Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Research paper

COVID-19 lockdown impact on mental health in a large representative sample of Italian adults

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ABSTRACT

Background: The potential benefits of the COVID-19 lockdown need to be carefully weighed versus the possible impact on people's daily life and negative mental health effects.We aimed to assess the prevalence of depression, anxiety, insomnia and quality of life before and during the COVID-19 lockdown,identifying subgroups at higher risk of mental distress as a consequence of COVID-19 associated restrictions.

Methods: Within the *Lost in Italy* project, a web-based cross-sectional study was conducted on a representative sample of 6003 Italian adults aged 18–74 recruited from April 27 to May 3, 2020, within the nation-wide stay-at-home order.

Results: The prevalence of depressive symptoms (PHQ-2 $\geq$ 3) increased from 14.3% before lockdown to 33.2% during lockdown, anxiety symptoms (GAD-2 $\geq$ 3) from 18.1% to 41.5%, insufficient sleep ($\leq$6 h/day) from 33.7% to 41.1%, unsatisfactory sleep from 17.0% to 38.8% and unsatisfactory quality of life from 13.1% to 42.1%.Overall, 47.7% reported worsened depressive symptoms, 43.6% worsened anxiety symptoms, sleep quantity (31.5%) and quality (35.0%),and 64.1% worsened quality of life.A statistically significant relationship with all mental health outcomes considered was found for women vs. men (multivariate odds ratio,OR between 1.13 and 1.63), for current vs. never smokers (OR between 1.15 and 1.25), and with increasing physical activity (p for trend<0.001 for all the indicators).The use of at least one psychotropic drug increased by 20% compared to pre-lockdown (from 9.5% to 11.4%).

Conclusions: This is the first cross-sectional study conducted in Italy on a representative sample of adults to testify the huge implications of the lockdown on mental health.

INTRODUCTION

Italy was the first country to be hit by the 2019 coronavirus disease (COVID-19) in Europe and is within those holding the highest clinical burden (Odone et al., 2020a). Italy was also the first country to impose on 9th March 2020 a nation-wide stay-at-home order, as an attempt to stop the coronavirus spread. The Italian COVID-19 pandemic lockdown lasted for almost three months, until the 3rd of May, and confined over 60 million people inside their homes. This COVID-19 lockdown measure is considered within the most radical ones implemented so far.

The potential benefits of mandatory lockdown need to be carefully weighed versus the possible impact on people's daily life and negative mental health effects emphasized by duration and difficulties to be confined at home, fears of infection, frustration and boredom, inadequate supplies and information, financial loss and stigma (Webster et al., 2020).

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An early review documented the mental health impact of lockdowns during Severe Acute Respiratory Syndrome (SARS), Ebola, H1N1 influenza, middle east respiratory syndrome (MERS), and equine influenza epidemics (Brooks et al., 2020). Unsurprisingly, confined people were very likely to show mood lability, depressive and anxiety symptoms, irritability, insomnia, acute and post-traumatic stress symptoms. Severe depression, increased alcohol use, self-medication and long-lasting avoidance behavior were reported as long-term effects (even up to three years after being confined). Moreover, along with social isolation and financial loss, lockdowns would seem to increase suicide ideation and behavior among at-risk populations (Chan et al., 2006).

Additional clinical and social risk and protective factors can play a role in developing mental disorders (Serafini et al., 2020). On the one hand, alexithymic traits could increase the risk of psychiatric consequences reducing the psychological resilience and coping ability to manage stress. On the other hand, social support can help to relieve fears and loneliness of stressed individuals, thus to reduce anxiety and depressive symptoms particularly in vulnerable populations (Amerio et al., 2020a).

To date, an overload of studies have investigated different mental health effects of COVID-19 and its response, but most of them are descriptive studies that do not allow to quantify the impact of specific aspects of the COVID-19 emergency at different time points (i.e., short-, medium- and long-term effects). Moreover, very few of these studies were conducted timely enough to capture the impacts of first wave lockdown measures and, most importantly, the large majority are conducted on heterogenous convenience samples (Shi et al., 2020; Jia et al., 2020). Data on the issue from representative samples are available for selected European and non-European countries (Sønderskov et al., 2020; Pieh et al., 2020; Ettman et al., 2020; Dawel et al., 2020). This is the first cross-sectional multi-disciplinary consortium study conducted in Italy on a representative sample of the adult population to assess the impact of national lockdown measures on selected mental health outcomes, exploring its determinants and mediators.

