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# Changes in the use of nicotine-containing products during and after the COVID-19 pandemic in a representative sample of the Italian adult population

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**Abstract**

***Introduction.*** To assess nicotine-containing products (NCPs; heated tobacco products and/or electronic cigarettes) use in relation to conventional smoking.

***Methods.*** "LOST IN ITALY" ("LOckdown and Lifestyles IN ITALY") and "LOST IN TOSCANA" cross-sectional surveys estimated lifestyles changes before, during, and after the lockdown in a representative sample of the Italian population. A Poisson regression model was used to estimate prevalence ratios of NCP use according to socio-demographic, mental distress, and smoking variables.

***Results.*** The prevalence of conventional cigarette smokers did not decrease, remaining stable at 23%. Exclusive conventional cigarette smokers decreased from 21% before the lockdown in 2020 to 15% in 2023 but dual users, representing the large majority of NCP users, increased by 4 times, and exclusive NCP users decreased from 7% in 2020 to 5% in 2023.

***Conclusions.*** NCPs are mostly accompanying instead of replacing conventional cigarettes. A targeted campaign should be developed in Italy to raise awareness on that.

**Key words**
- smoke
- tobacco control
- e-cigarettes
- heated tobacco products
- COVID-19

## INTRODUCTION

### *COVID-19 pandemic and Italians' lifestyles*

SARS-COV2 (COVID-19) up to the end of 2023 caused more than 770 million cases and almost 7 million deaths worldwide. In Italy, it caused 26 million cases and about 192,000 deaths (https://data.who.int/dashboards/covid19/cases?n=c). As known, the first outbreak of COVID-19 in Italy dates back to 21 January 2020 and since then the virus spread rapidly throughout the country. In order to contrast the epidemic, a lockdown restrictive measure was adopted as of 8 March 2020. It consisted in prohibiting all Italian citizens from leaving their homes, except for reasons of basic necessity or health needs, and in closing most workplaces and public places (with the exception of tobacco retailers, since smoking was considered a basic necessity) [1]. As the epidemic declined, the restrictive measures were gradually relaxed; until 31 March 2022,

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when the COVID-19 state of emergency was declared over, various containment measures and vaccination campaigns alternated according to the severity of the epidemic. The lives of millions of Italians were profoundly changed by the restrictions. Although the containment measures had a positive effect in reducing the number of COVID-19 cases, these measures changed the habits of millions of people, leading to an increase in psychological discomfort and significant changes in diet, physical activity, alcohol and drug consumption and smoking habits [2-6].

### *Nicotine-containing products ahead of the pandemic*

Tobacco use is the modifiable risk factor causing the largest number of deaths in the world with around 8 million estimated premature deaths per year [7]. Furthermore, tobacco epidemic has become complex with the emergence of alternative products such as electronic cigarettes (e-cigs) and Heated Tobacco Products (HTPs) [8]. In Italy, the use of e-cigs increased since 2010, while the use of HTPs became widespread since 2016 [9]. Their use grew rapidly worldwide, partly due to the tobacco industry's promotion of these products as a safer alternative to conventional tobacco cigarettes [10]. However, although their long-term health consequences are still unknown, there is growing evidence that these products are not harmless [11] (http://data.europa.eu/88u/dataset/S2146_87_1_458_ENG). Through the multi-purpose survey "Aspects of Daily Life", the Italian National Institute of Statistics (Istituto nazionale di statistica, Istat) started to assess e-cig use since 2014 and HTP use since 2021 in the Italian population aged 14 years and over. In 2021, the survey sample included over 45,000 individuals, and e-cig and HTP users were 2.8%, and 2.1%, respectively (https://www.istat.it/it/files//2023/01/TODAY-Sigaretta-elettronica-tabaccoriscaldato.pdf). Similar percentages of users were recorded through the cross-sectional "Progressi delle Aziende Sanitarie per la Salute in Italia" (PASSI) Italian behavioural risk factor surveillance system, a survey on a representative sample of the Italian population aged 18-69 years, including 22,000 subjects: e-cig users in 2021 were 2.4%, HTP users 2.5% [12].

