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## Impact of lockdown against COVID-19 epidemic on psychological and nutritional habits in Italy: results from the #PRESTOinsieme study

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# Impact of lockdown against COVID-19 epidemic on psychological and nutritional habits in Italy: results from the #PRESTOinsieme study

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## Abstract

**Objectives.** The present work aims to present the results of the “*PRESTOinsieme*” (“*we’ll be together soon*” in English) project, a web-based survey ([www.prestoinsieme.com](http://www.prestoinsieme.com)) aimed at describing lifestyle habits and prevalence of psychological discomfort symptoms in the Italian population during the COVID-19 lockdown and at characterizing subjects presenting with impaired psychological discomfort.

**Design:** Web-based survey

**Setting:** Italy

**Participants:** Italian population older than 16 years of age

**Exposure:** The survey consisted of validated questionnaires.

**Main Outcomes and Measures:** Survey respondents’ psychological health and lifestyle habits.

**Results:** Survey respondents were 5008. Most of the respondents (88.6%) suffered from psychological distress and from moderate (25.5%, 1057 subjects) or severe (22%, 909 subjects) depressive symptoms. Lower age, female gender, being unemployed (OR 1.57, 95% C.I. 1.217-2.024) or being students (OR 1.726, 95% C.I. 1.306-2.28) were found to be predictors of more severe depressive symptoms.

**Conclusions.** Present results might be useful in facing the second wave of COVID-19, providing indications on the need to implement public programs of psychological support for the community.

**Keywords.** Italy; COVID-19; Lockdown; Dietary habits; Psychological distress

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**Strengths and limitations of this study**

- The study is a web-based survey consisting of a set of validated questionnaires to assess Italian population’s psychological wellbeing and lifestyle habits during the COVID-19 lockdown.
- The survey involves 5008 subjects aged over > 16 years and allows for the characterization of those subjects more vulnerable to the side effects of the lockdown.
- The survey was performed during the first COVID-19 lockdown in Italy; it would be interesting to collect data during the second Italian lockdown and compare them.

For peer review only

## Introduction

Containment measures (e.g., social distancing, national lockdown) are the critical public health strategies to fight the COVID-19 outbreak [1]. Even though such actions are essential to contain the COVID-19 epidemic, it is worth pointing out that they might affect physical [2] and psychological [3] health and seem to be associated with an increased risk of domestic accidents [4].

Italy is the first European country where the COVID-19 epidemic outbreak took place [5], causing an excess of mortality with severe overloads for the healthcare system [6,7]. The first containment measures have been introduced on the 23<sup>rd</sup> of February in the two Italian regions in which the epidemic outbreak has spread first (Veneto and Lombardia) [8]. However, in a short time, the epidemic outbreak has also spread in the other Italian regions, so that the Italian government has introduced new containment measures at the national level on the 11<sup>th</sup> of March. Finally, on the 22<sup>nd</sup> of March, the nationwide lockdown has been decided. Preliminary data on the Italian population during the lockdown show impaired emotional wellbeing and unhealthy lifestyle changes [9].

These days, some of the European countries initially most affected by COVID-19 are experiencing a second wave of the epidemic. We cannot rule out that severe containment measures might be introduced again to control the virus spread in the next few months.

Looking at preliminary data in the field, it appears to be of extreme importance to take appropriate public health actions to mitigate the adverse effects of lockdown [10]. Unfortunately, public health interventions may potentially favour the onset of severe side effects [11]. Containment measures leading to social distancing/isolation are even riskier, exposing or worsening people's vulnerabilities [12,13]. It would be of primary importance to identify population groups more vulnerable to potential side effects of lockdown to develop public health actions meant explicitly for these subjects [10].

The present work aims to present the results of the "*PRESTOinsieme*" ("*we'll be together soon*" in English) project, a web-based survey conducted in Italy. The study aims to describe lifestyle habits and prevalence of psychological discomfort symptoms in the Italian population during the COVID-19 lockdown and at characterizing subjects presenting with impaired psychological discomfort.

## Methods

The "*PRESTOinsieme*" (imPact of quaRantine mEasures againST cOvid19) project is a web-based survey open to volunteers older than 16 years of age ([www.prestoinsieme.com](http://www.prestoinsieme.com)). The project started in Italy on the 20<sup>th</sup> of March 2020 to assess the national lockdown effect on the population's psychological health and lifestyle habits.

