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Smoking intensity changes during the COVID-19 pandemic waves in a cohort of smokers in Italy

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Abstract

Introduction. COVID-19 lockdown in Italy resulted in increased smoking consumption, mainly associated with mental distress. This study aims to update previous findings investigating changes in smoking intensity during the whole COVID-19 pandemic.

Methods. This analysis was carried out within the "LOST IN ITALY" ("LOckdown and lifeSTyle IN ITALY") and "LOST IN TOSCANA" studies on 880 smokers with information collected during main pandemic peaks. Changes in cigarettes/day were investigated in association with survey-periods, socio-demographic and psychological characteristics through a linear mixed-model.

Results. Net of psychological distress and socio-demographic variables, in comparison to pre-pandemic period cigarettes/day increased by 1.16 during lockdown, and remained over half higher subsequently. In the overall period, an increase of >1 cigarette/day was also associated to lower education, older age, male gender and psychotropics drugs use.

Conclusions. After 2 years of pandemic, cigarettes/day have not yet returned to the pre-pandemic levels, mainly due to socio-demographic factors, but also to nicotine addiction, that tends to stabilize consumption.

Key words

- smoking intensity
- nicotine addiction
- COVID-19 pandemic
- COVID-19 waves
- mental distress

INTRODUCTION

The coronavirus disease (COVID-19), firstly identified in December 2019, has spread worldwide causing almost 700 million cases and 6 million deaths in January 2023 [1]. At the beginning, many countries worldwide implemented lockdown interventions to detain the virus spread [2]. However, several COVID-19 waves were recorded [3]. After the initial wave which comprised a pre-pandemic phase in January-May 2020 and a first wave in June 2020-February 2021, the COVID-19 pandemic comprised other three global waves up to the beginning of 2022: the second, March-June 2021; the third, July-October 2021; the fourth, November 2021-March 2022 [3]. Each of these waves was associated with different restriction policies that varied from country to country.

The isolation measures implemented during the first wave were linked to a general declining mental health [4] and lifestyles changes, comprising smoking habits, related both to mental distress and to a large amount of time spent at home [5]. The impact of the COVID-19 pandemic on smoking habits is complex and uncertain [6]. Most studies found a reduction of smokers; however, among smokers, contrasting results were found, with a recent meta-analysis reporting a reduced and an increased consumption respectively among 21% and 27% of smokers, and quitting smoking among 4% [7]. In Italy, results from the "LOckdown and lifeSTyle IN ITALY" (LOST IN ITALY) project, a cross-sectional study investigating changes in smoking habits during lockdown, showed a huge effect of the 2020 lockdown in increasing smoking consumption. In fact, despite a reduced prevalence in younger ages, maybe due to the social role of smoking among youth, a consumption increase accounted for most changes, with 36% of

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smokers reporting a higher consumption [5]. Most of the determinants of such increase were related to mental distress, such as insufficient amount of sleep and anxiety and depression symptoms. In addition, among those who continued smoking during the first pandemic phase, there were more frequently novel product users, i.e. electronic cigarette (e-cigarette) and heated tobacco product (HTP) users [8].

In the framework of the "LOST IN ITALY" project and its extension "LOST IN TOSCANA", the aim of this study was to update previous results by investigating how smoking intensity changed during the COVID-19 pandemic waves following lockdown.

METHODS

The "LOST IN ITALY" study cohort, described in detail elsewhere [5, 9] is based on a cross-sectional survey on 6,003 participants representative of the Italian adult population who completed a web-based interview during the Italian lockdown (April 27-May 3, 2020). The fieldwork was conducted by Doxa, the Italian branch of the Worldwide Independent Network/Gallup International Association.

Within the "LOST IN ITALY" study, about half of the initial cohort was re-contacted during the first and the second COVID-19 waves (3,185 in November 27-December 20, 2020, and 3,000 in May 7-18, 2021). Finally, 4,831 participants (80.4%) were re-contacted during the last COVID-19 wave (February 24-March 21, 2022) within the "LOST IN TOSCANA" study. For the purpose of this analysis, only respondents who were current smokers at all waves and that have information in at least two surveys (the first, with the pre-lockdown and lockdown measurements, and another survey) were kept into the analysis (N=880). Each subject included has a number of measurements that goes from three to five, resulting in an unbalanced design.