### *Changes in smoking habits during the pandemic*

As with all behaviours, smoking habits changed during the pandemic. The effect of COVID-19 lockdown on smokers is equivocal and appears to lead to either an improvement or worsening of smoking habits [3, 13]. In Italy, on the whole during the pandemic, an increased use was reported for conventional cigarettes, e-cigs and HTPs [13-16], and the number of people who started or resumed smoking was higher than the number of people who quit smoking during the pandemic [13]. In detail, smoking prevalence decreased among young people, occasional smokers and unemployed people, and increased if psychological distress symptoms were present [3]. New e-cig users during lockdown were more frequently men and young adults; new HTP users were with higher education level [6]. Moreover, in Italy quit attempts were more frequent among exclusive smokers of conventional cigarettes than exclusive e-cig users [17].

Despite these data, there are only few studies to date regarding the simultaneous use of several tobacco products during the lockdown in Italy. Furthermore, no data have been published on the change in smoking habits after the lockdown, once all work activities and social habits have resumed. It is therefore crucial to understand how behavioural changes caused by the epidemic changed again when pre-epidemic conditions were restored.

### *Aim*

This study aims to assess the prevalence of HTP and/or e-cig users in relation to conventional cigarette smoking habit during and after the COVID-19 pandemic, using two cross-sectional surveys carried out on a representative sample of the Italian adult population. Secondarily, the study outlines the characteristics of conventional cigarettes and nicotine-containing products (NCPs) users in 2023 in order to adopt targeted tobacco control strategies.

## MATERIALS AND METHODS

### *Setting, study design and study population*

The paper is based on data from the studies "LOckdown and LifeSTyles IN ITALY" (LOST IN ITALY) and "LOckdown and LifeSTyles IN TOSCANA" (LOST IN TOSCANA), which were focused on behavioural changes in lifestyle and mental health during and after COVID-19 lockdown. The former project was coordinated by the Mario Negri Institute in Milan, the latter by the Institute for cancer research, prevention and clinical network (Istituto per lo Studio, la Prevenzione e la Rete Oncologica, ISPRO) in Florence, in collaboration with the Italian National Institute of Health (Istituto Superiore di Sanità, ISS), and other Italian universities and research institutes. The two study protocols were approved by the Ethics Committee of the coordinating centres (Istituto Besta, file number: 71-73, April 2020, and Comitato Etico Regionale per la Sperimentazione Clinica della Toscana, Sezione Area Vasta Centro, file number: CEAVC 19834, April 2021, respectively). All the enrolled participants provided informed consent to participate in the study [18].

The "LOST IN ITALY" project included 6,003 people, with an oversampling of Lombardy, the Italian region initially most affected by the COVID-19 epidemic. The sample, representative of the Italian population, was drawn from the DOXA online panel. The latter is based on a sample of the Italian population aged 18-74, including approximately 40,000 active subjects, i.e., people who have participated in at least one survey in the last 12 months (average update: 25%), for a total of over 120,000 subjects [19]. Participants reported their habits via a self-administered online questionnaire before the start of the lockdown and at the time of the interview, which took place between 27 April and 3 May 2020.

The "LOST IN TOSCANA" Study collected data comparable to the national data previously collected by the "LOST IN ITALY" project, through two further

surveys carried out between 24 February and 21 March 2022 and between 1 April and 30 April 2023, respectively, thus maintaining the representativeness of the Italian adult population, with an oversampling for Lombardy and Tuscany regions. The total sample recruited in March 2022 consisted of 6,600 people, of whom 4,831 also participated in the baseline survey of "LOST IN ITALY"; the sample recruited in April 2023 consisted of 6,600 people, of whom 4,445 also participated in "LOST IN ITALY". Subjects were re-interviewed using a 20-minute self-administered online questionnaire that included questions about their lifestyles, mental health, quality of life and other aspects related to the pandemic (vaccinations, use of social networks, changes in interpersonal relationships). For new recruits, information on socio-demographic characteristics was also collected.

