem/der Betreuer/in, angegeben sind. Sämtliche Publikationen, die aus dieser Dissertation hervorgegangen sind und bei denen ich Autor bin, entsprechen den URM (s.o) und werden von mir verantwortet.

Die Bedeutung dieser eidesstattlichen Versicherung und die strafrechtlichen Folgen einer unwahren eidesstattlichen Versicherung (§156,161 des Strafgesetzbuches) sind mir bekannt und bewusst.“

Datum

Unterschrift

Anteilserklärung an den erfolgten Publikationen

Frederik von Rosen hatte folgenden Anteil an den folgenden Publikationen:

Beitrag zu der den Publikationen zugrunde liegenden Studie:

Gemeinsam mit meiner Koautorin Antonella J. von Rosen habe ich mit Unterstützung von PD Dr. Falk Müller-Riemenschneider und Dr. Peter Tinnemann die den vorgelegten Publikationen zugrundeliegende Querschnittsstudie zum sexualgesundheitlichen Wissen von Berliner Jugendlichen durchgeführt. Zu den hierbei mit A.J.v.R. in paritätischer Aufteilung durchgeführten Tätigkeiten zählten die Idee zur Studie, die Konzeption und Planung, sowie das Einwerben von Drittmitteln des Bundesministeriums für Bildung und Forschung. Weiterhin wurden erfolgreich ein Votum der Ethikkommission der Charité – Universitätsmedizin Berlin und die Genehmigung durch die Senatsverwaltung für Bildung, Wissenschaft und Forschung eingeholt. Es wurden alle staatlichen weiterführenden Schulen in Berlin kontaktiert und die Studie in interessierten Schulen und in allen Schulkonferenzen der teilnehmenden Schulen persönlich vorgestellt. Daraufhin haben wir die Erhebung selbstständig in den Schulklassen durchgeführt.

Publikation 1:

von Rosen FT, von Rosen AJ, Müller-Riemenschneider F, Tinnemann P. Awareness and Knowledge regarding Emergency Contraception in Berlin Adolescents. The European Journal of Contraception and Reproductive Health Care 2017, 22(1):45–52.

Impact Factor: 1.627

Beitrag im Einzelnen:

Alleine und selbstständig habe ich die Fragestellung der obenstehenden Publikation erarbeitet. Ich habe die Publikation geplant und das Manuskript erstellt. Ich habe die Rohdaten aufbereitet. Weiterhin habe ich sämtliche Schritte der statistischen Auswertung selbstständig durchgeführt, von der Auswahl der Methoden bis zur Kalkulation der bivariaten Statistiken

und der Multilevel Mixed-Effects Regression in SPSS. Ich habe daraufhin die Ergebnisse der statistischen Auswertung in den Text eingearbeitet. Das Journal fordert für alle eingereichten Manuskripte eine externe Überprüfung der statistischen Methoden. Diese wurde durch das Kompetenzzentrum für Klinische Studien der Universität Bremen unter Leitung von Prof. Dr. Werner Brannath durchgeführt. Der korrekte Einsatz der statistischen Methoden wurde bestätigt. Ich habe das Manuskript bei der Fachzeitschrift eingereicht und alle Kommentare aus der Peer Review in das Manuskript eingearbeitet und einzeln beantwortet.

Publikation 2:

von Rosen AJ, von Rosen FT, Tinnemann P, Müller-Riemenschneider F. Sexual Health and the Internet: Cross-Sectional Study of Online Preferences among Adolescents. Journal of Medical Internet Research 2017, 19(11):e379.

Impact Factor: 5.175

Beitrag im Einzelnen:

Für die obenstehende Publikation habe ich die statistische Auswertung selbstständig geplant und durchgeführt. Weiterhin habe ich bei der Erstellung des Manuskripts und der Revisionen im Rahmen des Peer Review Prozesses mitgewirkt.

Publikation 3:

von Rosen FT*, von Rosen AJ* (*geteilte Erstautorenschaft), Müller-Riemenschneider F, Damberg I, Tinnemann P. STI Knowledge in Berlin Adolescents. International Journal of Environmental Research and Public Health 2018, 15(1):110.

Impact Factor: 2.101

Beitrag im Einzelnen:

Ich habe die Fragestellung der Publikation gemeinsam mit meiner Koautorin A.J.v.R. ausgearbeitet und die Hintergrundrecherche durchgeführt. Während der Fokus von A.J.v.R.

auf der Konzeption der Abschnitte Einführung und Diskussion lag, lag mein Fokus auf der Planung der Abschnitte Methoden und Ergebnisse. Im Anschluss habe ich das Manuskript geschrieben, in enger Abstimmung mit A.J.v.R. Ich habe weiterhin alleine und selbstständig die statistische Auswertung vorgenommen. Ich habe das Manuskript beim Verlag eingereicht. Weiterhin habe ich den Text anhand des Feedbacks der Reviewer modifiziert.

Unterschrift, Datum und Stempel des betreuenden Hochschullehrers

Unterschrift des Doktoranden

Druckexemplar der 1. Publikation

von Rosen FT, von Rosen AJ, Müller-Riemenschneider F, Tinnemann P.

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Druckexemplar der 2. Publikation

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Original Paper

Sexual Health and the Internet: Cross-Sectional Study of Online Preferences Among Adolescents

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Abstract

Background: The Internet is widely used by adolescents for sexual health information and bears the potential to increase knowledge and positively affect behavior.

Objective: The objective of this study is to assess students' preferences when looking for sexual health information online.

Methods: We conducted a cross-sectional survey among ninth grade students in a convenience sample of 13 secondary schools in Berlin, Germany. During a regular school period, participants were requested to rate the importance they attribute to nine aspects of sexual health websites in a paper-based questionnaire. Bivariate and multivariable analyses were used to assess awareness and preferences by gender, age, migrant background, and school type.

Results: Of 1190 eligible students, 1177 (98.91%) students with a mean age of 14.6 (SD 0.7) years participated, 52.52% (605/1152) were male, and 52.94% (612/1156) had at least one parent born abroad. Participant numbers were spread equally across three types of secondary schools in Berlin. Website aspects most frequently cited as important were easily comprehensible wording (88.33%, 961/1088), clear information layout (80.57%, 871/1081), and reliability of the website's publisher (79.28%, 857/1081), whereas the visual style of a website was deemed important by the lowest number of students (35.13%, 378/1076). There was a marked gender difference in the importance students attached to website publisher reliability. Although 437/515 (84.9%) of female participants regarded this as important, only 420/566 (74.2%) of male participants did likewise ($P < .001$). In multivariable analyses, demographic differences were also particularly visible in the importance of publisher reliability: male participants were significantly less likely to find this aspect important (OR 0.50, 95% CI 0.37-0.69). The odds ratio for students with migrant background was 0.64 (95% CI 0.50-0.81, reference=no migrant background) and OR 2.04 (95% CI 1.03-4.03) for students in the most academic school type (reference=least academic).

Conclusions: Students prefer easily understandable online resources. Setting up sexual health websites according to the explicit preferences of the target audience might encourage usage, especially by those subpopulations less likely to critically assess information validity: male adolescents, children of immigrants, and the academically disadvantaged.

(*J Med Internet Res* 2017;19(11):e379) doi:[10.2196/jmir.7068](https://doi.org/10.2196/jmir.7068)

KEYWORDS

adolescent; adolescent behavior; Internet; reproductive health; health literacy; sex education; cross-sectional studies; online preferences; eHealth literacy

Introduction

The Internet as a Source of Sexual Health Information

The rapid expansion of the Internet [1,2] has led to an information revolution that affects nearly all aspects of our lives. It completely changed the way we access, analyze, and use information. This holds true even for areas as delicate and private as health. In the United States, searching for health information became the third most popular online activity for all Internet users in 2010 [3]. Several studies show that the vast majority of adolescents look for health information online [4-6]. Of particular interest for teenagers is sexual health, an area raising a multitude of questions perceived as embarrassing, controversial, or sensitive [5-9]. The threshold for adolescents to search for answers to these questions is lowered by the anonymous nature of the Internet, its easy and quick availability, and its low cost [10,11]. A digital divide has been widely described, with socioeconomically disadvantaged subpopulations less likely to have access to the Internet and to use it regularly [12]. However, recent evidence shows that the divide regarding Internet access is closing in industrialized countries, especially among adolescents and young adults. A representative survey in Germany in 2016 showed that across socioeconomic and ethnic divides, 100% of respondents aged 16 to 24 years had Internet access [13], with 97% stating daily usage [14].

The Internet hence bears the potential to increase sexual health knowledge and promote healthy behavior, especially in socioeconomic and ethnic groups with lower levels of access to traditional sources of sexual health information [5,15]. However, reputable sexual health websites with sound content coexist with a vast array of websites presenting incorrect or incomplete information that can misinform and might ultimately lead to unhealthy behavior [16,17]. In the competitive market for online patronage, user centricity has been suggested as an important advantage [18]. Providers of sexual health information, such as public health agencies, should strive to offer online resources that closely match the requirements and preferences of their target population.

To date, evidence on adolescents' health website preferences is scarce and exclusively qualitative. The sole study focusing specifically on adolescents' evaluation of a sexual health website found that interviewees frequently disliked text-heavy style and appreciated interactive features and "real-life stories" from other adolescents [19]. A study on adolescents' evaluation of a general health website yielded similar results [20]. A study on adolescents' website preferences, albeit with a mental health focus, concluded that interviewees were highly critical of website publisher credibility, and that academically disadvantaged participants in particular preferred low text density [21].

To our knowledge, no quantitative study design has to date been employed to assess adolescents' sexual health website preferences. Although qualitative research is clearly useful in gaining an in-depth understanding of preferences, a quantitative study can offer insight into preferences of a wider sample and highlight and quantify differences between different subpopulations.

Study Objective

The objective of this study is to assess which aspects of a website adolescents deem important when they look for sexual health information online, and to assess differences between demographic subpopulations.

Methods

Study Design

Data were collected as part of a larger cross-sectional study on sexual health knowledge that was conducted throughout the year 2012 in the ninth grades of secondary schools in Berlin, Germany. The study, its methodology, and participant demography have been partially described elsewhere [22].

The study design was approved by the Ethics Committee of the Charité – Universitätsmedizin Berlin, as well as the Berlin Senate's Department for Education, Youth and Science. In accordance with legal requirements, the study was discussed and approved by parent-teacher conferences in all schools prior to study onset. As demanded by state law, students aged 13 years and younger were required to provide written parental consent.

Reporting on this study was based on the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement guidelines [23].

Sampling and Data Collection

The project study group contacted the heads of the biology or natural science departments of all public secondary schools by phone in late 2011 and supplied schools with further information on the study via email. Of a total of 287 eligible schools, the heads of department were successfully contacted in 142 cases, with 13 schools agreeing to participate. In all 13 schools, the parent-teacher conferences voted in favor of participation. Of the schools choosing not to partake, all quoted time constraints of teaching staff as the reason.

Since a major education reform implemented in 2010, state secondary education in Berlin formally consists of two school forms: university-preparatory schools [Gymnasium] and Integrated Secondary Schools [Integrierte Gesamtschule]. An important subdivision can be made in the latter category between schools allowing for their highest-achieving students to continue up to year 12 to qualify for university access, and schools where no such option exists and most students are likely not to continue their formal education past year 10. For brevity, these three school types were reported in results as "highest (academic) tier" (gymnasium), "intermediate (academic) tier" (integrated secondary school with option to qualify for university), and "lowest (academic) tier" (integrated secondary school up to year 10 only). All three school types were represented in the sample, as were seven of the 12 Berlin city districts (Mitte, Pankow, Charlottenburg-Wilmersdorf, Spandau, Steglitz-Zehlendorf, Treptow-Köpenick, and Marzahn-Hellersdorf). Districts from both the former Eastern and Western parts of Berlin were included, and districts with participating schools ranged from inner city to suburban and from the most affluent to relatively deprived [24].

Study Setting

The survey was conducted by a member of the project team during a school period in the regular classroom setting. A short presentation informed students on the aim of the study and of the voluntary and anonymous nature of participation. It was emphasized that results would not be disclosed to teaching staff, parents, or fellow students. To safeguard anonymity, it was stressed that it was strictly prohibited to attempt to read other students' responses, and an exam-like, nonclustered seating layout in the classroom was adopted. Subsequently, a paper-based questionnaire was administered to all participating students. A member of the research team supervised the class until all questionnaires had been collected.

Questionnaire

Due to the lack of existing tools for the research question, the study questionnaire was devised by the authors to assess students' preferences and requirements when looking for sexual health information online. To ascertain the adequacy of the questionnaire for the adolescent sample population, a pretest was performed in one school class, with comments from students leading to minor modifications. Following discussion with students from the pretest sample, wording was phrased indirectly ("How important would you find the following aspects when looking for sexual health information on the Internet?"). Importance was rated on a five-point Likert scale, on which students were to choose between "important," "somewhat important," "neither important nor unimportant," "rather unimportant," and "unimportant" (authors' translation from German).

Demographic variables on gender, age, and migrant background (parental place of birth) were included in the questionnaire. For the latter, response options were restricted to "Germany" or "other country" in accordance with the principle of parental informational self-determination.

