

Prevention of Sexually Transmitted Infections: Level of Knowledge Among Freshmen of Four Italian Universities

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Abstract

Background. With the aim to inform potential SHE programs in Italian schools, we run a survey on 4,552 freshmen of four different Italian universities (Padua, Palermo, Bergamo and Milan) to investigate their level of SHK on STI prevention and associated factors.

Methods. The survey was conducted with an anonymous self-reported paper questionnaire administered during teaching lectures to university freshmen of four Italian universities and different undergraduate courses.

Results. The final number of freshmen surveyed was 4,552 (97.9% response rate), 1,842 (40.5%) from the university of Padua; 1,743 (38.3%) from the university of Palermo; 667 (14.7%) from the university of Bergamo and 300 (6.6%) from the university of Milan. The mean age of respondents was 21.4 ± 2.2 years and most of them (70.3%) were females. An overall low STI knowledge among sample students was found. Only 28% respondents knew the most effective contraceptives to prevent STI (i.e. condom and sexual abstinence), with a slightly higher prevalence of correct answers among females (31.3%) than males (25.8%). Students with history of STIs reported referring mostly to their GP (38.1%), rather than discussing the problem with a family member (15.1%), booking an appointment with a consultant gynecologist (13.1%), discussing with their partner (13.1%) or with an experienced friend (12.5%). At multivariable analysis significantly lower levels of STI knowledge was found among males, students of the university of Palermo, those who completed a vocational secondary school education and non-Italian nationals. Categories with significantly less SHK on the most effective contraceptives to prevent STIs included males, students of the university of Palermo, students of educational sciences, students of economics/political sciences, those of foreign nationality, those with two siblings and those whose fathers had a lower educational level.

Conclusions. The above findings provided indirect information on the standard of SHE delivered in Italian schools and call for the development of tailored multi-agency SHE programs involving several actors. In addition to school-based SHE programs, primary care services dedicated to sexual health should be strengthened in Italy.

Background

Sexually Transmitted Infections (STIs) are a considerable public health threat across all ages in high income countries, but particularly among teen-agers [1]. Despite making up approximately 25% of the sexually active population, individuals aged 15-24 years account for half of the 20 million incident cases of STIs notified annually in the USA [2], where in 2013 28% of all cases of gonorrhea and 30% cases of chlamydia were notified among individuals 15-19 years old, and 1,863 incident cases of human immunodeficiency virus (HIV) were reported among subjects aged 13-19 years [1,3,4].

The daily number of incident cases of STIs is estimated to overtake 1 million worldwide [5,6] and in Italy the incidence of STIs is reportedly 19.5% among individuals 15-24 years old [7].

If untreated, STIs can cause serious health consequences, ranging from infertility, to pelvic inflammatory disease, AIDS and hepatocellular carcinoma [8].

Adolescents are at higher risk of STIs for a number of reasons, including inadequate sexual health knowledge (SHK), reduced access to health care services and higher chance of risk-taking behaviors [5]. Recent surveys reported the first sexual intercourse occurring at the average age of 15.6-16.0 years among Italian adolescents, frequently without protection [9].

Condoms, early testing and treatment are the most effective approaches to prevent STIs and their related health impact [3,4]. Primary prevention of STIs in adolescents relies upon tailored sexual health education (SHE) and ad hoc counselling [5]. However, modifying risk taking behaviors is a difficult task, especially in younger ages [5]. Moreover, the typical asymptomatic status featuring several STIs contributes to lower the awareness of the infectious risk associated with unprotected sex [10].

Schools are one of the strategic settings recommended by the World Health Organization (WHO) to promote health in young people for a number of reasons [11], as they allow to reach a large proportion of adolescents, they offer a social environment suitable for education and teachers are already available as educators [12,13].

SHE is grounded upon internationally recognized human rights and plays a central role in the preparation of young people for a safe, productive and fulfilling life [14]. SHE is included among the competences of the European Union (EU), within a wider framework of

public health, as established by the article 168 of the EU treaty [15,16]. With the Lisbon treaty of 2009, the European Charter of Human Rights has obtained the same importance of the principles of European Treaties. The European Court can be consulted if the fundamental human rights are not respected [16]. The article 11 of the European Social Charter enforces member states to provide counselling and infrastructures for the delivery of health promotion, and SHE is among fundamental elements to promote health in young people. Neglecting these public health needs by member states constitutes a violation of the European Social Charter [16]. Nonetheless, the EU does not have executive power to propose SHE policies within each individual EU member state. This has led to a heterogeneity inside the EU, with SHE being mandatory in most member states (especially in Northern Europe), but not in a handful of them, including Italy [16,17].

In a recent study on 16 secondary schools from the city of Genoa (Liguria region, Northern Italy) and 5 schools from the city of Lecce (Apulia region, Southern Italy), for a total 2,867 sampled students, 95% respondents believed schools should be a priority setting to deliver SHE [18]. Nonetheless, only 9% interviewees of the latter survey considered SHE received at school as adequate, 36% reported it as poor and 23% as totally missing. Consistently, only 0.5% students recognized all STIs from a list of 9 diseases and just 22% knew that condoms and sexual abstinence are the only effective methods to prevent STIs [18].

In another survey conducted in the city of Messina (Sicily region, Southern Italy) during January-June 2017, targeting 932 last year secondary school students and 396 university freshmen (for a total 1,228 respondents), the main reference source of information/discussion on sexuality were reportedly the media (first choice for secondary school students), doctors (first choice for university freshmen) and friends/relatives, with schools being neglected [12]. Only 7.9% students of the latter survey were able to recognize all STIs from a list of 6 diseases [12].

In another survey on 2,895 students from 3 secondary schools from the Province of Ferrara (Emilia Romagna region, Northern Italy) during 2011-2012, the majority of males and females reported receiving sexual health information especially from television, school and friends, with internet coming after newspapers [19]. However, the lack of differences in the answers provided across the 3 different types of schools investigated hinted that pupils might have received STIs information mainly from internet and television [19].

A recent cross-sectional study was conducted on 6 secondary schools of the council of Siena (Tuscany region, Italy) during May-June 2018 on 540 pupils [17]. Ninety-five percent respondents considered SHE as "important" and 44% deemed "the school" as the main setting where SHE should be delivered, whereas in an Italian national survey conducted in 1998 the main reference were considered "friends". However, "mass media" (56%) were indicated as the main source for STIs information in the former study, overtaking schools (41%) and family doctors (20%) [17]. Furthermore, whilst 48% interviewees of the Siena survey considered sexual health information received thus far as "sufficient" and 40% "adequate", the knowledge of some relevant STIs decreased from 1998 to 2018 [17,20].

By contrast, in Hungary SHE programs have been implemented in secondary schools since 1978. In a study on 472 students (298 females and 174 males) from the university of Szeged (Hungary), mean aged 21 years, conducted between 2009 and 2011, although the media were the main source of sexual health information for the majority of interviewees, 62.1% of them considered peer sexual health education from secondary schools as reliable and authentic, particularly females and those students living in an urban area [21]. Furthermore, parents of 785 college students from Hungary surveyed in 2009 attributed the major role for delivering STIs information to schools [22] and 74.2 % out of 419 students from Irish universities recalled receiving SHE at secondary school, with 84% of them finding it useful [23].

In order to be effective, public Health interventions should be grounded on population needs assessment. There is in fact evidence that health promotion should focus on defined categories, and that those categories should be engaged in the design, implementation and appraisal of any behavioral interventions [5]. Whilst most sexual health studies targeted secondary school students, first year university students represent an important group, because they are young adults, still trying to reach independence from their family of origin, but usually already sexually active and often keen to new sexual experiences, although often with limited SHK yet. Further, the investigation of sexual health among university freshmen indirectly offers important elements to assess the level of SHE delivered in secondary schools, albeit adolescents can receive sexual health information by several channels [24].

In view of the above, we decided to run a survey to investigate 4,552 first year students from four different Italian universities, to assess the respective SHK gaps and needs and the association with their socio-demographic profile, education received and family

background. The prospect was to inform SHE programs potentially being implemented in Italian schools.

Methods

The survey was conducted with an anonymous self-reported paper questionnaire – which has been published elsewhere [24] - administered during teaching lectures during 2012. The questionnaire was in Italian as alternative versions of the questionnaire in languages other than Italian were deemed unnecessary. Facilitators were present and also provided some guidance to fill up the questionnaire. One hour (on a single occasion) was given to the students to complete the questionnaire. Approval to conduct the study was obtained from the ethic committee of the University of Padua and all research methodology was in accordance with the relevant guidelines and regulations. Since all students were 18 years of age or older, parental consent was not required. Informed consent for study participation was obtained from the study subjects.

First year students of four Italian university campuses (Padua, Bergamo, Milan, Palermo) located in three different Italian regions (Veneto, Lombardy and Sicily) were recruited by convenience sampling, on the basis of individual negotiations with the respective academic staff, as follows:

- Veneto: University of Padua (research coordinating centre);
- Lombardy: University of Milan and University of Bergamo;
- Sicily: University of Palermo.

Students enrolled in courses of educational sciences, foreign language/literature, biology, chemistry, medicine, natural sciences, engineering, architecture, political sciences and economics were selected to take part to the survey (Table 1). Approval to conduct the study was obtained from the ethic committee of the University of Padua and all research methodology was in accordance with the relevant guidelines and regulations.