### *Variables of interest*

In addition to socio-demographic information, the questionnaire included detailed sections on psychological characteristics (symptoms of anxiety and depression, quality and quantity of sleep, quality of life, use of psychoactive drugs), lifestyle habits (smoking habits, use of HTPs and e-cigs).

With regard to conventional cigarette use, participants were asked to indicate whether, at the time of completing the questionnaire, they were current smokers (i.e., they smoked at least 100 cigarettes in their lifetime and were currently smoking), former smokers (i.e., they smoked at least 100 cigarettes in their lifetime but were not currently smoking) or never smoked 100 cigarettes in their lifetime (never smokers). With regard to e-cig or HTP use, current users were those who reported having used e-cigs or HTPs in the last 30 days, former users who had used e-cigs/HTPs in the past but not in the last 30 days, and non-users who had never used e-cigs or HTPs. Dual users were defined as respondents who used e-cigs or HTPs and were also smokers of conventional cigarettes.

"Other smokers" were defined as dual users (smokers of conventional cigarettes that also used at least one NCP) plus exclusive users of NCPs.

To quantify the risk of smoking in association to psychological distress, we focused on anxiety and depression symptoms using validated scales. Anxiety symptoms were assessed using the 2-item generalised anxiety disorder (GAD-2), a short version of the 7-item scale (GAD-7) [20]. A score of GAD-2≥3 indicated the presence of anxiety symptoms. The presence of depressive symptoms was established using the 2-item Patient Health Questionnaire (PHQ-2), based on the 9-item validated scale (PHQ-9) and a score of PHQ-2≥3 indicated the presence of depressive symptoms [21].

### *Statistical analysis*

Statistical weights were used to ensure that the samples, for each survey, were representative of the total Italian adult population aged 18-74 years in terms of age, gender and geographical area. A Poisson regression multivariate model with robust variance was used for estimating adjusted prevalence ratios (PR) of conventional cigarette, e-cig or HTP use according to selected demographic, socio-economic characteristics and symptoms of anxiety and depression of the survey conducted in 2023. All the analyses were performed using STATA 17.0 software.

## RESULTS

Out of a total of 6,003 subjects recruited at baseline, almost 50% were males (*Table 1*). The most common age group was 35-54 years (about 41% of the sample), about half of participants were from Northern Italy (20% Center and 34% South and Islands) and about 34% of participants reported having a high education level (university degree). More than half of the sample was employed at baseline.

Almost a quarter of participants (23.4%) reported smoking conventional cigarettes before the lockdown (*Table 2*). The prevalence decreased to 21.9% during the lockdown, and then increased again in March 2022 and April 2023, when 24.5% and 23.4% of participants reported smoking conventional cigarettes, respectively, returning to the pre-lockdown prevalence. Regarding e-cig use, there was an increasing trend with 8.1% of respondents used e-cigs before lockdown, and 10.4% in 2023. Similarly, the number of HTP users increased steadily across all surveys: from 4.0% before lockdown to 7.3% in 2023.

A steady decrease in the proportion of exclusive conventional cigarette smokers occurred, from 21.3% in

**Table 1**
Description of the total sample by sex, age, geographical area, education level and working status (Italy, 2020)

| | Raw N (% weighed) |
|---|---|
| **Total** | 6,003 (100.0) |
| **Sex** | |
| Male | 3,026 (49.3) |
| Female | 2,977 (50.7) |
| **Age** | |
| 18-34 years | 1,456 (25.9) |
| 35-54 years | 2,760 (40.9) |
| 55-74 years | 1,787 (33.2) |
| **Geographical area** | |
| North | 3,386 (46.0) |
| Center | 1,026 (20.0) |
| South & Islands | 1,592 (33.9) |
| **Education level** | |
| High[a] | 2,283 (34.3) |
| Medium[b] | 2,895 (50.5) |
| Low[c] | 825 (15.2) |
| **Working status** | |
| Employed | 4,166 (62.4) |
| Inactive | 1,301 (24.8) |
| Retired | 536 (12.8) |

[a]Participants with a degree; [b]participants with a diploma; [c]participants with a secondary school qualification or lower.