Aspects were chosen by the authors following an in-depth analysis of the different characteristics and features of 10 prominent German-language websites providing sexual health information: Loveline [25], Mach's mit [26], profamilia [27], Sexundso [28], sextra [29], BRAVO [30], gutefrage [31], mädchen.de [32], gofeminin [33], and Lovetalk [34]. Websites were chosen based on a search on Google for the following keywords and combinations thereof: adolescents, students, love, sex, first time, contraception, condom, pill, pregnancy, STIs, and HIV (authors' translation of the German keywords). Google was used as the most frequently cited starting point for sexual health information online in previous research [35]. A total of nine aspects belonging to three principal groups were identified: "who and for whom" (publisher and explicit target audience of a website), "information presentation" (visual style, clear layout of information, easily understandable language, and text shortness), and "website features" (facilities to ask individual questions, a section where people can report their own personal experiences, and advice provided by people of similar age). The

websites as well as the nine website aspects were discussed with and deemed appropriate by our pretest sample.

Statistics and Data Analysis

For the analysis of the survey data, IBM SPSS version 23 was used. Descriptives were computed. For the statistical analyses, outcomes were dichotomized for the sake of readability: the variables "important" and "rather important" were clustered to "(rather) important," as were the categories "of medium importance," "rather unimportant," and "unimportant" to "other response." Descriptives and chi-square tests for the original five-point outcome scale are included in [Multimedia Appendix 1](#).

Descriptives and Bivariate Analysis

Aspects were ranked by the aggregate percentage of students selecting "(rather) important." Using two-sided chi-square tests, bivariate relationships were calculated between the demographic variables age, gender, migratory background, and school type and the outcome variables measuring the importance participants attribute to the different aspects of sexual health information websites. For statistical analysis, migrant background was defined as having at least one parent who was born abroad.

Multivariable Analysis

Regression models were used to quantify the effect of age, gender, migratory background, and school type on outcome variables. Due to the clustered nature of observation in class and school groups, a mixed multilevel regression model (SPSS GENLINMIXED) containing school and class as random effects was used. Odds ratios and 95% confidence intervals for all outcome variables were computed from mixed multilevel regression. To account for possible violations of model assumptions, we used robust estimation. Missing cases were excluded from bivariate and regression analysis.

Results

Population

The study was conducted in 61 school classes. A total of 1190 students were present in class on the day of the study and thus eligible for participation. Ten students aged 13 years could not participate due to missing parental consent and a further two students chose not to participate. One student could not participate due to lacking the required basic language proficiency. Therefore, a total of 1177 participants were included in the survey, equating to a response rate of 98.91%. The overall mean age of participants was 14.6 (SD 0.8) years, the mean for boys being 14.6 (SD 0.7) years and 14.5 (SD 0.7) years for girls. [Table 1](#) shows the demography of study participants, as reported previously [22].

Descriptives and Bivariate Analysis

[Table 2](#) shows the distribution of responses for the items in the three groups of website aspects, the relative rank of each aspect by cumulative percentage selecting "(rather) important," and stratification by gender.

Table 1. Demography of participants (N=1177).

Population characteristic	n (%)
Age (years)	n=1162^a
13	23 (1.98)
14	565 (48.62)
15	480 (41.31)
16	94 (8.09)
Gender	n=1152^a
Female	547 (47.48)
Male	605 (52.52)
Migrant background	n=1156^a
Both parents born in Germany	544 (47.06)
Both parents born abroad	352 (30.45)
Only mother born abroad	127 (10.99)
Only father born abroad	133 (11.51)
School type	n=1177^b
Lowest tier	390 (33.14)
Intermediate tier	395 (33.56)
Highest tier	392 (33.31)

^aTotal number of responses for each variable.

^bEntered for all participants at school level.

Table 2. Website preferences by gender (bivariate analysis).

Website aspect group and website aspect	Aspect rank ^a	Population in (rather) important, n (%)			P ^b
		Female	Male	Total	
Who and for whom					
Reputable publisher (n=1081 ^c)	3	437 (84.85)	420 (74.20)	857 (79.28)	<.001
Explicitly addressed at adolescents (n=1088 ^c)	7	366 (70.66)	311 (54.56)	677 (62.22)	<.001
Information presentation					
Language easily understandable (n=1088 ^c)	1	463 (89.38)	498 (87.37)	961 (88.33)	.35
Information clearly laid out (n=1081 ^c)	2	425 (83.17)	446 (78.25)	871 (80.57)	.045
Texts short and concise (n=1084 ^c)	8	260 (50.58)	304 (53.33)	564 (52.03)	.39
Visual style/design attractive (n=1076 ^c)	9	149 (29.22)	229 (40.46)	378 (35.13)	<.001
Website features					
Possibility to ask questions (n=1079 ^c)	4	378 (74.14)	406 (71.35)	784 (72.66)	.34
Section with personal experiences (n=1080 ^c)	5	361 (70.23)	381 (67.31)	742 (68.70)	.32
Advice by other adolescents (n=1072 ^c)	6	336 (66.14)	373 (66.13)	709 (66.14)	>.99

^aBy percentage (rather) important.

^bCalculated from chi-square tests.

^cNumber of participants included in the analysis.

Student Preferences: Who and for Whom

Publisher reliability was described as (rather) important by 857 of 1081 students (79.28%), the percentage for girls being higher than for boys. Students of migrant background were significantly less likely to attach importance to this aspect ($P<.001$), as were students in the lowest academic tier of schools ($P=.01$). Whether a website is explicitly addressed at adolescents was an aspect to which students attributed relatively little importance. Again, the aspect was considerably more important to girls, although there was no association with the other demographic variables.

Student Preferences: Information Presentation

Understandable language was the most important aspect overall. Importance was higher in the highest academic school tier ($P=.001$) and lower for children of immigrants ($P<.001$). Across the sample, 871 of 1081 respondents (80.57%) described it as (rather) important that information should be clearly laid out. Girls were significantly more likely than boys to regard this aspect as (rather) important. Again, school type and migratory background were significantly associated with outcomes: the higher the school tier, the more important the issue was considered ($P=.03$), and children of immigrants were less likely to regard the aspect as (rather) important ($P<.001$).

Whether information text on sexual health websites was short and concise was an issue of relatively low importance in our survey, with 564 of 1084 students (52.03%) attaching importance. Students from the lowest tier of schools and children of immigrants were significantly more likely to regard this aspect as (rather) important ($P=.01$ for both).

Visual style was the least important issue overall. Although no significant difference by migratory background was observed, school type was significantly associated with the importance attached to a website's visual style: students from the lowest tier of schools were significantly more likely to regard this aspect as (rather) important ($P=.01$).

Student Preferences: Website Features

Among participating students, 784 of 1079 (72.66%) found it (rather) important that sexual health websites offer the possibility to ask individual questions, thus putting it in fourth place overall. It was followed in fifth place by the aspect that websites should include a section where people can report their own personal experiences and in sixth place by whether websites included advice written by people of similar age as the user. Students with migrant background were less likely to deem personal experiences and writing by age peers (rather) important ($P=.04$ and $P=.03$, respectively). Otherwise, for website feature variables, no significant difference by gender, age, migratory background, or school type was observed.

Multivariable Analysis

Results from the regression model are presented in Table 3. Differences in odds were especially marked on the issue of the reputability of a website's publisher: female students were nearly twice as likely to attach importance to this aspect, with not having a migrant background and attending a school in the highest academic tier also greatly increasing the odds to select this option. Being of female gender also increased the odds of attributing importance to whether a website was explicitly addressed at adolescents by more than twofold.

Table 3. The effect of the demographic variables on outcomes (multivariable analysis).

Aspect group and website aspect	Variable, OR (95% CI) ^a				
	Age (per year increase)	Gender (male)	Migration (migrant background)	School type (intermediate tier)	School type (highest tier)
Who and for whom					
Reputable publisher (n=1074 ^b)	1.23 (1.03-1.47) ^c	0.50 (0.37-0.69) ^c	0.64 (0.50-0.81) ^c	1.39 (0.70-2.73)	2.04 (1.03-4.03) ^c
Explicitly addressed at adolescents (n=1081 ^b)	1.16 (0.96-1.40)	0.48 (0.35-0.67) ^c	0.76 (0.66-0.88) ^c	1.08 (0.74-1.57)	1.02 (0.83-1.26)
Information presentation					
Language easily understandable (n=1081 ^b)	1.02 (0.91-1.13)	0.85 (0.51-1.39)	0.47 (0.29-0.75) ^c	1.33 (0.70-2.53)	2.62 (1.36-5.06) ^c
Information clearly laid out (n=1074 ^b)	1.13 (1.01-1.27) ^c	0.71 (0.48-1.06)	0.71 (0.48-1.04)	1.10 (0.42-2.86)	1.75 (0.85-3.59)
Texts short and concise (n=1077 ^b)	1.32 (1.10-1.58) ^c	1.02 (0.84-1.25)	1.46 (1.10-1.94) ^c	0.71 (0.50-1.03)	0.81 (0.46-1.44)
Visual style/design attractive (n=1069 ^b)	1.15 (1.00-1.32) ^c	1.57 (1.08-2.29) ^c	1.02 (0.78-1.32)	0.68 (0.52-0.90) ^c	1.07 (0.70-1.52)
Website features					
Possibility to ask questions (n=1072 ^b)	1.00 (0.82-1.24)	0.87 (0.71-1.07)	0.89 (0.64-1.24)	1.06 (0.71-1.58)	1.14 (0.80-1.62)
Section with personal experiences (n=1073 ^b)	1.17 (1.02-1.33) ^c	0.84 (0.63-1.14)	0.88 (0.69-1.11)	0.87 (0.48-1.60)	1.17 (0.68-2.01)
Advice from other adolescents (n=1065 ^b)	1.08 (0.06-8.62)	0.99 (0.76-1.23)	0.78 (0.59-1.04)	0.91 (0.61-1.37)	1.27 (0.92-1.75)

^aReference category for gender was female, migration was none, and for both school types was lowest tier.

^bNumber of participants included in the analysis.

^c $P<.05$.

Discussion

We conducted a study among ninth graders in Berlin secondary schools to evaluate adolescents' preferences when looking for sexual health information online. Despite the voluntary nature of participation, only two of 1179 students chose not to participate. The overwhelming rate of participation might be an expression of a strong interest and curiosity invoked by the topic of sexual health and Internet research among adolescents. To our knowledge, no quantitative study with a similar focus on adolescent preferences in online resources has been conducted to date.

Easily comprehensible wording was most frequently selected as (rather) important. This was followed by clear information layout. In third place came the credibility of a website's publisher, which was described as (rather) important by about 80% of participants. We found that male gender, migratory background, and attending a school of the lowest academic tier were significantly associated with lower importance placed on publisher reliability in both bivariate and multivariable analyses. The possibility to ask questions, whether websites contained a section with personal experiences, and whether websites included advice from other adolescents were of intermediate relative importance to students in our sample. Interestingly, results for website feature aspects were relatively uniform across demographic divides. Both the visual style and the youth specificity of websites were relatively unimportant to study participants. Male respondents were more likely to regard this aspect as (rather) important.

The Internet has enabled direct access to a vast array of health information, which was previously only available through intermediaries such as health care professionals. The term "disintermediation" has been coined to describe this development [36]. It promises greater access to health information, especially in sensitive areas such as sexual health [9]. However, it also bears the risk that incorrect information is accessed and perceived as accurate [17,37]. This is emphasized by the visible minority of students in our sample neglecting publisher credibility of sexual health websites. From a public health perspective, a dual strategy should be employed to facilitate the access of adolescents to reliable sexual health information online. Firstly, health care professionals and educators can provide a certain degree of apomediation. Secondly, access of reliable and suitable sexual health information resources should be encouraged by adapting websites to explicitly cater to the target audience's preferences, and by educating adolescents to critically assess the validity of sexual health information online.

Apomediation describes the process in which individuals or institutions provide guidance in the digital sphere, for example by recommending particular websites [36]. One study has suggested that health care professionals can play a pivotal role in providing a list of suitable and reliable health websites as a first port of call [38]. The reach of such an intervention among adolescents might be even higher in Germany than in other contexts given that statutory health insurance covers and promotes a one-time routine checkup visit to a physician for all

youths aged 12 to 14 years [39]. Thus, physicians can extend their reach to healthy teenagers, and access is not impeded by financial considerations for adolescents or parents. A similar role with even greater reach could be played by schools. Peer apomediation, such as other adolescents recommending sexual health resources through social media, also bears the potential to spread knowledge regarding sexual health resources online. Further studies are needed to evaluate the reach and effectiveness of professional and peer apomediation.

Although recommendations of trustworthy websites by health care professionals, teachers, and possibly peers could play a role in providing adolescents with websites to start their search for sexual health information, it has to be taken into account that many users access health information including sexual health information starting with search engine queries rather than through apomediation [35,40,41]. User centrality is a key factor in preventing consumers from quickly "bouncing" back to search results [18]. Especially in the field of health where incorrect or misleading information can undermine healthy behavior, it is imperative that websites by reputable providers of sexual health information are set up according to the preferences and requirements of users. Our study can contribute to an understanding of adolescent preferences in sexual health websites. The most frequently cited aspect in our study, easily comprehensible language, should be actively pursued in the development of all sexual health resources. Beyond matching their preferences, it is axiomatic that information that users can linguistically comprehend is more likely to improve knowledge and potentially encourage healthy behavior. However, studies show that many health websites fall short in this regard and employ a language prohibitively sophisticated for many users, especially the young and/or educationally disadvantaged [42,43]. Our results likely reflect similar experiences of participants' with overly complicated sexual health information online. Sexual health websites should hence employ accessible language as a dually user-centric measure: to make a website both more used by and more useful to adolescents.

