

Impact of COVID-19 lockdown on smoking consumption in a large representative sample of Italian adults

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ABSTRACT

Objectives Italy is one of the first countries that imposed a nationwide stay-at-home order during the COVID-19 outbreak, inevitably resulting in changes in lifestyles and addictive behaviours. The aim of this work is to investigate the impact of lockdown restrictions on smoking habits using data collected within the Lost in Italy project.

Methods A web-based cross-sectional study was conducted on a representative sample of 6003 Italian adults aged 18–74 years. Study subjects were recruited from 27 April to 3 May 2020 and were asked to report changes in smoking habits before the lockdown and at the time of interview.

Results During the lockdown, 5.5% of the overall sample quit or reduced smoking, but 9.0% of the sample started, relapsed smoking or increased their smoking intensity. In total, the lockdown increased cigarette consumption by 9.1%. An improvement in smoking habits was associated with younger age, occasional smoking and unemployment, whereas a worsening was mainly associated with mental distress. In particular, an increase in cigarette consumption during lockdown was more frequently reported among those with worsening quality of life (OR: 2.05; 95% CI: 1.49 to 2.80), reduction in sleep quantity (OR: 2.29; 95% CI: 1.71 to 3.07) and increased anxiety (OR: 1.83; 95% CI: 1.38 to 2.43) and depressive symptoms (OR: 2.04; 95% CI: 1.54 to 2.71).

Conclusions COVID-19 lockdown had a huge impact on smoking consumption of the Italian general population. The main concern is for smokers who increase their cigarette consumption due to an increased mental distress. Providing greater resources for cessation services capable of reducing mental health symptoms in smokers is urgently needed.

INTRODUCTION

The COVID-19 outbreak has severely affected the whole world. COVID-19 is responsible for more than 100 million confirmed cases worldwide, including over 2 million deaths, in February 2021.¹ The pandemic is still in place, with a second wave of infections ongoing.

In the absence of evidence for effective treatment regimens or a successful vaccine, the major approach has been the adoption of severe restrictions to increase physical distancing (referred to by some as social distancing) to minimise person-to-person transmission. Most countries have implemented ‘lockdown’ policy interventions at varying degrees and at different times. The main

aim of lockdown was to prevent more rapid spread of COVID-19 and to allow more time for public health and healthcare services to become better prepared for the prevention and management of the disease.^{2,3}

The efficacy of lockdown measures is currently under active investigation; however, preliminary evidence showed an overall reduction in COVID-19 incidence,^{4–11} with effectiveness increasing with rigidity of lockdown.¹²

Italy developed the earliest COVID-19 epidemic among the European countries¹³ and was the first country to implement a national lockdown, even before the WHO announced COVID-19 outbreak as a pandemic, on 11 March 2020. In Italy, in fact, a nationwide stay-at-home order was imposed from 9 March 2020 so that most of the workplaces and public places, including shops, bars and restaurants, have been forced to close and people were forbidden to leave their homes except for basic necessities and health problems, and most people were allowed to work from home, whenever the job type made it possible.¹⁴ Starting from May 4, 2020, the containment measures were gradually relaxed, starting the so-called ‘phase 2’, with the gradual reopening of some commercial activities, allowing people to leave their homes and move to the national territory.

Despite the positive effect of the lockdown measures to contain the first wave of the COVID-19 spread, the restrictions imposed have suddenly changed the lives of millions of Italians,¹⁴ resulting in changes in lifestyles and addictive behaviours related to a large amount of time spent at home. In addition, the lockdown may have led to mental distress, such as increased monotony, stress, anxiety, depression, irritability and insomnia.^{15,16} A non-negligible percentage of the Italian population was also directly exposed to the effects of COVID-19, resulting in a potential post-traumatic stress disorder.¹⁷ Moreover, the lockdown and the subsequent phase had a strong impact on the Italian economy, determining job loss, that is potentially linked to mental distress.

The increase in mental distress may have led to an increase in smoking during lockdown, given the positive association between smoking and mental illness.^{18–21} Accordingly, the prevalence of smoking is higher among people experiencing anxiety, depression or other mental illnesses, and many smokers think that smoking helps them to reduce or control stress.¹⁹ On the contrary, social

isolation may have led to a reduction in social smokers, that is, people smoking primarily in social contexts.²² Moreover, although the association between smoking and SARS-CoV-2 infection is not clear, there is evidence of a direct association between cigarette smoking and COVID-19 severity,^{23 24} with smokers almost doubling the risk of COVID-19 progression and death²⁵ compared with non-smokers. This link between smoking and COVID-19 severity may have had the effect of encouraging smokers to quit.

Giving the potential of COVID-19 spread for a long time or the outbreak of a similar epidemic in future,^{3 26} stakeholders need to understand changes in behaviours that could result from a lockdown to design appropriate programmes for discouraging unhealthy changes in behaviours.