In all surveys, participants completed a questionnaire on socio-demographic information, lifestyle habits and mental distress. Moreover, at the first survey, changes before and during the lockdown were recorded. Current smokers were defined as respondents who reported having smoked ≥100 cigarettes during their life and that were current smokers (i.e., smoked >0 cigarettes per day – cig/day) at the time of the interview. Current e-cigarette or HTP users were defined as respondents using e-cigarettes or HTP occasionally or regularly. The dual use was defined as smokers using either e-cigarettes or HTP. The use of psychotropic drugs was registered and sleep disorders and anxiety or depression symptoms were recorded using validated tools [4, 10-12].

Changes in the number of cig/day were investigated in association with survey time, socio-demographic variables (sex, education, age at baseline), use of e-cigarettes or HTPs, use of psychotropic drugs, sleep disorders and anxiety or depression symptoms. In order to take into account for the repeated measures design and considering dependency of observations within subjects, and also allowing the inclusion of individuals who participated to different number of surveys, i.e., unbalanced design, linear mixed models were used. A random intercept model was implemented, with socio-demographic variables as time-invariant and variables on mental distress and novel products use as time-varying covariates. Since the psychological distress variables were not correlated (Pearson-R=0.18, R=0.21 for anxiety or depression and respectively sleep disorders and drugs use, and R=-0.02 for sleep disorders and drugs use), a model which adjusted for all those variables was used.

The Intraclass Correlation Coefficient (ICC) was calculated to estimate the percentage of the total variance that was explained by between-subjects variance.

RESULTS

A comparison of smokers who were retained *versus* lost to follow-up showed significant differences in age suggesting a missing at random mechanism *(Supplementary Table 1S available online)*. Thus, fitting a linear mixed model to the observed data can produce valid inference [13].

For each subject the number of measurements goes from three to five, resulting in an unbalanced design. An increase in psychological distress and psychotropic drugs use was observed during the lockdown with a subsequent decrease up to the last survey, reaching pre-pandemic levels for the drugs use only. The mean number of cig/day was 11.7 before lockdown, 13.0 during lockdown and it reached 12.3 in the last survey *(Supplementary Table 2S available online)*.

The ICC was 83.6% (95% CI: 81.4%-85.6%), implying that the measures were quite stable within subjects and suggesting that the use of random intercept models would be a good approximation to model such correlation. Net of psychological distress and socio-demographic variables, in comparison to the period before the lockdown, the number of cig/day significantly increased by 1.16 (95% CI 0.89, 1.44) during lockdown, by 0.62 (95% CI 0.31, 0.92) in November-December 2020, by 0.69 (95% CI 0.37, 1.02) in May 2021, and by 0.57 (95% CI 0.28, 0.86) in February-March 2022 *(Table 1)*.

Statistical evidence of association was observed between sleep disorders and cig/day, with those reporting inadequate sleep smoking 0.32 (95% CI 0.03, 0.60) cig/day more than people with adequate sleep. Moreover, smokers using psychotropic drugs reported over 1 cig/day more than people not using drugs (coefficient 1.07, 95% CI 0.48, 1.67). A significant association with gender was also observed, with men smoking 1.48 cig/day more than women (95% CI 0.60, 2.36), and also for people with low education level smoking 1.44 (95% CI 0.10, 2.78) cig/day more than people highly educated. People aged 35-54 and 55-74 years smoked respectively 1.56 (95% CI 0.47, 2.66) and 2.96 (95% CI 1.75, 4.17) cig/day more than younger respondents. No significant changes in cig/day among people who also use novel products were observed in comparison to exclusive conventional cigarette smokers.