One way to further user centrality is to invite target group participation at the different steps of development [19]. Because our study shows significant divergence between preferences even within a narrow age bracket, it is critical that participation is invited from adolescents across genders and ethnic and educational backgrounds. It can be hypothesized that reputable sexual health information providers, such as public health authorities, government bodies, or sexual health associations, could use this as a competitive advantage: their bona fide standing is likely to make it easier to co-opt youths to participate in website development, such as through schools.

In some cases, differences between demographic groups might warrant the setting up of separate resources. For example, our study shows pronounced differences in preferences between male and female adolescents. One solution would be to develop sexual health websites aimed at one gender only, or to set up male and female subsites to be selected by users within one sexual health website. Indeed, a previous study has shown that a majority of adolescents would prefer gender-stratified sexual health websites [20].

However, there are many cases in which it will not be possible to develop separate resources for subpopulations with divergent preferences. One innovative way to make online health resources palatable to a diverse target audience is to enable users to interactively modify different parameters of a website [44]. For example, users could select between a text-heavy and a more visual presentation of information or between elaborate and short articles. This enables users to adapt the website not only to general personal preferences, but also according to the specific search context and purpose. This innovative and user-centric concept has been implemented and positively evaluated for a general health information database [44].

Lastly, it is important that adolescents are educated and encouraged to access, comprehend, and critically evaluate online health information and sexual health information. The term “eHealth literacy” has been coined for this set of skills [45-47]. An integral part of eHealth literacy is the ability to appraise the validity of online information [48]. In our study, approximately 80% of students described the reliability of a website’s publisher as (rather) important. This is consistent with previous studies that found the majority of users are critical when looking for health information online, whereas a visible minority tend to neglect the issue of credibility of health websites [49-51]. We found that male gender, migratory background, and attending a school of the lowest academic tier were associated with lower importance placed on publisher reliability. With strong evidence that these groups are also more likely to have poor sexual health knowledge and to engage in risk-taking behavior both in Germany [15] and in other settings [52,53], it is crucial to educate students to critically evaluate the reliability of information resources, especially in these vulnerable subpopulations. Particularly in countries with mandatory school education, such as Germany, schools could be instrumental in providing health and sexual health online literacy education to virtually all adolescents. For this, the significant institutional inertia of school policy has to be overcome and joint initiatives at the different levels of school policy are called for [54].

A key strength of this study is the large study population including students from all types of public schools in Berlin. Furthermore, a voluntary participation rate of 98.9% of students

present in class makes it unlikely that participation/nonparticipation introduced a significant bias.

Unlike the student level, in which the rate of participation was very high, it has to be acknowledged that less than 5% of Berlin secondary schools participated. Although a majority of Berlin’s city districts and very diverse academic, socioeconomic, and geographic settings were represented in the sample, the generalizability of results might be limited by a systematic difference between participating and nonparticipating schools. Furthermore, it should be considered that findings of adolescents in Berlin might not be generalizable to other geographic settings.

A further limitation of this study is the fact that students were asked to evaluate the importance of different website aspects when looking for sexual health information online, without reference to specific websites during the survey. The abstract thinking this requires might have been challenging for at least some of the students in the sample. Future studies could include a more concrete evaluation of website aspects. For example, qualitative methods such as focus group interviews could be employed to have students evaluate different sexual health websites or to gain a more in-depth understanding of by what means and how accurately students evaluate publisher reliability. Furthermore, website analytics could be employed to quantify how successfully different sexual health website formats are in attracting and retaining visitors.

Websites providing sexual health information for adolescents bear the potential to improve sexual health knowledge and promote healthy behavior. To be effective, websites should be set up according to the preferences and requirements of the target population not merely regarding content, but also regarding the way information is presented. Divergent preferences might warrant the establishment of websites specifically geared at specific subpopulations, such as male adolescents or adolescents with a migrant background. Furthermore, parents, schools, and public health authorities should strive to improve online literacy among adolescents to make sure they have the facilities to critically evaluate the reliability of information online—in all aspects of information access, but especially in the critical field of sexual health.

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Conflicts of Interest

None declared.

Multimedia Appendix 1

Unclustered Likert-Scale outcomes of website preferences by gender.

[PDF File (Adobe PDF File), 31KB - [jmir_v19i11e379_app1.pdf](#)]

References

1. Statistisches Bundesamt. 2016. Staat & Gesellschaft - Ausstattung mit Gebrauchsgütern URL: https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/EinkommenKonsumLebensbedingungen/AusstattungGebrauchsguetern/Tabellen/ZeitvergleichAusstattung_IKT.html;jsessionid=722C21068A1FCFBEE9C222F124BC6AB9.cae4 [accessed 2016-08-07] [WebCite Cache ID 6jaePHtDc]
2. United States Census Bureau. 2012. Computer and Internet use in the United States: 2010 URL: <http://www.census.gov/prod/2013pubs/p20-569.pdf> [accessed 2015-03-26] [WebCite Cache ID 6XK03zZGC]
3. Zickuhr K. Pew Research Center. 2010 Dec 16. Generations 2010 URL: <http://www.pewinternet.org/2010/12/16/generations-2010/> [accessed 2016-08-07] [WebCite Cache ID 6jafBXNuO]
4. Gray NJ, Klein JD, Noyce PR, Sesselberg TS, Cantrill JA. Health information-seeking behaviour in adolescence: the place of the internet. *Soc Sci Med* 2005 Apr;60(7):1467-1478. [doi: [10.1016/j.socscimed.2004.08.010](https://doi.org/10.1016/j.socscimed.2004.08.010)] [Medline: [15652680](https://pubmed.ncbi.nlm.nih.gov/15652680/)]
5. Borzekowski DL, Rickert VI. Adolescent cybersurfing for health information: a new resource that crosses barriers. *Arch Pediatr Adolesc Med* 2001 Jul;155(7):813-817. [Medline: [11434849](https://pubmed.ncbi.nlm.nih.gov/11434849/)]
6. Skinner H, Biscope S, Poland B, Goldberg E. How adolescents use technology for health information: implications for health professionals from focus group studies. *J Med Internet Res* 2003 Dec 18;5(4):e32 [FREE Full text] [doi: [10.2196/jmir.5.4.e32](https://doi.org/10.2196/jmir.5.4.e32)] [Medline: [14713660](https://pubmed.ncbi.nlm.nih.gov/14713660/)]
7. Ralph LJ, Berglas NF, Schwartz SL, Brindis CD. Finding teens in TheirSpace: using social networking sites to connect youth to sexual health services. *Sex Res Soc Policy* 2011 Feb 22;8(1):38-49. [doi: [10.1007/s13178-011-0043-4](https://doi.org/10.1007/s13178-011-0043-4)]
8. Selkie EM, Benson M, Moreno M. Adolescents' views regarding uses of social networking websites and text messaging for adolescent sexual health education. *Am J Health Educ* 2011 Dec;42(4):205-212 [FREE Full text] [Medline: [22229150](https://pubmed.ncbi.nlm.nih.gov/22229150/)]
9. Racey M, Machmueller D, Field D, Kulak V, Newton GS. Perceptions and use of sources of health knowledge by young adolescents. *Int J Adolesc Med Health* 2016 Jun 14:pii. [doi: [10.1515/ijamh-2016-0002](https://doi.org/10.1515/ijamh-2016-0002)] [Medline: [27299195](https://pubmed.ncbi.nlm.nih.gov/27299195/)]
10. Suzuki LK, Calzo JP. The search for peer advice in cyberspace: An examination of online teen bulletin boards about health and sexuality. *J Appl Dev Psychol* 2004 Nov;25(6):685-698. [doi: [10.1016/j.appdev.2004.09.002](https://doi.org/10.1016/j.appdev.2004.09.002)]
11. Henderson EM, Keogh E, Eccleston C. Why go online when you have pain? A qualitative analysis of teenagers' use of the Internet for pain management advice. *Child Care Health Dev* 2014 Jul;40(4):572-579. [doi: [10.1111/cch.12072](https://doi.org/10.1111/cch.12072)] [Medline: [23663232](https://pubmed.ncbi.nlm.nih.gov/23663232/)]
12. Rice RE. Influences, usage, and outcomes of Internet health information searching: multivariate results from the Pew surveys. *Int J Med Inform* 2006 Jan;75(1):8-28. [doi: [10.1016/j.ijmedinf.2005.07.032](https://doi.org/10.1016/j.ijmedinf.2005.07.032)] [Medline: [16125453](https://pubmed.ncbi.nlm.nih.gov/16125453/)]
13. Statistisches Bundesamt. 2016. Staat & Gesellschaft - IT-Nutzung URL: <https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/EinkommenKonsumLebensbedingungen/ITNutzung/ITNutzung.html> [WebCite Cache ID 6ovXXPb05]
14. Statistisches Bundesamt. 2016. Private Nutzung von Informations- und Kommunikationstechnologien 2016: Durchschnittliche Nutzung des Internets URL: https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/EinkommenKonsumLebensbedingungen/ITNutzung/Tabellen/NutzungInternetAlter_IKT.html [accessed 2017-03-13] [WebCite Cache ID 6ovXGSihG]
15. Heßling A, editor. Youth Sexuality 2010: Repeat Survey of 14 to 17-year-olds and their parents. Cologne: Bundeszentrale für Gesundheitliche Aufklärung (BZgA); 2010.
16. Kanuga M, Rosenfeld WD. Adolescent sexuality and the internet: the good, the bad, and the URL. *J Pediatr Adolesc Gynecol* 2004 Apr;17(2):117-124. [doi: [10.1016/j.jpag.2004.01.015](https://doi.org/10.1016/j.jpag.2004.01.015)] [Medline: [15050988](https://pubmed.ncbi.nlm.nih.gov/15050988/)]
17. Madden T, Cortez S, Kuzemchak M, Kaphingst KA, Politi MC. Accuracy of information about the intrauterine device on the Internet. *Am J Obstet Gynecol* 2016 Apr;214(4):499.e1-499.e6. [doi: [10.1016/j.ajog.2015.10.928](https://doi.org/10.1016/j.ajog.2015.10.928)] [Medline: [26546848](https://pubmed.ncbi.nlm.nih.gov/26546848/)]
18. van Gemert-Pijnen JE, Nijland N, van Limburg M, Ossebaard HC, Kelders SM, Eysenbach G, et al. A holistic framework to improve the uptake and impact of eHealth technologies. *J Med Internet Res* 2011;13(4):e111 [FREE Full text] [doi: [10.2196/jmir.1672](https://doi.org/10.2196/jmir.1672)] [Medline: [22155738](https://pubmed.ncbi.nlm.nih.gov/22155738/)]
19. McCarthy O, Carswell K, Murray E, Free C, Stevenson F, Bailey JV. What young people want from a sexual health website: design and development of Sexunzipped. *J Med Internet Res* 2012;14(5):e127 [FREE Full text] [doi: [10.2196/jmir.2116](https://doi.org/10.2196/jmir.2116)] [Medline: [23060424](https://pubmed.ncbi.nlm.nih.gov/23060424/)]
20. Franck LS, Noble G. Here's an idea: ask the users! Young people's views on navigation, design and content of a health information website. *J Child Health Care* 2007 Dec;11(4):287-297. [doi: [10.1177/1367493507083941](https://doi.org/10.1177/1367493507083941)] [Medline: [18039731](https://pubmed.ncbi.nlm.nih.gov/18039731/)]
21. Havas J, de Nooijer J, Crutzen R, Feron F. Adolescents' views about an internet platform for adolescents with mental health problems. *Health Educ* 2011 Apr 19;111(3):164-176. [doi: [10.1108/0965428111123466](https://doi.org/10.1108/0965428111123466)]
22. von Rosen FT, von Rosen AJ, Müller-Riemenschneider F, Tinnemann P. Awareness and knowledge regarding emergency contraception in Berlin adolescents. *Eur J Contracept Reprod Health Care* 2017 Feb;22(1):45-52. [doi: [10.1080/13625187.2016.1269162](https://doi.org/10.1080/13625187.2016.1269162)] [Medline: [28056564](https://pubmed.ncbi.nlm.nih.gov/28056564/)]
23. von Elm E, Altman DG, Egger M, Pocock SJ, Göttsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet* 2007 Oct 20;370(9596):1453-1457. [doi: [10.1016/S0140-6736\(07\)61602-X](https://doi.org/10.1016/S0140-6736(07)61602-X)] [Medline: [18064739](https://pubmed.ncbi.nlm.nih.gov/18064739/)]

