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Tobacco Use and Self-Reported Perceptions of Health Risks among 7,213 Adolescents Living in Sicily (Italy): A Cross-Sectional Survey-Based Study



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Abstract

Background Tobacco consumption, including electronic nicotine delivery systems (ENDS), is rising among adolescents and is often associated with misperceptions about health risks. Reliable epidemiological data are essential to guide prevention policies, particularly in regions where evidence remains limited.
Objective To assess tobacco and e-cigarette use, risk perceptions, and educational exposure among adolescents in Sicily (Italy).
Methods A cross-sectional observational survey was conducted among 7,213 students aged 11–19 years attending 48 middle and high schools. Data were collected through an anonymous, self-administered questionnaire investigating tobacco use, vaping behaviors, and awareness of systemic and oral health risks. Associations and response patterns were examined using Multiple Correspondence Analysis (MCA).
Results Most participants reported no current use (82.8%); nevertheless, experimentation with tobacco cigarettes (28.6%), e-cigarettes (27.0%), or both (42.5%) was frequent. Nearly half of e-cigarette users perceived vaping as less harmful than conventional smoking (48.0%). Gender differences emerged, with higher e-cigarette use among females ($p = 0.019$). MCA revealed distinct behavioral and perceptual profiles, showing that e-cigarette use clustered with inconsistent or underestimated risk perception, especially among students lacking family- or school-based education on smoking risks. Despite generally high awareness of smoking-related harm, knowledge alone appeared insufficient to prevent experimentation.
Conclusions Adolescent experimentation with tobacco and e-cigarettes remains substantial despite high levels of reported risk awareness. Misperceptions about vaping safety and gaps in educational exposure highlight the need for structured, age-appropriate school-based prevention programs and provide a descriptive basis for future longitudinal and interventional research.

KEYWORDS tobacco consumption; electronic nicotine delivery systems; ENDS; smoking; awareness; survey; survey and questionnaires; adolescents; vaping; electronic cigarettes; e-cigarettes; Multiple Correspondence Analysis.

INTRODUCTION

Tobacco consumption represents the primary cause of cancer mortality worldwide and is associated with nearly two-thirds of all lung cancer cases [Siegel et al., 2022]. Tobacco causes approximately 7 million deaths worldwide each year, with 6 million resulting from direct consumption and 1.2 million from exposure to secondhand smoke [O'Brien et al., 2015]. In Italy, tobacco smoking remains a major contributor to cancer burden, accounting for approximately 17.3% of all new cancer cases and 24.5% of cancer-related deaths, with particularly high attributable fractions for lung (73.9%), pharyngeal (61.7%), laryngeal (61.3%), and oral cavity cancers (39.4%) [Collatuzzo et al., 2024]. Moreover, about 20% of individuals aged ≥14 years in Italy are current smokers, while approximately 23% are former smokers, underscoring the persistent public health relevance of tobacco exposure [ISTAT, 2024]. Smoking is a leading cause of preventable cancers, linked to multiple cancer sites through numerous carcinogens in tobacco and combustion products, with a risk that increases according to both dose and duration of use [Rota et al., 2024].

According to the World Health Organization (WHO), oral diseases represent a major global public health burden, affecting approximately 3.5 billion people worldwide, and encompass a broad spectrum of conditions, including dental caries, periodontal diseases, oral potentially malignant disorders (OPMD), oral squamous cell carcinoma (OSCC), oral infections, and oral mucosal inflammatory diseases [Peres et al., 2019; World Health Organization, 2022]. Among these, periodontal diseases, OPMD, and OSCC are of relevance due to their chronic course, impact on quality of life, and potential for malignant transformation [Bray et al., 2018]. Tobacco smoking is recognized as a major shared risk factor for several oral pathologies, including periodontal disease, oral leukoplakia, erythroplakia, and OSCC [Warnakulasuriya, 2009]. Since their introduction in the mid-2000s, the consumption and purchase of tobacco products have increasingly shifted toward alternative nicotine delivery systems, raising public health concerns due to their growing popularity. Electronic cigarettes (e-cigarettes) are battery-operated devices engineered to administer nicotine via aerosolization, providing a smoke-free alternative to conventional tobacco use [Pepper and Brewer, 2014].

