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Smoking habits, ETS exposure and knowledge of tobacco and e-cigarettes/HTPs among university students in Italy—a multicentre study

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Abstract

Background Tobacco smoking is a leading cause of morbidity and mortality worldwide, responsible for about 61,300 deaths annually in Italy. In addition to tobacco cigarettes, the use of electronic cigarettes (e-cigs) and heated tobacco products (HTPs) has increased among young people, raising public health concerns. This study aimed to investigate smoking habits, exposure to passive smoke, and awareness of health risks among Italian university students.

Methods A multicentre observational survey was carried out by 8 Italian Universities to promote smoke-free lifestyles among students. All students were sent an anonymous online questionnaire via email regarding their smoking habits, their exposure to second-hand smoke, and their knowledge of, and opinions on, smoking. Descriptive statistics and multinomial logistic regression models were applied to assess associations between tobacco and nicotine use with sex and areas of study.

Results A total of 20,644 students from different study areas were included in the study: 62.3% did not smoke, 9.9% were former smokers, 14.4% were smokers of tobacco cigarettes exclusively, 6.5% of e-cigs or HTPs, and 6.9% were dual smokers (total smokers 27.8%). Smoking prevalence was highest among Law (35.9%) and Economics (33.7%) students, and lowest among Medicine and Sciences and Technology students (22%). Males were more likely to smoke tobacco or to be dual users, while females reported higher e-cig use; most smokers consumed fewer than 10 cigarettes/day with mild nicotine dependence. Among e-cig/HTP users, over 60% started as an alternative to cigarettes, but 22% started or resumed tobacco smoking after using them and 22% had never smoked tobacco cigarettes before. Passive smoke exposure was common: 26.5% lived with smokers and 58.9% reported peer exposure. While nearly all students recognized the harms of both active and passive tobacco smoking, only 60% considered passive exposure to e-cigs/HTPs as dangerous. About 70% were favourable to stricter enforcement of university smoking bans. Conclusions: Traditional cigarettes remain the most used product among Italian university students,

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but e-cigs and HTPs are increasingly widespread and socially accepted, even among never smokers. Awareness of the risks of alternative products is limited, and passive exposure remains underestimated. These findings underline the importance of targeted educational campaigns and stronger enforcement of smoke-free policies in academic settings.

Keywords University students, Tobacco smoke, E-cigarette, HTP, ENDS, Smoking habits, Passive smoke, Awareness, Knowledge

Introduction

Active tobacco smoking and environmental tobacco smoke (ETS) represent a major public health issue worldwide, as major risk factor for cancer, cardiovascular and respiratory diseases [1]. Worldwide, tobacco smoking is responsible for approximately 7.7 million deaths per year [2], while in Italy it is estimated to cause about 61,300 deaths per year [3]. Despite the fact that several legislative measures have been implemented in Italy in recent decades, the prevalence of smoking has decreased only from 24% in 2001 to 22% in 2019 [4].

In recent years, in addition to the smoking of traditional cigarettes, a major concern has been the spread of different nicotine products, such as heated tobacco products (HTPs), electronic cigarettes (e-cig), and other disposable electronic nicotine delivery systems (ENDS), for example shaped like USB flash drives, which are particularly popular among young people and are becoming the most common tobacco product in this age group [5, 6].

In Italy, the vaping market has continued to grow, with an estimated 1.5 million vapers in 2021 [7]. The 2022 Global Youth Tobacco Survey (GYTS) [4] shows that the percentage of young Italians aged 13–15 years using traditional cigarettes is decreasing, falling from 21% in 2018 to 16% in 2022 (13% for boys, 17% for girls). On the contrary, the number of those using e-cig has risen over the years among current smokers (at least once in the past 30 days), passing from 4% in 2014 to 20% in 2022. The e-cigarette use is more common among females (21%) than males (18%). As regards HTPs, the use of which was recorded for the first time in the 2022 Italian survey, they are used by 23% of never smokers of tobacco cigarettes (20% of boys and 27% of girls) and 14% of current smokers (12% of boys and 16% of girls). In 2022, therefore, the proportion of smokers was higher among girls than boys for all products considered. The proportion of boys and girls who used only traditional cigarettes (2%) was drastically reduced in favour of the combined use of traditional cigarettes and e-cigarettes or HTPs (14%).

Among Italian young adults (18–24 years), the prevalence of exclusive traditional cigarettes smokers is 24.2%, decreasing with increasing educational level, while the prevalence of e-cigarette or HTP users in the same age group is 7.5% and 9%, lower than in the younger group [8].

This increasing trend in the use of e-cigs and HTPs in young Italians highlights the need for educational interventions on the harms of smoking (both traditional cigarettes and alternative products), particularly targeted to young people [9, 10]. Legislative measures have been taken to address the problem of smoking among young people, including a specific ban on smoking in outdoor areas of schools and colleges (Italian Law DL128/2013). However, the prevalence of smoking among young people in Italy is still one of the highest in Europe.

Although most people start smoking during adolescence, smoking often becomes a regular habit during young adulthood [11]. Therefore, specific prevention and cessation strategies should be directed to this age group. In particular, college and university campuses are considered effective environments for both preventing smoking and supporting cessation among young adults [12, 13].

With the aim of implementing common policies of health promotion to counter the use of tobacco cigarettes and new products among university students, the University of Milan (Italy) carried out a survey among Milan university students [14, 15] and coordinated the national initiative "University Smoke free" involving 14 universities. The main objectives of the network are: to update and homogenize the university smoking regulations, to investigate active and passive smoking among students and staff, to implement initiatives for supporting smoking cessation, and to produce information and teaching materials. In the frame of this initiative, a multicentre survey in 8 Italian Universities (Bergamo, Brescia, Milan Statale, Milan Bicocca, Milan Humanitas, Parma, Pavia, and Urbino) was carried out to provide a comprehensive overview of smoking habits among Italian college students, their exposure to passive smoke at home and with peers, their compliance with smoking bans, and their awareness about health effects of active and passive smoking. The aim of this study is to present the results of this national survey, with a focus on differences possibly arising from the diverse educational programmes.