24. Amt für Statistik Berlin-Brandenburg. 2016. Regionaler Sozialbericht Berlin und Brandenburg 2015 URL: https://www.statistik-berlin-brandenburg.de/produkte/pdf/SP_Sozialbericht-000-000_DE_2015_BBB.pdf [accessed 2017-04-02] [WebCite Cache ID 6pQ5WHLoe]
25. Loveline - das Jugendportal der Bundeszentrale für gesundheitliche Aufklärung BZgA. URL: <https://www.loveline.de/startseite.html> [accessed 2017-10-25] [WebCite Cache ID 6uTPpJBLp]
26. Mach's mit. URL: <https://www.liebesleben.de/fuer-alle/> [accessed 2017-10-25] [WebCite Cache ID 6uTPvEe4Q]
27. profamilia. URL: <https://www.profamilia.de/> [accessed 2017-10-25] [WebCite Cache ID 6uTQK4GDi]
28. Sexundso – Online Beratung. URL: <http://www.sexundso.de> [accessed 2017-10-25] [WebCite Cache ID 6uTQKjLI]
29. sextra. URL: <https://profamilia.sextra.de/> [accessed 2017-10-25] [WebCite Cache ID 6uTQLTPxr]
30. BRAVO. URL: <http://www.bravo.de/> [accessed 2017-10-25] [WebCite Cache ID 6uTQbuMsv]
31. gutefrage. URL: <https://www.gutefrage.net/> [accessed 2017-10-25] [WebCite Cache ID 6uTQReIJY]
32. Mädchen.de. URL: <http://www.maedchen.de> [accessed 2017-10-25] [WebCite Cache ID 6uTQSBddA]
33. gofeminin. URL: <http://www.gofeminin.de> [accessed 2017-10-25] [WebCite Cache ID 6uTQWeaQp]
34. Lovetalk – das Forum für Liebe und mehr. URL: <https://www.lovetalk.de/> [accessed 2017-10-25] [WebCite Cache ID 6uTQX8Nhg]
35. Buhi ER, Daley EM, Fuhrmann HJ, Smith SA. An observational study of how young people search for online sexual health information. *J Am Coll Health* 2009;58(2):101-111. [doi: [10.1080/07448480903221236](https://doi.org/10.1080/07448480903221236)] [Medline: [19892646](https://pubmed.ncbi.nlm.nih.gov/19892646/)]
36. Eysenbach G. Medicine 2.0: social networking, collaboration, participation, apomediation, and openness. *J Med Internet Res* 2008;10(3):e22 [FREE Full text] [doi: [10.2196/jmir.1030](https://doi.org/10.2196/jmir.1030)] [Medline: [18725354](https://pubmed.ncbi.nlm.nih.gov/18725354/)]
37. Kortum P, Edwards C, Richards-Kortum R. The impact of inaccurate Internet health information in a secondary school learning environment. *J Med Internet Res* 2008 Jun 30;10(2):e17 [FREE Full text] [doi: [10.2196/jmir.986](https://doi.org/10.2196/jmir.986)] [Medline: [18653441](https://pubmed.ncbi.nlm.nih.gov/18653441/)]
38. Lee K, Hoti K, Hughes JD, Emmerton L. Dr Google and the consumer: a qualitative study exploring the navigational needs and online health information-seeking behaviors of consumers with chronic health conditions. *J Med Internet Res* 2014;16(12):e262 [FREE Full text] [doi: [10.2196/jmir.3706](https://doi.org/10.2196/jmir.3706)] [Medline: [25470306](https://pubmed.ncbi.nlm.nih.gov/25470306/)]
39. Traub U, Schmierer R, Kauth T, Schönauer T. J1-Initiative: “Every hero needs a doctor”; Neuere Ansätze zur Verbesserung der Teilnahme an der Jugendgesundheitsuntersuchung (J1). *Gesundheitswesen* 2015 Apr 9;77(04):1. [doi: [10.1055/s-0035-1546902](https://doi.org/10.1055/s-0035-1546902)]
40. Eysenbach G, Köhler C. How do consumers search for and appraise health information on the world wide web? Qualitative study using focus groups, usability tests, and in-depth interviews. *BMJ* 2002 Mar 9;324(7337):573-577 [FREE Full text] [Medline: [11884321](https://pubmed.ncbi.nlm.nih.gov/11884321/)]
41. Pang PC, Verspoor K, Chang S, Pearce J. Conceptualising health information seeking behaviours and exploratory search: result of a qualitative study. *Health Technol* 2015 Feb 10;5(1):45-55. [doi: [10.1007/s12553-015-0096-0](https://doi.org/10.1007/s12553-015-0096-0)]
42. Berland GK, Elliott MN, Morales LS, Algazy JI, Kravitz RL, Broder MS, et al. Health information on the Internet: accessibility, quality, and readability in English and Spanish. *JAMA* 2001;285(20):2612-2621 [FREE Full text] [Medline: [11368735](https://pubmed.ncbi.nlm.nih.gov/11368735/)]
43. Cline RJ, Haynes KM. Consumer health information seeking on the Internet: the state of the art. *Health Educ Res* 2001 Dec;16(6):671-692 [FREE Full text] [Medline: [11780707](https://pubmed.ncbi.nlm.nih.gov/11780707/)]
44. Pang PC, Chang S, Verspoor K, Pearce J. Designing health websites based on users' web-based information-seeking behaviors: a mixed-method observational study. *J Med Internet Res* 2016 Jun 06;18(6):e145 [FREE Full text] [doi: [10.2196/jmir.5661](https://doi.org/10.2196/jmir.5661)] [Medline: [27267955](https://pubmed.ncbi.nlm.nih.gov/27267955/)]
45. Lee K, Hoti K, Hughes JD, Emmerton LM. Consumer use of “Dr Google”: a survey on health information-seeking behaviors and navigational needs. *J Med Internet Res* 2015;17(12):e288 [FREE Full text] [doi: [10.2196/jmir.4345](https://doi.org/10.2196/jmir.4345)] [Medline: [26715363](https://pubmed.ncbi.nlm.nih.gov/26715363/)]
46. Agree EM, King AC, Castro CM, Wiley A, Borzekowski DLG. “It's got to be on this page”: age and cognitive style in a study of online health information seeking. *J Med Internet Res* 2015;17(3):e79 [FREE Full text] [doi: [10.2196/jmir.3352](https://doi.org/10.2196/jmir.3352)] [Medline: [25831483](https://pubmed.ncbi.nlm.nih.gov/25831483/)]
47. Norman CD, Skinner HA. eHealth literacy: essential skills for consumer health in a networked world. *J Med Internet Res* 2006 Jun;8(2):e9 [FREE Full text] [doi: [10.2196/jmir.8.2.e9](https://doi.org/10.2196/jmir.8.2.e9)] [Medline: [16867972](https://pubmed.ncbi.nlm.nih.gov/16867972/)]
48. Tennant B, Stelfox M, Dodd V, Chaney B, Chaney D, Paige S, et al. eHealth literacy and Web 2.0 health information seeking behaviors among baby boomers and older adults. *J Med Internet Res* 2015;17(3):e70 [FREE Full text] [doi: [10.2196/jmir.3992](https://doi.org/10.2196/jmir.3992)] [Medline: [25783036](https://pubmed.ncbi.nlm.nih.gov/25783036/)]
49. Gray NJ, Klein JD, Noyce PR, Sesselberg TS, Cantrill JA. The Internet: a window on adolescent health literacy. *J Adolesc Health* 2005 Sep;37(3):243. [doi: [10.1016/j.jadohealth.2004.08.023](https://doi.org/10.1016/j.jadohealth.2004.08.023)] [Medline: [16109345](https://pubmed.ncbi.nlm.nih.gov/16109345/)]
50. Jones RK, Biddlecom AE. Is the internet filling the sexual health information gap for teens? An exploratory study. *J Health Commun* 2011 Feb;16(2):112-123. [doi: [10.1080/10810730.2010.535112](https://doi.org/10.1080/10810730.2010.535112)] [Medline: [21207311](https://pubmed.ncbi.nlm.nih.gov/21207311/)]
51. Hargittai E, Young H. Searching for a “Plan B”: young adults' strategies for finding information about emergency contraception online. *Policy Internet* 2012 Mar;4(2):1-23. [doi: [10.1515/1944-2866.1176](https://doi.org/10.1515/1944-2866.1176)]
52. Santelli JS, Lowry R, Brener ND, Robin L. The association of sexual behaviors with socioeconomic status, family structure, and race/ethnicity among US adolescents. *Am J Public Health* 2000 Oct;90(10):1582-1588. [Medline: [11029992](https://pubmed.ncbi.nlm.nih.gov/11029992/)]

53. de Graaf H, Vanwesenbeeck I, Meijer S. Educational differences in adolescents' sexual health: a pervasive phenomenon in a national Dutch sample. *J Sex Res* 2015;52(7):747-757. [doi: [10.1080/00224499.2014.945111](https://doi.org/10.1080/00224499.2014.945111)] [Medline: [25260077](https://pubmed.ncbi.nlm.nih.gov/25260077/)]
54. Harris FJ. Challenges to teaching credibility assessment in contemporary schooling. In: Metzger MJ, Flanagin AJ, editors. *Digital Media, Youth, and Credibility*. Cambridge, MA: MIT Press; 2008:155-180.

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Article

STI Knowledge in Berlin Adolescents

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Abstract: Sexually transmitted infections (STIs) pose a significant threat to individual and public health. They disproportionately affect adolescents and young adults. In a cross-sectional study, we assessed self-rated and factual STI knowledge in a sample of 9th graders in 13 secondary schools in Berlin, Germany. Differences by age, gender, migrant background, and school type were quantified using bivariate and multivariable analyses. A total of 1177 students in 61 classes participated. The mean age was 14.6 (SD = 0.7), 47.5% were female, and 52.9% had at least one immigrant parent. Knowledge of human immunodeficiency virus (HIV) was widespread, but other STIs were less known. For example, 46.2% had never heard of chlamydia, 10.8% knew of the HPV vaccination, and only 2.2% were aware that no cure exists for HPV infection. While boys were more likely to describe their knowledge as good, there was no general gender superiority in factual knowledge. Children of immigrants and students in the least academic schools had lower knowledge overall. Our results show that despite their particular risk to contract an STI, adolescents suffer from suboptimal levels of knowledge on STIs beyond HIV. Urgent efforts needed to improve adolescent STI knowledge in order to improve the uptake of primary and secondary prevention.

Keywords: sexual health; sexually transmitted diseases; sexually transmitted infections; adolescent health; Berlin; Germany

1. Introduction

Sexually transmitted infections (STIs) are a serious public health problem worldwide, with an estimated one million new infections each day [1]. They have a wide range of negative consequences on individual health, ranging from physical discomfort to infertility, malignancy, severe maternal and foetal pregnancy complications, and loss of life [2]. Beyond the detrimental effect on individual health, STIs also represent a significant economic burden. It is estimated that more than ten billion dollars per year are spent on STIs other than human immunodeficiency virus (HIV) in the United States alone [3]. The most frequent viral STI pathogens are human papillomavirus (HPV), herpes simplex virus 2 (HSV-2), HIV, and Hepatitis B. The most widespread bacterial STIs are chlamydia trachomatis, gonorrhoea, and syphilis [4,5].

Although HIV prevalence in Germany is still low compared to most other European countries [6], there has been a marked rise in the number of newly diagnosed cases of HIV resulting from both homosexual and heterosexual intercourse, as well as intravenous drug use over the last five years [7].

An even higher increase in incidence has been observed in other STIs: chlamydia, commonly regarded as the most frequent cause of female infertility in developed countries [8,9], is becoming widespread in Germany [10,11]. The number of newly diagnosed syphilis cases in Germany has risen more than fourfold since 2000 [12,13], and gonorrhoea cases are becoming more widespread, with increasing antibiotic resistance being an additional problem [14,15]. Furthermore, HPV-related neoplasia is a growing problem. For example, vulvar cancer, often linked to an infection with HPV, has greatly increased in Germany over the last decade [16]. HPV is also frequently transmitted in oral and anal sexual practice, causing high rates of local infection of the oropharyngeal and anal regions [17,18]. This is likely to be the cause of the increasing rates of HPV-related neoplasia of the head and neck [19], and of the anus [20].

Despite increasing numbers of new infections with STIs, the limited existing research indicates a considerable ignorance regarding the existence and dangers of STIs other than HIV in Germany. One study found that in a representative sample of adults across Germany, a majority had never heard of syphilis, gonorrhoea, hepatitis, genital herpes, chlamydia, and HPV. Only 6% were aware of HPV and 14% of chlamydia as the two most frequent viral and bacterial STIs [21]. Another study amongst adolescents in two cities in Northern Germany discovered that participants perceive the likelihood of infection with HIV much higher than that of the much more prevalent infection with HPV [22]. Furthermore, adolescents were found to be largely ignorant of the existence of chlamydia, even in an urban setting of particularly high prevalence [23].

One reason for this large-scale ignorance might be that STIs other than HIV escaped the attention of German public health authorities and sexual health educators for a long time. For example, over the last two decades, the Federal Centre for Health Education (Bundeszentrale für gesundheitliche Aufklärung, BZgA) as the national authority for health education and health promotion has launched a multitude of campaigns warning of the risk of HIV, but an awareness campaign for other STIs, such as hepatitis B or chlamydia, was only launched in 2016 [24].

Due to more frequently changing sexual partners and lower rates of correct and consistent contraceptive use, adolescents and young adults are particularly at risk of contracting and transmitting STIs [25–27]. For women it has been argued that, the risk of infection in adolescence or early adulthood is elevated further due to a greater anatomical susceptibility to certain STIs at young age [28,29]. Indeed, studies show a higher incidence of STIs in this age bracket [30–32]. One review estimated that adolescents and young adults account for 50% of new infections with STIs, while representing only 25% of the sexually active population [33]. Young people are also likely to suffer most from long-term sequelae, for example if an infection with an oncogenic type of HPV leads to neoplasia years or decades later [34], or if they experience hypofertility at a later stage caused by untreated infection with chlamydia [35]. Therefore, adolescents can be regarded as a particularly suitable audience for primary and secondary STI prevention.