The use of e-cigarettes has grown over the past decade. A 2019 review of surveys on e-cigarette use in Europe found that, among both adults and young people, current use ranged from 0.2% to 27%, ever-use from 5.5% to 56.6%, and daily use from 1% to 2.9% [Kapan et al., 2020]. E-cigarette vapor contains many of the same toxins as tobacco cigarettes, such as formaldehyde, cadmium, and lead, though generally at lower levels. Nonetheless, their short- and long-term health effects remain unclear, and marketing often creates the misleading suggestion that they are safer than traditional cigarettes [Goniewicz et al., 2014].

The packaging and marketing strategies adopted for electronic nicotine delivery systems (ENDS), including e-cigarettes, have

ITEM #1
What do you smoke?
☐ I don't smoke
☐ Tobacco cigarette
☐ E-cigarette
☐ Both (tobacco and e-cigarette)

ITEM #2
If you smoke, at what age did you start smoking?
☐ Between 10-12
☐ Between 13-15
☐ Between 16-18
☐ After 18

ITEM #3
If you smoke, what made you start smoking?
☐ I don't smoke
☐ For fun or as a game
☐ Out of boredom
☐ To be like other friends
☐ Because my parents and/or siblings smoke

ITEM #4
How often do you smoke now?
☐ Never
☐ Every day
☐ Occasionally
☐ Only in the evening when I go out with friends

ITEM #5
How many cigarettes do you smoke per day?
☐ I don't smoke
☐ A couple
☐ Fewer than 5
☐ Between 5 and 10
☐ More than 10

ITEM #6
Was the video you just watched interesting to you?
☐ Yes
☐ Yes, but it wasn't clear
☐ No

ITEM #7
Are you aware of the health risks associated with smoking?
☐ Yes, I learned about them by watching the video
☐ Yes, I already knew about them
☐ No

ITEM #8
Do you think smoking is dangerous for your health?
☐ Yes, very dangerous
☐ Yes, but not very dangerous
☐ No

ITEM #9
Do you think smoking is dangerous for your oral health (tongue, cheeks, gums)?
☐ Yes, very dangerous
☐ Yes, but not very dangerous
☐ No

ITEM #10
Do you think smoking is dangerous for your dental health (teeth)?
☐ Yes, very dangerous
☐ Yes, but not very dangerous
☐ No

ITEM #11
Do you go to the dentist at least twice a year for prevention?
☐ Yes
☐ No

ITEM #12
Do you think vaping is less dangerous than smoking tobacco cigarettes?
☐ Yes
☐ No
☐ I don't know

ITEM #13
Have you been exposed to secondhand smoke in the past month?
☐ Yes
☐ No
☐ I don't know

ITEM #14
Do you know how harmful secondhand smoke is?
☐ Yes, I learned about it by watching the video
☐ Yes, I already knew about it
☐ No

ITEM #15
Do you know the difference between first-hand, second-hand, and third-hand smoke exposure?
☐ Yes, I learned about it by watching the video
☐ Yes, I already knew about it
☐ No

ITEM #16
Can guests smoke in your home?
☐ Yes, wherever they want
☐ Yes, only in certain rooms/on the balcony
☐ No

ITEM #17
Has your family talked about the risks related to smoking?
☐ Yes
☐ No
☐ I don't know

ITEM #18
Do you think schools should provide information about the risks of smoking and alternatives to smoking?
☐ Yes
☐ I think it's important, but not necessary
☐ No

ITEM #19
Have you been taught at school about the risks of smoking?
☐ Yes, I learned about them by watching the video
☐ Yes, they talked about it on other occasions
☐ No
☐ I don't know

FIG. 1 English version of the online questionnaire.

attracted considerable attention, particularly because of their appeal to adolescents and young adults [Pérez-Jardón et al., 2025].