METHODS

Within the project LOckdown and LifeSTyles IN ITALY (*Lost in Italy*), a web-based cross-sectional study was conducted on a representative sample of 6003 Italian adults (2962 men and 3041 women) aged 18–74 years (representing approximately 73% of the general Italian population), with an oversample of subjects living in Lombardy region, the Italian area most affected by coronavirus outbreak. Data were collected from April 27 to May 3, 2020, i.e., within the Italian nation-wide lockdown (Odone et al., 2020b). The survey was conducted by DOXA, the Italian branch of the Worldwide Independent Network/Gallup International Association, in collaboration with the Italian National Institute of Health (Rome, Italy) and the Mario Negri Institute for Pharmacological Research (Milan, Italy).

Survey participants were selected among the DOXA online panel, which includes more than 40,000 active panelists. A quota sampling method was used to ensure our sample representativeness of the general Italian adult population by age, sex and region (the first-level constituent Italian entities).

The study protocol was approved by the ethics committee (EC) of the coordinating group (EC of Fondazione IRCCS Istituto Neurologico Carlo Besta, File number 71–73, April 2020) and consent to participate was collected by all study participants.

Recruited subjects filled out an online self-administered questionnaire, including information on demographic and socioeconomic characteristics, such as level of education, geographic area, municipality size, marital status, number of people per room in the house and body mass index (BMI) and on selected lifestyle habits prior the COVID-19 lockdown (i.e., early-February), including physical activity (hours/week), time spent outside (hours/week), smoking status, hazardous alcohol drinking, according to AUDIT-C scale (Babor et al., 2001), and gambling habit.

Measures

A specific section of the questionnaire was focused on mental health and wellbeing. In particular, selected mental health outcomes were explored: i) depressive status; ii) anxiety levels; iii) quality of sleep; iv) quantity of sleep; and v) quality of life. Participants were also asked to report their use of psychotropic drugs.

In order to quantify the impact of COVID-19 lockdown on participants' mental health status and use of psychotropic drugs, all the questions in this section of the questionnaire were asked referring to both before and during the lockdown.

The presence of depressive and anxiety symptoms was collected using the 2-item Patient Health Questionnaire (PHQ-2) and the 2-item generalized anxiety disorder (GAD-2) (Kroenke et al., 2007, 2003), respectively, applied to prior (i.e. two weeks before the COVID-19 pandemic; reference time: early February) and during (i.e. at the time of the interview) the national lockdown. A score of PHQ-2 ≥ 3 indicated the presence of depressive symptoms and a score of GAD-2 ≥ 3 indicated the presence of anxiety (Staples et al., 2019).

Sleep quantity and quality were assessed in the four weeks preceding the COVID-19 lockdown (reference time: from mid-January to mid-February) and in the last four weeks before the interview during the national lockdown, using items from the Pittsburgh Sleep Quality Index (PSQI) questionnaire (Buysse et al., 1989). Sleep quantity was reported in hours of sleep as a continuous measure (integer number), and was assessed using the question: "How many hours of actual sleep did you get at night? (this may be different than the number of hours spent in bed)" (PSQI item #4). Subjective evaluation of sleep quality was asked through the question: "How would you rate your sleep quality overall?" (PSQI item #9). Possible answers were: (1) very good; (2) quite good; (3) quite bad (4) very bad. We defined sleep to be insufficient when the number of hours of sleep per night was less than 7, and sleep to be of poor quality if participants evaluated their overall sleep as quite bad or very bad.

Quality of life (QoL) before (reference time: early February) and during (at the time of the interview) the COVID-19 lockdown was measured through a Visual Analogue Scale (VAS) ranging between 1 (low quality of life) and 10 (high quality of life). A VAS score <6 indicated a low quality of life.

Participants were asked to report their use of psychotropic drugs during the four weeks preceding the COVID-19 lockdown (reference time: from mid-January to mid-February) and in the last four weeks before the interview during the COVID-19 lockdown. These drugs included i) "antidepressants (e.g. Sertraline, Citalopram, Paroxetine)"; ii) "anxiolytics/benzodiazepine (e.g., Lorazepam, Alprazolam, Delorazepam)"; iii) "hypnotics (e.g., Zolpidem, Lormetazepam, Triazolam)"; iv) "antipsychotics (e.g., Risperidone, Olanzapine, Quetiapine)"; and v) "mood stabilizers (e.g., Lithium, Valproate,)". Subjects reporting the use of at least one of these drug categories were classified as "users of psychotropic drugs".

In order to identify the change (either a worsening or an improvement) in participants' mental health status due to COVID-19 lockdown we defined: i) a worsening in depression and anxiety if the participant reported any increase in PHQ-2 or GAD-2 scale, respectively, and a worsening in sleep quantity, sleep quality and QoL if the participant reported any decrease in the hours/day slept, in the sleep quality score and in the QoL VAS scale, respectively; ii) an improvement in depression and anxiety if the participant reported any decrease in PHQ-2 or GAD-2 scales, respectively, and an improvement in sleep quantity, sleep quality and QoL if the participant reported any increase in the hours/day slept, in the sleep quality score and in the QoL VAS scale, respectively.