Condom use is an effective method to prevent infection with an STI [36,37]. Moreover, several STIs can be readily prevented through vaccination (Hepatitis B, HPV) [38,39]. Others, such as chlamydia, gonorrhoea, or syphilis, are curable with appropriate antibiotic regimens, thus enabling the prevention of long-term sequelae [40–42]. However, awareness of the existence and risk of different STIs are prerequisites to actual utilization of preventive and curative options.

Currently, readily available prevention methods are not widely utilized in Germany. One study found that only 39% of boys and 31% of girls used a condom in their last sexual contact [43]. Only 11.3% of women under 25 participated in the recommended chlamydia screening in 2015 [24], and less than a third of girls are vaccinated against HPV at the average age of sexual debut [44]. This is despite the fact that both adolescent HPV vaccination and chlamydia screening are strongly endorsed by German medical bodies and are fully covered by statutory health insurance [45,46].

Considering the limited existing research on adolescent STI knowledge in Germany, we assessed self-reported and factual knowledge on different STIs amongst 9th-graders in Berlin, Germany. Specifically, we assessed the extent to which participants were aware of different STIs and how they self-rated their knowledge. Factual knowledge on STI curability and on the existence of vaccines

for STIs was tested. Results could help schools, parents, and other sexual health educators to address particular “areas of need”, in order to raise awareness and knowledge amongst a population disproportionately at risk of acquiring STIs.

2. Methods

2.1. Study Design

Data on STI awareness was collected within the framework of a larger survey on the knowledge of sexual health issues amongst Berlin adolescents. Details of the study and its population and methodology have been partially described elsewhere. It was demonstrated that adolescents were ill-informed on the important issue of emergency contraception [47]. Furthermore, adolescents’ preferences regarding online sexual health resources were assessed [48]. The survey was conducted throughout the year 2012 in grade nine of secondary schools in Berlin.

The study was conducted with the approval of the Ethics Committee of the Charité-Universitätsmedizin Berlin and the Berlin Senate’s Department for Education, Youth and Science. In accordance with Berlin state law, written parental consent was mandatory for all students who had not yet reached 14 years of age, and a favourable vote of the parent-teacher-conference was a prerequisite for a school’s participation.

2.2. Sampling and Data Collection

All public secondary schools in Berlin were contacted by telephone and email with in-depth information on the study and a request to include the school in the sample. Schools allocated regular lessons in which the study was conducted using paper questionnaires. Students were informed of the aim of the study and the range of topics addressed. It was pointed out that participation was voluntary and anonymous, and that the survey did not represent a formal school assignment or otherwise affected school grades. Following the collection of questionnaires, students were provided with the correct answers to all knowledge questions.

2.3. Questionnaire

The questionnaire was designed by the authors to assess self-evaluated and actual knowledge on different STIs, amongst other sexual health questions. A pre-test in one school class was conducted and the comments led to minor modifications in the wording of questions.

In the general part of the questionnaire, students were requested to state their age and gender. Furthermore, students were asked to provide their parents’ place of birth to assess migratory background. To safeguard parental informational self-determination in accordance with Berlin Senate policy, options were limited to “Germany” and “abroad”, and no information on the time of migration was collected.

Furthermore, the variable of school type was coded for each participant to assess the differences between the three types of Berlin secondary schools: the most academically selective type of University-Preparatory Schools (Gymnasium), Comprehensive Secondary Schools (Integrierte Gesamtschule) with the option to qualify for university access, and the least academic school type—Comprehensive Secondary Schools without this option. For clarity, these three school types were reported below as “highest academic tier”, “intermediate academic tier”, and “lowest academic tier”.

In the part on STIs, students were first asked to self-evaluate their knowledge of the seven most frequent bacterial and viral STIs: HIV/AIDS, syphilis, genital herpes, hepatitis B, gonorrhoea, chlamydia, and HPV. A Likert-Scale was employed, with the options to rate knowledge as “good”, “rather good”, “mediocre”, “rather bad”, and “bad”, and a further option to select “I have never heard of this STI”. Furthermore, factual knowledge was tested by asking students to state whether a reliable cure and/or a vaccination exists for the following STIs (correct responses in brackets, according to the current Centers for Disease Control and Prevention (CDC) Guidelines [49]): HIV (no cure, no

vaccination), hepatitis B (no cure, vaccination exists), chlamydia (curable, no vaccination), HPV (no cure, vaccination exists), and genital herpes (no cure, no vaccination).

2.4. Statistical Analysis

IBM SPSS Statistics Version 25 (SPSS Inc., Chicago, IL, USA) was employed for data analysis. Frequencies were computed for all items. We used chi-square statistics to test for bivariate relationships between the independent variables gender, migratory background, and school type, and the outcomes of self-reported awareness and knowledge in the factual questions on STIs.

Using multiple regression models, we quantified the effect of demographic variables on outcomes. Since age, gender, migratory background, and academic standing had all been shown to be predictors of sexual health knowledge in different previous studies [50–52], they were maintained as factors in all of the analyses. To account for the possible effect of clustering by school or class, a mixed multilevel regression model (SPSS GENLINUXMIXED) was employed and school and class included as random effects. Odds ratios and confidence intervals were calculated from regression. For clarity of results, outcome categories were dichotomized for regression. The regression outcome variables were thus “high knowledge” (response either “good” or “rather good” knowledge) on individual STIs, “never heard” for individual STIs, and “correct response” for each of the knowledge questions. Robust estimation was used to take into account possible violations of model assumptions. Missing cases were excluded from statistical analyses.

The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [53] was followed in the presentation of the methods and results of this study. The statistical methodology used was approved by the Competence Center for Clinical Trials of the University of Bremen.

The original dataset of the study cannot be made available to the general public due to the constraints placed on data availability by the Berlin Senate’s Department for Education, Youth and Science. The dataset can be obtained upon reasonable request from the corresponding author.

3. Results

3.1. Study Participants

We successfully contacted the heads of the biology departments in 142 out of 287 schools. Subsequently, 13 schools with a total of 61 ninth grade classes agreed to participate. The limited time to teach the demanding state curriculum was most frequently given as the reason for non-participation.

Participating schools hailed from seven of the twelve Berlin City Districts (Mitte, Pankow, Charlottenburg-Wilmersdorf, Spandau, Steglitz-Zehlendorf, Treptow-Köpenick, and Marzahn-Hellersdorf) and included very diverse settings. Schools in former East and West Berlin were included, as were schools from inner-city to suburban, and from the most wealthy to relatively impoverished city areas [54].

During the lessons that were allocated by participating schools, 1190 students were in attendance. Ten students aged 13 failed to provide parental consent and could thus not participate. Two students elected not to take part, and one very recently arrived immigrant was unable to read German. Thus, a total of 1177 students participated.

Of participants providing gender information, 547 were female (46.5%) and 605 (51.4%) were male. Age ranged from 13 to 16 years, with a mean age of participants of 14.6 (SD 0.8). For migratory background, 544 (46.2%) had two German-born parents, 260 (22.5%) participants reported one, and 352 (30.4%) two parents of foreign birth. Participants were virtually equally spread across the three school types, with 390 (33.1%) participants attending a school of the lowest, 395 (33.6%) of the intermediate, and 392 (33.3%) of the highest academic tier.

3.2. Self-Reported STI Knowledge

Self-evaluated knowledge regarding the most widespread bacterial and viral STIs, sorted in order of decreasing awareness is shown in Table 1. This order will be followed in subsequent tables. HIV was

known to virtually all participants, with many stating good or rather good knowledge. Knowledge and awareness were visibly lower for other STIs, of which the most frequently known infection was hepatitis B. Despite being the bacterial STI with the highest prevalence, chlamydia was the infection with the lowest proportion of participants claiming good knowledge and the lowest rate of awareness.

Table 1. Self-rated knowledge of sexually transmitted infections (STIs) in order of decreasing awareness.

STI	Self-Rated Knowledge					
	Good n (%)	Rather Good n (%)	Mediocre n (%)	Rather Bad n (%)	Bad n (%)	Never Heard n (%)
HIV n = 1148 *	438 (38.2%)	379 (33.0%)	217 (18.9%)	58 (5.1%)	39 (3.4%)	17 (1.5%)
Hepatitis B n = 1136 *	142 (12.5%)	170 (15.0%)	292 (25.7%)	231 (20.3%)	150 (13.2%)	151 (13.3%)
Genital herpes n = 1130 *	109 (9.7%)	129 (11.4%)	264 (23.4%)	219 (19.4%)	143 (12.7%)	266 (23.5%)
Syphilis n = 1131 *	80 (7.1%)	129 (11.4%)	238 (21.0%)	188 (16.6%)	116 (10.3%)	380 (33.6%)
HPV n = 1129 *	66 (5.9%)	82 (7.3%)	163 (14.4%)	218 (19.3%)	178 (15.8%)	422 (37.4%)
Gonorrhoea n = 1125 *	84 (7.5%)	76 (6.8%)	170 (15.1%)	173 (15.4%)	141 (12.5%)	481 (42.8%)
Chlamydia n = 1134 *	63 (5.6%)	71 (6.3%)	154 (13.6%)	174 (15.3%)	148 (13.1%)	6.2%

* number of responses included.

Distribution of self-evaluated knowledge by gender is shown in Table 2. Association between gender and reported knowledge was statistically significant for all STIs, except for hepatitis B and chlamydia. Female respondents reported lower knowledge and were more likely to state complete lack of awareness for each of the STIs apart from chlamydia. While chlamydia was the STI with the lowest awareness overall and amongst male participants, gonorrhoea was the infection least known to girls in the sample.

Table 2. Self-rated knowledge by gender.

STI	Gender	Self-Rated Knowledge						p (from χ^2)
		Good	Rather Good	Mediocre	Rather Bad	Bad	Never Heard	
HIV n = 1134 *	female	32.0%	35.1%	22.6%	5.5%	3.9%	0.9%	0.001
	male	43.3%	31.0%	15.9%	4.7%	3.0%	2.0%	
Hepatitis B n = 1122 *	female	11.3%	15.6%	25.6%	21.2%	13.2%	13.2%	0.96
	male	12.9%	14.6%	25.9%	20.0%	13.2%	13.4%	
Genital herpes n = 1116 *	female	6.8%	9.7%	23.7%	20.6%	13.1%	26.1%	0.03
	male	11.4%	13.1%	23.1%	18.5%	12.2%	21.6%	
Syphilis n = 1117 *	female	5.1%	8.1%	19.4%	16.0%	11.1%	40.3%	<0.001
	male	8.2%	14.3%	22.7%	17.4%	9.2%	28.2%	
HPV n = 1116 *	female	3.8%	5.3%	14.0%	19.8%	15.5%	41.6%	0.01
	male	7.2%	9.2%	14.8%	19.1%	15.8%	33.9%	
Gonorrhoea n = 1112 *	female	4.2%	6.2%	12.5%	15.7%	13.4%	48.0%	<0.001
	male	9.6%	7.4%	17.5%	15.4%	11.7%	38.4%	
Chlamydia n = 1121 *	female	5.8%	6.2%	11.6%	17.1%	13.1%	46.2%	0.45
	male	4.8%	6.5%	15.1%	14.1%	12.9%	46.6%	

* number of responses included.

A table of differences by gender, migrant status and school type of participants who selected the “never heard of” option for the presented STIs can be found in Supplementary File 1. Students from

the intermediate tier of schools were generally least likely to have never heard of the different STIs. Students of two foreign-born parents were most likely to be fully unaware of the existence of all STIs, bar hepatitis B.

3.3. Factors Associated with Self-Reported STI Knowledge in Multivariable Analysis

Table 3 depicts the results of the regression model for high self-evaluated knowledge. For all STIs bar hepatitis B and chlamydia, female respondents were significantly less likely to evaluate their knowledge as “good” or “rather good”.

Table 3. Factors associated with high self-evaluated knowledge in multivariable analysis.

Variable	HIV n = 1127 **	Hepatitis B n = 1115 **	Genital Herpes n = 1109 **	Syphilis n = 1110 **
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age (per year increase)	1.00 (0.83–1.19)	1.12 (0.89–1.41)	1.23 (0.92–1.66)	1.20 (0.83–1.74)
Female Gender *	0.71 (0.52–0.97) ***	1.03 (0.73–1.45)	0.65 (0.51–0.82) ***	0.55 (0.4–0.75) ***
Migratory Background *	0.58 (0.45–0.74) ***	0.96 (0.75–1.23)	1.04 (0.71–1.51)	0.69 (0.49–0.97) ***
Intermediate School Tier *	1.51 (0.72–3.17)	0.92 (0.76–1.10)	1.62 (0.59–4.43)	1.30 (0.66–2.55)
Highest School Tier *	1.13 (0.51–2.50)	0.66 (0.44–0.98) ***	0.66 (0.25–1.74)	1.19 (0.59–2.40)
	HPV n = 1109 **	Gonorrhoea n = 1106 **	Chlamydia n = 1114 **	
	OR (95% CI)	OR (95% CI)	OR (95% CI)	
Age (per year increase)	1.20 (0.87–1.65)	1.41 (1.07–1.86) ***	0.97 (0.72–1.32)	
Female Gender *	0.56 (0.40–0.78) ***	0.65 (0.43–0.99) ***	1.15 (0.69–1.91)	
Migratory Background *	1.05 (0.78–1.43)	0.77 (0.5–1.21)	0.89 (0.57–1.39)	
Intermediate School Tier *	1.12 (0.54–2.33)	0.69 (0.33–1.43)	1.09 (0.60–1.99)	
Highest School Tier *	0.44 (0.22–0.88) ***	0.58 (0.28–1.21)	0.44 (0.23–0.82) ***	

OR: Odds ratio; CI: Confidence interval; * Reference categories are male gender, no migrant background, and lowest school tier. ** number of participants included in the regression model; *** $p < 0.05$.