Adolescent susceptibility to e-cigarette use is influenced by intrapersonal factors such as age, interpersonal dynamics including family or peer conflicts, and contextual factors like community structures and regulations, while product features and marketing, including flavors, lack of age restrictions, and appeals to social or sexual identity, further increase their attractiveness [Kong et al., 2015]. However, the health impacts of these devices on both users and the broader public are still poorly understood [Callahan-Lyon, 2014]. Widespread prevalence, especially among young people, underscores the need for awareness campaigns to warn of the risks [Pérez-Jardón et al., 2025]. The present study aims to investigate tobacco consumption habits and awareness of related health risks within a study population of middle and high school students in Sicily. The null hypothesis of this study is that no significant differences exist in the prevalence of vaping and tobacco smoking among adolescents, nor in the perception of health-related risks between users and non-users.

MATERIALS AND METHODS

Study description

The present study was designed as a cross-sectional, survey-based observational study. The study population consisted of 7,213 adolescents aged 11–19 years attending both public and private middle and high schools across Sicily, Italy. Data were collected through a structured, anonymous, self-administered online questionnaire accessed via a QR code, which was projected on monitors in participating classrooms during school hours to enable students to access and complete the survey using their personal mobile devices.

The questionnaire included mandatory demographic items and 19 closed-ended questions exploring smoking behaviors, motivations for initiation, frequency and intensity of use, perceptions of risk, family and school-based education, and exposure to passive smoking (Figure 1).

The study protocol was approved by the University Hospital "P. Giaccone" of Palermo Institutional Local Ethics Committee (#4/2023); within an educational project, a structured questionnaire was administered in 48 middle and high Sicilian schools. Participation was voluntary and anonymous. All data collected was processed in compliance with legislative order N. 196/03 and the European Regulation N. 2016/679 on the processing and protection of personal data.

The educational video focused on key topics such as the harmful components found in cigarettes, the dangers of vaping, the distinction between first, second, and third-hand smoke, and the health risk associated with tobacco use. To

better engage the younger audience, the content incorporated elements inspired by social media formats commonly used by adolescents.

This approach was intended to reduce variability in baseline knowledge and to limit potential bias, thereby supporting the overall consistency and validity of the collected responses.

No selection or categorization of students was carried out based on age or gender; therefore, the observed distribution of participants across these variables reflects the natural composition of the surveyed school population.

Questionnaire description

The questionnaire comprised structured items assessing tobacco use and risk awareness (Figure 1). It investigated smoking behaviors (Items #1–5), perceived clarity of the educational video (Item #6), awareness of smoking-related health risks (Items #7–10), frequency of dental appointments (Item #11), awareness of vaping-related risks (Item #12), passive smoking risks (Items #13–14), knowledge of first-, second-, and third-hand smoke (Item #15), family smoking habits (Items #16–17), and school-based education on smoking prevention (Items #18–19).

Preliminary Analysis

All variables were categorical and summarized using absolute frequencies and percentages, stratified by gender and age group. Given the exploratory and educational nature of the study, no a priori sample size calculation was performed.

Descriptive analyses examined current smoking status, age at initiation, and perceived risks related to tobacco and vaping. Selected items were recoded or aggregated to enhance interpretability and capture broader constructs, including overall smoking risk perception.

Further analyses focused on predefined variables relevant to smoking behavior, risk perception, and preventive education: current smoking status (non-smoker, tobacco smoker, e-cigarette user, dual user), smoking frequency, reasons for initiation, number of cigarettes per day, perceived harmfulness of vaping versus tobacco, family discussion of smoking risks, and school-based education.

Two derived variables were created for exploratory purposes:

- Overall risk perception: sum of three ordinal items assessing perceived danger to general health, oral soft tissues, and dental health (0 = No; 1 = Yes, but not very dangerous; 2 = Yes, very dangerous), yielding a score from 0 to 6.
- Maximum perceived risk category: highest domain rated as "very dangerous," based on the hierarchy general health < oral health < dental health.

Statistical Analysis

Multiple Correspondence Analysis (MCA) was used as an exploratory multivariate method to investigate associations among selected categorical variables related to smoking behavior, vaping, education, and risk perception. MCA was selected for its appropriateness for nominal and ordinal data and its capacity to display complex response patterns in a low-dimensional space [Greenacre and Blasius, 2006]. The analysis was exploratory and aimed at hypothesis generation rather than causal inference. All analyses were performed using R software.