Several studies are in progress to determine the effect of lockdown on various aspects of lifestyles and mental distress of the Italian population. To the best of our knowledge, the effect of lockdown on smoking habits was evaluated mainly on voluntary population samples,^{27–29} and first results suggest an increase in the amount of cigarettes smoked among smokers²⁷ as well as a decrease in smoking prevalence, mainly due to a fall in youth.^{28 29}

During the first phase of the lockdown imposed in the first wave of the COVID-19 pandemic, within the project 'Lockdown and LifeSTyles IN ITALY' (Lost in Italy), we conducted a web-based cross-sectional study on a representative sample of Italian adults aged 18–74 years to assess the behavioural changes related to lifestyles and mental disorders.³⁰ In particular, the aim of this study is to investigate the impact of lockdown on smoking habits in the Italian general population.

METHODS

The Lost in Italy survey interviewed 6003 people, including an oversampling for Lombardy, the Italian region most affected by the COVID-19 epidemic with over half the number of Italian deaths. The fieldwork was conducted by Doxa, the Italian branch of the Worldwide Independent Network/Gallup International Association. The sample, representative of the Italian population aged between 18 and 74 years in terms of age, sex, socio-economic characteristics and geographic area, was extracted from the Doxa online panel.³⁰ The latter is based on a sample of Italian adults aged 18–74 years, including about 40 000 active subjects, or people who have participated in at least one research in the last 12 months (average update: 25%), for a total of over 120 000 subjects.³¹ Online self-administered interviews were collected between 27 April and 3 May 2020, thus all within the first part of the lockdown related to the first wave of the pandemic.

The study protocol was approved by the ethics committee of the coordinating centre (EC of Istituto Besta, file number: 71-73, April 2020). Consent to participate was collected by all study participants through a tick in the electronic questionnaire.

The survey collected information on lifestyle habits, mental distress and quality of life before and during the lockdown imposed during the first wave of the COVID-19 pandemic through a self-managed online questionnaire in Italian language lasting about 20 min. In particular, the questionnaire collected information on sociodemographic characteristics, such as age, sex, level of education, geographic area of residence and conditions during lockdown, such as working condition and number of people per room. In addition, the questionnaire included detailed sections on current lifestyles, such as smoking habits, and a section on some psychological aspects, such as the overall

quality of life, quantity of sleep, anxiety or depression, and motor impulsiveness.

Ever smoking was assessed by asking, 'Have you smoked at least 100 cigarettes in your entire life?'; then participants were asked whether they were current or former smokers both before lockdown and at the time of the interview.

All the mental health variables were measured using validated tools. Global quality of life was assessed with the Visual Analogue Scale (VAS), a 0–10 scale to rate subjective quality of life, with 10 indicating the best health status. Quantity of sleep was assessed using one item of the Pittsburgh Sleep Quality Index which asked for the number of hours of sleep at night.³² Anxiety and depression were assessed using, respectively, the two-item Generalised Anxiety Disorder scale and the two-item Patient Health Questionnaire scale.^{33 34} Finally, motor impulsiveness was assessed through the 11 items of the Barratt Impulsiveness Scale.³⁵

As for smoking habits, mental health aspects (except motor impulsiveness) were investigated with particular attention to their change during the lockdown, asking participants to indicate their health conditions before the start of the lockdown and at the time of the interview. Dichotomous variables of worsening of the health condition were defined by comparing the scores before and during the lockdown.

Data were analysed using statistical weights to generate representative estimates of the Italian general population. Descriptive statistics on relative frequency and its corresponding 95% CIs for categorical variables were computed taking into account statistical weights. Comparisons of descriptive statistics were performed by computing p value for current smokers versus non-smokers, that is, former and never smokers, as this study aims to highlight changes in the habits of current smokers.

The outcomes of this analysis were improvement and worsening of smoking habits. The first included quitting smoking and decreasing smoking intensity, that is, reduction in the number of cigarettes smoked per day. Worsening of smoking habit included starting smoking among never smokers or relapsing among former smokers, and increasing the number of cigarettes smoked per day.

The association between improvement and worsening in smoking habits was evaluated estimating ORs and their corresponding 95% CIs through unconditional multiple logistic models taking into account statistical weights. All the models were adjusted for selected sociodemographic variables (sex, age, level of education, having children), known as factors influencing smoking status in Italy,³⁶ geographic area and smoking variables, such as cigarettes smoked per day or smoking status (base model). Conditions during lockdown (working condition and people per room) and mental health variables were analysed in separated models. Analyses were performed using Stata V.16.