### *Sampling strategy*



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3 The survey was web-based, via Lime Survey [14], and disseminated via messaging apps (i.e.,  
4 WhatsApp and Telegram), and social networks (i.e., Instagram, Facebook, LinkedIn). Survey  
5 respondents were encouraged to spread the survey to their contacts, i.e., virtual snowball sampling.  
6 Five thousand nine hundred and thirty survey accesses were registered during the study period; 5008  
7 responded (response rate: 89.45%). The response rate ranged between 70% and 95% during the study  
8 period (Figure S1, Panel A). Most of the survey accesses and survey responses were recorded until  
9 the end of the lockdown, i.e., the 3<sup>rd</sup> of May 2020 (Figure S1, Panel B, and C). The regions more  
10 affected by the outbreak (i.e., Lombardia, Veneto, Piemonte, Emilia-Romagna) provided the highest  
11 number of website accesses, except for Campania and Friuli Venezia Giulia (Figure S1, Panel D).  
12 Figure S2 reports the proportion of missing data for each region.

21 *Questionnaires*

23 The survey consisted of validated questionnaires examining subjects' socio-demographic personal  
24 and household characteristics, psychological health, and lifestyle habits.

27 For what concerns psychological health, three screening instruments, for psychological distress,  
28 depression, and post-traumatic stress, were administered. The General Health Questionnaire (GHQ-  
29 12) was used to screen for psychological distress. GHQ-12 was scored using the 4-point Likert  
30 method (0-1-2-3), with a threshold at 14 points to indicate psychological distress [15]. The Impact of  
31 Event Scale-Revised (IES-R) was used to screen for post-traumatic stress. According to a recent  
32 publication in the field [16], the total score of the IES-R was classified as following, 0–23 (normal),  
33 24–32 (mild psychological impact), 33–36 (moderate psychological impact), and ≥37 (severe  
34 psychological impact). Finally, the Center for Epidemiologic Studies Depression Scale (CES-D) was  
35 used to screen for depression, considering three classes of symptoms severity: 0-15 (no/mild  
36 depressive symptoms), 16-23 (moderate depressive symptoms), and 24-60 (severe depressive  
37 symptoms).

46 The lifestyle habits were assessed using a validated questionnaire routinely used in the Italian Food  
47 Consumption Survey (INRAN), asking about weekly food and physical activity frequency.

50 *Patient and Public Involvement*

52 Not applicable

54 *Statistical analysis*

57 Continuous data were reported as median (I, III quartiles); categorical data were summarized as  
58 percentages and absolute frequencies. The Wilcoxon-type tests were performed for continuous  
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variables and the Pearson chi-square test, or Fisher exact test, whatever appropriate, for categorical ones.

The categorized CES-D, IES-R, and GHQ-12 scores were considered as endpoints. A Proportional Odds Model was estimated for the ordinal responses with more than two categories (CES-D and IES-R). A Logistic regression model was estimated for the binary response variable (GHQ-12).

The variables to be included in the model were selected via the backward elimination method and Akaike Information Criterion (AIC). The non-linear effects on the study outcome (i.e., respondents' age and time effect) were included in the model using Restricted Cubic Splines (RCS). The model estimated Odds Ratios (OR) together with the 95% confidence interval, and the p-values were reported.

The computations were performed using the software R 4.0.2 [17] with the rms [18] package.

## Results

Survey respondents were 5008. The median age was 38 years, and the female gender was the most prevalent (63%). For what concerns socioeconomic status, about half of the sample received secondary education (52%), and two-thirds were active employees (67%).

Table S1 (Supplementary Material) reports the analysis of respondents' socio-demographic characteristics according to the place where they lived. Subjects living in areas with high COVID-19 incidence were significantly older and had a higher socioeconomic status than residents of regions with low COVID-19 incidence. They were found to have received most often university education and were more likely to have a job and to live in a single-family house with a garden.