Statistical analysis

Multiple logistic regression models after adjustment for sex, age group (18–34, 35–54, 55–74), level of education (low, intermediate,

high), and geographic area (North West, North East, Center, South and Islands) were used to derive odds ratios (OR), and corresponding 95% confidence intervals (CI), for: i) participants who worsened their mental health indicators and ii) participants who improved their mental health indicators.

A statistical weight was applied to all the analyses to guarantee the representativeness of the national sample in terms of sex, age, socio-economic status, and geographic area. All statistical analyses were performed using SAS 9.4 (Cary, North Carolina, USA).

RESULTS

The prevalence of reported depressive and anxiety symptoms, sleep characteristics, and quality of life in the study population before and during lockdown, by age group is reported in Table 1. Among 6003 Italian adults, compared to the time period before the lockdown, those reporting depressive (PHQ-2 $\geq$ 3) and anxiety (GAD-2 $\geq$ 3) symptoms during lockdown increased by 132% (from 14.3% to 33.2%) and by 129% (from 18.1% to 41.5%), respectively. Also insufficient sleep ($\leq$6 h/day) and unsatisfactory sleep (poor sleep quality) increased during lockdown by 22% (from 33.7% to 41.1%) and 128% (from 17.0% to 38.8%), respectively. Unsatisfactory quality of life has been reported by 13.1% of participants before and 42.1% during lockdown, corresponding to an increase by 221%.

Table 2 shows the prevalence, and corresponding ORs, of subjects worsening their mental health status during the lockdown, in the total sample and by selected demographic and socioeconomic characteristics. Overall, 47.7% (N = 2863) of the Italian adults reported an increase in depressive symptoms during lockdown, 43.6% (N = 2617) reported an increase in anxiety symptoms, 31.5% (N = 1891) and 35.0% (N = 2101) reported a decrease in their sleep quantity and quality, respectively, and 64.1% (N = 3848) reported a decrease in quality of life during lockdown. A worsening in each on the five specific mental health indicators was more frequently reported in women compared to men (OR=1.32; 95% CI: 1.19–1.46 for depression; OR=1.19; 95% CI: 1.07–1.32 for anxiety; OR=1.49; 95% CI: 1.33–1.66 for sleep quantity; OR=1.63; 95% CI: 1.46–1.81 for sleep quality; OR=1.13; 95% CI: 1.02–1.26 for quality of life). A worsening in depressive symptoms was less likely reported in 35–54 years old subjects (OR=0.79; 95% CI: 0.69–0.89) compared to people aged between 18 and 34 years. Worsening in sleep quality increased with decreasing age (p for trend <0.001) and worsening in sleep quantity and quality of life increased with increasing age (p for trend <0.001 for both measures). An increase in level of education was related to worsening in quality of life (p for trend <0.001). Compared to northern, people living in southern Italy more frequently reported a worsening in anxiety symptoms (OR=1.19; 95% CI: 1.06–1.34), in sleep quantity (OR=1.30; 95% CI: 1.15–1.47) and sleep quality (OR=1.36; 95% CI: 1.21–1.54). Compared to married, divorced and separated subjects less frequently reported a worsening in anxiety symptoms (OR=0.80; 95% CI: 0.64–0.99) and in quality of life (OR=0.77; 95% CI: 0.62–0.96), widowed less likely reported a worsening in their quality of sleep (OR=0.51; 95% CI: 0.32–0.81) and single people less frequently reported a worsening in their quality of life (OR=0.84; 95% CI: 0.73–0.96). An increase in the municipality size was related with worsening depressive symptoms (p for trend=0.021) and quality of life (p for trend <0.001). A worsening in anxiety symptoms and in sleep quantity and quality were more frequently observed with increasing the number of people per room (p for trend=0.004, <0.001 and <0.001,

Table 1
Distribution of 6003 Italian adults aged 18–74 years according to selected mental health indicators (depression and anxiety), sleep characteristics, and quality of life before and during the COVID-19 lockdown, overall and by sex and age group. Italy, 2020.