Interpretation of MCA dimensions was based on variable contributions (η^2) and category positions in the factorial space. Category quality was evaluated using standard diagnostics (coordinates, $\cos^2$, v.test, and contribution indices). Detailed results are provided in the Supplementary Material.

RESULTS

Demographic, smoking patterns and gender features

The survey was completed by 7,213 students (49% males, 49% females, and 2% other), with a mean age of 14.3 ± 2 years. Most respondents declared that they did not smoke (82.8%). Among self-reported smokers (n = 1,217), the majority used both electronic and tobacco cigarettes (42.5%), followed by tobacco cigarettes (28.6%) and e-cigarettes (27%); 1.9% did not specify the product used.

Smoking initiation most frequently occurred between 13 and 15 years of age, reported by 62% of e-cigarette users, 58% of tobacco smokers, and 57% of dual users. Forty percent smoked 1–5 cigarettes per day, while approximately 8% reported more than 10 cigarettes daily, suggesting early signs of potential dependence.

A significant gender difference was observed only for e-cigarette use, which was more prevalent among females (Pearson's χ^2 $p = 0.019$). No gender differences were found for tobacco or dual use. Smoking was mainly occasional, and the most common reasons were curiosity (7.5%), boredom (4.8%), and peer influence (2.4%). Some inconsistency emerged in self-definition, as occasional smokers often identified themselves as non-smokers.

Concerning vaping perception, many e-cigarette and dual users believed vaping to be less harmful than tobacco (48% and 43%, respectively), whereas 51% of tobacco smokers recognized its danger. Because smoking status was a key stratification variable, 23 questionnaires with missing responses to Item #1 were excluded from related analyses.

Only 21% of students knew the difference between first-, second-, and third-hand smoke before the video, while 55% learned it during the video. Almost half reported that smoking risks were never discussed within their family. Most students acknowledged the importance of school-based prevention, yet many had never received formal education on smoking-related health consequences, highlighting the need for structured programs. Despite universal awareness of systemic and oral health risks, smoking persists among adolescents.

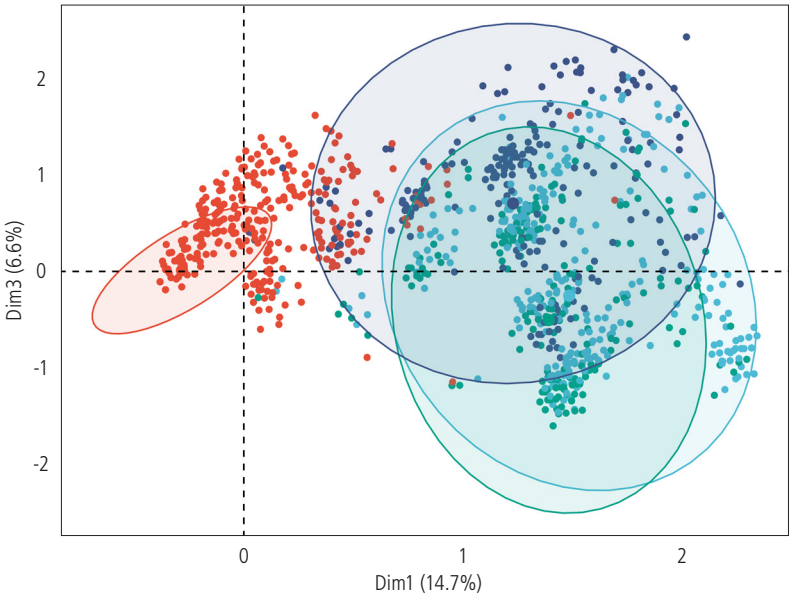
Multiple Correspondence Analysis

A complete case analysis was conducted, excluding 799 observations with missing data in key variables (gender, smoking status [Item #1], perceived health risks [Items #8–10], and reasons for initiation [Item #3]). Dimension retention was based on scree plot inspection, cumulative inertia, and axis interpretability. Six dimensions were retained, explaining 46.99% of total inertia; further details are provided in the Supplementary Material.