The results of the regression model for the outcome of “unawareness” of the different STIs are presented in Table 4. While there were no significant differences for HIV, hepatitis B, and chlamydia, female students were significantly more likely to have never heard of HPV, syphilis, and gonorrhoea. Students with an immigrant background were more likely to have never heard of genital herpes and syphilis.

Table 4. Factors associated with unawareness of STIs in multivariable analysis.

Variable	HIV n = 1127 **	Hepatitis B n = 1115 **	Genital Herpes n = 1109 **	Syphilis n = 1110 **
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age (per year increase)	0.96 (0.70–1.32)	0.92 (0.66–1.28)	0.86 (0.67–1.11)	0.87 (0.68–1.11)
Female Gender *	0.88 (0.65–1.19)	1.00 (0.61–1.65)	1.27 (0.85–1.92)	1.74 (1.37–2.22) ***
Migratory Background *	1.34 (0.96–1.88)	1.48 (0.87–2.51)	1.95 (1.52–2.49) ***	1.70 (1.08–2.67) ***
Intermediate School Tier *	0.61 (0.34–1.08)	0.81 (0.30–2.19)	0.47 (0.19–1.19)	0.63 (0.39–1.01)
Highest School Tier *	0.66 (0.36–1.24)	1.08 (0.48–2.42)	0.97 (0.42–2.24)	0.91 (0.52–1.56)
	HPV n = 1109 **	Gonorrhoea n = 1106 **	Chlamydia n = 1114 **	
	OR (95% CI)	OR (95% CI)	OR (95% CI)	
Age (per year increase)	0.95 (0.78–1.16)	0.77 (0.60–0.997) ***	0.85 (0.66–1.10)	
Female Gender *	1.29 (1.01–1.66) ***	1.39 (1.02–1.91) ***	0.92 (0.66–1.28)	
Migratory Background *	1.4 (0.94–2.09)	1.49 (0.98–2.26)	1.44 (0.94–2.20)	
Intermediate School Tier *	0.83 (0.38–1.85)	1.11 (0.49–2.47)	0.73 (0.44–1.18)	
Highest School Tier *	1.78 (0.78–4.08)	1.33 (0.64–2.78)	1.33 (0.83–2.11)	

OR: Odds ratio; CI: Confidence interval; * Reference categories are male gender, no migrant background, and lowest school tier. ** number of participants included in the regression model; *** $p < 0.05$.

3.4. Factual STI-Knowledge

3.4.1. Bivariate Analyses

Correct response rates to the knowledge questions on the curability and existence of vaccines for STIs are presented in Table 5. While it was widely known that no reliable cure has been found for HIV to date, knowledge was much lower regarding the curability of other STIs. For vaccination, again a majority knew that no vaccination protects from HIV, and slightly less than half knew that a vaccination exists for hepatitis B. Knowledge was low for the other STIs, and only 10.8% of participants were aware of the existence of an HPV vaccine.

Table 5. Correct answers on STI cures and vaccinations.

Question	Correct Response	n (%) Correct
HIV cure (n = 1131 *)	no reliable cure	946 (83.6%)
Hepatitis B cure (n = 1122 *)	no reliable cure	245 (21.8%)
Genital herpes cure (n = 1121 *)	no reliable cure	88 (7.9%)
HPV cure (n = 1126 *)	no reliable cure	25 (2.2%)
Chlamydia cure (n = 1125 *)	cure exists	212 (18.8%)
HIV vaccination (n = 1133 *)	no vaccination	716 (63.2%)
Hepatitis B vaccination (n = 1134 *)	vaccination exists	552 (48.7%)
Genital herpes vaccination (n = 1125 *)	no vaccination	200 (17.8%)
HPV vaccination (n = 1133 *)	vaccination exists	122 (10.8%)
Chlamydia vaccination (n = 1130 *)	no vaccination	113 (10.0%)

* number of responses included.

Results by gender varied depending on the STI and there was no trend suggesting general knowledge superiority of either gender. While awareness of the HPV vaccine was low overall, it was significantly higher among boys than girls.

Students with migratory background overall tended to have lower rates of correct responses. For example, of students with two German-born parents, 370 out of 528 (70.1%) were aware that no vaccination was available for HIV and 463 out of 529 (87.5%) knew that HIV could not reliably be cured. Corresponding numbers with both parents born abroad were 177/343 (51.6%) for vaccination and 252/339 (74.3%) for curability (p (from χ^2) <0.001 and <0.001). While association was not significant for most STIs, lower proportions of children of immigrants selected the correct response on all of the questions but on curative options for HPV and genital herpes. A table with STI knowledge by migratory background can be found in Supplementary File 2.

For all questions bar on the curability of infection with HPV, it was students from the intermediate academic tier of schools who had the highest rate of correct responses. There was no clear knowledge difference between students from the lowest or the highest tier of schools. The full results for knowledge differences by school type can be found in Supplementary File 3.

3.4.2. Multivariable Analyses

Multivariate analysis was performed for the questions on curability and vaccination options for HIV, Hepatitis B, HPV, genital herpes, and chlamydia. The dichotomous outcome categories were “correct response” vs. “other response”. Results are presented in Table 6.

Table 7 shows the results from the multivariable regression model for the outcome variable of correct responses on cure and vaccination questions. As in bivariate analyses, autochthonous German students were more likely to know the lack of curative and vaccination options for HIV, as were students from the intermediate tier of schools. Male students were again significantly more likely to know that a vaccination exists for HPV.

Table 6. Correct answers on STI cures and vaccinations by gender.

Question	Gender	Percentage Correct	<i>p</i> (from χ^2)
HIV cure n = 1116 *	male	82.5%	0.29
	female	85.0%	
Hepatitis B cure n = 1108 *	male	24.4%	0.03
	female	19.0%	
Genital herpes cure n = 1107 *	male	11.0%	<0.001
	female	4.2%	
HPV cure n = 1113 *	male	2.6%	0.41
	female	1.7%	
Chlamydia cure n = 1112 *	male	18.3%	0.76
	female	19.1%	
HIV vaccination n = 1119 *	male	66.8%	0.02
	female	59.8%	
Hepatitis B vaccination n = 1120 *	male	45.5%	0.02
	female	52.4%	
Genital herpes vaccination n = 1111 *	male	17.4%	0.70
	female	18.3%	
HPV vaccination n = 1119 *	male	12.9%	0.01
	female	7.9%	
Chlamydia vaccination n = 1116 *	male	8.8%	0.23
	female	11.0%	

* number of responses included.

Table 7. Factors associated with correct responses on cure and vaccination questions.

Variable	HIV n = 1109 *	Hepatitis B n = 1101 *	Genital Herpes n = 1100 *	HPV n = 1106 *	Chlamydia n = 1105 *
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age (per year increase)	1.00 (0.82–1.22)	1.23 (0.94–1.61)	1.14 (0.90–1.45)	1.02 (0.86–1.22)	1.29 (1.08–1.54) **
Female Gender *	1.14 (0.82–1.58)	0.93 (0.71–1.22)	0.37 (0.22–0.61) **	0.91 (0.68–1.21)	1.13 (0.83–1.52)
Migratory Background *	0.73 (0.47–1.12)	0.82 (0.53–1.28)	1.22 (0.82–1.81)	1.50 (1.06–2.12) **	0.86 (0.65–1.14)
Intermediate School Tier *	3.14 (1.56–6.29) **	1.55 (1.02–2.34) **	1.89 (0.79–4.55)	0.98 (0.55–1.77)	1.62 (1.16–2.26) **
Highest School Tier *	2.32 (1.11–4.84) **	1.43 (0.88–2.32)	0.41 (0.13–1.29)	0.83 (0.57–1.22)	1.05 (0.60–1.83)

Variable	HIV n = 1112 *	Hepatitis B n = 1113 *	Genital Herpes n = 1104 *	HPV n = 1112 *	Chlamydia n = 1109 *
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age (per year increase)	1.10 (0.98–1.25)	1.07 (0.89–1.27)	1.13 (0.86–1.49)	1.29 (0.93–1.79)	1.14 (0.88–1.47)
Female Gender *	0.70 (0.47–1.04)	1.30 (0.99–1.70)	1.09 (0.80–1.47)	0.60 (0.41–0.88) **	1.24 (0.94–1.64)
Migratory Background *	0.61 (0.43–0.88) **	0.82 (0.69–0.98)	0.75 (0.53–1.07)	0.74 (0.45–1.23)	0.71 (0.47–1.07)
Intermediate School Tier *	2.59 (1.71–3.94) **	1.31 (0.83–2.07)	1.61 (0.79–3.29)	1.77 (1.10–2.87) **	1.88 (1.34–2.63) **
Highest School Tier *	1.70 (1.01–2.86) **	1.14 (0.77–1.68)	1.12 (0.43–2.92)	0.65 (0.29–1.46)	1.12 (0.72–1.73)

OR: Odds ratio; CI: Confidence interval; * number of participants included in the regression model; ** $p < 0.05$.

4. Discussion

We measured self-rated and factual knowledge regarding different STIs in the framework of a cross-sectional study assessing the sexual health knowledge of Berlin adolescents. We encountered a high participation rate (1177/1179) despite the explicit emphasis on the voluntary nature of participation. It was assessed whether students had heard of different STIs, how they would describe their own knowledge, and whether they were able to state which STIs were curable and for which a vaccination exists.

With a mean participant age of 14.6 years, population-level data suggests that a majority of adolescents in our study had already experienced some form of sexual contact or intimacy, although most have not engaged in penetrative sexual intercourse [43]. Across Germany, the mean age of sexual debut is 14.9 years for female and 15.1 years for male adolescents [55].

As expected, nearly all of the students had heard of HIV, and a majority rated their knowledge as (rather) good and knew that HIV could neither be cured nor vaccinated against. However, overall knowledge for other STIs was much less satisfactory, with low self-reported knowledge and high levels of ignorance regarding individual STIs. For example, more than 46% of participants had never heard of chlamydia and merely 18% knew that chlamydia can be cured. This widespread lack of knowledge is in line with previous studies in Germany on both adolescents and the population at large [21,22]. Results from adolescents in South-East England point towards a similar level of ignorance [56], whereas Swedish studies show between 86% [57] and 96% [58] of adolescents to be aware of chlamydia. This lack of awareness that is shown by our study is particularly noteworthy given the fact that chlamydia is the most frequent bacterial STI [4], has a particularly high incidence among adolescents and young adults [59,60], and is a frequent reason for infertility later in life [9]. Despite the ready and cost-free availability of chlamydia screening and treatment to German adolescents, our results show the target population is hardly aware of the disease's existence.

Another STI for which there was a widespread lack of knowledge was HPV. Despite being the STI with the highest prevalence [4], more than a third of students responded to have never heard of it, and fewer than 13% described high knowledge. Results for the factual questions were dire, with less than 2.2% of respondents knowing that there is currently no treatment to cure HPV infection, and that the HPV vaccine is only known to 10.8% of respondents. This is visibly lower than the rates that are found amongst adolescents in a previous study in Germany [51] and in other European countries [61–63]. In contrast to these previous studies, the male participants in our sample were significantly more likely to be aware of the HPV vaccine, shown both in bivariate and regression analysis. This is especially surprising given that the HPV vaccine is primarily marketed to a female audience in Germany: in all German states except for Saxony, HPV vaccination is exclusively recommended for female adolescents [64], and only few statutory health insurance providers cover male HPV vaccination [65].

Condoms can prevent infection with STIs. However, their use requires motivation. Research shows that adolescents regard condoms primarily as a method to prevent pregnancy. If STI prevention is considered at all, it is mainly the risk of HIV that is taken into account [56,66]. However, most sexually active adolescents in Germany rely on hormonal methods of contraception to prevent pregnancy, with only a minority employing condoms instead or concurrently [43]. HIV, due to its low prevalence in Germany, is unlikely to be an effective motivator for condom use, at least in heterosexual intercourse. Our results show, that other STIs—most of which are much more prevalent than HIV—are relatively little known to adolescents. This lack of knowledge is likely to diminish motivation to use condoms and/or access other methods of STI prevention, both primary (such as HPV or hepatitis B vaccination) and secondary (such as Pap tests or chlamydia screening). If adolescents and young adults are to make a truly informed choice on the uptake of preventive options, the level of STI awareness and knowledge needs to be improved.