**Table 2**
Prevalence (weighted %) of smokers of conventional cigarettes, users of e-cig and HTP before, during and after the lockdown (Italy 2020-2023)

| | Pre-lockdown February 2020 % | During lockdown April-May 2020 % | March 2022 % | April 2023 % |
|---|---|---|---|---|
| Conventional cigarette smokers | 23.3 | 21.9 | 24.4 | 23.3 |
| E-cig users | 8.1 | 9.1 | 9.0 | 10.4 |
| HTP users | 4.0 | 4.5 | 6.7 | 7.3 |
| Exclusive conventional cigarette smokers | 21.3 | 19.9 | 16.5 | 14.9 |
| Conventional cigarette smokers & e-cig users | 1.0 | 1.1 | 2.9 | 3.4 |
| Conventional cigarette smokers & HTP users | 0.1 | 0.0 | 1.8 | 2.1 |
| Conventional cigarette smokers & e-cig & HTP users | 1.0 | 0.9 | 3.3 | 3.0 |
| Exclusive e-cig users | 3.9 | 4.3 | 2.2 | 3.1 |
| Exclusive HTP users | 0.8 | 0.8 | 0.9 | 1.3 |
| Exclusive e-cig and HTP users | 2.2 | 2.9 | 0.7 | 1.0 |

E-cig: electronic cigarettes; HTP: heated tobacco products.

pre-lockdown 2020 to 14.9% in 2023 (*Figure 1*; *Table 2*). In contrast, the dual use of conventional cigarettes with HTPs and/or e-cigs recorded a 4-time increase: from 2.1% during the 2020 pre-lockdown to 8.5% in 2023. Interestingly, the exclusive use of NCPs decreased from 6.9% in the 2020 pre-lockdown, to 5.4% in 2023.

Among conventional cigarette smokers, the proportion of those using only conventional cigarettes decreased over time, from 91.0% (=21.3%/23.3%; *Table 2*) before the lockdown to 63.9% (=14.9%/23.3%) in 2023. Most NCP users were dual users: by 2023, 61.5% (=(3.4%+3.0% [dual users])/10.4%) of vapers were using e-cigs and concurrently smoking conventional cigarettes, compared with only 24.7% (=(1.0%+1.0%)/8.1%) before the lockdown. Similarly, the proportion of HTP users who concurrently smoked conventional cigarettes more than doubled, from 27.5% (=(0.1+1.0)/4.0) who also smoked conventional cigarettes before the lockdown to 69.9% in 2023 (=(2.1+3.0)/7.3). For both NCP, the proportion of NCP users who concurrently smoked conventional cigarettes increased from 22.9% before the 2020 lockdown to 61.0% in 2023.

In 2023, when all work activities and social habits have resumed, exclusive conventional smokers were 14.9%, exclusive NCP users or dual users 13.9%, never and former smokers 33.4% and 37.9%, respectively (*Table 3*). Results from the multivariate model highlight that males smoked significantly more than females both conventional cigarettes only and new products (PR=1.17, 95% confidence intervals [95% CI]: 1.03-1.34; PR=1.28,