Dimension 1 (14.7%) reflected current smoking behavior, distinguishing non-smokers from occasional and daily smokers and separating tobacco, e-cigarette, and dual users according to frequency, intensity, and motivations. Dimension 2 (7.1%) captured global perceived health risk, contrasting high versus low-risk perception, largely independent of smoking status. Dimension 3 (6.6%) represented risk–behavior coherence, differentiating concordant from discordant profiles.

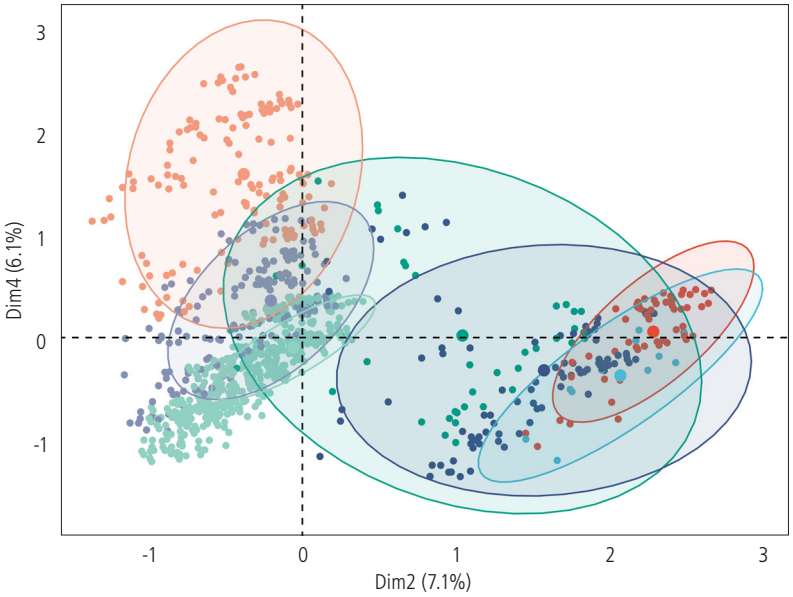
Dimensions 4–6 (6.1%, 5.6%, and 4.4%) refined aspects of risk perception and information exposure; notably, Dimension 6 distinguished students reporting school or family education from those selecting "I do not know."

Overall, MCA indicated that smoking behavior, perceived risk, and educational background are partially independent yet interconnected components shaping adolescents' profiles. The



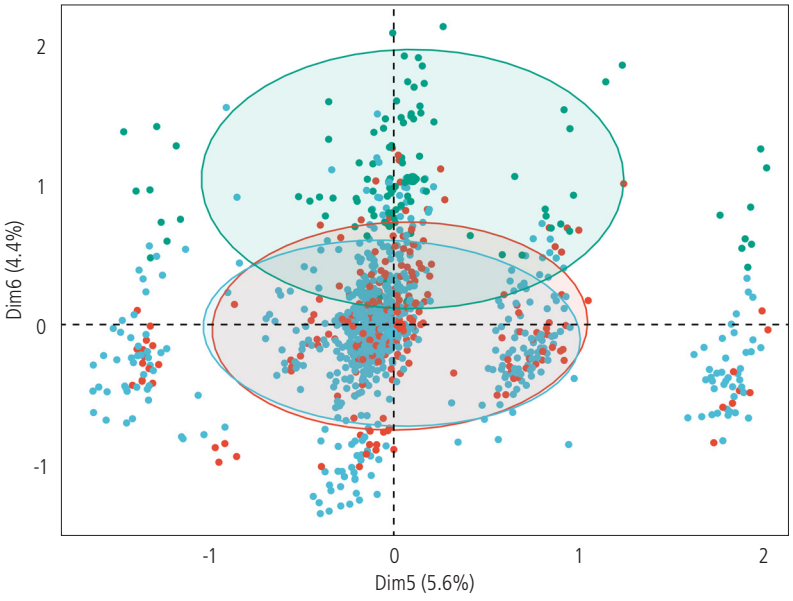
What do you smoke?
Nothing
Both (tobacco and electric)
Tobacco cigarette
Electric cigarette

FIG. 2 MCA projection of individuals onto axes 1 and 3, coloured by What do you smoke?, with group confidence ellipses.