Endpoints

The different endpoints investigated in this present study were built using multiple choice questions.

Endpoint 1

Question 78 asked: “Please indicate which of the following diseases can be transmitted by sex”. The multiple answer options were the following: “Gonorrhea; Mononucleosis; Syphilis; AIDS; HPV (Human Papilloma virus); Hepatitis C (HCV); Hepatitis B (HBV); Hepatitis A (HAV); Genital Herpes; Streptococcal infection; Venereal lymphogranuloma; Wart; Psoriasis; Candidiasis; Tuberculosis”. The interviewees had to answer whether each of the above diseases were:

- Sexually transmittable;
- Non sexually transmittable;
- Or whether (s)he did not know.

With the exception of psoriasis (negative control), all the above were STIs. A value of 1 was assigned each time the above diseases were considered “Sexually transmittable”. In case the student answered “Non sexually transmittable” or “I do not know” a value of 0 was assigned to the respective disease. All values were then summed up to create a linear numerical score ranging from 0 to 15, which was used as Endpoint 1 in the statistical analysis.

Endpoint 2

Question 76 asked: “Which of the following are the most efficacious methods to prevent sexually transmitted infections?” The multiple answer options were the following: Basal temperature thermometer; oil; Anti-contraceptive pill; Billings method; Morning after pill; Diaphragm; Interrupted coitus; Spermicide; Condom; Transparent membrane; Abstinence; Contraceptive plaster; Male pill; Ulipristal acetate; Cervical cap; Vaginal washing; Contraceptive sponge. Interviewees could provide up to four answers, which could either be:

- correct answers, where “Sexual abstinence” and “Condom” (simultaneously) were indicated, even if additional options were ticked.
- wrong answer: any other combination.

Endpoint 2 was a dichotomous variable coding 0 (wrong answer) or 1 (correct answer) on knowledge of STI prevention.

Endpoint 3

Students were also asked whether they had ever contracted a STI. Those who answered “Yes” (5.1% = 226/4,418) were then asked: “What did you do when you contracted a STI in the past?” Up to three different answers could be chosen on the questionnaire, among the following:

- I asked advice a friend;
- I referred to a consultant gynecologist;
- I tried to solve it on my own;
- I went to my general practitioner (GP);
- I went to accident & emergency (A&E);
- I discussed with a member of my family;
- I discussed with my partner.

Total answers provided for each of the above 7 options were collected.

Statistical analysis

Endpoint 1 (STI knowledge) was employed as dependent variable in a multiple linear regression model. Endpoint 2 (contraceptives to prevent STI) was the dependent variable in a multiple logistic regression model. In both models backward stepwise selection was used; $p < 0.05$ was the criterion to select confounders from the factors (socio-demographic profile, educational level, family background and university campus) displayed in table 1. Results were expressed as regression coefficients (RC) for multiple linear regression or odds ratio (OR) for multiple logistic regression, with the corresponding 95% confidence interval (95%CI). Missing values were excluded and complete case analysis was performed.

Results

Descriptive analysis

The final number of university freshmen recruited by the survey was 4,552 broken down as follows:

- University of Padua: 1,842 (40.5%);
- University of Palermo: 1,743 (38.3%);
- University of Bergamo: 667 (14.7%);
- University of Milan: 300 (6.6%).

Table 1 reports the distribution of variables (socio-demographic profile, educational level and family background by university campus) as frequencies and percentages. As can be seen most survey participants were women (70.3%) and the mean age of all students was 21.4 ± 2.2 years; Students of Italian nationality were 96.8% out of all respondents.

The distribution of students by undergraduate course of study was fairly homogeneous. However, no students of the course of literature/foreign language were recruited from the University of Padua. The vast majority of students recruited from the University of Palermo were enrolled in courses of educational sciences. By contrast, students from the University of Bergamo were mainly enrolled in literature/foreign language courses. Students surveyed in the University of Milan were all from educational sciences.

59.5% interviewees received classical/scientific secondary school education or already had a university degree, whereas 13.7% had a secondary education on art or foreign languages or socio-pedagogical classes and 26.8% came from a vocational secondary school. 21.0% lived in a city centre, 18.5% in a city outskirts, 17.0% in a town with more than 15,000 inhabitants, 43.5% in a small town with less than 15,000 people.

61.7% of the interviewees had a nuclear family; 18.6% reported being a single child, 53.4% had one sibling; 21.9% two siblings, 6.1% three or more siblings. Students with a foreign mother were 3.3%, those with a foreign father were 2.7%. 18.0% of the students' fathers and 1.7% of mothers had a postgraduate education. Fathers with an educational level limited to junior secondary school were 34.4%, the respective proportion for mothers was 34.6%.

Students in a stable relationship were 60% (=2,710/4,515), 65.8% (=2,088/3,174) among males, 46.4% (=618/1,333) among females. The percentage of stable relationships increased with age of interviewees: 56.9% among students 18-20 years old; 61.6% among those 21-24 years old; 68,9% in students 25 or older. Among those in a romantic relationship, 90% described themselves as being in love with the respective partner, 9% did not know, and only 2% described themselves as not being in love with their partner. Stable relationships were ongoing for at least 24 months in 52% cases, 13-24 months in 21% cases, 7-12 months in 12% cases and 3-6 months in 81% cases.

Table 2 and Figure 1 show the answers to the question: "Which of the following diseases can be transmitted by sex?" With the aim to identify areas that could benefit increasing SHE, STIs were arranged in table 2 in descending order of "I do not know" (DK). More than half students (males as well as females) did not know that Streptococcus, Lymphogranuloma venereum and Hepatitis A belong to STIs. Among males, a percentage > 50% did not know that Candida and HPV are STIs. On the other hand, AIDS was known to 97% respondents. 84% students were aware of the sexual transmissibility of herpes genitalis, with rather consistent distribution by sex and university campus. 80% respondents recognized syphilis as STI, although with a lower proportion (70%) among students of the university of Palermo. Knowledge of HBV and HCV as STI displayed a distribution fairly consistent across different universities. Gonorrhoea was indicated as STI by 45% students and lymphogranuloma venereum (Chlamydia) by 32.1%, with alike distribution by university and sex.

Table 3 displays the answers provided to the question "Which of the following are the most efficacious methods to prevent sexually transmitted infections?" It can be noted that as many as 86% of the respondents (males 85% and females 87%) knew the use of condom to prevent STI. Sexual abstinence was reported as the second most effective contraceptive option to prevent STIs after condoms, with fairly consistent distribution across different university campus and gender.

Table 4 shows the parameters of Endpoint 1 (mean, standard deviation, median and interquartile range, IQR) and the distribution of Endpoint 2 (number and percentage of wrong and correct answers) in the entire sample and in subgroups broken down by sex and university campus. The overall average score for the Endpoint 1 was 5.3 ± 2.9 (the median was 6 and IQR: 3-7). The average score for Endpoint 1 was slightly higher among female students across all four campuses and it was lower in the university of Palermo (4.8 ± 3.2) compared to the other three campuses of Northern Italy. As can be seen, only 28% respondents knew the most effective contraceptives to prevent STI (i.e. sexual abstinence and condom). The percent of correct answers on knowledge of STI prevention was slightly higher among female (31%) than males (28%), a finding confirmed also in the analysis by university campus. However, the proportion of correct answers was higher among students of the university of Padua (35.1%) and Bergamo (34.2%), than Milan (28.3%) and Palermo (22.0%).

Table 5 reports that in case of STI, the reference figure was mainly the General Practitioner for both males (42%) and female (37%); females students also tend refer to a consultant gynecologist (16%). A similar distribution was found in university campuses of Padua, Bergamo and Milan. By contrast, in the university of Palermo the role of partner (19.6%) and advisor family members (16.9%) was considerably less pronounced than in the other three campuses of Northern Italy. Such differences between the university of Palermo as compared with the other three campuses of Northern Italy were mainly due to female students. Considering the entire sample, males were more inclined than females to self-manage the STI condition (11.7% vs. 3.1%) or to refer to their partner (16.7% vs. 13.7%).

Outcome analysis

Table 6 reports the results of the multiple linear regressions investigating factors associated with Endpoint 1 (STI knowledge). It can be seen that males (RC=-0.63; 95%CI: -0.85; -0.41), students from the university of Palermo (RC=-1.23; -1.45; -1.01), those who completed a vocational secondary school education (RC= -0.20; -0.41; -0.02) and non-Italian students (RC=-1.25; 95%CI: -1.80; -0.70) had a significantly lower STI knowledge. Compared to the students of biology/medicine/chemistry/natural sciences, who acted as reference group, all other students showed a lower knowledge of STI, particularly students enrolled at educational science (RC=-1.04; -1.41; -0.66) and literature/foreign language (RC=-0.72; -1.01; -0.43).

Table 6 also displays the results of the multiple logistic regression analysis investigating the knowledge of most effective contraceptives to prevent STIs. As can be seen, males (OR=0.67; 95%CI: 0.54; 0.82), students of the university of Palermo (OR=0.40; 0.33; 0.48), those registered with educational sciences (OR=0.56; 0.45; 0.71), economics/political sciences (OR=0.62; 0.48; 0.80) and students of foreign nationality (OR=0.14; 0.06; 0.33) showed a significantly lower level of SHK. Further, students with 2 siblings (OR=0.69; 0.49; 0.97), those whose fathers had an educational level limited to secondary school (OR=0.64; 0.51; 0.82) or junior secondary school (OR= 0.69; 0.53; 0.90) had a significantly lower level of knowledge on the most efficacious contraceptive to prevent STI.