DISCUSSION

After 2 years of pandemic, smoking intensity have not yet returned to the pre-pandemic levels. The greater increase was observed during lockdown, with respondents

Table 1
Association between number of cigarettes smoked per day and survey period, socio-demographic characteristics, novel (tobacco) product use, psychotropic drugs use and mental distress variables (anxiety or depression symptoms and sleep disorders). Coefficients and 95% confidence intervals (CI) from the random intercept model

Variables		Coefficient (95% CI)
Survey*	Pre lockdown	Ref.
	Lockdown	1.16 (0.89, 1.44)
	Survey 2	0.62 (0.31, 0.92)
	Survey 3	0.69 (0.37, 1.02)
	Survey 4	0.57 (0.28, 0.86)
Sex	Female	Ref.
	Male	1.48 (0.60, 2.36)
Level of education	High	Ref.
	Medium	0.90 (-0.05, 1.85)
	Low	1.44 (0.10, 2.78)
Age	18-34 years	Ref.
	35-54 years	1.56 (0.47, 2.66)
	55-74 years	2.96 (1.75, 4.17)
Dual use**	Yes	Ref.
	No	0.28 (-0,06; 0.63)
Use of psychotropic drugs***	No	Ref.
	Yes	1.07 (0.48, 1.67)
Anxiety or depression symptoms****	No	Ref.
	Yes	0.30 (-0.01, 0.62)
Sleep disorders*****	No	Ref.
	Yes	0.32 (0.03, 0.60)

*Pre-lockdown and lockdown: survey carried out in April-May 2020 referring respectively to the pre lockdown period and to the pre-pandemic COVID-19 wave; Survey 2: carried out in November-December 2020 referring to the COVID-19 wave 1; Survey 3: carried out in May 2021 referring to the COVID-19 wave 2; Survey 4: carried out in February-March 2022 referring to the COVID-19 wave 4.
**Dual use: smokers using either e-cigarettes or heated tobacco products.
***Use of psychotropic drugs: respondents using at least one drug among antidepressants, anxiolytics/benzodiazepine, hypnotics, antipsychotics and mood stabilizers [4].
****Anxiety or depression symptoms: respondents with value higher than 3 in the 2-item generalized anxiety disorder scale [10] or in the 2-item Patient Health Questionnaire scale [11].
*****Sleep disorders: respondents who reported to sleep less than 7 hours per night or who evaluated their overall sleep as quite bad or very bad [12].

smoking 1.16 cig/day more than before. These results confirmed the initial trend observed in the previous "LOST IN ITALY" analysis [5]. Moreover, this study shows that in the subsequent COVID-19 waves, the initial increase halved, remaining around 0.6 cig/day more than before the pandemic.

These results suggest that the restrictions imposed during the lockdown resulted in changes in smoking intensity mainly related to mental distress [5]. Then, during the subsequent COVID-19 waves, mental distress had not yet returned to the pre-pandemic levels, but this had no direct impact on tobacco consumption, which was mainly associated to socio-demographic factors usually related to tobacco addiction [14], such as a lower education, older age and being male, and to the use of psychotropic drugs. Therefore, once smoking intensity increases, it is not easy to come back to initial levels for smokers with specific socio-demographic characteristics, probably also due to tobacco and nicotine addiction themselves that tends to stabilize consumption [14].

Finally, our results did not support the harm reduction theory, which suggests that novel product use should determine a decrease in smoking intensity [15]. In fact, in our study, the dual use of novel products and traditional cigarettes was not associated with a decrease in cig/day.

Limitations of our study include the possible information bias due to the self-reported responses and, more importantly, a possible selection bias, being this study based on a sample of online panelists, characterized by a higher socioeconomic level compared with the general population. Moreover, we did not include quitters, since there are many differences between determinants of decreasing smoking intensity and of smoking cessation [16].

This study has several strengths. First of all, the statistical modelling allowed to take into account for the longitudinal structure of the data by considering the correlation within individuals. Moreover, despite the limitation of having a reduced number of observations in the two middle COVID-19 waves, the modeling strategy allowed to include all the observations coming from surveys with different sample sizes in an unbalanced design, without loss of power, and with not equally spaced measurements. Finally, the surveys were carried out during most of the COVID-19 pandemic waves (i.e. all except the third between July and October, 2021), allowing thus to capture the possible effect of the pandemic peaks on the population psychological distress and lifestyle changes.

CONCLUSIONS

After 2 years of pandemic, smoking intensity has not yet returned to the pre-pandemic levels, and this is explained mainly by socio-demographic factors, but also by tobacco and nicotine addiction, that tends to stabilize consumption.

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Data availability

The data underlying this article will be shared on reasonable request to the corresponding Author.

Conflict of interest statement

The Authors declare no conflicts of interest.

Ethics

The studies received Ethics Committee approval (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 participants provided an informed consent to participate to the study.

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