Material and methods

Study design, setting and participants

The multicentre observational survey was carried out by 8 Italian Public and Private Universities: Bergamo, Brescia, Milan Statale, Milan Bicocca, Milan Humanitas, Parma, Pavia, and Urbino. Most of these Universities

offer a multidisciplinary educational program, including bachelor's or single-cycle degrees (3-, and 5- or 6-year courses, respectively) and master's degrees (2-year courses), and collectively host more than 215,000 students. The survey consisted of filling out a web-based and previously validated questionnaire on smoking habits and perceptions [14].

In 2023/2024, students from the bachelor's, single-cycle degrees, and master's degrees of the participating Universities received an invitation letter from the Dean, or the delegate, of their university to participate in the research, followed by a letter from the researchers involved in the project containing the link to access the consent form and the questionnaire. Students from doctoral programs (Ph.D), postgraduate schools, and second level vocational master's programs were not included in the survey. The survey was conducted using the online survey tools Lime-survey or Qualtrics. To maximize the response rate, three subsequent reminders two weeks apart were sent to students who did not complete the questionnaire. The students could express their informed consent to participate in the study by clicking on the appropriate link, and only after giving their consent, they had access to the questionnaire. A copy of the informed consent was available for download. The responses were collected anonymously as each student was assigned a random unique identifier. Students were able to complete the questionnaire even if it was only partially filled out; however, they were required to respond to each question in order to proceed through the questionnaire. After submitting the form, even if it was not fully completed, the responses were saved and the student could no longer access the questionnaire.

The study was approved first by the local Ethics Committee of the principal investigator unit (University of Milano Statale, protocol number 85/22) and then by the competent Ethics Committee of each University.

Questionnaire for the assessment of smoking habits, attitudes, knowledge, and needs

The questionnaire used for the survey was developed and validated by the principal investigator unit as described previously [14, 15]. Both an Italian and an English version of the questionnaire were available to participants.

The questionnaire included 92 items organized in seven sections: demographics (4 items), current smoking of traditional tobacco cigarettes (9 items plus 6 items from Fagerström Test to evaluate the nicotine dependence), past use of traditional tobacco cigarettes (7 items), current or past use of e-cigarettes or HTP products (23 items), passive smoke exposure (6 items), awareness of health issues related to smoking (15 items plus 8 items related to the role of health professionals in helping patients to quit smoking derived from the WHO Global Health Professions Student Survey (GHPSS)) [16], and knowledge and attitudes towards Italian smoking legislation, and educational needs (11 items).

The first section of the questionnaire included the self-classification of smoking status according to the following categories: never smoker (i.e., never smoked or have smoked less than 100 cigarettes in life), past smoker (current non-smoker, but has smoked more than 100 cigarettes in life), current smoker of traditional tobacco cigarettes exclusively, current user of electronic cigarette or HTP products exclusively, current dual users (both traditional and e-cigs or HTPs). Based on this smoking declaration, participants had access to different sections of the questionnaire.

Data analysis

Only questionnaires containing at least the smoking status self-classification were analysed. To describe smoking habits by sex, "intersex" and "preferred not to answer" categories were grouped together due to the small number of responders who chose these answers (1.2% of the total responders).

Similarly, the specific course degrees of each university were grouped by study area as follows: MED = Medicine + veterinary + pharmacy; LAW = Law; ECO = Economics + political studies; ENG = Engineering; STE = Life Science + Physical Science + Maths + Chemistry + Technology studies; HUM = Humanistic studies + arts + educational studies + communication.

Categorical variables were summarized by absolute frequency and percentage, while numerical variables by mean and standard deviation (± SD).

A multinomial multivariable logistic regression model was then used to estimate the association between individual characteristics and smoking status. The dependent variable included four categories: non-smoker (reference category), exclusive tobacco smoker, exclusive e-cigarette/HTPs user, and dual user (users of both tobacco cigarettes and e-cig or HTPs), while the covariates simultaneously included in the model were sex, age group, and study area. Interactions were tested, but not included in the final model, as they were not statistically significant. Odds ratios (ORs) and 95% confidence intervals (95% CI) were calculated for each outcome category relative to non-smokers. Multicollinearity was excluded using Cramer's V for each pair of covariates. The analyses were performed using the Stata TM 17.0 statistical package (Stata Statistical Software Release 17.0, 2021; Stata Corporation, College Station, Texas, USA).

Results

Study participants

A total of 24,224 students from different Universities accessed the questionnaire, while 20,644 questionnaires

were available for the statistical analysis as contained at least the smoking status self-classification. The percentage of completeness was different from one section to another, slowly decreasing along the questionnaire and being 92.5% at the last section. The response rate was 9.6% of the target population (215,027 students), ranging from 3.6% (Parma University) to 25.6% (Milano Humanitas University) (Table SM1).

Table 1 shows the distribution of students for each study area, the number of responders and their characteristics by sex. The percentage of females who responded was higher ($p < 0.001$) than males in all study areas: the proportion of female respondents was 63.0% compared to 35.8% of males, reflecting the higher proportion of females in the student population (58.3% vs 41.7% males). Only a small percentage of students declared themselves to be intersex (0.2%) or did not declare their sex (1.0%). According to the study area, the survey participants were mainly from the HUM area (30.5%), while the LAW students constitute the smallest group (5.9%), similar to the target student population. Participation rates ranged from 6.0% (LAW) to 14.6% (MED).

Most responders were aged between 18 and 25 (81.9%), 12.0% were aged between 26 and 33, and 6.1% were older (data not shown in table).

Smoking habits

Figure 1 and Table SM2 show the percentage of smokers (of all products), former smokers and never smokers. Most students (62.3%) classified themselves as never smokers, 9.9% as former smokers (total non-smokers 72.2%), 14.4% as current smokers of tobacco cigarettes exclusively, 6.5% as current users of e-cigs or HTPs exclusively, and 6.9% as dual smokers, so 27.8% of students were found to be smokers of any product (Table SM2). According to the study area, some differences were noted: LAW students had the highest percentage of smokers (35.9%), followed by ECO students (33.7%) (Fig. 1). The lowest percentages of smokers were found among STE and MED students (approximately 22%). Multinomial logistic regression models showed that ECO, LAW, and HUM students had higher probability to smoke, both tobacco cigarettes and e-cig/HTPs, or being dual users, than MED students ($p < 0.001$), while STE students had a lower probability of being e-cig/HTPs or dual users than MED students (Table 2).