Discussion

The present survey evidenced:

- an overall low knowledge of STI among sample students (Table 2 and Figure 1);
- that only 28% of the students knew the most effective contraceptives to prevent STI (i.e. sexual abstinence and condom), with a slightly higher prevalence of correct answers among females (31.3%) than males (25.8%) ($p<0.001$) (table 4)
- that students with history of STIs reported referring mostly to their GP (38.1%), rather than discussing with a family member (15.1%), booking an appointment with a consultant gynecologist (13.1%), discussing with their partner (13.1%) or with an experienced friend (12.5%) (table 5)
- That significantly lower levels of STI knowledge were found among males, students of the university of Palermo, those who completed a vocational secondary school education and non-Italian nationals (table 6)
- That categories significantly less knowledgeable on the most effective contraceptives in preventing STI included males, students of the university of Palermo, students of educational sciences, students of economics/political sciences, those with foreign nationality, those with two siblings and those whose fathers had a lower educational level (table 6).

Interpretation of findings in relation to other studies

HIV, genital herpes, HPV, syphilis, Candida, Gonorrhoea and HCV were the STIs more correctly recognized in the present study, with rather balanced figures between males and females, apart from HPV, herpes genitalis and candida, for which females scored higher.

Genital warts were by far the most unknown STIs in our survey. However, when "I don't know" (DKs) were added to negative answers, TB becomes first. TB is not spread through sexual intercourse or kissing or other touch. TB bacteria are spread through the air when a person with TB coughs, sneezes, speaks, or sings. Several associations between the risk for TB and lifestyle factors have been identified. For example, unmarried persons are at higher risk of TB than married individuals. Moreover, HIV co-infection is the strongest known risk factor for disease progression from latent to active TB [25].

Aside HIV/AIDS, a systematic review on young European adolescents aged 13-20 years reported a low level of knowledge of STIs, their diffusion, means of contagion, preventative methods, risky behaviors and health impact [26]. Whilst HIV/AIDS was reportedly more known across various studies on young individuals, both in Italy and elsewhere, regardless of their educational level (secondary school or university students), knowledge of other STIs tended to be higher among undergraduates (table 7) [12, 17-20, 27-53].

The relatively higher knowledge of HIV/AIDS has been probably influenced by the extensive preventative and informative campaigns deployed at international level over the last thirty years [27,34,54,55]. For instance, a survey on 1,177 secondary school students from the city of Berlin (average age 14.6 years, 47.5% females and 52.9% with at least one foreign born parent), scaled the knowledge of 7 STIs (HIV, HBV, HPV, Genital herpes, syphilis, gonorrhoea and chlamydia) from "never heard of" to "very good". In the latter study, whilst the knowledge about HIV/AIDS was adequate in most students (90.1%), combining knowledge self-rated as "very good" (38.2%),

“good” (33.0%) and “mediocre” (18.9%), the respective combined figures for other STIs like Chlamydia (25.5%), Gonorrhoea (29.4%) or HPV (27.6%) was rather unsatisfactory [40]. By contrast, higher levels of SHK were found in an online survey targeting 3,872 students from Romanian universities, aged 18-25 years: whilst 98% knew that AIDS is an STI (similar to findings of the present study), 75.8% and 61.1% knew about Gonorrhoea and Chlamydia trachomatis, respectively [34]. The higher age and educational level of respondents (undergraduate vs. secondary school students) likely explains the different findings between the Romanian and the above German survey.

However, SHK can be rather variable even for a relatively well-known disease like HIV/AIDS as is influenced by several factors. A recent survey on 200 university students from the Mid-Western part of the USA reported adequate knowledge about HIV transmissibility in only 4% of them [56]. The authors of the latter study supposed an inversed relationship between SHK and stigma toward HIV/AIDS affected individuals [56].

The decreased STI knowledge observed in Italy over the past 20 years is probably the aftermath of fading AIDS awareness campaigns at international level over the past two decades [17]. As a likely result, 83.9% new cases of HIV notified in Italy in 2013 were attributable to unprotected sex [57].

While HIV and Syphilis were correctly recognized as STIs by 97% and 80% respondents in the present survey, with a lower proportion (70%) of correct answers among students of the university of Palermo, gonorrhoea was correctly identified by 44.9% freshmen and Chlamydia (lymphogranuloma venereum) by 32.1%, with rather similar distribution by university campus and gender. In a recent study from the university of Palermo, similar levels of SHK were detected for Syphilis (93%) and Gonorrhoea (84%), but Chlamydia's (82%) was considerably higher than the present survey [27]. Chlamydia infection is the most common STI across Europe, featured by an incidence rate of 146 per 100,000 in 2018 across the entire EU [58,59]. The geographical distribution of Chlamydia varies importantly though, with notifications being considerably higher among Northern European countries, especially in the UK, which accounted for 60% of all cases notified in 2018 in the entire EU [59]. As a result of this, whilst 20 EU countries adopted a comprehensive surveillance system (with mandatory notifications) for chlamydia, 6 – including Italy - employed a sentinel surveillance system [58].

The above-mentioned Romanian survey on undergraduate students showed poor recognition of hepatitis B (HBV) and C (HCV) as STIs - only known to 30% respondents - a percentage similar to our findings (31.5% for HBV e 42.2% for HCV). In the present survey, the distribution of knowledge on HBV and HCV as STIs was fairly consistent across different university campuses; in particular, students of the University of Palermo gave 36.9% and 34.5% correct answers for HBV and HCV, respectively. SHK seems rather variable within Sicily, though. In a survey on 1,228 students of 17+ years of age (freshmen and last year students of secondary school) recruited from the city of Messina during 2016, the mean knowledge of HIV/AIDS was 98.9%, HBV's was 62.3%, syphilis' 68.3% and HPV's 35% [12]. In another survey conducted in 2018 on 1,022 biomedical students aged 18-27 years recruited from the university of Palermo, only 4.1% and 4.4% managed to correctly recognize HBV and HCV as STIs respectively – and this was perhaps even more surprising given that the survey was purely conducted among biomedical students [27]. The knowledge of transmissibility by sex of HBV (5.4% vs. 3.6%) and HCV (6.0% vs. 3.7%) was higher in males than females in the latter Sicilian survey [27]. However, females generally have a higher risk perception associated with STIs and unprotected sex according to the open literature [10]. For instance, females were significantly more knowledgeable about HPV, syphilis and Gonorrhoea in the above German study on secondary school pupils of Berlin [40]. Likewise, males were less knowledgeable on both outcomes investigated in the present study at multivariable analysis.

The impact of STIs and knowledge of health related risks is reportedly rather variable across the various surveys conducted in Italy [59]. For example, whilst respondents able to recognize all STIs (N=5) from a list of diseases were just 7.9% in the above survey conducted in 2016 on last year secondary school students and freshmen of the city of Messina (Sicily region, Southern Italy) [12], the respective figure for 9 listed STIs was 0.5% among 2,867 pupils surveyed during 2013-2014 from 21 secondary schools from the Italian regions of Liguria e Apulia [18] and it was 0.3% (out of 15 listed STIs) among freshmen of the present survey. The above discrepancies likely depend also on the different number of STIs investigated and the different age (and therefore educational level) of responders. For instance, knowledge of HPV progressively increased even from the first to sixth undergraduate course year among 522 medical students surveyed from the faculty of Medicine of Tîrgu Mureş university (Romania) [35]. Nonetheless, age was not associated with the two SHK outcomes at multiple regression in the present study.

Lower SHK also makes younger adolescents less likely to be tested against STIs [60]. Furthermore, since STIs are frequently asymptomatic, the awareness of the potential risk from unprotected sex is relatively low [26]. 51% individuals aged 13-24 years diagnosed with HIV in the USA during 2012 were not even aware of their seropositive status [56]. In Italy 110,000-150,000 individuals are estimated to live with HIV, 25% of whom being unaware of their infected condition [29]. Furthermore, the age of sexual debut is decreasing almost everywhere, as confirmed by the above-mentioned Romanian study, where 54% respondents reported the first sexual intercourse at the age of 14-18 years and in 30% cases even before the age of 14 [34]. The same survey reported that 30% students declared multiple sexual partners during the year preceding the survey and no use of any sexual prophylaxis at first sexual intercourse, with similar percentages between males (25.9%) and females (23.3%) [34]. In Italy the age of first sexual intercourse was estimated to be 16 years (median value) for both females and males in a previous survey conducted on 7,298 students aged 14-24 years, sampled from five Italian cities [9].

Undergraduate Course of Study

In the present study biomedical students had a significantly higher knowledge and understanding of both STIs and the most effective ways to prevent them, a finding consistent with the existing literature [12,27,31,61,62]. In a study on 2,074 students from the university of Madrid, medical students were less sexually active, had their sexual debut at a later stage, and had less sexual partners as compared to law students [61]. Biomedical students are being considered for peer education in schools, to maximize the delivery of SHE [1].