In our results, for most STIs, even groups that are usually shown to have superior sexual health proficiency (such as female adolescents, the academically-advantaged, and non-ethnic minority students [43,51,67,68]) have only non-satisfactory knowledge. We regard this as indicative that schools, parents, primary care physicians, public health authorities, and other providers of sexual health information fail to communicate the most basic facts about STIs beyond HIV, even to the most accessible population groups. The recent launch of the first (non-HIV) STI awareness campaign by the BZgA is a much needed initiative towards improving STI knowledge. However, in a country with compulsory school education, we regard schools as the most promising vector to multiply relevant health information and reach virtually all adolescents. For this, it is imperative that STIs and STI prevention are explicitly included in the school curriculum. The current state curriculum in Berlin, unfortunately, falls short in this respect. Condoms are the only prevention method, and “HIV/AIDS” the sole STI specifically included in the curriculum [69]. Comprehensive teacher-delivered school tuition on STIs and preventive instruments could address the widespread information gap that is highlighted by our study, as could the co-optation of external providers of STI prevention education into schools [70].

Beyond schools, STI information can—and should—also be spread through other means, for example through healthcare professionals [71], social media channels [72], mass media campaigns [73], and through peer education programmes [74]. A multidimensional approach combining different channels of access to adolescents bears the promise to improve STI knowledge, and thus potentially curtail the increasing rates of new infections and lower the rate of long-term sequelae of infection.

Strengths and Limitations

The relatively large number of participants from a sample of schools of all three types of Berlin public schools represents a strength of the study, as does the virtually complete rate of participation.

Only 13 out of a total of 287 eligible schools, however, took part in the study. Despite schools hailing from very diverse social and geographical settings, there might be a systemic difference between participating and non-participating schools, for example in terms of the teaching bodies' interest and openness regarding sexual health education.

Furthermore, students were asked to evaluate their knowledge regarding STIs on a multiple choice questionnaire, which might have led to the over-reporting of knowledge as compared to a questionnaire in which participants were to list STIs in an open question.

5. Conclusions

Sexually transmitted infections pose a serious threat to individual as well as public health. Despite different effective instruments of primary and secondary prevention being readily available, their uptake is impeded by widespread lack of knowledge. This is especially true for adolescents and young adults, an age group that is particularly at risk of contracting an STI. Our study shows that across demographic divides, adolescents in Berlin, Germany suffer from a low level of knowledge on all of the most frequent STIs apart from HIV, despite their growing incidence. It is crucial that this lack of knowledge is addressed and that adolescents are educated on the threats that are posed by different infections, and on the existing and readily available methods to prevent, detect, and cure STIs. Knowledge is a necessary prerequisite to making an informed choice regarding STI prevention, screening, and treatment and schools as well as health information providers need to address current knowledge deficits.

Supplementary Materials: The following are available online at www.mdpi.com/1660-4601/15/1/110/s1, Supplementary File 1: lack of awareness of STIs by gender, migrant background, and school type, Supplementary File 2: Correct answers on STI cures and vaccinations by migrant background, Supplementary File 3: Correct answers on STI cures and vaccinations by school type.

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References

1. World Health Organization. Sexually Transmitted Infections (STIs). Available online: <http://www.who.int/mediacentre/factsheets/fs110/en/> (accessed on 20 September 2017).
2. World Health Organization. Global Health Sector Strategy on Sexually Transmitted Infections, 2016–2021. Available online: <http://www.who.int/reproductivehealth/publications/rtis/ghss-stis/en/> (accessed on 20 September 2017).
3. Institute of Medicine; Committee on Prevention and Control of Sexually Transmitted Diseases. *The Hidden Epidemic: Confronting Sexually Transmitted Diseases*; Butler, W.T., Eng, T.R., Eds.; National Academies Press: Washington, DC, USA, 1997; ISBN 978-0-309-05495-9.

4. National Prevention Information Network. Incidence, Prevalence, and Cost of Sexually Transmitted Infections in the United States. Available online: <https://npin.cdc.gov/publication/incidence-prevalence-and-cost-sexually-transmitted-infections-united-states> (accessed on 20 September 2017).
5. Schmidt-Petruschkat, S. Allgemeine Gynäkologie. Zunahme von Geschlechtskrankheiten in Deutschland—Ein bislang unbeachtetes Risiko? *Geburtshilfe Frauenheilkd.* **2009**, *69*, 429–432. [CrossRef]
6. Murray, C.J.L.; Ortblad, K.F.; Guinovart, C.; Lim, S.S.; Wolock, T.M.; Roberts, D.A.; Dansereau, E.A.; Graetz, N.; Barber, R.M.; Brown, J.C.; et al. Global, regional, and national incidence and mortality for HIV, tuberculosis, and malaria during 1990–2013: A systematic analysis for the Global Burden of Disease Study 2013. *Lancet* **2014**, *384*, 1005–1070. [CrossRef]
7. Robert Koch-Institut. Archiv 2016—Schätzung der Zahl der HIV-Neuinfektionen und der Gesamtzahl von Menschen mit HIV in Deutschland. Available online: https://www.rki.de/DE/Content/Infekt/EpidBull/Archiv/2016/45/Art_01.html (accessed on 17 July 2017).
8. Mårdh, P.-A. Tubal factor infertility, with special regard to chlamydial salpingitis. *Curr. Opin. Infect. Dis.* **2004**, *17*, 49–52. [CrossRef] [PubMed]
9. Westrom, L.V. Chlamydia and its effect on reproduction. *J. Br. Fertil. Soc.* **1996**, *1*, 23–30.
10. Griesinger, G.; Gille, G.; Klapp, C.; von Otte, S.; Diedrich, K. Sexual behaviour and Chlamydia trachomatis infections in German female urban adolescents, 2004. *Clin. Microbiol. Infect.* **2007**, *13*, 436–439. [CrossRef] [PubMed]
11. Stock, C.; Guillén-Grima, F.; Prüfer-Krämer, L.; Serrano-Monzo, I.; Marin-Fernandez, B.; Aguinaga-Ontoso, I.; Krämer, A. Sexual behavior and the prevalence of Chlamydia trachomatis infection in asymptomatic students in Germany and Spain. *Eur. J. Epidemiol.* **2001**, *17*, 385–390. [CrossRef] [PubMed]
12. Robert Koch-Institut. Epidemisches Bulletin 44/2013. Available online: https://www.rki.de/DE/Content/Infekt/EpidBull/Archiv/2013/Ausgaben/44_13.pdf (accessed on 17 September 2017).
13. Jansen, K.; Schmidt, A.J.; Drewes, J.; Bremer, V.; Marcus, U. Increased incidence of syphilis in men who have sex with men and risk management strategies, Germany, 2015. *Eurosurveillance* **2016**, *21*. [CrossRef] [PubMed]
14. Abraham, S.; Poehlmann, C.; Spornraft-Ragaller, P. Gonorrhoea: Data on antibiotic resistance and accompanying infections at the University Hospital Dresden over a 10-year time period. *J. Dtsch. Dermatol. Ges. J. Ger.* **2013**, *11*, 241–249. [CrossRef] [PubMed]
15. Regnath, T.; Mertes, T.; Ignatius, R. Antimicrobial resistance of Neisseria gonorrhoeae isolates in south-west Germany, 2004 to 2015: Increasing minimal inhibitory concentrations of tetracycline but no resistance to third-generation cephalosporins. *Eurosurveillance* **2016**, *21*. [CrossRef] [PubMed]
16. Holleczeck, B.; Sehouli, J.; Barinoff, J. Vulvar cancer in Germany: Increase in incidence and change in tumour biological characteristics from 1974 to 2013. *Acta Oncol.* **2017**, *1*–7. [CrossRef] [PubMed]
17. Ciccicarese, G.; Herzum, A.; Rebor, A.; Drago, F. Prevalence of genital, oral, and anal HPV infection among STI patients in Italy. *J. Med. Virol.* **2017**, *89*, 1121–1124. [CrossRef] [PubMed]
18. Drago, F.; Herzum, A.; Ciccicarese, G.; Bandelloni, R. Prevalence of oral human papillomavirus in men attending an Italian sexual health clinic. *Sex. Health* **2016**, *13*, 597–598. [CrossRef] [PubMed]
19. Tanaka, T.I.; Alawi, F. Human Papillomavirus and Oropharyngeal Cancer. *Dent. Clin. N. Am.* **2018**, *62*, 111–120. [CrossRef] [PubMed]
20. Lin, C.; Franceschi, S.; Clifford, G.M. Human papillomavirus types from infection to cancer in the anus, according to sex and HIV status: A systematic review and meta-analysis. *Lancet Infect. Dis.* **2017**. [CrossRef]
21. Bundeszentrale für Gesundheitliche Aufklärung. AIDS im Öffentlichen Bewusstsein der Bundesrepublik Deutschland 2016. Available online: <https://www.infodienst.bzga.de/?id=teaserext2.13&idx=7018> (accessed on 27 September 2017).
22. Samkange-Zeeb, F.; Pöttgen, S.; Zeeb, H. Higher risk perception of HIV than of chlamydia and HPV among secondary school students in two German cities. *PLoS ONE* **2013**, *8*, e61636. [CrossRef] [PubMed]
23. Gille, G.; Klapp, C.; Diedrich, K. Chlamydien—Eine Heimliche Epidemie unter Jugendlichen Prävalenzbeobachtung bei Jungen Mädchen in Berlin (18 July 2005). Available online: <http://www.aerzteblatt.de/archiv/47702> (accessed on 30 December 2012).
24. Bremer, V.; Dudareva-Vizule, S.; Buder, S.; an der Heiden, M.; Jansen, K. Sexuell übertragbare Infektionen in Deutschland. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* **2017**, *60*, 948–957. [CrossRef] [PubMed]

25. Kan, M.L.; Cheng, Y.A.; Landale, N.S.; McHale, S.M. Longitudinal Predictors of Change in Number of Sexual Partners across Adolescence and Early Adulthood. *J. Adolesc. Health* **2010**, *46*, 25–31. [[CrossRef](#)] [[PubMed](#)]
26. Santelli, J.S.; Brener, N.D.; Lowry, R.; Bhatt, A.; Zabin, L.S. Multiple Sexual Partners among U.S. Adolescents and Young Adults. *Fam. Plan. Perspect.* **1998**, *30*, 271–275. [[CrossRef](#)]
27. Panatto, D.; Amicizia, D.; Lugarini, J.; Sasso, T.; Sormani, M.P.; Badolati, G.; Gasparini, R. Sexual behaviour in Ligurian (Northern Italy) adolescents and young people: Suggestions for HPV vaccination policies. *Vaccine* **2009**, *27*, A6–A10. [[CrossRef](#)] [[PubMed](#)]
28. Hwang, L.Y.; Ma, Y.; Benningfield, S.M.; Clayton, L.; Hanson, E.N.; Jay, J.; Jonte, J.; Godwin de Medina, C.; Moscicki, A.-B. Factors that influence the rate of epithelial maturation in the cervix in healthy young women. *J. Adolesc. Health* **2009**, *44*, 103–110. [[CrossRef](#)] [[PubMed](#)]
29. Lee, V.; Foley, E.; Tobin, J.M. Relationship of cervical ectopy to chlamydia infection in young women. *J. Fam. Plan. Reprod. Health Care* **2006**, *32*, 104–106. [[CrossRef](#)] [[PubMed](#)]
30. Bremer, D.V.; Hofmann, A.; Hamouda, O. Epidemiologie der Chlamydia-trachomatis-Infektionen. *Hautarzt* **2007**, *58*, 18–23. [[CrossRef](#)] [[PubMed](#)]
31. Fortenberry, J.D. Unveiling the Hidden Epidemic of Sexually Transmitted Diseases. *JAMA J. Am. Med. Assoc.* **2002**, *287*, 768–769. [[CrossRef](#)]
32. Kraut, A.A.; Schink, T.; Schulze-Rath, R.; Mikolajczyk, R.T.; Garbe, E. Incidence of anogenital warts in Germany: A population-based cohort study. *BMC Infect. Dis.* **2010**, *10*, 360. [[CrossRef](#)] [[PubMed](#)]
33. Siracusano, S.; Silvestri, T.; Casotto, D. Sexually transmitted diseases: Epidemiological and clinical aspects in adults. *Urologia* **2014**, *81*, 200–208. [[CrossRef](#)] [[PubMed](#)]
34. McCredie, M.R.E.; Sharples, K.J.; Paul, C.; Baranyai, J.; Medley, G.; Jones, R.W.; Skegg, D.C.G. Natural history of cervical neoplasia and risk of invasive cancer in women with cervical intraepithelial neoplasia 3: A retrospective cohort study. *Lancet Oncol.* **2008**, *9*, 425–434. [[CrossRef](#)]
35. Land, J.A.; Van Bergen, J.E.A.M.; Morré, S.A.; Postma, M.J. Epidemiology of Chlamydia trachomatis infection in women and the cost-effectiveness of screening. *Hum. Reprod. Update* **2010**, *16*, 189–204. [[CrossRef](#)] [[PubMed](#)]
36. Centers for Disease Control and Prevention (CDC). Update: Barrier protection against HIV infection and other sexually transmitted diseases. *MMWR Morb. Mortal. Wkly. Rep.* **1993**, *42*, 589–591, 597.
37. Pierce Campbell, C.M.; Lin, H.-Y.; Fulp, W.; Papenfuss, M.R.; Salmerón, J.J.; Quiterio, M.M.; Lazcano-Ponce, E.; Villa, L.L.; Giuliano, A.R. Consistent condom use reduces the genital human papillomavirus burden among high-risk men: The HPV infection in men study. *J. Infect. Dis.* **2013**, *208*, 373–384. [[CrossRef](#)] [[PubMed](#)]
38. Peto, T.J.; Mendy, M.E.; Lowe, Y.; Webb, E.L.; Whittle, H.C.; Hall, A.J. Efficacy and effectiveness of infant vaccination against chronic hepatitis B in the Gambia Hepatitis Intervention Study (1986–1990) and in the nationwide immunisation program. *BMC Infect. Dis.* **2014**, *14*, 7. [[CrossRef](#)] [[PubMed](#)]
39. Herweijer, E.; Sundström, K.; Ploner, A.; Uhnoo, I.; Sparén, P.; Arnheim-Dahlström, L. Quadrivalent HPV vaccine effectiveness against high-grade cervical lesions by age at vaccination: A population-based study. *Int. J. Cancer* **2016**, *138*, 2867–2874. [[CrossRef](#)] [[PubMed](#)]
40. Geisler, W.M.; Uniyal, A.; Lee, J.Y.; Lensing, S.Y.; Johnson, S.; Perry, R.C.W.; Kadrnka, C.M.; Kerndt, P.R. Azithromycin versus Doxycycline for Urogenital Chlamydia trachomatis Infection. *N. Engl. J. Med.* **2015**, *373*, 2512–2521. [[CrossRef](#)] [[PubMed](#)]
41. Kerani, R.P.; Stenger, M.R.; Weinstock, H.; Bernstein, K.T.; Reed, M.; Schumacher, C.; Samuel, M.C.; Eaglin, M.; Golden, M. Gonorrhea treatment practices in the STD Surveillance Network, 2010–2012. *Sex. Transm. Dis.* **2015**, *42*, 6–12. [[CrossRef](#)] [[PubMed](#)]
42. Clement, M.E.; Okeke, N.L.; Hicks, C.B. Treatment of Syphilis: A Systematic Review. *JAMA* **2014**, *312*, 1905–1917. [[CrossRef](#)] [[PubMed](#)]
43. Heßling, A. *Youth Sexuality 2010: Repeat Survey of 14 to 17-Year-Olds and Their Parents*; Bundeszentrale für Gesundheitliche Aufklärung (BZgA): Cologne, Germany, 2010; ISBN 978-3-937707-80-8.
44. Robert Koch-Institut. Archiv 2017—Aktuelles aus der KV-Impfsurveillance: Impfquoten der Rotavirus-, Masern-, HPV- und Influenza-Impfung in Deutschland. Available online: https://www.rki.de/DE/Content/Infekt/EpidBull/Archiv/2017/01/Art_01.html (accessed on 6 September 2017).
45. Mund, M.; Sander, G.; Potthoff, P.; Schicht, H.; Matthias, K. Introduction of Chlamydia trachomatis screening for young women in Germany. *JDDG J. Dtsch. Dermatol. Ges.* **2008**, *6*, 1032–1037. [[CrossRef](#)] [[PubMed](#)]