Students aged 18–25 were more likely to be tobacco smokers, exclusively e-cig/HTPs users, or dual users than older students, while males had a higher probability to be tobacco cigarette smokers or dual smokers than females, whereas more females used e-cig than males (Table 2).

Smoking of traditional tobacco cigarettes

Table 3 reports the smoking habits of tobacco smokers (both tobacco-only and dual smokers) according to study area. Overall, 76.3% of smokers smoked tobacco cigarettes daily. The average age at initiation was about 16 years old, similar in all study areas. The main reasons for starting to smoke were peer pressure (25.5%), pleasure (22.3%), and stress (12.2%) (data not shown in table). More than half of the smokers reported to smoke fewer than 10 cigarettes/day, with small differences among study areas. The highest percentage of mid-to heavy smokers (15–19 cigarettes a day) and heavy smokers (more than 20 cigarettes per day) was found among ENG and LAW students (12.0% and 4.7%, respectively), while the lowest was found among MED students (5.2% and 2.6%, respectively).

Fagerström test scores showed that most tobacco smokers were mildly addicted to nicotine (about 15% were moderate, and 2.0% were very strongly addicted). Students showed moderate differences by study area, with the highest percentages of strong or very strong addiction in the LAW and HUM areas, while the highest prevalence of students with mild addiction was found in the MED area ($p = 0.03$). The prevalence of students planning to quit tobacco cigarettes was higher among LAW and ENG students (> 25%) than other students ($p < 0.01$).

Most smokers reported smoking only outdoors (58.6%), however 40.7% reported smoking both outdoor and indoor, with a slightly higher prevalence in the ECO, LAW and HUM areas. More than half of the students

Table 1 Target population and responders for each study areas

	Target population		Responders				
Study area	**Total (N, %)**	**Females (N, %)**	**Total (N, %)**	**Females (N, %)**	**Males (N, %)**	**Intersex or not declared sex (N, %)**	**Response rate (%)**
ECO	31,770 (17.3)	15,738 (49.5)	2986 (14.5)	1699 (56.9)	1266 (42.4)	21 (0.7)	9.4
LAW	20,400 (11.1)	13,603 (66.7)	1217 (5.9)	874 (71.2)	333 (27.4)	10 (0.8)	6.0
ENG	21,241 (11.6)	5756 (27.1)	2461 (11.9)	787 (32.0)	1656 (67.3)	18 (0.7)	11.6
MED	32,148 (17.5)	19,469 (60.6)	4691 (22.7)	3249 (69.3)	1405 (29.9)	37 (0.8)	14.6
STE	29,782 (16.2)	15,036 (50.5)	2984 (14.5)	1562 (52.3)	1376 (46.1)	46 (1.6)	10.0
HUM	79,686 (43.3)	55,645 (69.8)	6305 (30.5)	4831 (76.6)	1358 (21.6)	116 (1.8)	7.9
Total (N, %)	**215,027 (100)**	**125,247 (58.3)**	**20,644 (100)**	**13,002 (63.0)**	**7394 (35.8)**	**248 (1.2)**	**9.6**

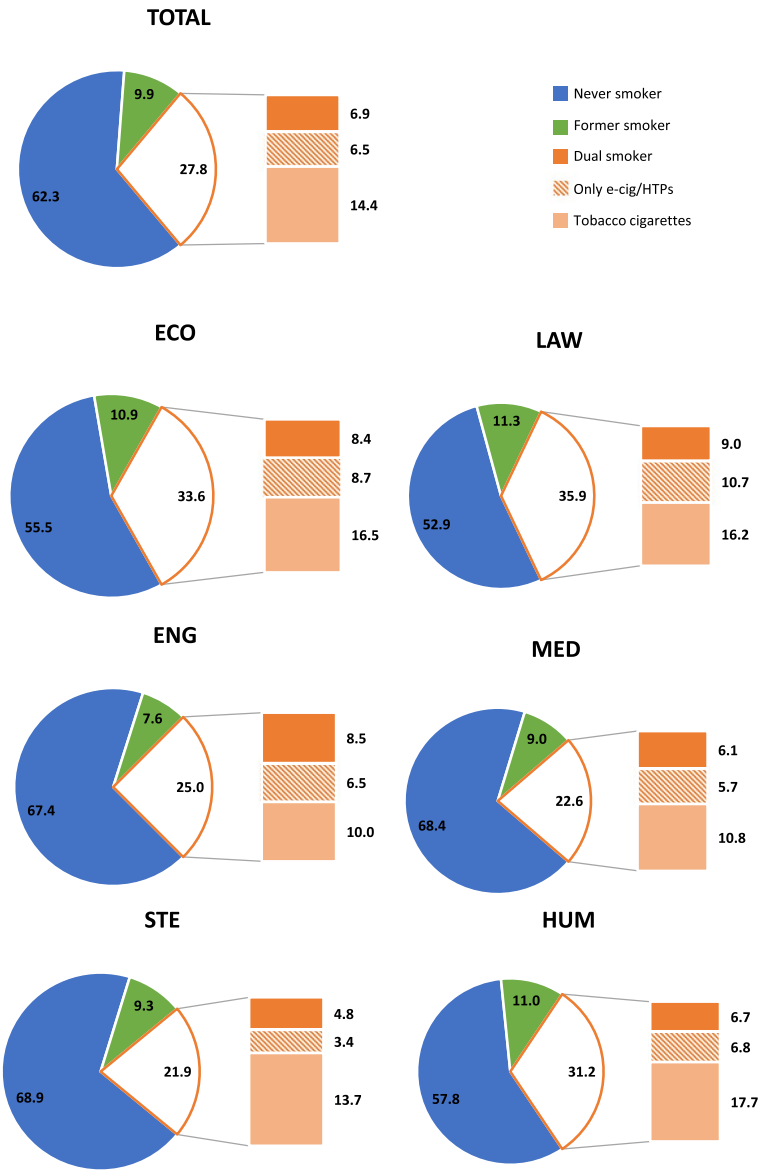

Fig. 1 Frequency of ever users of cigarettes and/or e-cig/HTP in smoker responders according to study areas

(57.9%) smoked in the presence of family without restrictions, with significant differences among the study areas ($p = 0.01$).

While on campus, most smokers (38.1%) reported smoking only outdoors, 12.6% only in designated smoking areas, while 4.3% reported not smoking on campus (data not reported in table).