Regional Differences

The present study evidenced relevant cross-regional differences within Italy on SHK in terms of STIs prevention. In particular, students of the university of Palermo consistently showed significant lower levels of SHK, somehow confirming the cultural barriers for the implementation of SHE in Southern Italy [63], as already suggested by the above survey on 2,867 secondary schools students from the city of Genoa and Lecce [18]. Sexuality is indeed still considered a taboo in Italy and discussing it in the family is difficult, especially in the southern part of the country [37,63].

This was somehow endorsed also in the present study, where female students of the university of Palermo were remarkably less inclined than their colleagues from Northern Italy to refer to a family member or their partner in case of STI.

By contrast, in a survey conducted in 2016 in the city of Tirana (Albania) on 70 undergraduates (42 nurse and 28 Physiotherapy students), aged 18 to 29 years (average: 21.8 years) - 42 females vs. 28 males - communication with parents on sexuality was rated excellent by 51.4% and good by 37.2% interviewees. Moreover, 77% students of the latter survey stated that they felt sufficiently informed about STIs, considered teachers (49%) and parents (44%) the main source of sexual health information and 53% respondents rated SHE received at school good or sufficient [37]. Conversely, most Italian students complained about lack of information on STIs provided by qualified staff [12,18]. In Albania, education on "sexuality and life skills" has been mandatory for all students aged 10-18 since 2015 [64].

STI Prevention

The rate of condom use is rather variable according to the open literature [26]. In a recent surveyed on 2,895 secondary students from the city of Ferrara (Emilia Romagna region, Northern Italy) condom was the first tool considered to prevent STIs, indicated by 89.0% interviewees, with rather balanced percentage between males (88.6%) and females (89.2%), followed by single partner (56.6%; 57.0% among males vs. 57.3% in females) [19].

A number of studies reported condom as the main contraceptive used by university students [18,60]; this was also confirmed by the survey amongst undergraduate biomedical students of Palermo discussed earlier, where condom was also the most known contraceptive method [27]. In the latter study however, 7% students did not use any specific contraception and a large percentage reported using contraceptive pills and vaginal rings, certainly effective to prevent unintended pregnancies but ineffective against STIs [27]. In the above survey from Emilia Romagna region, a considerable proportion of students was convinced that contraceptive pills (22.1% vs. 23.5%), spermicides (14.6% vs. 46.9%), intra-uterine device (IUD) (18.25 vs. 39.1%), coitus interruptus (8.1% vs. 38.1%) and

morning after pill (9.8% vs. 30.0%) were respectively “partly safe” versus “very safe” to prevent STIs [19]. Likewise, in another survey on 139 students attending the 3rd class of a secondary school in Milan (Lombardy Region, Northern Italy), albeit condom was reported by 92.1% respondents as a reliable method to prevent STIs, the contraceptive pill (24.5%), morning-after pill (20.1%), diaphragm (11.5%) and coitus interruptus (10.8%) were also wrongly indicated, casting legitimate concerns on the likely conceptual confusion between contraception and STIs prevention among an important part of Italian adolescents [33].

In the study here presented the contraceptive pill was the third most considered contraceptive option rated effective to prevent STIs following condom, with fairly consistent distribution across different university campuses and gender. Qualitative studies from various Western European countries suggest that young individuals’ principal concern is preventing unintended pregnancies rather than STIs [65]. The relatively low use of condoms is therefore a worrying problem in Europe, given the increase of STIs such as Chlamydia among young individuals, regardless of their gender [65]. Although condom was considered by far (86.2%) the most effective contraceptive against STIs in the present survey, with similar distribution by university campus and sex of respondents, only 28.0% of the students acknowledged both condoms as well as sexual abstinence as the most efficacious contraceptives to prevent STIs. Likewise, only 22% of 2,867 students from the cities of Lecce and Genoa knew that both condoms and sexual abstinence were the most reliable methods to prevent STIs [18].

Sexual Health Education

The low level of STI knowledge and prevention found in the present survey indirectly confirmed the poor standard of SHE delivered in Italian schools [24]. For instance, in the above survey on 2,695 secondary school students from the Emilia Romagna Region, only 52.3% knew the definition of STIs (i.e. a communicable disease transmitted mostly, although not exclusively, by sex) [19].

Despite several sexual health studies conducted in Italy over the past 20 years claimed the importance of school-based SHE, there are still no laws to define and establish SHE in the country, although several proposals and compromises have been attained over the last 30-40 years. The first legislative proposal for the introduction of school-based SHE programs in Italy began in the early 1900s, but it was not successful. A further law proposal in 1991, aiming to include SHE in the biology curriculum of schools (though not mandatory) was not approved. Although the debate has been continuing, not much progress has been achieved since then [63,66,67]. By contrast, in Eastern Europe, the rise of STI rates during the nineties following the collapse of communism pushed the respective governments to implement schools-based national SHE programs which achieved successful public health outcomes [68,69].

Although SHE delivered by school teachers is the most common model employed in all European countries, the methods to deliver SHE vary remarkably across Europe and range from traditional formal class teaching to peer-education. Material used range from videos, mass-media, theatre and internet, which is increasingly used for didactical purposes. Traditional didactical lectures remain the most common way to deliver SHE, although studies reported pupils prefer more interactive approaches [70-73]. Charities and non-governmental organizations are often involved as integrative sources for school SHE programs. These charities have large spectrum of tasks, comprising provision of seminars, organization of peer-education campaigns, support and reception.

A recent novelty is the experimental use of medical students in “peer-to-peer” school programs of health education to students aged 12-13 years in Rhode Island (USA) [1]. These programs proved effective to significantly improve the SHK of scholars on contraception, reproductive physiology/anatomy, STI prevention, safe sex, sexual abuse and aware choices [1]. At the end the latter “peer-to-peer” educational program, participants significantly improved their perception on the importance of school SHE and their attitude to interplay with adults to discuss sexuality related issues [1].

There is high level of heterogeneity across Europe on the ideal age to start SHE in schools. Some member states already started SHE at primary school, some others at secondary school level. Nevertheless, there is general consensus on the fact that SHE should start as soon as possible. Whilst informal SHE commences already immediately after birth, with parents sending their children involuntary messages concerning body and intimacy, the delivery of formal SHE should be adapted to the age of recipients [74,75].

In March 2017, political pressures induced the Department of Education of the British government to announce that Sex and Relationship Education (SRE) would have been officially introduced in British primary schools by September 2019 [75]. SRE enables children and young adults to gradually acquire information, competences and values to understand and fully enjoy their own sexuality, manage safe and satisfactory relationships and be responsible for the health of themselves and others’ [64].

Sexual Health Clinics

The above survey conducted on 2,895 secondary school students of Emilia Romagna region during 2011-2012 reported lack of reference to primary care services in case of sexual health issues [19]. Moreover, health professionals are seldom involved in school-based sexual health programs, with the exception of few countries employing nurses (e.g. Hungary) [63]. However, in a survey on 785 college students from Hungary conducted in 2009, the most trusted source of sexual health information were health professionals [21].

In addition to the introduction of school SHE, the delivery of sexual health services at primary care should be strengthened in Italy. According to the committee for the rights of the child (CRC) all adolescents "*should have access to free, confidential, adolescent-responsive and non-discriminatory sexual and reproductive health services, information and education*" [76]. Most EU member states offer free access to community reproductive and sexual health services, considered critical for adolescents (especially girls) [76,77]. For instance, youth centres free of charge for individuals under 25 years of age have been implemented in Estonia since 1991-1992, delivering screening and treatment for STIs, counselling on contraception and STI prevention and support to teachers for school SHE programs [69].

The creation of sexual health clinics implies the institution of specialist training programs for sexual health professionals, who should cooperate with families, school teachers, local pharmacies and other allied health professionals (public health specialists, GPs, consultant gynecologists, health educators) to promote sexual health within an integrated multi-agency framework [77].

Conclusions

Consistently with other surveys conducted in Italy and elsewhere, university freshmen investigated in this study had a poor level of STIs and their prevention. These findings provide relevant indirect information on the standard of SHE delivered in Italian schools and call for the development of tailored multi-agency SHE programs involving several actors.

SHE programs should take into account the categories less knowledgeable about the STI risk, which in the present survey were males, students from the university of Palermo, those with vocational secondary school education, those of non-Italian nationality and whose fathers had a lower educational level. By contrast, biomedical students were significantly more knowledgeable. The difference in SHK between students from Sicily as compared to their colleagues of Northern Italy may confirm the obstacles SHE is facing to be introduced in the South of the country.

In addition to school-based SHE programs, primary care services dedicated to sexual health should be strengthened. The implementation of sexual health clinics should also be considered in Italy, with the view of providing adolescents with confidential, wide yet specialist reproductive and sexual health services, as in other EU countries, balancing prevention and counselling services for STIs as well as for birth control.

This entire cultural process of change needs the overcoming of the sexuality taboo, especially in Southern Italy.

Abbreviations

A&E=Accident & Emergency Service

EU=European Union

GP=general practitioner

HIV= human immunodeficiency virus

HAV= Hepatitis A virus

HBV=Hepatitis B virus

HCV= Hepatitis C virus

HPV=Human Papilloma virus

IUD=intra-uterine device

SHE= Sexual Health Education

SHK= Sexual Health Knowledge

STI= Sexually Transmitted Infection

WHO=World Health Organization

Declarations

Ethics approval and consent to participate. This study was approved by the ethical committee of the University of Padua. Written informed consent was obtained from study participants.