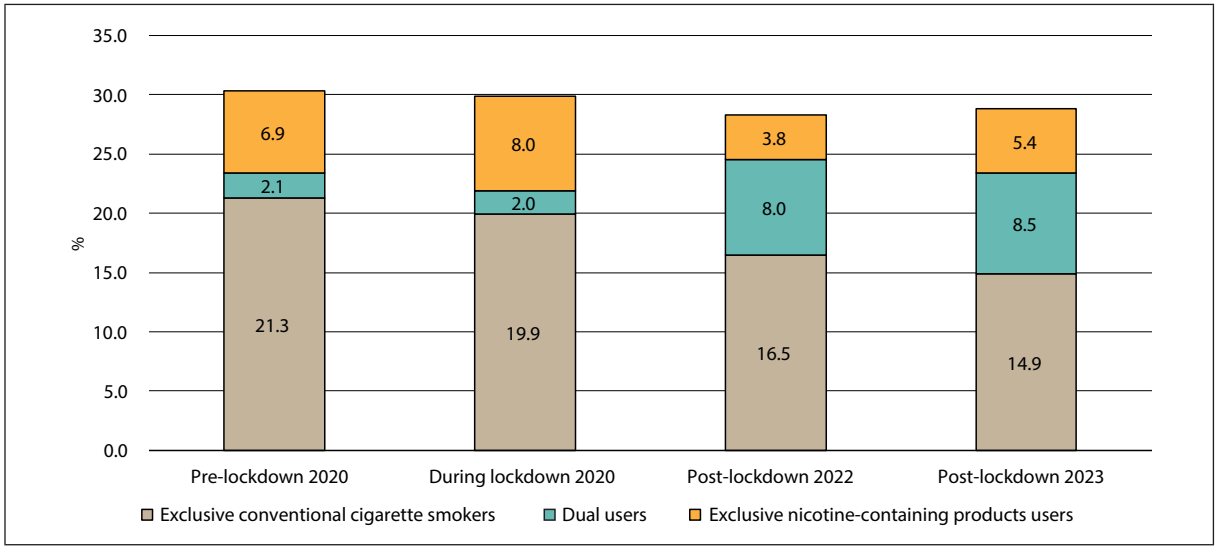


**Figure 1**
Prevalence (weighted %) of exclusive conventional cigarette smokers, dual users of conventional cigarettes and nicotine-containing products (heated tobacco products and/or electronic cigarettes), and exclusive users of nicotine-containing products before, during and after the lockdown, Italy.

**Table 3**
Distribution of exclusive smokers of conventional cigarettes, other smokers (i.e., all smokers not considering the exclusive smokers of conventional cigarettes) and never smokers of conventional cigarettes after the lockdown according to sex, age, geographical area, education level, working status, anxiety and depression symptoms. Total numbers of survey participants in each strata of the population, prevalence (weighted %) and aPR with corresponding 95% CI (Italy, 2023)