Electronic cigarettes or HTP use

The percentage of participants who currently used exclusively e-cig and/or HTP was 6.5% (Table SM2).

Table 4 reports smoking habits of e-cig and HTP users. About 50% of e-cig smokers were daily users and most of them used e-cig with nicotine and flavours (64.1%), with the highest prevalence in the MED and ENG study areas. Among HTPs smokers, 61% were daily smokers with the highest prevalence in the ECO and LAW study areas and most students used less than 10 refills per day (data not reported in table).

About 80% of students used e-cigs both outdoors and indoors, similar to HTPs users (77.4%), but unlike tobacco cigarettes smokers (40.7%, see Table 3).

A higher percentage of students used e-cig/HTPs freely with their family than tobacco cigarette smokers (63.9% and 62.5% vs. 57.9%), with no significant differences among the study areas.

Of those who have ever used e-cigarettes or HTPs, most started using these electronic devices as an alternative to tobacco cigarettes (63.1% and 68%, respectively), because they considered these devices less harmful to health than

Table 2 Results from multinomial logistic regression model evaluating variables associated with the probability of being an exclusive tobacco smoker, exclusive e-cigarette/HTPs user, and dual user, using non-smoker as the reference category

Variable	Exclusive tobacco smoker vs Non-smoker		Exclusive e-cigarette/HTPs user vs Non-smoker		Dual user vs Non-smoker	
	OR (95%CI)	*p-value*	OR (95%CI)	*p-value*	OR (95%CI)	*p-value*
Sex						
Female	Ref		Ref		Ref	
Male	1.53 (1.40—1.67)	< 0.0001	0.74 (0.65—0.85)	< 0.0001	1.19 (1.05—1.35)	0.007
Intersex/Not declared	1.84 (1.34—2.53)	0.0002	0.57 (0.29—1.13)	0.1067	1.46 (0.90—2.36)	0.1295
Age class						
18–25	Ref		Ref		Ref	
26–33	1.11 (0.99—1.26)	0.0844	0.93 (0.78—1.11)	0.44	0.77 (0.64—0.94)	0.0088
34–41	0.75 (0.59—0.96)	0.0226	0.41 (0.26—0.65)	0.0001	0.26 (0.15—0.46)	< 0.0001
42–49	0.60 (0.43—0.84)	0.0027	0.44 (0.26—0.76)	0.0029	0.23 (0.11—0.48)	0.0001
> = 50	0.56 (0.39—0.81)	0.0021	0.20 (0.08—0.48)	0.0003	0.31 (0.16—0.64)	0.0014
Study area						
MED	Ref		Ref		Ref	
ECO	1.63 (1.42—1.88)	< 0.0001	1.76 (1.46—2.11)	< 0.0001	1.56 (1.29—1.88)	< 0.0001
ENG	0.80 (0.67—0.95)	0.0114	1.31 (1.06—1.62)	0.0141	1.32 (1.07—1.62)	0.0098
HUM	1.94 (1.72—2.18)	< 0.0001	1.32 (1.12—1.55)	0.0009	1.35 (1.14—1.60)	0.0004
LAW	1.81 (1.51—2.19)	< 0.0001	2.16 (1.72—2.71)	< 0.0001	1.95 (1.53—2.48)	< 0.0001
STE	1.16 (1.00—1.34)	0.0514	0.59 (0.46—0.74)	< 0.0001	0.72 (0.58—0.90)	0.0041

OR Odds Ratio, *CI* Confidence Interval, *MED* Medicine + veterinary + pharmacy, *LAW* Law, *ECO* Economics + political studies, *ENG* Engineering, *STE* Life Science + Physical Science + Maths + Chemistry + Technology studies, *HUM* Humanistic studies + arts + educational studies + communication

Table 3 Tobacco cigarettes smoking habits among tobacco cigarettes and dual smokers according to study area

	Study area							
	ECO N (%)	LAW N (%)	ENG N (%)	MED N (%)	STE N (%)	HUM N (%)	All participants N (%)	*P value*
Age at starting smoking (years)	16.3 ± 2.2	16.3 ± 3.2	16.6 ± 2.4	16.6 ± 2.2	16.7 ± 2.2	16.3 ± 2.4	16.4 ± 2.4	ns
Daily smokers	542 (77.4)	234 (78.5)	310 (74.3)	532 (72.1)	418 (77.3)	1152 (77.5)	3218 (76.3)	ns
Cigarettes/day								
1–4	187 (34.1)	57 (24.5)	90 (28.5)	178 (32.8)	132 (31.1)	348 (30.2)	992 (30.8)	0.01
5–9	186 (33.9)	83 (35.6)	103 (32.6)	213 (39.3)	157 (37.0)	450 (39.0)	1192 (37.1)	
10–14	115 (21.0)	54 (23.2)	70 (22.1)	109 (20.1)	92 (21.7)	221 (19.2)	661 (20.6)	
15–19	44 (8.0)	28 (12.0)	38 (12.0)	28 (5.2)	29 (6.8)	101 (8.7)	268 (8.3)	
≥ 20	16 (2.9)	11 (4.7)	15 (4.8)	14 (2.6)	14 (3.3)	34 (2.9)	104 (3.2)	
Fagerström test (points)								
< 2 mild addiction	521 (76.2)	201 (69.6)	300 (74.1)	571 (79.3)	402 (75.8)	1071 (73.4)	3066 (75.0)	0.03
3–4 moderate addiction	100 (14.6)	52 (18.0)	67 (16.5)	97 (13.5)	80 (15.1)	228 (15.6)	624 (15.3)	
5–6 strong addiction	44 (6.4)	27 (9.3)	30 (7.4)	42 (5.8)	36 (6.8)	139 (9.5)	318 (7.7)	
≥ 7 Very strong addiction	19 (2.8)	9 (3.1)	8 (2.0)	10 (1.4)	12 (2.3)	22 (1.5)	80 (2.0)	
Planned to quit smoking	136 (19.6)	74 (25.1)	106 (25.6)	143 (19.6)	94 (17.6)	256 (14.4)	809 (19.5)	0.001
Smoking area								
Only outdoor	389 (55.6)	169 (57.3)	272 (65.4)	456 (62.3)	333 (61.5)	821 (55.4)	2440 (58.6)	0.002
Both indoor and outdoor	307 (43.9)	126 (42.7)	141 (33.9)	271 (37.0)	203 (37.5)	650 (43.8)	1698 (40.7)	
Smoking freely with family	356 (50.9)	187 (63.4)	244 (59.4)	360 (49.5)	302 (56.2)	954 (64.4)	2403 (57.9)	0.01