	Total	Sex		Age group (years)		
		Men	Women	18–34	35–54	55–74
N	6003	2962	3041	1557	2457	1989
Depression						
With depressive symptoms (PHQ-2 $\geq$ 3) pre-lockdown,%	14.3	12.3	16.3	17.6	13.7	12.6
With depressive symptoms (PHQ-2 $\geq$ 3) during lockdown,%	33.2	27.5	38.7	38.1	31.4	31.5
Change in PHQ-2, mean (SD)	+0.93 (1.63)	+0.80 (1.49)	+1.05 (1.76)	+0.95 (1.74)	+0.86 (1.56)	+1.00 (1.64)
Change PHQ-2 item #1 (interest or pleasure)	+0.43 (0.92)	+0.37 (0.84)	+0.48 (0.99)	+0.45 (0.99)	+0.38 (0.88)	+0.47 (0.92)
Change PHQ-2 item #2 (down, depressed, hopeless)	+0.50 (0.90)	+0.43 (0.82)	+0.57 (0.97)	+0.49 (0.96)	+0.48 (0.88)	+0.53 (0.88)
Anxiety						
With anxiety symptoms (GAD-2 $\geq$ 3) pre-lockdown,%	18.1	14.7	21.5	23.1	17.7	14.8
With anxiety symptoms (GAD-2 $\geq$ 3) during lockdown,%	41.5	35.2	47.6	44.7	40.3	40.6
Change in GAD-2, mean (SD)	+0.80 (1.51)	+0.71 (1.39)	+0.88 (1.62)	+0.76 (1.65)	+0.74 (1.44)	+0.89 (1.48)
Change GAD-2 item #1 (nervous, anxious or on edge)	+0.40 (0.81)	+0.36 (0.75)	+0.44 (0.86)	+0.39 (0.91)	+0.38 (0.76)	+0.45 (0.79)
Change GAD-2 item #2 (worried)	+0.39 (0.83)	+0.35 (0.77)	+0.43 (0.89)	+0.36 (0.89)	+0.37 (0.80)	+0.45 (0.82)
Sleep quantity						
Insufficient sleep ($\leq$6 h/night) pre-lockdown,%	33.7	36.8	30.6	27.2	34.8	37.3
Insufficient sleep ($\leq$6 h/night) during lockdown,%	41.1	39.1	43.0	29.5	42.0	49.0
Change in hours/night, mean (SD)	−0.08 (1.63)	+0.07 (1.56)	−0.23 (1.69)	+0.21 (2.02)	−0.09 (1.49)	−0.29 (1.46)
Sleep quality						
Poor sleep quality pre-lockdown,%	17.0	16.6	17.3	17.3	16.8	16.9
Poor sleep quality during lockdown,%	38.8	32.9	44.5	39.3	39.4	37.7
Quality of life (QoL)						
Low QoL (VAS $\leq$5) pre-lockdown,%	13.1	12.1	14.2	15.2	12.0	13.0
Low QoL (VAS $\leq$5) during lockdown,%	42.1	39.5	44.7	41.9	42.3	42.1
Change in VAS, mean (SD)	−1.37 (1.74)	−1.30 (1.67)	−1.44 (1.80)	−1.24 (1.81)	−1.36 (1.67)	−1.50 (1.76)

SD: standard deviation.

Table 2
Distribution of Italians having worsened their depressive symptoms, anxiety symptoms, sleep quantity, sleep quality, and quality of life during the COVID-19 lockdown, according to selected demographic and socioeconomic features. Corresponding odds ratios* (OR) and 95% confidence intervals (CI). Italy, 2020.