| | Exclusive smokers of conventional cigarettes | Other smokers | Never smokers of conventional cigarettes | Exclusive smokers *vs* Never smokers | Other smokers *vs* Never smokers |
|---|---|---|---|---|---|
| | N (%) | N (%) | N (%) | aPR (95% CI) | aPR (95%CI) |
| **Total** | 984 (14.9) | 916 (13.9) | 2,282 (33.4) | | |
| **Sex** | | | | | |
| Male | 491 (49.7) | 474 (53.9) | 1,032 (44.8) | **1.17 (1.03-1.34)** | **1.28 (1.12-1.46)** |
| Female | 493 (50.3) | 442 (46.1) | 1,250 (55.2) | 1* | 1* |
| **Age** | | | | | |
| 18-34 years | 216 (22.0) | 272 (33.6) | 486 (22.2) | **0.80 (0.65-0.98)** | 1.11 (0.91-1.35) |
| 35-54 years | 459 (38.4) | 437 (40.1) | 1,193 (45.4) | **0.72 (0.62-0.84)** | **0.82 (0.69-0.98)** |
| 55-74 years | 309 (39.6) | 207 (26.3) | 603 (32.4) | 1* | 1* |
| **Geographical area** | | | | | |
| North | 493 (46.9) | 425 (44.1) | 425 (46.4) | 1* | 1* |
| Center | 248 (25.9) | 211 (23.2) | 211 (23.2) | **1.22 (1.04-1.44)** | 1.14 (0.96-1.37) |
| South & Islands | 243 (27.3) | 280 (32.8) | 280 (32.8) | 1.16 (0.99-1.35) | **1.33 (1.15-1.55)** |
| **Education level** | | | | | |
| High[a] | 318 (30.5) | 360 (34.2) | 926 (36.7) | 1* | 1* |
| Medium[b] | 504 (51.9) | 462 (53.5) | 1,087 (49.3) | 1.17 (1.00-1.37) | 1.13 (0.98-1.29) |
| Low[c] | 162 (17.6) | 94 (12.3) | 269 (14.0) | **1.30 (1.06-1.59)** | 1.00 (0.80-1.25) |
| **Working status** | | | | | |
| Employed | 689 (64.5) | 728 (72.0) | 1,684 (66.7) | 1* | 1* |
| Inactive | 168 (16.5) | 130 (19.6) | 319 (15.2) | 1.04 (0.88-1.24) | 1.06 (0.87-1.29) |
| Retired | 127 (19.0) | 58 (8.4) | 279 (18.1) | 0.88 (0.71-1.09) | **0.53 (0.39-0.72)** |
| **Anxiety** | | | | | |
| Low | 709 (73.4) | 637 (69.1) | 1,761 (78.3) | 1* | 1* |
| High | 275 (26.6) | 279 (30.9) | 521 (21.7) | 1.18 (1.00-1.38) | **1.21 (1.03-1.43)** |
| **Depression** | | | | | |
| Low | 785 (82.0) | 709 (77.4) | 1,952 (85.5) | 1* | 1* |
| High | 199 (18.0) | 207 (22.6) | 330 (14.5) | 1.12 (0.94-1.34) | **1.21 (1.02-1.45)** |

Bold indicates statistically significant results. *Reference category; [a]participants with a degree; [b]participants with a diploma; [c]participants with a secondary school qualification or lower; aPR: adjusted prevalence ratios; CI: confidence intervals.

95% CI: 1.12-1.46 for conventional cigarettes and other products, respectively). Exclusive conventional smokers were less likely to be aged <35 years (PR=0.80, 95% CI: 0.65-0.98), while young adults were more likely to use NCPs. Respondents from Central Italy used conventional cigarettes more than those from Northern Italy (PR=1.22, 95% CI: 1.04-1.44), whereas respondents from Southern Italy and Islands used more frequently NCPs (PR=1.33, 95% CI: 1.15-1.55). Those with lower education levels used conventional cigarettes more than those with a university degree (PR=1.30, 95% CI: 1.06-1.59). Retired respondents were less likely to be NCP users in comparison to employed ones (PR=0.53, 95% CI: 0.39-0.72). Respondents manifesting anxiety and depression symptoms were more frequently smokers of both conventional cigarettes and other tobacco products (anxiety: PR=1.18, 95% CI: 1.00-1.38, and PR=1.21, 95% CI: 1.03-1.43 for conventional cigarettes and other products, respectively; depression: PR=1.12, 95% CI: 0.94-1.34 and PR=1.21, 95% CI: 1.02-1.45 for conventional cigarettes and other products, respectively).

## DISCUSSION

In summary, in our study the prevalence of conventional cigarette smokers did not decrease, remaining stable at 23%. Exclusive conventional cigarette smokers decreased from 21% before the lockdown in 2020 to 15% in 2023 but dual users, representing the large majority of NCP users, increased by 4 times, and exclusive NCP users remained from 2020 to 2023 decreased from 7% in 2020 to 5% in 2023.