RESULTS

The baseline characteristics of the Lost in Italy overall sample and according to smoking habits before the lockdown imposed during the first wave of the COVID-19 pandemic are reported in [table 1](#). Smokers showed a lower education compared with never and former smokers ($p=0.006$) and had more frequently children in comparison with never and former smokers ($p<0.001$). Significant differences were observed also by gender ($p=0.025$ for current vs never smokers, $p=0.030$ for current vs former smokers, $p<0.001$ for former vs never smokers); by age group, with former smokers mainly aged 55–74 years ($p=0.012$ for current vs never smokers, $p<0.001$ for current vs former smokers, $p<0.001$ for former vs never smokers); and in the

Table 1 Descriptive characteristics at baseline of the Lost in Italy sample by smoking habit, N (%)

Variable	Overall sample N=6003	Current smokers N=1400	Former smokers N=549	Never smokers N=4053	P value*
<i>Baseline characteristics</i>					
Gender					
Male	2962 (49.3)	724 (51.7)	322 (58.7)	1916 (47.3)	0.116
Female	3041 (50.7)	677 (48.3)	227 (41.4)	2137 (52.7)	
Age					
18–34	1557 (25.9)	331 (23.6)	86 (15.7)	1140 (28.1)	0.216
35–54	2457 (40.9)	588 (42.0)	165 (30.0)	1705 (42.1)	
55–74	1989 (33.1)	482 (34.4)	299 (54.4)	1209 (29.8)	
Education					
Low	911 (15.2)	260 (18.6)	131 (23.8)	520 (12.8)	0.006
Intermediate	3032 (50.5)	691 (49.3)	271 (49.3)	2071 (51.1)	
High	2060 (34.3)	450 (32.1)	148 (26.9)	1462 (36.1)	
Living with children aged 0–14					
Yes	1707 (28.4)	464 (33.1)	129 (23.6)	1114 (27.5)	<0.001
No	4296 (71.6)	937 (66.9)	420 (76.5)	2939 (72.5)	
Geographic area					
North	2764 (46.0)	647 (46.2)	254 (46.2)	1864 (46.0)	0.884
Centre	1201 (20.0)	287 (20.5)	120 (21.9)	795 (19.6)	
South and Islands	2037 (33.9)	467 (33.4)	176 (32.0)	1395 (34.4)	
<i>Psychological variables</i>					
Quality of life					
Low (<6)	789 (13.1)	217 (15.5)	81 (14.8)	490 (12.1)	0.023
Intermediate (6–8)	4534 (75.5)	1047 (74.8)	404 (73.6)	3082 (76.0)	
High (>8)	681 (11.3)	136 (9.7)	64 (11.7)	481 (11.9)	
Amount of sleep					
<8 hours per night	3982 (66.3)	928 (66.3)	415 (75.5)	2639 (65.1)	0.959
≥8 hours per night	2021 (33.7)	473 (33.8)	135 (24.6)	1414 (34.9)	
Anxiety					
Low	4915 (81.9)	1124 (80.3)	448 (81.6)	3343 (82.5)	0.165
High	1088 (18.1)	277 (19.8)	102 (18.5)	710 (17.5)	
Depression					
Low	5143 (85.7)	1170 (83.6)	468 (85.3)	3504 (86.5)	0.051
High	861 (14.3)	230 (16.4)	81 (14.8)	549 (13.6)	
Motor impulsivity					
Low	2248 (37.4)	473 (33.8)	146 (26.6)	1628 (40.2)	<0.001
Intermediate	1811 (30.2)	397 (28.4)	180 (32.8)	1233 (30.4)	
High	1945 (32.4)	530 (37.8)	223 (40.7)	1192 (29.4)	

*P value for current versus non-smokers (ie, former and never smokers).

amount of hours of sleep per night, with fewer sleep duration for current and former smokers compared with never smokers ($p=0.025$).

Before lockdown, current smokers showed a lower quality of life in comparison with both former and never smokers, with 9.7%, 11.7% and 11.9% reporting a high quality of life, respectively (ie, VAS >8; p value for current vs former and never smokers=0.023). Moreover, both current and former smokers showed a higher motor impulsivity before lockdown compared with never smokers, with 37.8%, 40.7% and 29.4%, respectively (ie, impulsivity score >21, p value for current and former smokers vs never smokers <0.001).

Regarding working condition during lockdown, a higher proportion of people who lost their job among current smokers at baseline, a higher proportion of people not working and a lower proportion of people working from home among former smokers, and a higher proportion of people regularly working among never smokers were recorded (data not shown). Compared with both never and former smokers at baseline, current smokers showed a greater household crowding during lockdown ($p=0.024$) and a worsening in mental health variables, in particular showing a significant increase in anxiety and depression (data not shown).

The prevalence of smoking decreased during lockdown from 23.3% to 21.9%, with a relative reduction by 6.2%. Among current smokers, the average number of cigarettes per day increased during lockdown from 10.9 (SD=7.3) before lockdown to 12.7 (SD=10.9) during lockdown, corresponding to a relative increase by 16.4%. Taking into account both smoking prevalence and smoking intensity, the overall consumption of cigarettes increased by 9.1%, mainly in women (3.7% in men and 15.2% in women) and in younger ages (11.5% in age class 18–34, 14.5% in age class 35–54 and 2.7% in age class 55–74).

In Lombardy region (N=1832), smoking prevalence decreased by 7.0% (from 20.1% to 18.7%), and, among current smokers, the average number of cigarettes per day increased by 12.2%. Considering both smoking prevalence and smoking intensity, the overall consumption of cigarettes increased by 4.4% in Lombardy (data not shown).

In the overall Italian sample, 5.5% of people improved their smoking habits during lockdown, with 8.6% of smokers at baseline who quit smoking and 15.0% who reduced the amount of cigarettes smoked per day.