### *Psychological distress*

Most of the survey respondents (88.6%) suffered from psychological distress (GHQ score  $\geq 14$ ). The prevalence of psychological distress was significantly higher in females (p-value 0.049), unemployed (p-value 0.001), and in those who did not perform physical activity (p-value  $< 0.001$ ) (Table 1). The results were confirmed at the multivariable analysis (Table 4). Unemployed/retired/homemakers were found to be at significantly higher risk for psychological distress compared to active employees (OR 2.00, 95% C.I. 1.4-2.85), together with females (OR 0.77 95% CI 0.63-0.94, male vs. female).

### *Depression*

Half of the sample suffered from moderate (25.5%, 1057 subjects) or severe (22%, 909 subjects) depressive symptoms. At univariable analysis (Table 2), young women were significantly more likely to suffer from severe depressive symptoms (median age of 29 years of subjects with severe symptoms

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3 vs. median age of 43 and 34 years of subjects with no or moderate depressive symptoms, respectively,  
4 p-value <0.001). In addition to that, subjects living in multi-family houses/single-room apartments  
5 without a garden were significantly more likely to suffer more frequently from moderate/severe  
6 symptoms of depression. In line with univariable analysis, lower age (OR 0.39 for interquartile range  
7 (IQR) 26-54, 95% C.I. 0.32-0.48), female gender, being unemployed/retired/homemaker (OR 1.57,  
8 95% C.I. 1.22-2.02) or being students (OR 1.73, 95% C.I. 1.31-2.28) were found to be significant  
9 predictors of more severe depressive symptoms (Table 4). Also, subjects who lived alone (OR 1.50  
10 95% C.I. 1.17-1.91) and experienced a loss (OR 1.34, 95% C.I. 1.05-1.73) were found to be  
11 significantly more likely to suffer from depressive symptoms. Conversely, doing physical activity  
12 was found to be protective against worse depressive symptoms (OR 0.64, 95% C.I. 0.55-0.75).

21 *Post-traumatic stress*

23 The prevalence of moderate and severe psychological impact was of 5.6% and 17.7%, respectively.  
24 As for moderate/severe depressive symptoms, the prevalence of moderate/severe psychological  
25 impact was significantly higher in females, younger subjects, and in subjects living in multi-family  
26 houses and single-room apartments (Table 3). The multivariable analysis confirmed such results  
27 (Table 4).

32 *Dietary habits*

35 Overall, subjects reported eating pasta/rice/cereals and cereal-based products a median of 7 times per  
36 week. The meat was reported more frequently than fish (median of 3 times per week vs median of 2  
37 times per week, respectively), while the consumption of legumes was reported to be a median of 2  
38 times per week. The consumption of fruits and vegetables was of a median of 7 times per week each.  
39 The analysis of dietary habits according to psychological wellbeing (Tables 1-2-3) scales shows no  
40 statistically significant differences for GHQ scores, except for vegetables and legumes consumption  
41 (significantly lower for subjects with psychological distress, p-value 0.002). Subjects with  
42 moderate/severe depressive symptoms were found to eat less frequently milk-based products  
43 (<0.001), fruit (<0.001), dried fruit (<0.001), and vegetables (0.013). Conversely, they were  
44 significantly more likely to eat more frequently foods high in fat and sugar (p-value 0.008). Similarly,  
45 subjects with moderate/severe psychological impact showed a lower consumption of fruit (p-value  
46 0.003). At the same time, they were more likely to eat more frequently foods high in fat and sugar (p-  
47 value 0.012).

59 **Discussion**

Present findings show a high prevalence of moderate/severe depressive symptoms during the lockdown. The characterization of such subjects showed that female students and unemployed/retired/homemaker people living in a multi-family house without a garden are at higher risk of moderate/severe depressive symptoms. Conversely, only a small proportion of subjects reported to suffer from moderate/severe psychological impact, and, again, females of young age and unemployed/retired/homemakers were the most affected.

A recent review in the field has shown that, in the short term, quarantine is associated with an increased prevalence of anxiety, depression, and post-traumatic stress symptoms [19]. Such findings are confirmed by surveys conducted in the most affected countries during the COVID-19 lockdown, showing that the population presented with increased feels of anxiety and depression [9,16]. Furthermore, emotional eating has been frequently reported [20], highlighting the strong association between psychological wellbeing and lifestyle habits, which have been profoundly affected by the lockdown [21]. Surveyed people have reported doing less physical activity and snacking more frequently during the lockdown, with consequent weight gain [22,23]. Worryingly, such changes have been shown to affect also children [24] with potentially detrimental consequences for their health since we cannot rule out that such changes in lifestyle habits could result in an increased risk for noncommunicable diseases in the long run.