traditional cigarettes (52.8% and 53.6%, respectively), as an aid to quit smoking traditional cigarettes (42.1% and 36.5%, respectively), or because these products are trendy (42.8% and 28.5%, respectively) (Figure SM1). Figure SM2 reported the change in smoking habits in tobacco smokers after starting to use e-cigs or HTPs: 24.8% and 40.2% of students, respectively, stopped smoking tobacco cigarettes, while 28.9% and 24.6%, respectively, reduced the number of traditional cigarettes smoked. However, 22.1% and 22.7% of e-cig and HTPs users, respectively, started or returned to smoking traditional cigarettes after starting to use electronic devices and approximately 2.2% smoked more traditional cigarettes than before. Notably, 22.0% of e-cig and 12.5% of HTP users did not smoke traditional cigarettes so they were "nicotine-naive" before using electronic devices (Figure SM2).

Table 4 Smoking habits of e-cig and HTPs users, including dual smokers

	Study area							
	ECO N (%)	LAW N (%)	ENG N (%)	MED N (%)	STE N (%)	HUM N (%)	All participants N (%)	*P value*
E-cig daily users	197 (44.7)	119 (56.4)	171 (55.1)	240 (47.3)	113 (49.3)	334 (45.3)	1174 (48.2)	0.001
Type of e-cig								
With nicotine, no flavours	41 (16.7)	31 (22.3)	17 (9.9)	34 (11.7)	20 (12.8)	61 (15.6)	204 (14.7)	0.02
With nicotine and flavours	154 (61.9)	82 (59.0)	142 (79.2)	228 (83.4)	189 (65.4)	243 (62.0)	892 (64.1)	< 0.001
No nicotine, with flavours	14 (5.7)	8 (5.7)	24 (14.0)	28 (9.7)	14 (9.0)	45 (11.5)	133 (9.6)	0.03
e-cig smoking area								
Only outdoor	23 (12.4)	13 (11.1)	27 (16.0)	30 (12.9)	15 (13.5)	55 (17.0)	163 (14.2)	ns
Both indoor and outdoor	163 (85.3)	95 (81.2)	136 (80.5)	191 (82.0)	87 (78.4)	251 (77.7)	923 (80.7)	
Only indoor	5 (2.6)	9 (7.7)	6 (3.5)	12 (5.1)	9 (8.1)	17 (5.3)	58 (5.1)	
Smoking freely with family	122 (63.9)	79 (67.5)	105 (62.5)	144 (61.8)	71 (64.6)	208 (64.6)	729 (63.9)	ns
HTP daily users	277 (70.6)	143 (73.3)	145 (52.9)	239 (57.6)	92 (47.4)	399 (61.2)	1295 (61.0)	< 0.001
HTPs smoking area								
Only outdoor	44 (16.1)	18 (13.0)	38 (26.7)	41 (17.6)	25 (27.5)	72 (18.1)	238 (18.7)	ns
Both indoor and outdoor	217 (79.5)	115 (82.7)	98 (69.0)	182 (78.1)	62 (68.1)	313 (78.8)	987 (77.4)	
Only indoor	12 (4.4)	6 (4.3)	6 (4.2)	10 (4.3)	4 (4.4)	12 (3.0)	50 (3.9)	
Smoking freely with family	160 (58.8)	98 (70.5)	86 (60.5)	144 (61.0)	51 (56.7)	259 (65.2)	798 (62.5)	ns

Passive smoking

Exposure to passive smoke was investigated among all students, regardless of their active smoking status. As regards smoke exposure at home, 26.5% of participants reported living with smokers and being exposed to traditional cigarettes smoke (85.5%) or e-cig/HTPs smoke (32.8%), while 7.9% lived with smokers who did not smoke in their presence (data not shown in table).

The analysis by study areas showed differences among students ($p < 0.01$): LAW and HUM students had the highest prevalence of smoke exposure at home (31.2% and 28.9% respectively), while ENG and MED students had the lowest prevalence (17.7% and 25.1%, respectively). Regarding peer exposure, 58.9% of students reported exposure to peer smoking, with higher reporting among ECO and LAW students (approximately, 64%) compared to STE and ENG students (54.6% and 55.1%, respectively) ($p < 0.01$) (data not shown in table).

Awareness of smoking health-related issues

Almost all students (99.1%) considered active smoking of traditional cigarettes dangerous for health. As regards e-cigs and HTPs, most students considered active smoking to be dangerous for health (83.0% and 88.3%, for e-cigs and HTPs, respectively), and only a minority considered smoking e-cigs or HTPs dangerous only in particular health conditions (e.g., pregnancy or illness) (1.8% and 1.1%), or not dangerous at all (1.2% and 0.4%). A relatively small percentage of students lacked knowledge on this topic (13.9% and 10.2%).

Students considered e-cig and HTPs to be less dangerous than traditional cigarettes (36.6%), equally dangerous (39.1%), or more dangerous (5.2%). Around a fifth of students (19.1%) answered "I don't know" on the subject.

As regards passive smoking, the great majority of the students (92.6%) considered passive smoking of traditional cigarettes to be dangerous for health, while fewer students considered passive exposure to e-cig and HTP aerosol dangerous (60.5% and 61.7% respectively). A significant proportion of students considered passive smoking of e-cig and of HTPs to be harmless (10.4% and 25.3%, respectively), while 21.2% of students answered "I don't know" on this subject.

There were significant differences in awareness on the health effects of passive e-cig and HTP smoking across study areas ($p < 0.01$): for e-cigs and HTPs, the percentage of student considering passive smoke dangerous was the highest among MED or ENG students and the lowest among STE students (Fig. 2).

The same analysis on awareness was carried out separately on smokers and non-smokers (Fig. 3): more non-smoking than smoking students considered passive smoking (of all types) to be dangerous to health ($p < 0.01$). Notably, a similar prevalence of students between smokers and non-smokers answered "I don't know" for both e-cig (21.4%) and HTPs (8.2%).