Changes in mental health variables were not associated with smoking cessation and reduction, but were associated with age, with younger people showing almost a double odds of quitting

Table 2 Association between improvement in smoking during lockdown (quitting smoking or reducing the number of cigarettes smoked per day) and selected individual variables (base model), conditions during lockdown and psychological variables: distribution at baseline (N), proportion of people improving their smoking habit (%) and corresponding ORs* with 95% CIs

Variable	Current smokers N	People who quit smoking during lockdown		People who reduced smoking during lockdown	
		%	OR (95% CI)	%	OR (95% CI)
Total	1400	8.6		15.0	
Gender					
Male	724	9.0	1	16.5	1
Female	677	8.2	0.95 (0.60 to 1.52)	13.3	0.83 (0.57 to 1.22)
Age					
55–74	482	6.1	1	13.5	1
35–54	588	7.5	1.01 (0.57 to 1.78)	11.4	0.85 (0.54 to 1.33)
18–34	331	14.3	1.92 (1.07 to 3.45)	23.4	2.14 (1.33 to 3.46)
Education					
Low	260	7.5	1	16.7	1
Intermediate	691	7.1	0.96 (0.47 to 1.97)	15.1	0.94 (0.54 to 1.61)
High	450	11.5	1.52 (0.74 to 3.12)	13.7	0.85 (0.47 to 1.52)
Living with children aged 0–14					
No	937	8.2	1	15	1
Yes	464	9.3	1.05 (0.63 to 1.74)	15	1.07 (0.7 to 1.64)
Geographic area					
North	647	8.2	1	16.9	1
Centre	287	6.6	0.81 (0.44 to 1.51)	13.2	0.77 (0.47 to 1.28)
South and Islands	467	10.4	1.24 (0.74 to 2.08)	13.4	0.80 (0.52 to 1.25)
Number of cigarettes smoked per day					
>15	282	4.8	1	11.4	2.07 (1.17 to 3.64)
6–15	723	5.1	0.99 (0.49 to 1.97)	15.5	1.59 (0.96 to 2.63)
≤5	395	17.7	3.55 (1.82 to 6.93)	18.7	1
Working condition during lockdown					
Regularly working	209	7.1	1	11.6	1
Working from home	392	9.3	1.10 (0.44 to 2.71)	11.5	1.06 (0.58 to 1.92)
Unemployed before lockdown	473	7.5	1.18 (0.48 to 2.88)	17.5	1.93 (1.02 to 3.64)
Job lost	327	10.3	1.59 (0.65 to 3.91)	17.5	1.51 (0.82 to 2.81)
People per room					
≤1	1109	8.9	1	13.6	1
>1	291	7.5	0.76 (0.41 to 1.42)	20.3	1.71 (1.02 to 2.84)
Decreased quality of life					
No	469	9.3	1	13.7	1
Yes	932	8.3	0.87 (0.53 to 1.43)	15.6	1.15 (0.75 to 1.77)
Decreased amount of sleep					
No	925	8.4	1	15.3	1
Yes	475	9.1	1.11 (0.68 to 1.79)	14.4	0.94 (0.64 to 1.39)
Increased anxiety					
No	748	9.9	1	14.9	1
Yes	653	7.2	0.67 (0.42 to 1.08)	15	0.99 (0.68 to 1.44)
Increased depression					
No	688	9.1	1	15.3	1
Yes	712	8.1	0.85 (0.54 to 1.35)	14.6	0.96 (0.65 to 1.41)

*ORs and corresponding 95% CIs were estimated through unconditional multiple logistic regression models after adjustment for gender, age, education, living with children aged 0–14, geographic area and number of cigarettes smoked per day. Estimates in bold are statistically significant at 0.05 level.

compared with older ones (OR: 1.92; 95% CI: 1.07 to 3.45 for cessation and OR: 2.14, 95% CI: 1.33 to 3.46 for smoking reduction in participants aged 18–35 years vs 55–74 years). Cessation was also associated with the number of cigarettes smoked per day, with light smokers showing an OR of 3.55 (95% CI: 1.82 to 6.93) of quitting compared with heavy smokers (table 2).

Smoking reduction resulted associated with heavy smoking (OR: 2.07, 95% CI: 1.17 to 3.64 for smokers of >15 cigarettes per day vs light smokers), being unemployed (OR: 1.93, 95% CI: 1.02 to 3.64 in unemployed vs people regularly working) and house crowding (OR: 1.71, 95% CI: 1.02 to 2.84 for >1 people per room vs ≤1) (table 2).

Despite the reduction in smoking prevalence, also a worsening in tobacco consumption was observed in 9.0% of the overall

sample, with a slight increase in people starting or relapsing smoking (0.7% of never and former smokers) and an increase in smoking intensity among current smokers before lockdown. Among the latter, 210 (15.0%) decreased the number of cigarettes smoked per day, 562 (40.1%) maintained the same amount and 509 (36.3%) increased the number of cigarettes by, on average, six cigarettes per day, with 443 subjects (31.6%) who increased by more than 25%.