Overall risk perception
0
1
2
3
4
5
6

FIG. 3 MCA projection of individuals onto axes 2 and 4, coloured by Overall risk perception, with group confidence ellipses.



Have you been taught at school about the risk of smoking
No
Yes
I do not know

FIG. 4 MCA projection of individuals onto axes 5 and 6, coloured by Have you been taught at school about the risks of smoking? with group confidence ellipses.

analysis was exploratory and hypothesis-generating.

Electronic cigarette use emerged as particularly complex: it showed a strong positive association with Dimension 1 (coord = 1.862) and Dimension 3 (coord = 1.538; contrib = 6.4%), and contributed to Dimension 4 (4.1%), suggesting frequent coexistence with traditional smoking and a tendency to minimize or rationalize risks. Figures 2–4 illustrate these patterns.

DISCUSSION

This cross-sectional survey of 7,213 Sicilian adolescents outlines tobacco and e-cigarette use patterns, harm perceptions, and knowledge gaps in a large southern Italian population. Although most participants were non-smokers, many experimented with cigarettes or e-cigarettes between 13 and 15 years, showing frequent dual use and persistent misconceptions about vaping safety. The widespread and often uncritical use of e-cigarettes, therefore, represents a growing public health concern [Pérez-Jardón et al., 2025].

This phenomenon has expanded rapidly, with the e-cigarette industry becoming a multibillion-dollar global market and promoting itself as an alternative to conventional tobacco products. Originally aimed at current and former smokers seeking reduced harm, e-cigarettes have increasingly attracted adolescents and young adults, reshaping nicotine use patterns [Marques et al., 2021]. Until 2021, vaping was uncommon among European never-smokers (<0.8%); however, over the past three years, the spread of inexpensive, discreet disposable devices containing high nicotine salt concentrations (≤20 mg/ml in the EU) has been associated with a marked rise in use among young people [Tattan-Birch et al., 2024].

According to the Global Burden of Disease Study, 82.6% of tobacco users begin between 14 and 25 years of age, with the risk of dependence declining thereafter. Adolescents and young adults are therefore the most vulnerable group, as ongoing neurodevelopment and social and peer influences increase susceptibility to nicotine addiction. Young people tend to be more impulsive and inclined toward risky behaviors. Many view e-cigarettes as safer and easier to hide than traditional cigarettes [Cooper et al., 2016]. Moreover, social media marketing strongly promotes vaping among adolescents, and retail displays near checkout counters and youth-oriented products reinforce the perception of e-cigarettes as common and socially accepted [Perikleous et al., 2018]. Proponents of e-cigarettes argue that, since they involve no combustion, they are safer than traditional cigarettes. Consequently, e-cigarettes have been proposed as a potential aid for smoking cessation among current smokers [Hartmann-Boyce et al., 2021]. Nevertheless, Etter and Bullen reported that 81% of those patients who were daily e-cig users continued vaping after 1 year [Etter and Bullen, 2014]. Also, among Italian e-cigarette users, those who restart smoking after using e-cigarettes outnumber those who stop smoking after using e-cigarettes [Liu et al., 2020].

Despite limited evidence regarding their long-term health effects, e-cigarettes are widely accessible in retail and online markets, supported by aggressive advertising. In 2016, 4.3% of U.S. middle school students and 11.3% of high school students used e-cigarettes. In the UK, ever-use among 11–16-year-olds ranged from 7% to 18%, while regular use ranged from 1% to 3%. Notably, nearly one-third of U.S. adolescents believe e-cigarettes are less harmful than tobacco cigarettes [Tattan-Birch et al., 2024].