Consent for Publication. Not Applicable.

Availability of data and materials' The datasets generated and analyzed during the current study are not publicly available, since they were purposively collected by the authors for the present study, but may be available from the corresponding author on reasonable request.

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Authors' contributions

Authors contributions. LC designed the study, analyzed/interpreted the data and wrote the original draft; MB and CX conceived the idea, designed the study, coordinated the data collection, contributed to interpret the data and to write the original draft; GM contributed to interpret the data and to draft the original manuscript; GP, SB and AC contributed to draft the original draft. All authors have read and approved the manuscript.

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Tables

Table 1. Distribution of socio-demographic profile, educational level and family background by university campus. Number and column percentage (%).

VARIABLES	CLASSES	Total	Padua	Palermo	Bergamo	Milan
Sex (Missing: 8)	Female	3,194 (70.3)	1,200 (65.2)	1,296 (74.7)	469 (70.3)	229 (76.3)
	Male	1,350 (29.7)	641 (34.8)	440 (25.4)	198 (29.7)	71 (23.7)
Age (years) (Missing: 24)	Mean	21.4 ± 2.2	21.1 ± 1.8	21.8 ± 2.7	21.3 ± 1.5	21.1 ± 1.5
	Median (IQ range)	21 (20; 22)	20 (20; 21)	20 (20; 23)	21 (20; 22)	21 (20; 22)
	<21	2,125 (46.9)	955 (52.0)	871 (50.0)	194 (29.2)	105 (36.6)
	21-24	1,956 (43.2)	770 (42.0)	574 (33.0)	441 (66.3)	171 (59.6)
	25+	447 (9.9)	110 (6.0)	296 (17.0)	30 (4.5)	11 (3.8)
Nationality	Italian	4,405 (96.8)	1,753 (95.2)	1,713 (98.3)	647 (97.0)	292 (97.3)
	Non-Italian	147 (3.2)	89 (4.8)	30 (1.7)	20 (3.0)	8 (2.7)
Undergraduate course of study	Educational Sciences	1,591 (35.0)	489 (26.6)	651 (37.4)	151 (22.6)	300 (100)
	Literature/Foreign language	516 (11.3)	0	233 (13.4)	283 (42.4)	0
	Biology/medicine/ chemistry/natural sciences	817 (18.0)	483 (26.2)	270 (15.5)	64 (9.6)	0
	Engineering/architecture	971 (21.3)	545 (29.6)	344 (19.7)	82 (12.3)	0
	Political sciences/ Economics	657 (14.4)	325 (17.6)	245 (14.1)	87 (13.2)	0
Previous education (Missing: 84)	Scientific/classic/ university degree	2,659 (59.5)	980 (53.4)	1,199 (70.8)	341 (53.5)	139 (47.8)
	Language/ socio-pedagogical/artistic	612 (13.7)	319 (17.4)	157 (9.3)	73 (11.2)	63 (21.7)
	Vocational (Technical)	1,197 (26.8)	535 (29.2)	337 (19.9)	236 (36.3)	89 (30.6)
Residence (Missing: 29)	City centre	951 (21.0)	329 (18.0)	492 (28.5)	68 (10.2)	62 20.7)
	City Outskirt	838 (18.5)	308 (16.8)	399 (23.1)	69 (10.4)	62 (20.7)
	Town > 15,000 inhabitants	768 (17.0)	306 (16.7)	313 (18.1)	94 (14.1)	55 (18.3)
	Town < 15,000 inhabitants	1,966 (43.5)	886 (48.4)	525 (30.4)	434 (65.3)	121 (40.3)
Mother's nationality (Missing: 251)	Italian	4,158 (96.7)	1,753 (95.2)	1,713 (98.3)	647 (97.0)	292 (97.3)
	Non-Italian	143 (3.3)	89 (4.8)	30 (1.7)	20 (3.0)	8 (2.7)
Father's nationality (Missing: 273)	Italian	4,163 (97.3)	1,678 (94.9)	1,578 (99.9)	620 (97.0)	287 (98.0)
	Non-Italian	116 (2.7)	89 (5.0)	2 (0.1)	19 (3.0)	6 (2.0)

Father's education (Missing: 148)	University/more	791 (18.0)	287 (16.0)	380 (22.8)	58 (8.9)	66 (22.4)
	Secondary	2,097 (47.6)	883 (49.3)	778 (46.6)	301 (46.4)	135 (45.8)
	Lower	1,516 (34.4)	622 (34.7)	510 (30.6)	290 (44.7)	94 (31.9)
Mother's education (Missing: 104)	University/more	711 (16.0)	251 (13.9)	359 (21.3)	58 (8.8)	43 (14.6)
	Secondary	2,200 (49.5)	914 (50.5)	769 (45.6)	333 (50.7)	184 (62.6)
	Lower	1,537 (34.6)	645 (35.6)	559 (33.1)	266 (40.5)	67 (22.8)
Father's Occupation (Missing: 361)	Manager/professionals	828 (19.8)	355 (20.6)	293 (19.0)	99 (15.7)	81 (27.7)
	Technical employees	2,077 (49.6)	814 (47.2)	839 (54.3)	281 (44.6)	143 (49.0)
	Generic employees	657 (15.7)	304 (17.6)	165 (10.7)	155 (24.6)	33 (11.3)
	Other	629 (15.0)	250 (14.5)	249 (16.1)	95 (15.1)	35 (12.0)
Mother's occupation (Missing: 306)	Manager/professionals	747 (17.6)	272 (15.5)	341 (21.8)	81 (12.7)	53 (18.1)
	Technical employees	1,455 (34.3)	701 (40.1)	400 (25.6)	225 (35.2)	129 (33.0)
	Generic employees	1,837 (43.3)	708 (40.5)	739 (47.3)	296 (46.3)	94 (32.1)
	Other	207 (4.9)	69 (3.9)	84 (5.4)	37 (5.8)	17 (5.8)
Type of family (Missing 17)	Nuclear	3,796 (83.7)	1,488 (81.1)	1,514 (87.3)	551 (82.7)	243 (81.3)
	Other	739 (16.3)	347 (18.9)	221 (12.7)	115 (17.3)	56 (18.7)
Number of siblings	0	846 (18.6)	343 (18.6)	273 (15.7)	154 (23.1)	76 (25.3)
	1	2,429 (53.4)	993 (53.9)	884 (50.7)	375 (56.2)	177 (59.0)
	2	999 (22.0)	386 (21.0)	477 (27.4)	107 (16.0)	29 (9.7)
	3+	278 (6.1)	120 (6.5)	109 (6.3)	31 (4.7)	18 (6.0)
Older sibling of same sex (Missing 8)	Singleton	842 (18.5)	338 (18.4)	268 (15.4)	148 (22.2)	76 (26.3)
	Female with at least on older sister	309 (6.8)	147 (8.0)	105 (6.0)	48 (7.2)	6 (2.1)
	Male with at least on older brother	812 (17.9)	275 (15.0)	377 (21.7)	111 (16.7)	45 (15.6)
	Other	2,581 (56.8)	1,077 (58.6)	987 (56.8)	359 (53.9)	162 (56.1)
Current relationship? (Missing: 37)	Yes	2,710 (60.0)	1,042 (56.8)	1,120 (64.9)	387 (58.9)	161 (54.2)

No		1,805 (40.0)	793 (43.2)	606 (35.1)	270 (41.1)	136 (45.8)
Analysis restricted to responders currently in a romantic relationship						
Are you in love with your partner? (Missing: 42)	Yes	2,378 (89.1)	902 (87.3)	997 (91.1)	344 (90.3)	135 (84.9)
	No	64 (2.4)	27 (2.6)	18 (1.6)	10 (2.6)	9 (2.4)
	Do not Know	226 (8.5)	104 (10.1)	80 (7.3)	27 (7.1)	15 (9.4)
Duration of the current relationship (months) (Missing: 29)	<3	199 (7.4)	86 (8.3)	76 (6.9)	30 (7.8)	7 (4.4)
	3-6	218 (8.1)	81 (7.8)	86 (7.8)	38 (9.9)	13 (8.2)
	7-12	312 (11.6)	130 (12.6)	113 (10.2)	48 (12.5)	21 (13.2)
	13-24	558 (20.8)	250 (24.2)	189 (17.1)	82 (21.4)	37 (23.3)
	24+	1,394 (52.0)	486 (47.1)	641 (58.0)	186 (48.4)	81 (50.9)
Place where you first met your partner (Missing: 1)	School	557 (10.6)	228 (21.9)	217 (19.4)	84 (21.7)	28 (17.4)
	Club	555 (20.5)	206 (19.8)	233 (20.8)	83 (21.5)	33 (20.5)
	Gym	87 (3.2)	27 (2.6)	47 (4.2)	9 (2.3)	4 (2.5)
	Friend's place	664 (24.5)	241 (23.1)	304 (27.2)	75 (19.4)	44 (27.3)
	Internet	162 (6.0)	38 (3.7)	97 (8.7)	22 (5.7)	5 (3.1)
	Charity	113 (4.2)	70 (6.7)	26 (2.3)	12 (3.1)	5 (3.1)
	Other	571 (21.1)	232 (22.3)	195 (17.4)	102 (26.3)	42 (26.1)

Table 2. Answers to the question: "Which of the following diseases can be transmitted by sex?" Number and row percentage (%). DK= I do not know.