Starting smoking was more frequently reported by former smokers compared with never smokers (OR: 3.12; 95% CI: 1.17 to 8.34) and by people who decreased their amount of sleep during lockdown compared with people who maintained the same amount of sleep (OR: 2.83; 95% CI: 1.06 to 7.57; table 3).

Table 3 Association between worsening in smoking habits during lockdown (starting or relapsing smoking or increasing number of cigarettes smoked per day) and selected individual variables (base model), conditions during lockdown and psychological variables: distribution at baseline (N), proportion of people worsening their smoking habits (%) and corresponding ORs* with 95% CIs

Variable	Never and former smokers N	People who started or relapsed smoking		Current smokers N	People who increased the number of cigarettes smoked per day	
		%	OR (95% CI)		%	OR (95% CI)
Total	4603	0.7		1400	36.3	
Gender						
Male	2239	0.8	1	724	32.8	1
Female	2364	0.6	0.71 (0.25 to 2.03)	677	40.1	1.40 (1.07 to 1.85)
Age						
55–74	1507	0.6	1	482	32.2	1
35–54	1870	0.4	0.41 (0.10 to 1.74)	588	39.9	1.27 (0.90 to 1.78)
18–34	1226	1.4	2.25 (0.73 to 6.98)	331	35.9	1.17 (0.77 to 1.77)
Education						
Low	651	0.2	1	260	34.1	1
Intermediate	2342	0.9	7.13 (0.87 to 58.64)	691	36.8	1.03 (0.69 to 1.53)
High	1610	0.7	5.09 (0.59 to 44.04)	450	36.9	1.02 (0.67 to 1.56)
Living with children aged 0–14						
No	3359	0.6	1	937	33.7	1
Yes	1243	1.1	2.73 (0.82 to 9.13)	464	41.6	1.33 (0.98 to 1.81)
Geographic area						
North	2118	0.5	1	647	34.1	1
Centre	915	1.4	2.79 (0.86 to 9.04)	287	39.3	1.28 (0.90 to 1.81)
South and islands	1571	0.7	1.30 (0.39 to 4.33)	467	37.6	1.15 (0.84 to 1.58)
Smoking status before lockdown						
Never smoker	4053	0.6	1	–	–	–
Former smoker	550	1.7	3.12 (1.17 to 8.34)	–	–	–
Cigarettes smoked per day before lockdown						
≤5	–	–	–	395	34.7	1
6–15	–	–	–	723	39.8	1.29 (0.92 to 1.79)
>15	–	–	–	282	29.8	0.85 (0.56 to 1.30)
Working condition during lockdown						
Regularly working	780	1.2	1	209	29.3	1
Working from home	1258	0.5	0.39 (0.12 to 1.30)	392	45.6	2.00 (1.29 to 3.11)
Unemployed before lockdown	1718	0.7	0.58 (0.14 to 2.40)	473	27.0	0.85 (0.54 to 1.36)
Job lost	847	0.7	0.53 (0.16 to 1.78)	327	43.2	1.77 (1.12 to 2.80)
People per room						
≤1	3801	0.6	1	1109	35.8	1
>1	801	1.3	1.79 (0.60 to 5.38)	291	38.3	0.94 (0.65 to 1.37)
Decreased quality of life						
No	1687	0.8	1	469	26.2	1
Yes	2916	0.7	0.97 (0.36 to 2.61)	932	41.4	2.05 (1.49 to 2.8)
Decreased amount of sleep						
No	3187	0.5	1	925	29.5	1
Yes	1416	1.3	2.83 (1.06 to 7.57)	475	49.7	2.29 (1.71 to 3.07)
Increased anxiety						
No	2639	0.4	1	748	29.8	1
Yes	1963	1.1	2.71 (0.99 to 7.39)	653	43.8	1.83 (1.38 to 2.43)
Increased depression						
No	2452	0.5	1	688	28.0	1
Yes	2150	1.0	1.97 (0.79 to 4.93)	712	44.4	2.04 (1.54 to 2.71)

*ORs and corresponding 95% CIs were estimated through unconditional multiple logistic regression models after adjustment for gender, age, education, living with children aged 0–14, geographic area, smoking status before lockdown (for the model on people who started or relapsed smoking) and number of cigarettes smoked per day (in the model on people who increased the number of cigarettes smoked per day). Estimates in bold are statistically significant at 0.05 level.

Among current smokers before lockdown, people who had a worsening in mental health variables showed a higher odds of increasing their smoking intensity in comparison with those who did not change their mental health status, that is, those who worsened their quality of life (OR: 2.05; 95% CI: 1.49 to 2.80), who reduced the amount of sleep (OR: 2.29; 95% CI: 1.71 to 3.07) and who increased anxiety (OR: 1.83; 95% CI: 1.38 to 2.43) and depression levels (OR: 2.04; 95% CI: 1.54 to 2.71; table 3). Moreover, women showed a higher odds of increasing the number of cigarettes smoked per day in comparison with

men (OR: 1.40; 95% CI: 1.07 to 1.85), as well as people working from home (OR: 2.00; 95% CI: 1.29 to 3.11) and those who have lost their job during lockdown (OR: 1.77; 95% CI: 1.12 to 2.80) compared with people regularly working during lockdown.