In Italy, while the prevalence of current smokers among adolescents remained stable at around 20%, vaping rose sharply: from 0% in 2010 to 7.4% in 2014 and 17.5% in 2018 [Gorini et al., 2020]. To the best of our knowledge, to date, very few studies have examined this public health concern in Italy, particularly among the adolescent population [Liu et al., 2020; Gorini et al., 2020; Prigitano et al., 2020]. The present study aims to investigate for the first time this issue in a study population of 7,213 students living in Sicily (south Italy) from both middle and high schools. In our study, although most students were non-smokers, many reported experimenting with cigarettes or e-cigarettes between 13 and 15 years, with widespread misconceptions about vaping safety and gaps in smoking-related knowledge. These findings underscore the urgent need for reinforced, structured school-based education to address early initiation. While anti-smoking campaigns have traditionally targeted high school students, the decreasing age of initiation supports implementing prevention programs beginning in middle school. A study performed on students enrolled in healthcare assistance programs, comparing first-year and final-year cohorts, reported a significant reduction in smoking habits over the course of university training [Prigitano et al., 2020]. Moreover, regarding gender differences, our findings performed on 7,213 Sicilian adolescents suggest a possible shift in the traditional smoking patterns reported in the literature. In the context of electronic cigarette use, girls in our study appeared more inclined to vape compared with boys, a trend that contrasts with previously published Italian data. For example, a study conducted in 2020 among Italian healthcare students reported similar smoking frequencies between genders (38.9% males vs. 33.4% females) [Prigitano et al., 2020]. Consistent with our findings, a recent ISTAT report indicates that the gender gap in smoking prevalence has narrowed substantially (from 10.2% in 2013 to 7.1% in 2023), mainly due to a decline among men, while rates among women have remained relatively stable [ISTAT, 2024].

This apparent trend reversal may reflect changing sociocultural dynamics in e-cigarette uptake among younger generations. In our study, however, this shift was observed only for electronic cigarettes, which were more prevalent among females, whereas conventional tobacco use remained more common among males. Notably, 2% of respondents did not identify exclusively as male or female, highlighting the presence of gender-diverse adolescents and the importance of inclusive interpretation of youth health behaviors.

Substantial confusion emerged regarding the definition of "smoking," as some occasional smokers subsequently identified themselves as non-smokers, suggesting subjective interpretation influenced by social norms or underestimation of occasional use. Students also showed persistent uncertainty about the relative harms of vaping versus conventional smoking, with many perceiving vaping as less dangerous or expressing no clear opinion. Consistent with previous literature, high initiation rates between 13 and 15 years confirm adolescence as a critical window for nicotine exposure. Although most smokers reported low daily consumption, the approximately 8% who smoked more than ten cigarettes per day raise concern for early addictive patterns. E-cigarettes occupy a behavioral and perceptual grey area: they are frequently used by students who also smoke traditional cigarettes and are perceived as a safer alternative, partly due to insufficient education on their risks. The customizable nature of e-liquids, particularly their flavors, increases their appeal and represents a growing public health concern among youth, especially women [DeVito et al., 2025].

Although the short- and long-term effects of e-cigarettes are not yet fully understood, recent studies have reported that

alterations in the salivary composition of smokers appear to be associated with an increased risk of developing conditions such as type 2 diabetes, hypertension, cardiovascular and renal diseases, as well as promoting tumorigenesis and impairing oral immune function. In contrast, analyses of e-liquids after use have not revealed any significant molecular or compositional changes [ISTAT, 2024; DeVito et al., 2025]. However, the levels of nicotine delivered through ENDS are comparable to, or even higher than, those of traditional cigarettes, with similar systemic retention. Moreover, individuals who use these devices tend to smoke more frequently, often even in indoor environments, further exacerbating exposure [Pérez-Jardón et al., 2025].

From an oral health perspective, increasing evidence suggests that both tobacco smoking and vaping negatively affect periodontal tissues, salivary composition, and oral mucosal homeostasis. E-cigarette use has been associated with increased risk of gingival inflammation, periodontal disease, dental caries, xerostomia, and tooth discoloration [Iacob et al., 2024]. Moreover, emerging metabolomic and microbiome studies indicate that vaping may alter salivary metabolites and microbial communities involved in inflammatory and carcinogenic pathways, potentially contributing to oral disease susceptibility [Carvalho et al., 2024]. These findings are particularly relevant for adolescents, in whom early exposure may predispose them to long-term oral health consequences.