STI	TOTAL			MALES			FEMALES		
	Yes	No	DK	Yes	No	DK	Yes	No	DK
Warts	575 (15.0)	309 (8.1)	2,943 (76.9)	156 (13.8)	123 (10.9)	854 (75.4)	417 (15.5)	186 (6.9)	2,085 (77.6)
Streptococcus	747 (19.6)	870 (22.8)	2,199 (57.6)	220 (19.5)	233 (20.7)	674 (59.8)	524 (19.5)	636 (23.7)	1,523 (56.8)
Lymphogranuloma venereum	1,247 (32.1)	444 (11.4)	2,194 (56.5)	378 (33.0)	150 (13.1)	618 (53.9)	867 (31.7)	292 (10.7)	1,574 (57.6)
Hepatitis A	733 (19.1)	1,051 (27.4)	2,050 (53.5)	256 (22.6)	285 (25.2)	591 (52.2)	477 (17.7)	763 (28.3)	1,456 (54.0)
Gonorrhoea	1,737 (44.9)	339 (8.8)	1,793 (46.3)	532 (46.6)	107 (9.4)	502 (44.0)	1,204 (44.2)	231 (8.5)	1,287 (47.3)
Hepatitis B	1,260 (31.5)	955 (25.1)	1,650 (43.4)	346 (30.4)	275 (24.2)	516 (45.4)	852 (32.0)	678 (25.5)	1,132 (42.5)
HPV	1,954 (50.5)	337 (8.7)	1,578 (40.8)	471 (41.0)	99 (8.6)	588 (50.4)	1,481 (55.0)	238 (8.8)	994 (36.6)
TB	327 (8.5)	2,018 (52.2)	1,524 (40.0)	98 (8.6)	549 (48.0)	498 (43.5)	229 (8.4)	1,464 (53.9)	1,025 (37.7)
Hepatitis C	1,629 (42.2)	862 (22.4)	1,366 (35.4)	479 (41.9)	244 (31.4)	419 (36.7)	1,148 (42.4)	617 (22.8)	944 (34.9)
Candida	2,258 (58.0)	277 (7.0)	1,385 (35.0)	470 (40.6)	104 (9.0)	585 (50.5)	1,825 (65.3)	173 (6.2)	798 (28.5)
Mononucleosis	1,139 (29.3)	1,791 (46.2)	948 (24.5)	430 (37.7)	409 (35.9)	301 (26.4)	707 (25.9)	1,379 (50.5)	646 (23.7)
Syphilis	3,195 (80.0)	147 (3.7)	62 (16.3)	930 (79.4)	46 (3.9)	196 (16.7)	2,260 (80.3)	100 (3.6)	456 (16.2)
Genital Herpes	3,369 (84.0)	157 (3.9)	491 (12.2)	926 (79.2)	55 (4.7)	189 (16.1)	2,438 (85.9)	100 (3.5)	301 (10.6)
AIDS	4,056 (97.2)	48 (1.2)	68 (1.6)	1,176 (95.0)	19 (1.6)	31 (2.5)	2,874 (97.3)	29 (1.0)	37 (1.3)
Psoriasis	305 (7.9)	1,389 (36.1)	2,154 (56.0)	115 (10.2)	308 (27.3)	707 (62.6)	188 (6.9)	1,079 (39.8)	1,445 (53.3)

Table 3. Answers to the question: “Which of the following are the most efficacious methods to prevent sexually transmitted infections?” (correct answers green marked). The number of subjects was used as denominator of the percentage (%).

METHODS	TOTAL	MALES	FEMALES
Condom	3,712 (86.4)	1,084 (85.3)	2,623 (86.9)
Sexual abstinence	1,467 (32.2)	392 (29.0)	1,074 (33.6)
Anti-contraceptive pill	1,152 (25.3)	362 (26.8)	787 (24.6)
Coil	432 (9.5)	118 (8.7)	314 (9.8)
Morning after pill	367 (8.1)	174 (12.9)	190 (6.0)
Diaphragm	254 (5.6)	80 (5.9)	172 (5.4)
Contraceptive plaster	121 (2.7)	26 (1.9)	95 (3.0)
Transparent membrane	116 (2.6)	41 (3.0)	75 (2.4)
Interrupted coitus	112 (2.5)	74 (2.8)	38 (2.3)
Cervical cap	99 (2.2)	22 (1.6)	77 (2.4)
Vaginal washing	95 (2.1)	32 (2.4)	63 (2.0)
Spermicide	90 (2.0)	36 (2.7)	52 (1.6)
Basal temperature thermometer	73 (1.6)	24 (1.8)	49 (1.5)
Billing method	61 (1.3)	24 (1.8)	37 (1.2)
Male pill	12 (0.3)	7 (0.5)	5 (0.2)
Ulipristal acetate	4 (0.1)	3 (0.2)	1 (0.0)
Contraceptive sponge	17 (0.4)	9 (0.7)	8 (0.3)

Table 4. Endpoint 1 (mean and standard deviation (SD); median and interquartile range (IQR)) and Endpoint 2 (number and row percentage of wrong and correct answer) in the whole population and, separately, by sex and University Campus.

Groups	Endpoint 1 (range: 0-15)		Endpoint 2@	
	Mean \pm SD	Median (IQR)	Wrong answer	Correct answer
Total	5.3 \pm 2.9	6 (3-7)	3,279 (72.0)	1,273 (28.0)
Males	5.1 \pm 3.1	5 (3-7)	1,022 (75.7)	328 (25.8)
Females	5.4 \pm 2.9	6 (4-7)	2,250 (68.7)	944 (31.3)
Padua	5.8 \pm 2.6	6 (4-7)	1,216 (66.0)	626 (35.1)
Palermo	4.8 \pm 3.2	5 (2-7)	1,391 (79.8)	352 (22.0)
Bergamo	5.6 \pm 2.7	6 (4-7)	453 (67.9)	214 (34.2)
Milan	5.1 \pm 2.9	5 (3-7)	219 (73.0)	81 (28.3)
@ = 256 missing values (blanks)				

Table 5. Answer to the question: "What have you done when you contracted a sexually transmittable infection in the past?" Number (N); Column percentage (%).

OPTIONS	ALL CAMPUSES			PADUA		PALERMO		BERGAMO		MILAN	
	Total	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
I asked advice to an expert friend	39 (12.5)	7 (11.7)	32 (12.5)	4 (12.9)	9 (7.7)	2 (12.5)	20 (26.0)	1 (9.1)	2 (4.9)	0	1 (5.0)
I referred to a gynecologist	41 (13.1)	1 (1.7)	40 (15.7)	1 (3.2)	15 (12.8)	0	19 (24.7)	0	4 (9.8)	0	2 (10.0)
I tried to resolve it on my own	15 (4.8)	7 (11.7)	8 (3.1)	4 (12.9)	4 (3.4)	3 (18.8)	2 (2.6)	0	1 (2.4)	0	1 (5.0)
I went to my GP	119 (38.1)	25 (41.7)	93 (36.5)	13 (41.9)	41 (35.0)	7 (43.8)	28 (36.4)	4 (36.4)	17 (41.5)	1 (50.0)	7 (35.0)
I went to A&E	10 (3.2)	2 (3.3)	8 (3.1)	1 (3.2)	2 (1.7)	0	1 (1.3)	1 (9.1)	3 (7.3)	0	2 (10.0)
I spoke with somebody of my family	47 (15.1)	8 (13.3)	39 (15.3)	4 (12.9)	21 (17.9)	2 (12.5)	4 (5.2)	2 (18.2)	9 (22.0)	0	5 (25.0)
I have spoken with my partner	45 (13.1)	10 (16.7)	35 (13.7)	4 (12.9)	25 (21.4)	2 (12.5)	3 (3.9)	3 (27.3)	5 (12.2)	1 (50.0)	2 (10.0)
Total answers provided	312	60	255	31	117	16	77	11	41	2	20
Missing values on outcome: 5; Missing values on variable sex: 8											

Table 6. Analysis of multiple linear regression (endpoint 1) and multiple logistic regression (endpoint 2). Regression coefficients (RC) and Odds ratio (OR) with 95% confidence interval (95%CI).