DISCUSSION

Results from the Lost in Italy study showed that in the lockdown imposed during the first wave of the COVID-19 pandemic,

along with a decrease in the prevalence of smoking, there was also a sharp increase in the number of cigarettes smoked per day, which led to an increase in consumption of 9%, mainly in women. Around 1 (9%) out of 10 participants reported an increase in smoking consumption during lockdown and around 1 (6%) out of 20 reported a decrease. In fact, on the one hand, 121 and 210 out of 1400 smokers, respectively, quit (9%) and decreased cigarette consumption (15%), and on the other hand, 24 (1%) out of 4053 never smokers started smoking, 9 (2%) out of 550 former smokers relapsed and 508 (36%) out of 1400 smokers increased their daily cigarette consumption.

The effect of lockdown on smoking cessation or smoking reduction was not associated with worsening of mental variables, but was observed mainly in smokers of less than five cigarettes per day, presumably due to their lower nicotine dependence severity than heavy smokers.³⁷ Moreover, net to the smoking intensity, people aged 18–34 years showed a higher odds of cessation in comparison with people older than 35 years. This could be explained with the social role of smoking among youth that ended with the social isolation due to lockdown and with the higher likelihood of successful quitting attempts among youth compared with older smokers.³⁶

Despite the decrease in smoking prevalence, an increase in cigarette consumption accounted for most of the worsening of smoking habits, with 36% of smokers reporting smoking more than they did prior to lockdown, with an average increase of six cigarettes per day. Most of the determinants of such increase were related to mental distress. First, the increase in smoking was higher in people who reported a deterioration in their quality of life during lockdown, a decrease in the amount of sleep and an increase in anxiety and depression. Second, the increase in cigarette consumption was mainly in women who had a more stressful perception of lockdown. In fact, the lockdown led to a significant increase in childcare and housework, given the closing of schools and the inability of having external domestic staff. Despite a slight increase in men's participation in housework and childcare, most of the burden fell on women, determining a more stressful confinement for women than for men.³⁸ Moreover, people who lost their job, and presumably with a high mental distress, showed a higher odds of increasing cigarette consumption in comparison with regular workers. In addition, people working from home showed a double odds of increasing smoking in comparison with people regularly working. This association was found after adjusting for having outdoor area at home (data not shown), suggesting that the possibility to smoke at home compared with workplace, and the increased monotony due to lack of sociality, led to an increase in the number of smoking breaks among people working from home.

The worsening in smoking habits was, however, not accompanied by a relaxation of household smoking bans. In fact, only a negligible proportion of the overall sample (0.11%; 0.04% among men and 0.20% among women) reported an increase in secondhand smoke exposure at home, despite (1) the observed increase in smoking consumption, (2) the lack among one out of five smokers of household smoking bans at baseline and (3) the large amount of time spent at home.

Smokers showed at baseline a greater household crowding compared with never and former smokers, possibly due to lower socioeconomic status among smokers.³⁹ However, greater household crowding resulted associated with a higher cessation among smokers, which could in part be explained both by the uprising of economic difficulties during lockdown and by a higher attention to secondhand smoke exposure in a crowded setting.

Current and former smokers in the Lost in Italy sample were characterised by a higher motor impulsivity, that is a higher propensity to act rashly without forethought, compared with never smokers, confirming findings from recent meta-analyses in which impulsivity-related traits were associated with smoking status and severity of nicotine dependence in both adults and adolescents.^{40–41} In adults, smoking status was most associated with positive urgency and a lack of planning, partly explaining the sudden worsening in smoking habits associated with the lockdown stressful changes.⁴⁰

The Lost in Italy study collected an oversample of the Lombardy to have a representative sample of the Lombardy population because the first wave of the COVID-19 pandemic in Italy focused on this particular region. The changes in smoking habit during lockdown for Lombardy were similar to those observed for the whole Italy.

Our results support earlier studies on the use of smoking to deal with mental distress^{19–20} and are consistent with findings from other surveys on convenience samples of the Italian population during lockdown in the first wave of the COVID-19 pandemic. In fact, in a survey among 490 residents in Northern Italy, which was the most affected area in Italy by the COVID-19 pandemic, more than a third of smokers increased their cigarette consumption during lockdown.²⁷ Another survey on 3533 Italians, mainly composed of women (76%), found that smoking prevalence decreased from 25.1% to 21.8%, with 3.3% of smokers quitting during lockdown.²⁸ Results from a survey carried out on 2125 Italian University students showed a reduction in smoking prevalence from 39.7% to 36.0%.²⁹

In a Dutch survey, the most stressed smokers during the first wave of the COVID-19 lockdown showed either an increase or a decrease in their smoking, suggesting that for some smokers monotony and social isolation might have stimulated smoking, whereas for others concern about contracting COVID-19 and becoming severely ill might have motivated them to stop smoking.⁴²

The main strength of this study is that the survey was carried out on a representative sample of the population aged 18–74 years, because most studies on this topic were carried out on voluntary and not representative samples of the population. Another strength was in the timing of data collection relative to lockdown restrictions in Italy. Limitations of our study include the possible information bias due to self-reported responses and a possible recall bias due to the fact that, at the time of the interview, participants were asked to report their smoking habits and psychological indicators also before the lockdown. More importantly, a possible selection bias should not be ruled out, this study being based on a sample of online panellists, characterised by higher socioeconomic levels compared with the general population.