Characteristics before the lockdown	N	Participants worsening depressive symptoms (increased PHQ-2)		Participants worsening anxiety symptoms (increased GAD-2)		Participants worsening sleep quantity (decreased number of slept hours/night)		Participants worsening sleep quality (decreased self-reported sleep quality)		Participants worsening quality of life (decreased VAS)	
		%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)
Total	6003	47.7		43.6		31.5		35.0		64.1	
Sex											
Men	2962	44.1	1	41.3	1	27.1	1	29.4	1	62.5	1
Women	3041	51.2	**1.32 (1.19–1.46)**	45.8	**1.19 (1.07–1.32)**	35.8	**1.49 (1.33–1.66)**	40.4	**1.63 (1.46–1.81)**	65.7	**1.13 (1.02–1.26)**
Age group											
18–34	1557	50.5	1	43.5	1	28.1	1	38.5	1	61.0	1
35–54	2457	44.3	**0.79 (0.69–0.89)**	42.0	0.95 (0.83–1.08)	31.6	**1.19 (1.04–1.37)**	35.8	0.90 (0.79–1.03)	64.5	**1.16 (1.02–1.33)**
55–74	1989	49.7	0.97 (0.85–1.11)	45.6	1.10 (0.96–1.26)	34.0	**1.32 (1.14–1.53)**	31.3	0.73 (0.63–0.84)	66.1	**1.28 (1.11–1.47)**
p for trend			0.939		0.124		**<0.001**		**<0.001**		**<0.001**
Level of education											
Low	911	45.0	1	40.6	1	31.1	1	29.9	1	57.5	1
Intermediate	3032	49.0	1.14 (0.98–1.32)	44.4	1.15 (0.99–1.34)	32.0	1.01 (0.86–1.19)	36.5	**1.24 (1.05–1.46)**	64.6	**1.36 (1.17–1.58)**
High	2060	46.9	1.07 (0.91–1.26)	43.7	1.14 (0.97–1.34)	31.0	0.98 (0.82–1.16)	35.1	**1.19 (1.00–1.41)**	66.2	**1.47 (1.25–1.72)**
p for trend			0.663		0.192		0.719		0.145		**<0.001**
Geographic area											
North	2764	46.9	1	42.1	1	29.0	1	32.2	1	64.4	1
Center	1201	47.7	1.04 (0.90–1.19)	41.9	0.98 (0.86–1.13)	32.0	1.15 (0.99–1.33)	34.3	1.10 (0.95–1.27)	63.2	0.93 (0.80–1.07)
South & islands	2037	48.7	1.08 (0.96–1.21)	46.5	**1.19 (1.06–1.34)**	34.6	**1.30 (1.15–1.47)**	39.2	**1.36 (1.21–1.54)**	64.1	0.99 (0.87–1.11)
Marital status											
Married	3949	47.8	1	44.0	1	32.0	1	34.4	1	65.9	1
Divorced/separated	394	43.9	0.83 (0.68–1.03)	38.5	**0.80 (0.64–0.99)**	35.5	1.14 (0.91–1.42)	35.7	1.13 (0.91–1.41)	60.3	**0.77 (0.62–0.96)**
Widowed	115	51.7	1.05 (0.72–1.53)	50.8	1.23 (0.85–1.80)	30.2	0.80 (0.53–1.21)	20.6	**0.51 (0.32–0.81)**	64.1	0.90 (0.61–1.33)
Single	1545	48.0	0.97 (0.85–1.11)	43.3	0.99 (0.87–1.13)	29.2	0.97 (0.84–1.12)	37.3	1.05 (0.91–1.20)	60.3	**0.84 (0.73–0.96)**
Municipality size (inhabitants)											
<10,000	1820	45.6	1	42.3	1	30.0	1	34.7	1	60.3	1
10,000–100,000	2771	48.3	1.12 (0.99–1.26)	44	1.06 (0.94–1.20)	32.4	1.11 (0.97–1.26)	35.2	1.02 (0.90–1.16)	64.9	**1.22 (1.08–1.39)**
100,000+	1412	49.3	**1.19 (1.03–1.38)**	44.4	1.11 (0.96–1.28)	31.7	1.11 (0.95–1.29)	35.1	1.08 (0.93–1.26)	67.5	**1.36 (1.17–1.58)**
p for trend			**0.021**		0.2		0.227		0.449		**<0.001**
Number of people per room											
<1	3429	47.5	1	42.6	1	29.3	1	32.2	1	64.2	1
1	1481	46.9	0.99 (0.87–1.12)	42.9	1.03 (0.91–1.16)	34.1	**1.29 (1.13–1.47)**	37.9	**1.24 (1.09–1.42)**	64.1	1.03 (0.90–1.17)
1+	1093	49.3	1.09 (0.94–1.25)	47.6	**1.24 (1.08–1.43)**	35.1	**1.34 (1.15–1.56)**	39.9	**1.31 (1.13–1.51)**	63.8	1.04 (0.90–1.21)
p for trend			0.285		**0.004**		**<0.001**		**<0.001**		0.483

*ORs and 95% CIs were estimated using unconditional multiple logistic regression models after adjustment for sex, age group (18–34; 35–54, 55–74), level of education (low, intermediate, high), and geographic area (North West, North East, Center, South, and Islands). Estimates in bold are statistically significant at 0.05 level.

respectively).

A worsening in quality of life was less frequently observed in participants with a high BMI before the lockdown (p for trend=0.002; Table 3). Participants reporting a higher number of hours/week of physical activity and longer time spent outside before the lockdown were more likely to report a worsening in depressive symptoms (p for trend <0.001), in anxiety symptoms (p for trend <0.001), in sleep quantity (p for trend<0.001), sleep quality (p for trend <0.001) and quality of life (p for trend <0.001). Compared to never smokers, current smokers more frequently reported a worsening in depressive symptoms (OR=1.25; 95% CI: 1.10–1.41), anxiety symptoms (OR=1.20; 95% CI: 1.06–1.36), sleep quantity (OR=1.17; 95% CI: 1.03–1.33), sleep quality (OR=1.15; 95% CI: 1.01–1.31), and quality of life (OR=1.17; 95% CI: 1.03–1.34). Former smokers more likely reported a worsening in depressive symptoms compared to never smokers (OR=1.30; 95% CI: 1.08–1.55). Having a hazardous alcohol drinking before the national lockdown was associated with an increase in anxiety symptoms (OR=1.15; 95% CI: 1.03–1.30) and an increase in unsatisfactory sleep quality (OR=1.13; 95% CI: 1.00–1.27). Gamblers more frequently reported a worsening in depressive symptoms (OR=1.31; 95% CI: 1.14–1.50), anxiety (OR=1.42; 95% CI: 1.24–1.64) and sleep quality (OR=1.21; 95% CI=1.04–1.40).