E-cigarettes and HTPs were considered attractive due to their flavouring (68.3%), the perceived possibility of using them in places where smoking traditional cigarettes is prohibited (65.9%), their being trendy (59.3%), the lack of lasting odour (56.8%), and finally the perception that they are less harmful to health than tobacco cigarettes (40.0%) (data not shown in table). However, most students admit that there is uncertainty about their long-term health effects (77.4%), and that they could encourage people to start smoking (72.4%) (not shown).

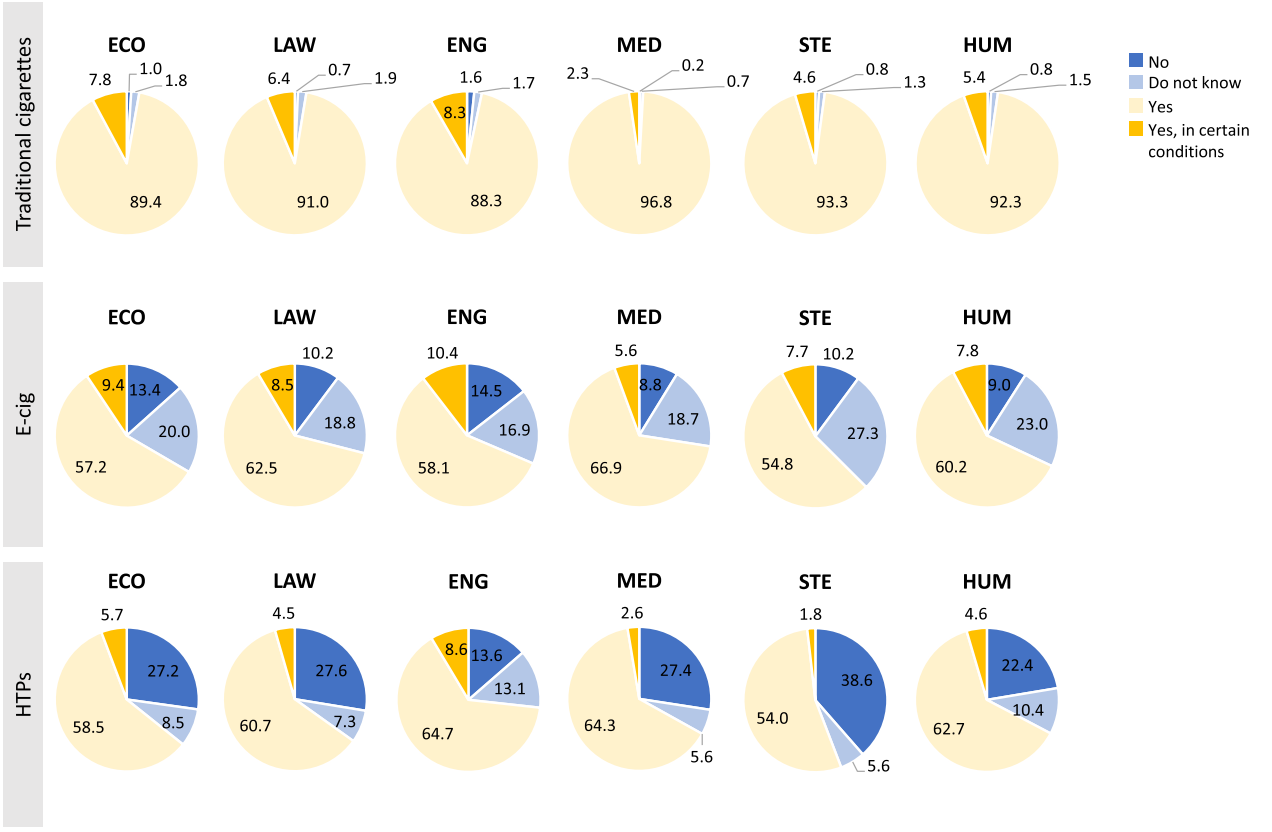

Fig. 2 Awareness of passive smoking health-related issues among study areas. MED = Medicine + veterinary + pharmacy; LAW = Law; ECO = Economics + political studies; ENG = Engineering; STE = Life Science + Physical Science + Maths + Chemistry + Technology studies; HUM = Humanistic studies + arts + educational studies + communication

Knowledge and attitudes towards smoking legislation and policy

Most students (> 80%) recognised the usefulness of the Italian legislation banning smoking in public places to protect the health of non-smokers, and were aware of the main dispositions of the legislation (e.g. prohibition of smoking in cars in the presence of children and pregnant women, selling e-cigs with nicotine to minors, not throwing cigarette butts on the ground).

The majority of students (88.9%) declared that they were aware of the damage caused by dispersed cigarette butts, but less than half (48.6%) were aware of the smoking ban of all smoking products in the outdoor areas of schools and universities, and of the internal University policy on smoking (44.5%) (data not shown in Table). In this regard, a very small percentage of students reported that the ban on smoking cigarettes (4.7%) and e-cigs/HTPs (5.9%) in outdoor areas of the University was enforced, and about 18% of students had no opinion.

Finally, 69.7% of students were in favour of stricter enforcement of the current smoking bans at their university. Additionally, 61.3% supported programmes to help smokers quit, informative campaigns on the harms of smoking (40.4%), and specific courses on smoking issues (56.2%).

Discussion

This survey involved students from 8 Italian Universities, with different courses and degree areas of study, collecting questionnaires on smoking habits, exposure to passive smoke in leisure time and at home, and knowledge and perceptions of smoking-related risks and anti-smoking policies. The main findings of the survey show that 21.3% of our sample smoke traditional cigarettes (considering both exclusive smokers and dual smokers) and 13.2% smoke e-cig/HTPs (considering both exclusive smokers of each product and dual smokers), for a total of 27.8% of smokers of any product.