In conclusion, in unexpected critical situations, such as the first wave of the COVID-19 pandemic, the main concern is for smokers who increase their cigarette consumption due to mental distress. The positive effect of reducing smoking among youth shows how, in that segment of the population, smoking has a significant social component, and thus, greater efforts should be made to reduce both positive beliefs and social acceptability perception of smoking among the younger generations. Moreover, these results highlight the importance of providing greater resources for cessation services capable of providing interventions to address high levels of stress, especially those administered in safer settings, such as internet-based quitting interventions

What this paper adds

- ▶ COVID-19 lockdown changed lifestyles and produced mental distress.
- ▶ The effect of the COVID-19 lockdown on changes in lifestyles in relation to mental distress is not known.
- ▶ COVID-19 lockdown produced an increase in smoking consumption in the Italian general population.
- ▶ In specific populations (youth and light smokers), the lockdown also determined an improvement in smoking habit (quitting or reducing the number of cigarettes smoked per day).
- ▶ In total, 36% of smokers increased their daily cigarette consumption.
- ▶ An increase in mental distress during lockdown was associated with a worsening of smoking habits.

(ie, mass media or social media stop smoking campaigns, programmes administered via smartphone applications or via motivational, informative and targeted mobile text messages). Evidence of the association between smoking and COVID-19 severity^{23–25} could provide greater motivation to quit.

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Contributors All authors conceptualised and designed the study. RP and AO provided data. GC, AL and CS analysed the data under the supervision of GG and SG. GC and GG wrote the first draft of the manuscript. AL, AA, AO, RP and SG provided important contributions for the interpretation of findings. AO, GG and SG provided important intellectual supports in various steps of the study. All authors carefully revised the final version of the manuscript. All authors have read and approved the last version of the manuscript.