FACTORS	CLASSES	Linear regression RC (95%CI)	Logistic regression OR (95%CI)
Sex	Female	Reference	Reference
	Males	-0.63 (-0.85; -0.41)	0.67 (0.54; 0.82)
Age (years)	<21	Reference	
	21-24	-0.11 (-0.30; 0.08)	
	25+	0.15 (-0.19; 0.49)	
University campus	Padua	Reference	Reference
	Palermo	-1.23 (-1.45; -1.01)	0.40 (0.33; 0.48)
	Bergamo	0.32 (0.01; 0.62)	0.91 (0.71; 1.17)
	Milan	-0.11 (-0.50; 0.29)	0.76 (0.54; 1.06)
Previous education	Classic/scientific/university degree	Reference	
	Artistic/language/socio-pedagogic	0.08 (-0.19; 0.36)	
	Vocational	-0.20 (-0.41; -0.02)	
Undergraduate course of study	Educational sciences	-1.04 (-1.41; -0.66)	0.56 (0.45; 0.71)
	Literature/Foreign language	-0.72 (-1.01; -0.43)	0.72 (0.53; 0.99)
	Biology/medicine/chemistry/natural sciences	Reference	Reference
	Engineering/architecture	-0.72 (-1.01; -0.43)	0.78 (0.61; 0.98)
	Political Science/ Economics	-0.63 (-0.94; -0.32)	0.62 (0.48; 0.80)
Nationality	Italian	Reference	Reference
	Non-Italian	-1.25 (-1.80; -0.70)	0.14 (0.06; 0.33)
Type of Family	Nuclear	Reference	
	Non-nuclear	0.36 (0.10; 0.59)	
Number of siblings	0	Reference	Reference
	1	0.01 (-0.24; 0.26)	0.95 (0.69; 1.30)
	2	-0.09 (-0.39; 0.20)	0.69 (0.49; 0.97)
	3	-0.18 (-0.59; 0.24)	1
Older sibling of same sex	Singleton		Reference
	Female with older sister		1.44 (0.92; 1.25)
	Male with older brother		1.39 (0.96; 2.01)
	Other		1
Father's education	University/more		Reference
	Secondary		0.64 (0.51; 0.82)
	Lower		0.69 (0.53; 0.90)
Mother's education	University/more	Reference	
	Secondary	0.04 (-0.26; 0.34)	
	Lower	-0.24 (-0.58; 0.10)	

Father's occupation	Manager/professionals	Reference	
	Technical employees	0.72 (0.53; 0.96)	
	Generic employees	1.06 (0.84; 1.33)	
	Other	0.95 (0.72; 1.26)	
Mother's occupation	Manager/professionals	Reference	Reference
	Technical employees	-0.09 (-0.38; 0.21)	0.90 (0.71; 1.13)
	Generic employees	0.12 (-0.19; 0.43)	0.89 (0.70; 1.12)
	Other	0.52 (0.04; 1.00)	1.40 (0.95; 2.07)

Endpoint 1. Knowledge of STI (Linear score 0-15). Model with 4,421 complete observations, adjusted for sex of interviewees, age of interviewees, university campus, undergraduate course of study, nationality of interviewee, previous education, type of family.

Endpoint 2. Knowledge of contraceptive methods most effective to prevent STI (Yes vs. No). Model with 3,982 complete observations, adjusted for sex of interviewee, university campus, undergraduate course of study, nationality of the interviewee, mother's occupation, father's occupation, number of siblings, older sibling of same sex, father's education.

Table 7. Knowledge of sexually transmitted infections (STIs): recognized as STIs from a list of diseases (% of correct answers, yellow marked); STI mentioned in an open question (% of correct answers, blue marked); self-rated knowledge of the STI (% of acceptable knowledge) green marked; knowledge of existence (or "heard) of the STI or its sexual related risk (% of correct answers, orange marked). Present results compared with published findings. T=Total study subjects; M=Males; F=Females. First column grey marked: surveys conducted on university students; first column blue marked= surveys conducted on secondary school students.

N. of study subjects analyzed (sampled, geographical area) [reference]	Pooled %	HIV/AIDS (%)			Syphilis (%)			Gonorrhea (%)			Chlamydia (%)			HPV (%)			HBV (%)			HCV (%)			HAV (%)			Candida (%)			Genital Herpes (%)				
		T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F					
ITALY																																	
4,552 (4,659) (present survey)		97.2	95.0	97.3	80.0	79.4	80.3	44.9	46.6	44.2	32.1	33.0	31.7	50.5	41.0	55.0	31.5	30.4	32.0	42.2	41.9	42.4	19.1	22.6	17.7	58.0	46.6	65.3	84.2	75.9	85.9		
1,022 (Palermo) [13]		99.4	99.3	99.5	93.5	95.0	93.0	83.8	86.2	82.7	81.8	81.5	81.9	82.6	84.2	81.9	4.1	5.4	3.6	4.4	6.0	3.7				4.3	4.4	4.3	82.6	84.2	81.9		
626 (Catanzaro) [14]	14.2	99.4			34.5						16.5					23.7															27.7		
1,228 (Messina) [15] (396 undergraduates)		97.4 [†]			76.1 [†]									41.4 [†]											62.7 [†]								
216 (251, Catanzaro) [29] 16		89.7 [‡]																															
6,467 (11 regions) [17]		98.4	98.1	98.6	17.3	17.2	17.5	8.9	8.8	8.9																							
2,867 (Lecce/Genoa) [18]	0.5 [‡]																																
2,695 (Ferrara) [19]		98.9	98.5	99.3																					72.0	71.6	72.0	65.5	48.9	77.1			
1,588 (Messina) [20]		91			45									19													22				28		
956 (Naples/Caserta) [21]														54.9																			
863 (Milan) [22]														66.3	51.2	71.6																	
1,228 (Messina) [13] (832 secondary school pupils)	7.9	99.3			67.9									23.0										55.9		52.8							
540 (Stena) [23]		96.0			17.0																												
139 (Milan) [24]		44.2			6.2			3.1			3.1			5.5			2.6 [‡]			2.6 [‡]						4.3					6.2		
EUROPE																																	
3,872 (Romania) [25]		98.0	97.1	98.4				75.8	71.5	77.4	61.1	51.3	64.2				36.9	36.6	37.0	40.0	41.1	39.7											
522 (Irigu Mures, Romania) [26]														82.1 [†]	(99.1)																		
367 (Galicia, Spain) [27]														80.1																			

N. of study subjects analyzed (geographical area) [reference]	Pooled %	HIV/AIDS (%)			Syphilis (%)			Gonorrhoea (%)			Chlamydia (%)			HPV (%)			HBV (%)			HCV (%)			HAV (%)			Candida (%)			Genital Herpes (%)					
		T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F						
70 (Tirana, Albania) [28]	20.0																																	
4,547 (Greece) [29]														42.8	35.5	47.9																		
2,614 (Galway, Eire) [30]		91.0																																
1,177 (Berlin, Germany) [31]		90.1 [*]			39.5 [*]			29.4 [*]			25.5 [*]			27.6 [*]			53.2 [*]												44.5 [*]					
769 (Pomerania, Germany) [32]		100	100	100																														
605 (Sweden) [33]														13.5	9.6	16.4																		
459 (Uppsala, Sweden) [34]		88.0					50.0				86.0			0.2																64.0				
432 (Devon, UK) [35]		97.7	96.2 [†]	100 [†]	45.0	45.3 [†]	47.0 [†]	53.0	52.4 [†]	53.0 [†]	34.0	13.2 [†]	22.7 [†]																59.1	71.7 [†]	75.8 [†]	52.4		
423 (Nicosia, Cyprus) [36]		92.0			21.0			48.2			6.9			24.4			28.6			18.7			18.4						13.7					
397 (Tampere, Finland) [37]														33.0																				
278 (Sarajevo, Bosnia) [38]		90.6	95.5		82.9			64.9			52.9																							
270 (Riga, Latvia) [39]														21.5	8.1	35.6																		
209 (Uppsala, Sweden) [40]		100									70.0	60.0	79.0																					
146 (Sweden) [41]		99.0																																
102 (S. Petersburg, Russia) [42]		92.0	86.0	97.0																														
88 (Sweden) [43]							98.0				96.0																			90.0				
108 (Zagreb & Nova Gradiska, Croatia) [44]		8.2 [†]																																

[‡] humanistic (top of the cell) vs. scientific (bottom of the cell) undergraduate students

@ Combined knowledge self-rated as “*excellent*” (7.9%) or “*good*” (40.3%) or “*moderate*” (41.5%)

& correct answers to HIV, syphilis, hepatitis A, hepatitis B, hepatitis C, herpes simplex infection, candida and genital warts

\$ “hepatitis”, not otherwise specified

€ 1st year (top of the cell) vs. 6th year (bottom of the cell) biomedical students

* Knowledge self-rated as “*good*” or “*rather good*” or “*mediocre*”

£ year 11 pupils (top of cell) vs. year 9 pupils (bottom of cell)

linear score ranging from -15 to +15

NOTES

[13] Santangelo et al. 2018: 1,022 undergraduate biomedical students (out of 1,100 sampled) aged 18-27 years from the university of Palermo, investigated in 2017 by self-administered questionnaire

[14] Trani et al. 2005: 644 undergraduate and secondary school students (out of 651 sampled) aged 14-20 analyzed, from the city of Catanzaro (Calabria, Italy), surveyed in 2003.

[15] Visalli et al. 2019: 1,228 students (out of 1,261 sampled) analyzed (396 university freshmen and 832 last year secondary school students) aged 17+ years sampled from the city of Messina (Sicily, Italy), surveyed in 2017 by self-administered questionnaire.

[16] Mazzitelli et al. 2016: 216 first year medical students (18-20 years of age; 100 males, 110 females), sampled from the university of Catanzaro (Calabria region, Italy), surveyed on HIV knowledge and prevention by self-completed questionnaire.