ORs describing the role of selected demographic and socioeconomic characteristics and various lifestyle habits in the improvement of depressive symptoms, anxiety, sleep quantity and quality, and quality of life are shown in **Supplementary Table 1** and **Supplementary Table 2**, respectively.

During lockdown, the use of at least one psychotropic drug increased by 20% compared to pre-lockdown (from 9.5% to 11.4%). The highest relative increase in use was observed for anxiolytics/benzodiazepine (percent increase by 32%: from 4.7% to 6.2%), followed by mood stabilizers (percent increase by 20%: from 1.5% to 1.8%), antidepressants (percent increase by 14%: from 3.6% to 4.1%) and hypnotics (percent increase by 8%: from 1.3% to 1.4%; Fig. 1; **Supplementary Table 3**).

DISCUSSION

During national COVID-19 lockdown in Italy national-level prevalence of depressive and anxiety symptoms doubled, getting to affect more than one third of the general adult population (respectively, 33% and 42%) and the use of at least one psychotropic drug – mostly

Table 3
Distribution of Italians having worsened their depressive symptoms, anxiety symptoms, sleep quantity, sleep quality, and quality of life during the COVID-19 lockdown, according to selected lifestyle habits and other individual-level characteristics. Corresponding odds ratios* (OR) and 95% confidence intervals (CI). Italy, 2020.

Characteristics before the lockdown	N	Participants worsening **depressive symptoms** (increased PHQ-2)		Participants worsening **anxiety symptoms** (increased GAD-2)		Participants worsening **sleep quantity** (decreased number of slept hours/night)		Participants worsening **sleep quality** (decreased self-reported sleep quality)		Participants worsening **quality of life** (decreased VAS)	
		%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)
Total	6003	47.7		43.6		31.5		35.0		64.1	
BMI											
Normal weight	3404	48.0	1.00	44.1	1.00	31.3	1.00	35.2	1.00	65.0	1.00
Overweight	1816	48.4	1.07 (0.95–1.21)	43.1	0.97 (0.86–1.09)	30.8	0.99 (0.87–1.12)	34.7	1.09 (0.97–1.24)	65.0	0.98 (0.87–1.11)
Obese	783	44.5	0.90 (0.77–1.06)	42.4	0.94 (0.80–1.10)	34.1	1.12 (0.94–1.32)	34.8	1.06 (0.90–1.25)	58.0	**0.74 (0.63–0.87)**
p for trend			0.548		0.409		0.332		0.273		**0.002**
Physical activity (hours/week)											
0	1506	41.4	1.00	38.1	1.00	27.8	1.00	31.2	1.00	55.4	1.00
1–3	1801	46.7	**1.27 (1.11–1.46)**	42.9	**1.25 (1.09–1.44)**	30.3	**1.18 (1.01–1.38)**	32.3	1.09 (0.93–1.26)	64.3	**1.45 (1.26–1.67)**
4–6	1481	52.5	**1.65 (1.42–1.91)**	46.0	**1.44 (1.24–1.67)**	35.2	**1.54 (1.31–1.80)**	40.0	**1.59 (1.36–1.86)**	69.7	**1.88 (1.61–2.18)**
7+	1215	51.1	**1.56 (1.34–1.82)**	48.4	**1.61 (1.37–1.88)**	33.4	**1.44 (1.22–1.71)**	37.6	**1.53 (1.30–1.80)**	67.7	**1.70 (1.45–2.00)**
p for trend			**<0.001**		**<0.001**		**<0.001**		**<0.001**		**<0.001**
Time outside (hours/week)											
≤6	2103	41.8	1.00	39.4	1.00	29.6	1.00	31.6	1.00	55.4	1.00
7–14	1821	49.8	**1.41 (1.24–1.60)**	43.6	**1.20 (1.05–1.36)**	31.9	1.13 (0.99–1.30)	36.1	**1.29 (1.13–1.48)**	66.0	**1.55 (1.36–1.77)**
15+	2079	51.8	**1.58 (1.39–1.79)**	47.8	**1.45 (1.28–1.64)**	33.1	**1.27 (1.11–1.45)**	37.5	**1.47 (1.29–1.68)**	71.1	**2.04 (1.79–2.32)**
p for trend			**<0.001**		**<0.001**		**<0.001**		**<0.001**		**<0.001**
Smoking status											
Never	4053	46.0	1.00	42.6	1.00	30.8	1.00	34.5	1.00	63.4	1.00
Former	549	51.8	**1.30 (1.08–1.55)**	43.3	1.04 (0.86–1.25)	30.5	0.98 (0.81–1.20)	35.2	1.19 (0.98–1.45)	63.0	1.00 (0.82–1.20)
Current	1400	50.9	**1.25 (1.10–1.41)**	46.6	**1.20 (1.06–1.36)**	33.9	**1.17 (1.03–1.33)**	36.3	**1.15 (1.01–1.31)**	66.5	**1.17 (1.03–1.34)**
Alcohol (AUDIT-C)											
Low risk	4417	47.2	1.00	42.7	1.00	31.3	1.00	34.3	1.00	64.9	1.00
Hazardous alcohol drinking	1586	48.9	1.06 (0.95–1.19)	46.1	**1.15 (1.03–1.30)**	32.2	1.05 (0.93–1.19)	37.0	**1.13 (1.00–1.27)**	62.0	0.89 (0.79–1.01)
Gambling											
No	5023	46.9	1.00	42.4	1.00	31.4	1.00	34.6	1.00	64.5	1.00
Yes	980	51.7	**1.31 (1.14–1.50)**	49.6	**1.42 (1.24–1.64)**	31.9	1.14 (0.98–1.32)	37.0	**1.21 (1.04–1.40)**	62.2	0.95 (0.82–1.10)