46. Pathirana, D.; Hillemanns, P.; Petry, K.-U.; Becker, N.; Brockmeyer, N.H.; Erdmann, R.; Gissmann, L.; Grundhewer, H.; Ikenberg, H.; Kaufmann, A.M.; et al. Short version of the German evidence-based Guidelines for prophylactic vaccination against HPV-associated neoplasia. *Vaccine* **2009**, *27*, 4551–4559. [[CrossRef](#)] [[PubMed](#)]
47. Von Rosen, F.T.; von Rosen, A.J.; Müller-Riemenschneider, F.; Tinnemann, P. Awareness and knowledge regarding emergency contraception in Berlin adolescents. *Eur. J. Contracept. Reprod. Health Care* **2017**, *22*, 45–52. [[CrossRef](#)] [[PubMed](#)]
48. Von Rosen, A.J.; von Rosen, F.T.; Tinnemann, P.; Müller-Riemenschneider, F. Sexual Health and the Internet: Cross-Sectional Study of Online Preferences among Adolescents. *J. Med. Internet Res.* **2017**, *19*, e379. [[CrossRef](#)] [[PubMed](#)]
49. Center for Disease Control and Prevention. Sexually Transmitted Diseases Treatment Guidelines, 2015. *MMWR Recomm. Rep.* **2015**, *64*, 1–137.
50. Hoff, T.; Greene, L.; Davis, J. National Survey of Adolescents and Young Adults: Sexual Health Knowledge Attitudes and Experiences. Available online: <https://kaisersfamilyfoundation.files.wordpress.com/2013/01/national-survey-of-adolescents-and-young-adults.pdf> (accessed on 14 September 2017).
51. Samkange-Zeeb, F.; Mikolajczyk, R.T.; Zeeb, H. Awareness and knowledge of sexually transmitted diseases among secondary school students in two German cities. *J. Community Health* **2013**, *38*, 293–300. [[CrossRef](#)] [[PubMed](#)]
52. Sheeran, P.; Taylor, S. Predicting intentions to use condoms: A meta-analysis and comparison of the theories of reasoned action and planned behavior. *J. Appl. Soc. Psychol.* **1999**, *29*, 1624–1675. [[CrossRef](#)]
53. Von Elm, E.; Altman, D.G.; Egger, M.; Pocock, S.J.; Gøtzsche, P.C.; Vandenbroucke, J.P. Strengthening the reporting of observational studies in epidemiology (STROBE) statement: Guidelines for reporting observational studies. *BMJ* **2007**, *335*, 806–808. [[CrossRef](#)] [[PubMed](#)]
54. Amt für Statistik Berlin-Brandenburg. *Regionaler Sozialbericht Berlin und Brandenburg 2015*; Amt für Statistik Berlin-Brandenburg: Berlin, Germany, 2016.
55. Bundeszentrale für Gesundheitliche Aufklärung. Jugendsexualität. Wiederholungsbefragung von 14-bis 17-Jährigen und Ihren Eltern. Available online: <https://publikationen.sexualaufklaerung.de/index.php?docid=227> (accessed on 17 September 2017).
56. Garside, R.; Ayres, R.; Owen, M.; Pearson, V.A.H.; Roizen, J. “They never tell you about the consequences”: Young people’s awareness of sexually transmitted infections. *Int. J. STD AIDS* **2001**, *12*, 582–588. [[CrossRef](#)] [[PubMed](#)]
57. Höglund, A.T.; Tydén, T.; Hannerfors, A.K.; Larsson, M. Knowledge of human papillomavirus and attitudes to vaccination among Swedish high school students. *Int. J. STD AIDS* **2009**, *20*, 102–107. [[CrossRef](#)] [[PubMed](#)]
58. Andersson-Ellstrom, A.; Forssman, L. Sexually transmitted diseases—Knowledge and attitudes among young people. *J. Adolesc. Health* **1991**, *12*, 72–76. [[CrossRef](#)]
59. Gale, M.; Hayen, A.; Truman, G.; Varma, R.; Forssman, B.L.; MacIntyre, C.R. Demographic and geographical risk factors for gonorrhoea and chlamydia in greater Western Sydney, 2003–2013. *Commun. Dis. Intell. Q. Rep.* **2017**, *41*, E134–E141. [[PubMed](#)]
60. Torrone, E.; Papp, J.; Weinstock, H.; Centers for Disease Control and Prevention (CDC). Prevalence of Chlamydia trachomatis genital infection among persons aged 14–39 years—United States, 2007–2012. *MMWR Morb. Mortal. Wkly. Rep.* **2014**, *63*, 834–838. [[PubMed](#)]
61. Balla, B.C.; Terebessy, A.; Tóth, E.; Balázs, P. Young Hungarian Students’ Knowledge about HPV and Their Attitude toward HPV Vaccination. *Vaccines* **2016**, *5*, 1. [[CrossRef](#)] [[PubMed](#)]
62. Sopracordevole, F.; Cigolot, F.; Gardonio, V.; Di Giuseppe, J.; Boselli, F.; Ciavattini, A. Teenagers’ knowledge about HPV infection and HPV vaccination in the first year of the public vaccination programme. *Eur. J. Clin. Microbiol. Infect. Dis.* **2012**, *31*, 2319–2325. [[CrossRef](#)] [[PubMed](#)]
63. Drago, F.; Ciccarese, G.; Zangrillo, F.; Gasparini, G.; Cogorno, L.; Riva, S.; Javor, S.; Cozzani, E.; Broccolo, F.; Esposito, S.; et al. A Survey of Current Knowledge on Sexually Transmitted Diseases and Sexual Behaviour in Italian Adolescents. *Int. J. Environ. Res. Public Health* **2016**, *13*, 422. [[CrossRef](#)] [[PubMed](#)]
64. Robert Koch-Institut. Mitteilung der Ständigen Impfkommision am RKI: Anwendung des Neunvalenten Impfstoffs Gegen Humane Papillomviren (HPV). Available online: <https://search.datacite.org/works/10.17886/EPIBULL-2016-027> (accessed on 29 October 2017).

65. Deutsches Ärzteblatt. Urologen Empfehlen HPV-Impfung für Jungen. Available online: <https://www.aerzteblatt.de/nachrichten/69265/Urologen-empfehlen-HPV-Impfung-fuer-Jungen> (accessed on 29 October 2017).
66. De Visser, R. One size fits all? Promoting condom use for sexually transmitted infection prevention among heterosexual young adults. *Health Educ. Res.* **2005**, *20*, 557–566. [[CrossRef](#)] [[PubMed](#)]
67. De Graaf, H.; Vanwesenbeeck, I.; Meijer, S. Educational Differences in Adolescents' Sexual Health: A Pervasive Phenomenon in a National Dutch Sample. *J. Sex Res.* **2015**, *52*, 747–757. [[CrossRef](#)] [[PubMed](#)]
68. Santelli, J.S.; Lowry, R.; Brener, N.D.; Robin, L. The association of sexual behaviors with socioeconomic status, family structure, and race/ethnicity among US adolescents. *Am. J. Public Health* **2000**, *90*, 1582–1588. [[PubMed](#)]
69. Berliner Senatsverwaltung für Bildung, Jugend und Familie. Allgemeine Hinweise zu den Rahmenplänen für Unterricht und Erziehung in der Berliner Schule a V 27: Sexualerziehung. Available online: https://www.berlin.de/sen/bildung/unterricht/faecher-rahmenlehrplaene/rahmenlehrplaene/mdb-sen-bildung-schulorganisation-lehrplaene-av27_2001.pdf (accessed on 17 September 2017).
70. Phillipson, L.; Gordon, R.; Telenta, J.; Magee, C.; Janssen, M. A review of current practices to increase Chlamydia screening in the community—A consumer-centred social marketing perspective. *Health Expect.* **2016**, *19*, 5–25. [[CrossRef](#)] [[PubMed](#)]
71. Millstein, S.G.; Igra, V.; Gans, J. Delivery of STD/HIV preventive services to adolescents by primary care physicians. *J. Adolesc. Health* **1996**, *19*, 249–257. [[CrossRef](#)]
72. Jones, K.; Baldwin, K.A.; Lewis, P.R. The potential influence of a social media intervention on risky sexual behavior and Chlamydia incidence. *J Community Health Nurs.* **2012**, *29*, 106–120. [[CrossRef](#)] [[PubMed](#)]
73. Oh, M.K.; Grimley, D.M.; Merchant, J.S.; Brown, P.R.; Cecil, H.; Hook, E.W. Mass media as a population-level intervention tool for Chlamydia trachomatis screening: Report of a pilot study. *J. Adolesc. Health* **2002**, *31*, 40–47. [[CrossRef](#)]
74. Stephenson, J.; Strange, V.; Forrest, S.; Oakley, A.; Copas, A.; Allen, E.; Babiker, A.; Black, S.; Ali, M.; Monteiro, H.; et al. Pupil-led sex education in England (RIPPLE study): Cluster-randomised intervention trial. *Lancet* **2004**, *364*, 338–346. [[CrossRef](#)]



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Lebenslauf

Mein Lebenslauf wird aus datenschutzrechtlichen Gründen in der elektronischen Version meiner Arbeit nicht veröffentlicht.

Publikationsliste

- 2018 von Rosen FT*, von Rosen AJ* (*geteilte Erstautorenschaft), Müller-Riemenschneider F, Damberg I, Tinnemann P. STI Knowledge in Berlin Adolescents. International Journal of Environmental Research and Public Health 2018, 15(1):110.
Impact Factor: 2.101
- 2017 von Rosen AJ, von Rosen FT, Tinnemann P, Müller-Riemenschneider F. Sexual Health and the Internet: Cross-Sectional Study of Online Preferences among Adolescents. Journal of Medical Internet Research 2017, 19(11):e379.
Impact Factor: 5.175
- 2017 von Rosen FT, von Rosen AJ, Müller-Riemenschneider F, Tinnemann P. Awareness and Knowledge regarding Emergency Contraception in Berlin Adolescents. The European Journal of Contraception and Reproductive Health Care 2017, 22(1):45–52.
Impact Factor: 1.627
- 2016 Scemla A, Charlier C, Noel LH, Amazzough K, von Rosen FT, Lesavre P, Lortholary O. Pauci-immune crescentic glomerulonephritis without ANCA in a patient presenting with Candida parapsilosis endocarditis. Médecine et maladies infectieuses 2016, 46(3).
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