The prevalence of moderate/severe depressive symptoms was found to be higher compared to a recent metanalysis in the field, i.e., prevalence of 33.7% [3]. However, when only severe depressive symptoms are considered, the prevalence is consistent with previous studies in the field [3]. Conversely, the prevalence of moderate/severe symptoms of post-traumatic stress was found to be lower than those reported in the literature [16,25,26], especially when only severe psychological impact is considered. In discussing such data, it is worth pointing out that studies in the field have employed different tools to ascertain the prevalence of depression, anxiety, and post-traumatic stress, making it difficult to compare results from other studies.

For what concerns the characterization of depressed subjects, in line with literature in the field, female gender, low socioeconomic status [27], younger age, and being students [28] were found to be significant predictors of depression.

### *Dietary habits*

The study of dietary habits during the lockdown showed that subjects were not compliant with the Mediterranean pyramid targets [29]. Half of the sample reported eating fruits and vegetables only twice a day, even though their consumption is recommended five times a day. In addition to that, subjects report to eating food high in fat and sugars (e.g., cakes) a median of 3 times a week

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(interquartile range 2-7), meaning that 25% of the sample eat such foods once a day, even though their consumption is recommended to be occasional. Such findings are in line with literature in the field, demonstrating that subjects tend to snack more frequently during the lockdown [22]. Fish consumption is recommended to be three times per week, while participants report eating fish a median of 2 times per week, we cannot rule out that the lockdown might pose difficulties in the fish purchase.

Interestingly, dietary patterns were found to be even worse in subjects with symptoms of depression and psychological impact. They were found to eat more frequently foods high in fat and sugar and to eat less frequently fruits and vegetables compared to subjects without symptoms of depression/psychological impact. Such finding could be interpreted as emotional eating that has been reported during the lockdown, showing that subjects suffering from anxiety and depressive symptoms referred to be more prone to emotional eating habits [20]. However, we can also hypothesize that subjects with psychological discomfort had worse eating habits because of a worse socioeconomic status since they were more likely not to have a job and to live in a smaller house without a garden. However, we cannot clear the issue since we did not investigate eating habits before the lockdown that is a study limitation.

Present results might be useful in facing the second wave of COVID-19, which is ongoing in almost all European countries. Such indications may provide data to implement public psychological support programs for the community if new containment measures should be introduced to face the second wave of COVID-19. Together with psychological support programs, diet and lifestyle should also be targeted by public health strategies to limit the long-term impact of the lockdown.

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**Competing interest.** None declared

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

**Patient consent.** Not applicable

**Ethical approval.** Not applicable



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Table 1. Respondents characteristics and habits according to GHQ score;  $\geq 14$  (psychological distress)

	N	0-13 (N=507)	14-36 (N=3931)	Combined (N=4438)	P-value
Age	4438	26/34/48	26/38/53	26/37/53	<0.001
Gender: Female	4438	59% (300)	64% (2502)	63% (2802)	0.049
Male		41% (207)	36% (1429)	37% (1636)	
Nationality: Other	4438	2% (8)	1% (53)	1% (61)	0.676
Italian		98% (499)	99% (3878)	99% (4377)	
Region: High COVID-19 incidence	4427	48% (242)	45% (1780)	46% (2022)	0.282
Low COVID-19 incidence		52% (263)	55% (2142)	54% (2405)	
Educational level: Secondary education	4438	49% (249)	47% (1831)	47% (2080)	0.493
University education		50% (256)	53% (2089)	53% (2345)	
Primary education		0% (2)	0% (11)	0% (13)	
Working status: Active employee	4438	71% (360)	67% (2630)	67% (2990)	0.001
Unemployed/Retired/Homemaker		8% (42)	14% (568)	14% (610)	
Student		21% (105)	19% (733)	19% (838)	
House type: Multi-family house	4438	64% (325)	66% (2589)	66% (2914)	0.221
Single room apartment		3% (16)	2% (79)	2% (95)	
Single-family house		33% (166)	32% (1263)	32% (1429)	
Garden: No	4438	39% (198)	42% (1658)	42% (1856)	0.18
Yes		61% (309)	58% (2273)	58% (2582)	
Nasopharyngeal swab: No	2873	96% (278)	93% (2391)	93% (2669)	0.038
Yes		4% (12)	7% (192)	7% (204)	
Recent loss: No	2858	91% (266)	89% (2289)	89% (2555)	0.24
Yes		9% (25)	11% (278)	11% (303)	
Living alone: No	4438	88% (448)	88% (3469)	88% (3917)	0.939
Yes		12% (59)	12% (462)	12% (521)	
Pet: No	4438	54% (274)	54% (2112)	54% (2386)	0.893
Yes		46% (233)	46% (1819)	46% (2052)	
Physical activity: No	3991	44% (203)	57% (2024)	56% (2227)	<0.001