*ORs and 95% CIs were estimated using unconditional multiple logistic regression models after adjustment for sex, age group (18–34, 35–54, 55–74), level of education (low, intermediate, high), and geographic area (North West, North East, Center, South, and Islands). Estimates in bold are statistically significant at 0.05 level.

anxiolytics/benzodiazepines – increased by 20%. Women more frequently worsened their mental health, as compared to men. A worsening in depressive symptoms during lockdown was more likely observed in young, in current and former smokers, in gamblers, and in subjects reporting longer time spent outdoor and more hours of physical activity before the lockdown.

Our findings can be interpreted in light of the pervasive impact that national lockdown adopted to contain the spread of the infection may have had on lifestyles, physical and mental health.

The result that women, compared to men, have worsened more their mental health status, is in line with current COVID-19 literature that estimates a greater risk in women than men of developing depression, anxiety and post-traumatic stress symptoms (Rossi et al., 2020).

A worsening in depressive symptoms and in the quality of life were more likely observed in young and more educated subjects who have reported longer time spent outdoor and more hours of physical activity before the lockdown, and might be more aware of the public health emergency and associated risks. In other words, compared to older people, youth with a more active life before the lockdown have undergone greater changes in lifestyle habits. In addition, in COVID-19 times, compared to older people, the reduced ability of the youth to tolerate uncertainty without knowing what their future will be, could explain these results (Ettman et al., 2020).

Although Italy's southern (that are also poorer) regions managed to avoid the worst of the initial phase of the pandemic, during lockdown we observe a worsening in anxiety symptoms, sleep quantity and quality in those regions. High levels of anticipatory anxiety, likely due to a vulnerable health-care system, less organized compared to that of northern regions, and fears of an impending economic crisis and recession and of losing the job, might have played a role in the observed worsening of selected mental health indicators in southern regions (The New York Times, 2020).

Findings from our survey confirm that imposed social distancing and isolation rules prevented people from meeting (mainly singles and non-cohabitants) forcing cohabiting subjects to spend long hours together with increasingly prevalent feelings of apprehension, fear of infection transmission during close contacts and anxiety (Amerio et al., 2020b).

Despite a better access to health care and other commodities, living in cities exposes people to risk factors originating from the urban social or physical environment, contributing to increased stress, which negatively impacts mental health (Núñez-González et al., 2020). In line with previous studies, worsening in depressive symptoms and in quality of life were observed more frequently among residents of large municipalities (Gruebner et al., 2017).

The association observed between increasing the number of people per room and a worsening in anxiety symptoms and in sleep disorders can be interpreted both in light of higher infection fear as well as a proxy for lower socioeconomic status with consequent higher uncertainty about the future associated to household-level economic impact of COVID-19 response (Amerio et al., 2020c).

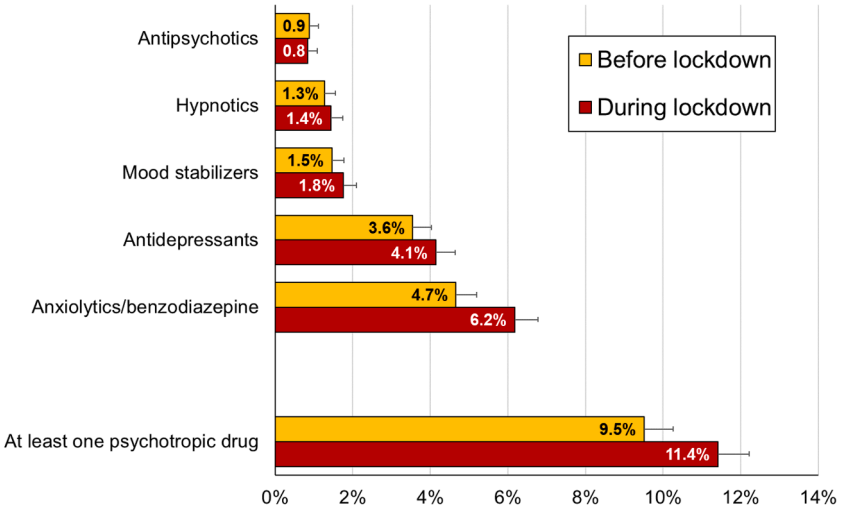

Fig.1. Percent use (%) of psychotropic drugs among 6003 Italian adults aged 18–74 years, before and during the COVID-19 lockdown. Italy, 2020.