An Italian population-based survey conducted in 2023–2024 reported a prevalence of 24.2% for tobacco smoking, and 7.5% and 9% of e-cig and HTPs, respectively, in subjects aged 18–24 years [8]. Compared with this data, our findings show a slightly lower prevalence of smokers, possibly reflecting a higher interest in health-related issues among highly educated individuals. Notably, approximately one fifth of respondents were students in the medical area. A main result of this study is the difference in smoking prevalence observed among

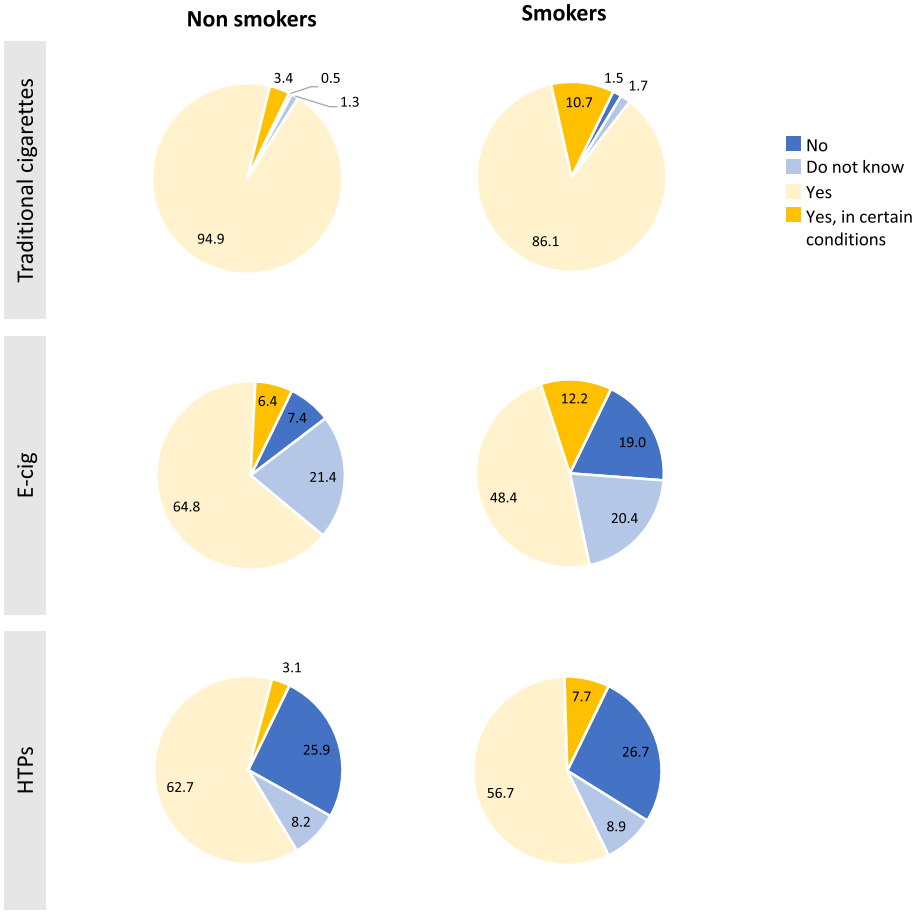

Fig. 3 Awareness of passive smoking health-related issues among smokers and non-smokers

study areas, with MED and STE students with the lowest prevalence (about 22% of total smokers), in contrast with LAW students (35.9%).

Among tobacco cigarette and dual smokers, the majority of students were moderate smokers (less than 10 cigarette per day) and the Fagerstrom test for nicotine dependence indicated a relatively small percentage of highly dependent subjects. Again, MED students had the lowest percentage of heavy smokers. On the other hand, LAW and ENG students were those with the highest willingness to quit smoking. These differences among study areas are likely related to the varying levels of health education in different study programs, the courses organization, and also personal inclination.

Daily e-cigarette and HTP users most commonly reported initiating these products as an alternative to tobacco cigarettes (more than 60%), because they perceived them less dangerous than tobacco (more than 50%), or because they can smoke in places where traditional cigarettes are banned (about 20%). In addition, as much as 43% and 28% of students stated that they use e-cig and HTPs, respectively, because they are trendy, in line with several studies that highlight the role of marketing on younger users (using social media advertising, promoting appealing flavours, and presenting the products as less harmful and socially acceptable than tobacco cigarettes) [17, 18]. In this regard, a comparison between three successive surveys among Italian teenagers [9] shows that, from 2010 to 2018, the percentage of cigarette smokers remained stable, whereas there was a significant increase in e-cig users, which rose by approximately threefold. Similar trends have been reported in young or very young populations also in other countries [19–22].

Another important aspect concerns the perception of e-cigarettes and HTPs as tools for quitting or reducing smoking. However, our data suggest limited effectiveness, as only about half of e-cig/HTPs users reported quitting or reducing cigarette smoking after starting e-cig or HTPs use. On the other hand, 22% self-reported initiating or resuming traditional cigarette smoking after initiating the use of these alternative products. Moreover, up to 22% of current e-cig/HTP users reported never having smoked combustible tobacco, showing that a substantial proportion of users were tobacco-naive prior to initiating e-cig or HTP use. Although these results rely on

self-reported data that have not been confirmed by measurements and may represent temporary habits that are not stable over time, they suggest that e-cigs and HTPs are attractive even for individuals without a prior interest in tobacco smoking.

Analogous results have been described in previous surveys conducted among students: a French survey reported that 20% of respondents started smoking traditional cigarettes after using e-cig [23] and a study among U.S. students identified e-cig as a significant predictor of subsequent cigarette smoking [18].

Although exposure to second-hand smoke is well recognised as hazardous to health, 26.4% responders were exposed to ETS at home, mainly to tobacco cigarettes (85.5% of exposed) and more than half of students (58.9%) spent leisure time with smokers. The great majority of students considered passive smoking of traditional cigarettes dangerous for health, while only about 60% considered e-cig/HTP passive smoking dangerous. Students perceived these products as less dangerous than tobacco cigarettes, to be used as an alternative to traditional cigarettes, possibly also in environments where cigarettes are banned, and for increasing their social acceptance.

Smoking freely in the family environment was claimed by about half of students, but for e-cigs and HTPs the percentage increased up to 68%. For MED students, the percentage of those smoking freely with family was the lowest for traditional cigarettes, but it was in line with the other study areas for e-cigs and HTPs. These findings are in accordance with the observed progressive normalization of vaping-related behaviour, in particular among adolescents and young adults. Indeed, national surveys show a marked increase in current use of electronic products especially among these age groups, together with a diffuse perception of reduced harm in comparison with traditional cigarettes [8, 24]. The last belief in particular may have contributed to greater social acceptance of vaping in both private and public settings, as shown by our data on smoking or vaping also indoors (40% vs. 80%). Parental acceptance has also been reported in other studies on younger age groups, where the perceived health risk of using these products is lower among adults as well [17] and the proportion of smoking freely at home increased from traditional cigarettes (28%) to e-cig or HTPs (41.5%–47.6%) [6]. Moreover, the possibility of purchasing these products online increases their availability to the very young through direct purchase, even though an Italian law prohibiting the online sale of nicotine products has been in force since January 2025 (Italian Law DL141/24).