Although the use of conventional cigarettes decreased during the lockdown (before the lockdown: 23.4% of the total sample; during the lockdown: 21.9%), at the end of the pandemic with the resumption of works and social activities it increased again (2022: 24.5%; 2023: 23.4%), confirming the plateau in smoking prevalence observed since 2014 in Europe (Special Eurobarometer 458: Attitudes of Europeans towards tobacco and electronic cigarettes - Data Europa EU). In any case, Italians are no more so loyal to conventional cigarettes: the exclusive use of them decreased steadily, from 91.0% in 2020 to 63.9% in 2023, and dual use of conventional cigarettes with e-cigs or HTPs, recorded a 4-time increase in 2023 [12]. These trends, with also an increase of vapers and HTP users, being most of them dual smokers, was reported also in previous studies [9, 12, 14].

Our study confirmed that males smoked significantly more than females both conventional cigarettes and NCPs (https://www.istat.it/it/files//2023/01/TODAY-Sigaretta-elettronica-tabaccoriscaldato.pdf; Istat-Audizione-Commissione-Affari-Sociali-3-ottobre-2023.pdf). Moreover, older people and those with lower education levels tend to be more loyal to exclusive conventional cigarette smoking, whereas NCP users are more likely to be young people with a diploma or a university degree, highlighting the progressive cultural change of the new generations regarding smoking habits. Regarding the geographical distribution, respondents from Central Italy used conventional cigarettes more than those from Northern Italy, whereas those from Southern Italy and Islands were more frequently NCPs users. Both conventional cigarettes smokers and other tobacco products users were more likely to manifest anxiety and depression symptoms than those who never smoked, reconfirming the close relationship between smoking and stress already found in the literature and underlining a similar association of NCPs (https://www.istat.it/it/files//2023/01/TODAY-Sigaretta-elettronica-tabaccoriscaldato.pdf) [9, 22]. Furthermore, it should be taken into account that during COVID-19 lockdown in Italy overall prevalence of depressive and anxiety symptoms doubled and these the psychological distress worsened addictive behaviours, including tobacco smoking [6].

Main findings of this paper could be interpreted in the light of the spread of NCPs which much more often accompany instead of replace conventional cigarettes, as evidenced by the increase in dual use after the pandemic and by the plateau or a slight decrease recorded in the prevalence of exclusive use of e-cigs or HTPs, which has not changed significantly over time.

It is noteworthy to highlight that in Italy disposable e-cigs have been on the market since 2021, with a high uptake and consumption rates especially among adolescents. Disposable e-cigs could be partially responsible of the increase in e-cig use in the study period.

New products obtained fiscal and regulatory benefits compared to conventional cigarettes and tobacco industries are selling new products using new marketing tactics [12, 23, 24]. Therefore, instead of accelerating the process towards a tobacco endgame, the availability of NCP provided negative feedback on tobacco control [9]. In addition, the use of more than one product at the same time may lead individuals to smoke more frequently (most conventional cigarette smokers use e-cigs where smoking conventional cigarettes is prohibited) and increase the negative health effects, considering also that combining smoking with e-cigs did not seem to reduce cardiovascular events [25, 26]. In practical terms, our data confirm that in real life NCPs are not effective as smoking cessation tools [27-29].

Limitations of this study were represented by the cross-sectional design, including the impossibility to infer causality in the observed associations. Our results should be confirmed by prospective cohort studies and extended to other European countries.

## CONCLUSIONS

In conclusion, after the pandemic there was a reduction in the exclusive consumption of conventional cigarettes, with an increased use of NCPs, mostly used in combination with conventional cigarettes. Preventing young people from smoking is crucial in order to stop the tobacco epidemic. The establishment of an effective and targeted tobacco control programme in Italy would need to take into account the increasing use of nicotine-containing products, mainly among young people, in order to increase smokers' awareness of the risks associated with new products, especially when used in combination with conventional cigarettes.

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***Conflict of interest statement***

No conflict of interest is declared by all the Authors regarding this paper.

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