A key finding is the marked confusion among adolescents regarding what it means to be a "smoker." Several students reporting occasional smoking subsequently identified as non-smokers, indicating subjective interpretation of smoking status, likely influenced by social desirability and underestimation of intermittent use, and representing an important methodological limitation. Moreover, vaping-related risk was substantially underestimated, with nearly half of e-cigarette users perceiving vaping as less harmful than conventional smoking. Similar misperceptions have been reported internationally, where about one-third of adolescents consider e-cigarettes less harmful than tobacco, indicating widespread misinformation regarding ENDS safety. The present findings support the need for strengthened public health policies aimed at regulating marketing, flavor availability, and accessibility of e-cigarettes to minors, as well as clearer health warnings regarding ENDS products. School-based prevention programs should be systematically implemented and aligned with national tobacco-control strategies [Liu et al., 2022]. Recent evidence suggests that the most effective strategies for promoting health awareness among adolescents focus on three elements: fostering a school-wide health ethic, creating a supportive health-promoting environment, and integrating health education into the formal curriculum [Lee et al., 2019]. Schools thus represent strategic settings for early interventions, particularly when programs are supported by family and community involvement; however, further rigorous research is needed to ensure that these interventions are evidence-based and truly effective [Gardner et al., 2024].

Limitations

This study possesses some limitations. First, the sample may not fully represent the general adolescent population, as it derives from a specific geographical and institutional context. Since all participants were from Sicily, the findings may not be generalizable, and differences in socioeconomic status, cultural attitudes, and access to vaping products may further limit external validity. Nevertheless, the large sample size, inclusion of 48 schools, and heterogeneity of backgrounds within the region strengthen internal validity and the robustness of observed patterns.

Second, because participants were adolescents, responses may be affected by inattention or inaccurate reporting. The exclusive use of self-reported data may not precisely reflect actual behaviors, especially for sensitive issues such as smoking or vaping. The predominance of occasional smoking and uncertainty in self-classification suggest that social norms and subjective interpretations influence reporting. However, questionnaire anonymity likely reduced this bias.

Another limitation is the use of a non-validated questionnaire, which may affect reliability and comparability; future studies should employ validated tools or perform formal validation. Finally, prior exposure to the educational video may have influenced students' knowledge and attitudes, potentially affecting responses. At the same time, the standardized video ensured uniform baseline information and improved comparability.

CONCLUSION

This study highlights a worrying prevalence of smoking among Sicilian adolescents, with frequent use of both tobacco and e-cigarettes and persistent misconceptions about vaping-related risks. These findings emphasize the urgent need for targeted, age-appropriate educational interventions that clearly differentiate vaping from traditional smoking and effectively communicate its health consequences. Early prevention is essential, as interrupting these behaviors during adolescence can substantially reduce future addiction and long-term disease. Strengthening school- and community-based prevention strategies is therefore crucial to limit the growing burden of tobacco- and vaping-related harm.

Declarations Abbreviations

ENDS: electronic nicotine delivery systems MCA: Multiple Correspondence Analysis E-cigs: electronic cigarettes

Ethics approval and consent to participate

The study protocol adhered to the ethical guidelines specified in the 1964 Declaration of Helsinki and its subsequent amendments, or comparable ethical standards. To ensure compliance, approval for the study and necessary permissions were obtained from the school management boards and the Sicilian Regional Department of Education and Professional Training. The Ethical Local Committee of the University Hospital of Palermo also approved it (#4/2023). Informed consent to participate was obtained from all participants or, in the case of minors under the age of 16, from their parents or legal guardians.

Consent for publication

Not applicable.

Availability of data and materials

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

Competing Interests

The authors declare no conflicts of interest.

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Authors' contributions

Conceptualization, G.C.; methodology, G.M., M.B., M.C., G.L.M., F.B., G.S., R.M., and D.M., validation, G.C. and G.M.; formal analysis, G.M. and M.C; investigation, M.B., F.B., G.L.M., G.S., M.C. and D.M.; resources, M.C., G.L.M., G.S., F.B. and D.M.; data curation, M.C. and G.M.; writing—original draft preparation, M.C., G.S. and M.B.; writing—review and editing, G.C., G.M. and R.M.; visualization, G.C. and G.M..; supervision, G.C.; project administration, G.C.; funding acquisition, G.C. All authors have read and agreed to the published version of the manuscript.

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