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REFERENCES

- 1 WHO. Coronavirus disease (COVID-19) pandemic. Available: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019> [Accessed 10 Feb 2021].
- 2 Prem K, Liu Y, Russell TW. Centre for the mathematical modelling of infectious diseases COVID-19 Working Group. The effect of control strategies to reduce social mixing on outcomes of the COVID-19 epidemic in Wuhan, China: a modelling study. *Lancet Public Health* 2020;5:e261–70.
- 3 Lewnard JA, Lo NC. Scientific and ethical basis for social-distancing interventions against COVID-19. *Lancet Infect Dis* 2020;20:631–3.
- 4 Islam N, Sharp SJ, Chowell G, et al. Physical distancing interventions and incidence of coronavirus disease 2019: natural experiment in 149 countries. *BMJ* 2020;370:m2743.
- 5 Verma BK, Verma M, Verma VK, et al. Global lockdown: an effective safeguard in responding to the threat of COVID-19. *J Eval Clin Pract* 2020;26:1592–8.
- 6 Kraemer MUG, Yang C-H, Gutierrez B, et al. The effect of human mobility and control measures on the COVID-19 epidemic in China. *Science* 2020;368:493–7.
- 7 Acuña-Zegarra MA, Santana-Cibrian M, Velasco-Hernandez JX. Modeling behavioral change and COVID-19 containment in Mexico: a trade-off between lockdown and compliance. *Math Biosci* 2020;325:108370.
- 8 Lau H, Khosrawipour V, Kocbach P, et al. The positive impact of lockdown in Wuhan containing the COVID-19 outbreak in China. *J Travel Med* 2020;27:taaa037.
- 9 Pulla P. Covid-19: India imposes lockdown for 21 days and cases rise. *BMJ* 2020;368:m1251.
- 10 Sjodin H, Wilder-Smith A, Osman S, et al. Only strict quarantine measures can curb the coronavirus disease (COVID-19) outbreak in Italy, 2020. *Eu Surveill* 2020;25:2000280.
- 11 Villela DAM. The value of mitigating epidemic peaks of COVID-19 for more effective public health responses. *Rev Soc Bras Med Trop* 2020;53:e20200135.
- 12 Vinceti M, Filippini T, Rothman KJ, et al. Lockdown timing and efficacy in controlling COVID-19 using mobile phone tracking. *EClinicalMedicine* 2020;25:100457.
- 13 Onder G, Rezza G, Brusaferro S. Case-Fatality rate and characteristics of patients dying in relation to COVID-19 in Italy. *JAMA* 2020;323:1775–6.
- 14 Paterlini M. Lockdown in Italy: personal stories of doing science during the COVID-19 quarantine. *Nature* 2020;10.
- 15 Serafini G, Parmigiani B, Amerio A, et al. The psychological impact of COVID-19 on the mental health in the general population. *QJM* 2020;113:531–7.
- 16 Amerio A, Brambilla A, Morganti A, et al. COVID-19 Lockdown: Housing Built Environment's Effects on Mental Health. *Int J Environ Res Public Health* 2020;17:5973.
- 17 Brooks SK, Webster RK, Smith LE, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 2020;395:912–20.
- 18 McKee SA, Sinha R, Weinberger AH, et al. Stress decreases the ability to resist smoking and potentiates smoking intensity and reward. *J Psychopharmacol* 2011;25:490–502.
- 19 Fluharty M, Taylor AE, Grabski M, et al. The association of cigarette smoking with depression and anxiety: a systematic review. *Nicotine Tob Res* 2017;19:3–13.
- 20 Siegel A, Korbman M, Erlich J. Direct and indirect effects of psychological distress on stress-induced smoking. *J Stud Alcohol Drugs* 2017;78:930–7.
- 21 Valtorta NK, Kanaan M, Gilbody S, et al. Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. *Heart* 2016;102:1009–16.
- 22 Schane RE, Glantz SA, Ling PM. Social smoking implications for public health, clinical practice, and intervention research. *Am J Prev Med* 2009;37:124–31.
- 23 Simons D, Shahab L, Brown J, et al. The association of smoking status with SARS-CoV-2 infection, hospitalization and mortality from COVID-19: a living rapid evidence review with Bayesian meta-analyses (version 7). *Addiction* 2020. doi:10.1111/add.15276. [Epub ahead of print: 02 Oct 2020].
- 24 Gallus S, Lugo A, Gorini G. No double-edged sword and NO doubt about the relation between smoking and COVID-19 severity. *Eur J Intern Med* 2020;77:33–5.
- 25 Patanavanich R, Glantz SA. Smoking is associated with COVID-19 progression: a meta-analysis. *Nicotine Tob Res* 2020;22:1653–6.
- 26 Pung R, Chiew CJ, Young BE, et al. Investigation of three clusters of COVID-19 in Singapore: implications for surveillance and response measures. *Lancet* 2020;395:1039–46.
- 27 Canello R, Soranna D, Zambra G, et al. Determinants of the lifestyle changes during COVID-19 pandemic in the residents of northern Italy. *Int J Environ Res Public Health* 2020;17:6287.
- 28 Di Renzo L, Gualtieri P, Pivari F, et al. Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey. *J Transl Med* 2020;18:229.
- 29 Gallè F, Sabella EA, Da Molin G, et al. Understanding knowledge and behaviors related to CoViD-19 epidemic in Italian undergraduate students: the EPICO study. *Int J Environ Res Public Health* 2020;17:3481.
- 30 Odone A, Lugo A, Amerio A, et al. COVID-19 lockdown impact on lifestyle habits of Italian adults. *Acta Biomed* 2020;91:87–9.
- 31 Colombo S, Gallus S, Beretta M, et al. Prevalence and determinants of early childhood caries in Italy. *Eur J Paediatr Dent* 2019;20:267–73.
- 32 Buysse DJ, Reynolds CF, Monk TH, et al. The Pittsburgh sleep quality index: a new instrument for psychiatric practice and research. *Psychiatry Res* 1989;28:193–213.
- 33 Kroenke K, Spitzer RL, Williams JBW, et al. Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. *Ann Intern Med* 2007;146:317–25.
- 34 Kroenke K, Spitzer RL, Williams JBW. The patient health Questionnaire-2: validity of a two-item depression screener. *Med Care* 2003;41:1284–92.
- 35 Patton JH, Stanford MS, Barratt ES. Factor structure of the Barratt impulsiveness scale. *J Clin Psychol* 1995;51:768–74.

- 36 Gorini G, Carreras G, Minardi V, *et al.* [Socioeconomic and regional inequalities in smoking cessation in Italy, 2014-2017]. *Epidemiol Prev* 2019;43:275–85.
- 37 Shiffman S, Ferguson SG, Dunbar MS, *et al.* Tobacco dependence among intermittent smokers. *Nicotine Tob Res* 2012;14:1372–81.
- 38 Power K. The COVID-19 pandemic has increased the care burden of women and families. *Sustain Sci Prac Pol* 2020;16:67–73.
- 39 Schaap MM, Kunst AE. Monitoring of socio-economic inequalities in smoking: learning from the experiences of recent scientific studies. *Public Health* 2009;123:103–9.
- 40 Kale D, Stautz K, Cooper A. Impulsivity related personality traits and cigarette smoking in adults: a meta-analysis using the UPPS-P model of impulsivity and reward sensitivity. *Drug Alcohol Depend* 2018;185:149–67.
- 41 Bos J, Hayden MJ, Lum JAG, *et al.* UPPS-P impulsive personality traits and adolescent cigarette smoking: a meta-analysis. *Drug Alcohol Depend* 2019;197:335–43.
- 42 Bommele J, Hopman P, Walters BH, *et al.* The double-edged relationship between COVID-19 stress and smoking: implications for smoking cessation. *Tob Induc Dis* 2020;18:63.