Subjects reporting longer time spent outdoor and more hours of physical activity before the lockdown might have suffered more from being forced to stay at home, with ultimate consequences on each on the five mental health indicators (Nese et al., 2020).

Several hypotheses have been proposed to explain the high rates of smoking in people with depression and anxiety. Individuals can present depression or anxiety because of the effects of smoking on a human's neurocircuitry that increases susceptibility to environmental stressors (Fluharty et al., 2017). Although the literature is inconsistent in terms of the direction of association most strongly supported, if we apply these theoretical pathways to interpret our data we can confirm a worsening in depressive symptoms in current and former smokers compared to never smokers. A worsening in anxiety symptoms, sleep quantity and quality, and quality of life was also reported more frequently in current smokers compared to never smokers. Finally, the well known association between both alcohol disorders and gambling and depressive and anxiety symptoms (Avery et al., 2020; Håkansson, 2020), emphasized by social distancing, isolation and lockdown restrictions, is confirmed by the results of our survey.

Therefore, subjects with addictive behaviors, including tobacco smoking, alcohol drinking, and gambling, more frequently worsened their mental health indicators. As widely confirmed in the literature, unhealthy lifestyles characterize sensation seekers that might have been more affected compared to others by the negative consequences of the lockdown restrictions and social isolation (Zuckerman, 1971).

In March 2020, in the first weeks of the pandemic, a panel of experts convened by the UK Academy of Medical Sciences and a mental health research charity (MQ: Transforming Mental Health) explored the psychological, social, and neuroscientific effects of COVID-19 and set out immediate priorities and longer-term strategies for mental health science research (Holmes et al., 2020). They identified as immediate priority the collection of high-quality data on the mental health and psychological effects of the COVID-19 pandemic across the whole population through the integration across different disciplines and sectors.

To our knowledge, the Lost in Italy project is the first multidisciplinary consortium study conducted on a large national representative sample exploring the effects of COVID-19 public health response in Italy on a rich set of behavioural risk factors, physical and mental health outcomes (Odone et al., 2020b).

This study needs to be interpreted in the light of several strengths and limitations. Among its strengths, the large sample size and the use of validated evidence-based psychiatric assessment tools. The adopted study design allowed us to simulate a pre-post analysis in the context of a cross-sectional study. Our results should be therefore confirmed by longitudinal studies assessing medium- and long- term effects of COVID-19 emergency on psychological symptoms. Potential selection bias could be due to the online panel. However, a computer-assisted personal interviewing (CAPI, i.e., face-to-face) questionnaire was not possible during the COVID-19 lockdown, and a computer-assisted telephone interviewing (CATI, i.e., telephone interview) questionnaire presented limited coverage in such a relatively young population. Limitations of our study include the possible information bias due to the 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 habits and psychophysical indicators also before the lockdown. Moreover, the nature of the survey, the interview modality and the large sample size did not make feasible the use of more sophisticated instruments. Another limitation is that only two items of the PSQI scale (and not the complete questionnaire) were used to assess sleep behaviours in our population. Furthermore, the PHQ-2 and GAD-2 scales used to assess depression and anxiety only represent a first step screening and not a clinical evaluation. However, this was not among the aims of the present survey and the length of the questionnaire did not allow any deeper investigation.

Our findings, although with limitations linked to the cross-sectional study design, provide timely representative estimates on the impact on nation-wide lockdown measures on mental health in the general population and suggest that, not only the large proportion of Italian adults presented an increase in depressive and anxiety symptoms, sleep disorders and psychotropic drug consumption with an unsatisfactory quality of life compared to the time period before the lockdown, but also how determinants and mediators of these changes are to be explored beyond imposed social distancing, into behavioural, environmental, social, and other determinants. If confirmed by future longitudinal studies, our findings could support evidence-based health and welfare policies on responding to this pandemic and on how to promote mental health and wellbeing, should future waves of infection emerge.

Authors' contributions

All authors conceptualized and designed the study. AL and CS analysed the data under the supervision of SG. AA, AO and SG wrote the first draft of the manuscript. TF, GG, RP, GS provided important contributions for the interpretation of findings. AO, GS 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.

Declaration of Competing Interests

Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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Availability of data and materials

Data that support the findings of this study and materials are available from the corresponding author, AO, upon request.

Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2021.05.117.

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