[17] Donati S et al 2000: 6,467 students (out of 7,484 sampled) surveyed from the first 2 years of secondary schools of 11 Italian regions

[18] Drago 2016 et al: 2,867 students (out of 2,880 sampled) aged 14-21, 1,271 males and 1,596 females, surveyed during 2013-2014 from 16 secondary schools of the city of Genoa (Liguria region, Italy) and 5 from the city of Lecce (Apulia region, Italy).

[19] Bergamini et al 2013: 2,695 secondary school students (out of 2,800 sampled) aged 14-19 years (average 17.1 years) from city of Ferrara (Emilia Romagna, Italy) during 2011-2012.

[20] Visalli et al. 2014: 1,588 students, surveyed from 7 secondary schools (last 3 class year) surveyed from the city of Messina (Sicily, Italy) in 2013 by self-administered questionnaire

[21] Napolitano et al. 2016: 956 undergraduate and secondary school students (out of 1,000 sampled) from Napoli and Caserta area (Campania region, Italy), aged 14-24 years (mean age 19.6 years), surveyed in 2015 by self-administered questionnaire

[22] Pelucchi et al 2010: 863 secondary school students (out of 1,092 sampled). Aged 14-20 years, selected by convenience sample from Great Milan area (Italy), home completed questionnaire.

[23] Kundisova et al. 2019: 540 students from 6 secondary schools of the city of Siena (Tuscany); survey conducted by self-administered questionnaire in 2018, 78% response rate

[24] Orlando et al 2019: 139 pupils (out of 178 sampled), aged 16-17 years, surveyed from a secondary school of Milan (Italy) in 2017 at pre-test, before an intervention based on 2 hour interactive sexual health conference.

[25] Grad et al. 2018: 3,872 undergraduate students aged 18-25, sampled from Romanian universities during January-February 2016, completed an internet based questionnaire

[26] Voidazan et al. 2016: 522 medical students (out of 670 sampled) surveyed from the university of Tirgu Mures (Romania) in 2015.

- [27] Villanueva et al. 2019: 367 nursing students (out of 365 sampled) from Spain (aged 18+; 292 females vs. 75 males)
- [28] Ciccurese et al. 2019: 70 freshmen (49 females and 21 males) from Nursing and Physiotherapy programs at the University of Tirana, aged 18-29 years (mean: 21.8 years), surveyed by self-administered questionnaire in 2016.
- [29] Vaidakis et al. 2019: Nationally representative survey (targeted population of approximately 100,000 subjects) on 4,507 students (2778 females and 1729 males), aged 17-18, sampled from 84 secondary schools of Greece, self-completion questionnaire.
- [30] Fogarthy J 1990: Classroom completed questionnaire on 2,614 leaving certificate students aged 15-18 from 50 second-level schools in Galway (Ireland), response rate (?)
- [31] Von Rosen et al. 2018: 1,177 students (out of 1,190 sampled) of 16 secondary schools of Berlin, mean age 14.6 years; surveyed by self-administered paper questionnaire in 2012
- [32] Sachsenweger et al. 2005: 769 secondary school students aged 11-18 from Pomerania (Germany), surveyed by classroom completed questionnaire.
- [33] Gotvall et al. 2008: 608 students (86% response rate) aged 15-16 years from 7 secondary schools in Sweden.
- [34] Hoglund et al. (year NOS): 459 students (98 % response rate) of 5 upper year secondary schools of Uppsala (Sweden), aged 15-20, response rate 98%, surveyed by classroom completed questionnaire
- [35] Garside et al. 2001: 432 adolescents, 13-16 years (year 9 and 11), surveyed from 1 secondary school in Devon (England) during 1999-2000, completed a classroom completed questionnaire
- [36] Kaptanoğlu et al. 2013: 423 students (out of 450 sampled) - mean age: 15.6 years- randomly sampled from the largest secondary school of Nicosia (North Cyprus).
- [37] Woodhall et al 2005: 397 year 9 pupils (21.5% response rate) aged 14-15, in Tampere (Finland), surveyed in 2005 by home completed questionnaire.
- [38] Mahmutovic Vranic S et al. 2019: 278 students (mean age 17.8 years) from 2 secondary schools of Sarajevo (Bosnia Herzegovina), completed a classroom questionnaire in 2018.
- [39] Patel et al 2017: 270 secondary school students aged 16-21, from Riga (Latvia), surveyed in 2015 by self-completed questionnaire administered during sexual health classes.
- [40] Tyden et al 1988: 209 students (98% response rate) aged 16-19 years from 5 upper secondary schools in Uppsala (Sweden), surveyed by class completed questionnaire in 1988.
- [41] Eriksson et al. 1994: 146 students (100% response rate) aged 14-16 years from 1 secondary school in Sweden (city NOS), surveyed by classroom completed questionnaire in 1994.
- [42] Goodwin et al. 2004: 102 secondary school pupils (age 14-17) from San Petersburg (Russia), Tbilisi (Georgia) and Kiev (Ukraine), underwent a face to face interview in 2000.
- [43] Andersson-Elstrom et al 1992: 88 year one secondary school pupils (58% response rate) aged 16-18 years from Karlstad (Sweden) completed a questionnaire at the clinic.
- [44] Macek et al. 2005: 108 students (year 7 and 8) from 2 secondary schools in Croatia, one from a small town (Nova Gradiška) and one from Zagreb (the capital), surveyed by classroom completed questionnaire.

Figures

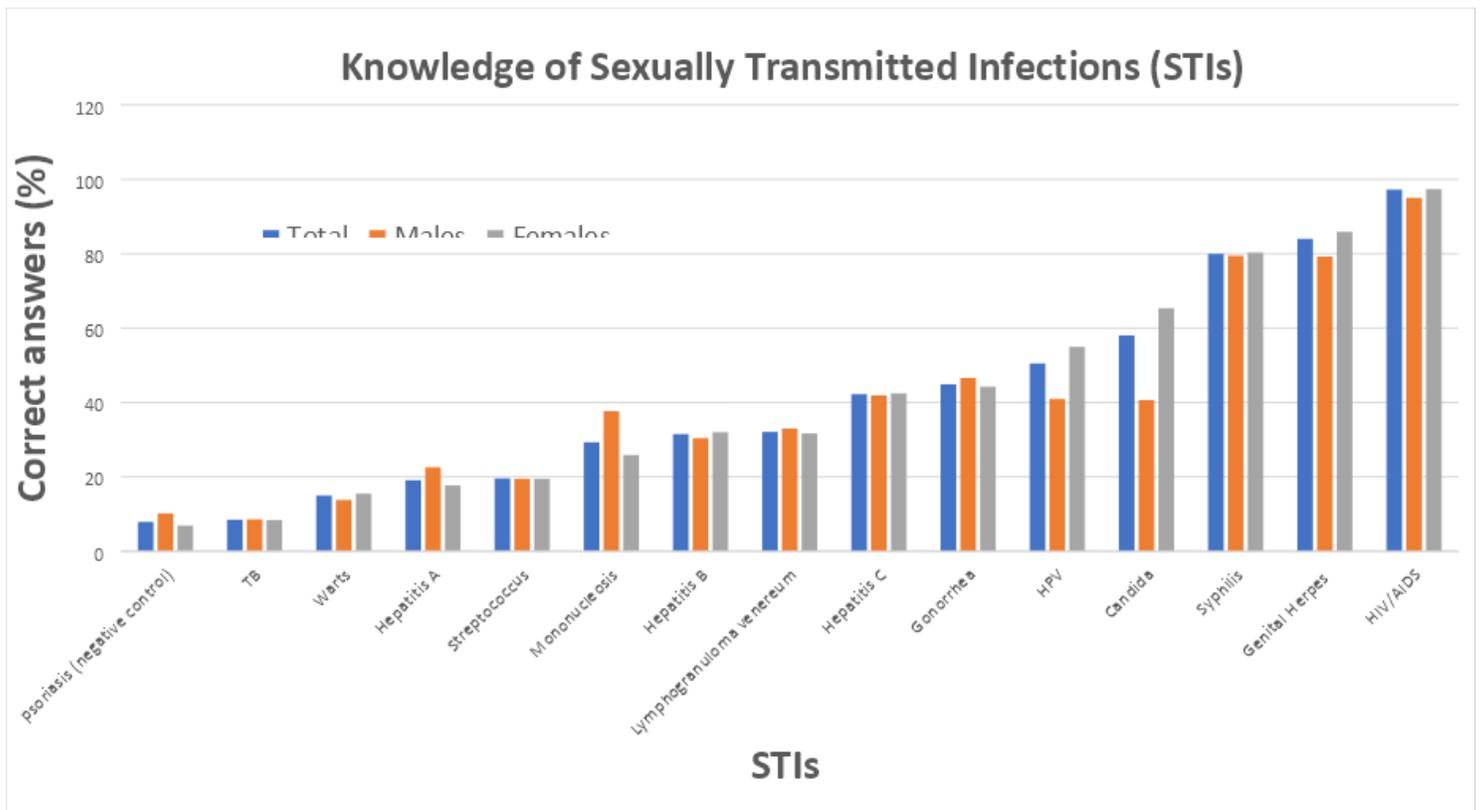


Figure 1

Distribution of correct answers (percentages) to the question “Which of the following diseases can be transmitted by sex?”, by sexually transmitted Infections (STI) and sex of interviewees.