Despite their knowledge of the harmful effects on health, young people are exposed to ETS, especially in their leisure time, and this seems to be at odds with their declaration/perception of the risk of exposure. Again, the greater social acceptance of vaping in comparison to traditional smoking may be a factor potentially increasing the exposure among non-users.

These results thus support the recent European and international policy developments aimed at strengthening protection against involuntary exposure to tobacco- and nicotine-related emissions. In particular, the Council of the European Union updated recently its recommendations on smoke-free environments, to include the exposure to second-hand emissions originating from the use of emerging products that emit smoke or aerosols [25]. This is in line also with the European Beating Cancer Plan that aims to create a 'Tobacco-Free Generation' by 2040 [26] and with the WHO Framework Convention on Tobacco Control [27], which underlines the need to address emerging nicotine products within comprehensive tobacco control strategies. However, it should be underlined that in Italy this recommendation has not yet been adopted.

Most students were aware of national legislation banning smoking in indoor and public places and in the presence of vulnerable groups (pregnant women and children), but only a small proportion claimed to be aware that the ban extends to outdoor school and university areas and that specific university regulations exist. In this regard, the questionnaire shows that a large proportion of students think that smoke bans should be stricter or more strictly enforced in open areas of the colleges.

Several limits of this study should be highlighted. The most important one is the low response rate (9.6%) that is a typical selection bias. However, the response rates were higher than, or similar to, those observed in other web-only surveys in college students, with reported response rates in the range 3–8% [28–30]. These findings may not be generalisable to entire eligible population. However, the data allow profiling the characteristics of responders with respect to smoke use and related knowledge for planning wellbeing interventions. Some students included in the analysis did not complete the questionnaire, however the completeness was as high as 92.5%, which can be considered an acceptable level. We observed that the completeness of the questionnaire was partly related to smoking habits, but this is consistent with the fact that smokers or e-cigs/HTP users had to complete more sections than non-smokers. Therefore, a certain level of over- or under- estimation of some proportions cannot be excluded.

Another limit regarded the percentage of females among participants that was slightly higher than in the target population (63% vs 58.8%): a non-response bias was found comparing the females' proportion between responders and non-responders (data not reported) both on overall and by study areas. The larger proportion of female responders is consistent with the sex

composition of university students and with women's higher engagement in topics concerning well-being than males. Although the target population participating in the survey included 43% of students from the HUM area, and actually HUM students represented the largest proportion of respondents (30.8%), these students, together with LAW students had the lowest response rate. On the contrary, MED and ENG students were more likely to participate and had the highest response rates (14.3% and 11.6%, respectively). Although the survey protocol was the same in the 8 participating universities, different response rates were obtained (range 3.6–25.6%). The highest response rate was obtained in Milan-Humanitas university, which is not a Public University and hosts only medical students. Furthermore, the four smallest universities (Humanitas, Brescia, Bergamo and Urbino) had the highest response rates, so other factors, probably related to local engagement of students, may have influenced the participation rate. A reason for these discrepancies may be the diverse study areas of the involved universities.

The last limitation was the lack of socio-economic and demographic information, apart from age and sex, that reduced our capability to further investigate the determinants of the smoking habits.

The main strength of the study is that the survey involved a large number of students using the same validated web-based questionnaire that allowed a comparison of data among university areas.

In conclusion, this survey showed that a large proportion of university students smoke tobacco cigarettes, although this percentage is slightly lower than that reported in the Italian data [8]. Regarding e-cig and HTP, they used these alternative products more often than reported in the Italian survey [8], without having the correct perception or awareness of the health risks associated with using these devices. Indeed, in a large part of users, e-cigs and HTPs are perceived as less dangerous and their use is more socially/familiarly accepted. Therefore, this study shows that greater educational need on direct and indirect health effects of e-cig and HTPs is necessary.

The results of the present study rely on the information collected among more than 20,000 university students, representing the 9.6% of eligible students of 8 Italian universities. The results, even if not fully representative of the target population, offer valuable insights into smoking behaviours and beliefs among students that may be useful for implementing prevention campaigns tailored to specific educational needs.

Abbreviations

ETS	Environmental tobacco smoke
HTPs	Heated tobacco products
e-cig	Electronic cigarettes
ENDS	Electronic nicotine delivery systems
GYST	Global Youth Tobacco Survey
GHPSS	Global Health Professions Student Survey
MED	Medicine + veterinary + pharmacy
LAW	Law
ECO	Economics + political studies
ENG	Engineering
STE	Life Science + Physical Science + Maths + Chemistry + Technology studies
HUM	Humanistic studies + arts + educational studies + communication
OR	Odds Ratio
CI	Confidence Interval

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-026-26840-4.

Supplementary Material 1.

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Authors' contributions

C.Z and L.Ca. wrote the main manuscript text; C.Z., L.Ca. and S.C. were responsible for data curation, C.Z., S.C. and S.V. made statistical analysis; C.Z., C.A., S.C. prepared figures and tables. L.Ca. and S.F. were responsible for project administration and supervision of survey. L.Ca, F.D., M.R., F.B., C.T., S.V., A.C, R.A., L.Ch., E.B. collected data for database. All authors reviewed the manuscript.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The protocol of this multicentre study was approved by the Ethics Committee of the University of Milano Statale (protocol N. 85/22) for University of Milano Statale and for Humanitas; by the Ethics Committee of Brescia (protocol N. NP5839); by Territorial Ethics Committee (CET) Lombardia 6 (Protocol N. 0043338/23) for University of Pavia; by the Ethics Committee of the University of Parma (protocol N. 75652); by the Ethics Committee of the University of Milano Bicocca (protocol N. 851); by the Ethics Committee of the University of Urbino (protocol N. 61/22); by the Ethics Committee of the University of Bergamo (protocol N. 11/2023).
All participants provided written informed consent prior to data collection during the on-line surveys, in accordance with the Declaration of Helsinki. The responses were collected anonymously as each participant was assigned a random unique identifier.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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