Yes		56% ( 259)	43% (1505)	44% (1764)	
Dietary habits (weekly consumption)					
Pasta, Rice, Cereals	3987	5/7/10	5/7/10	5/7/10	0.705
Cereal-based products	3984	3/7/7	4/7/7	3/7/7	0.214
Raw meat	3985	2/3/4	2/3/4	2/3/4	0.299
Cured meat	3981	1/2/3	1/2/3	1/2/3	0.05
Fish	3985	1/2/2	1/2/2	1/2/2	0.864
Milk and yogurt	3982	2/7/7	2/7/7	2/7/7	0.971
Milk-based products	3984	2/3/5	2/3/5	2/3/5	0.675
Fruit	3985	4/7/10	4/7/10	4/7/10	0.699
Dried fruit	3981	0/2/5	0/2/5	0/2/5	0.249
Vegetables	3984	6/7/14	6/7/14	6/7/14	0.003
Legumes	3982	1/2/5	1/2/4	1/2/4	0.002
Eggs	3984	1/2/3	1/2/2	1/2/2	0.1
Food high in fat and sugar	3980	1/3/6	2/4/7	2/3/7	0.158
Soft drinks	3979	0/0/1	0/0/1	0/0/1	0.478
Alcoholic drinks (e.g., wine, beer, spirits)	3981	0/1/3	0/1/4	0/1/4	0.08

Table 2. Respondents characteristics and habits according to CES-D score; 0-15 (no/mild depressive symptoms), 16-23 (moderate depressive symptoms), and 24-60 (severe depressive symptoms)

	N	0-15 (N=2179)	16-23 (N=1057)	24-60 (N=909)	Combined (N=4145)	P-value
Age	4145	29/43/57	25/34/50	23/29/44	26/37/53	<0.001
Gender: Female	4145	53% (1165)	70% (740)	80% (729)	64% (2634)	<0.001
Male		47% (1014)	30% (317)	20% (180)	36% (1511)	
Nationality: Other	4145	1% (27)	2% (17)	1% (9)	1% (53)	0.464
Italian		99% (2152)	98% (1040)	99% (900)	99% (4092)	
Region: High COVID-19 incidence	4135	45% (976)	44% (464)	48% (431)	45% (1871)	0.258
Low COVID-19 incidence		55% (1200)	56% (589)	52% (475)	55% (2264)	
Educational level: Secondary education	4145	45% (976)	44% (464)	52% (476)	46% (1916)	<0.001
University education		55% (1196)	56% (593)	47% (431)	54% (2220)	
Primary education		0% (7)	0% (0)	0% (2)	0% (9)	
Working status: Active employee	4145	73% (1583)	67% (709)	57% (521)	68% (2813)	<0.001
Unemployed/Retired/Homemaker		16% (338)	12% (130)	12% (111)	14% (579)	
Student		12% (258)	21% (218)	30% (277)	18% (753)	
House type: Multi-family house	4145	63% (1369)	68% (715)	69% (628)	65% (2712)	0.001
Single room apartment		2% (40)	2% (23)	3% (25)	2% (88)	
Single-family house		35% (770)	30% (319)	28% (256)	32% (1345)	
Garden: No	4145	36% (781)	44% (467)	52% (475)	42% (1723)	<0.001
Yes		64% (1398)	56% (590)	48% (434)	58% (2422)	
Nasopharyngeal swab: No	2684	92% (1223)	92% (612)	95% (660)	93% (2495)	0.023
Yes		8% (106)	8% (50)	5% (33)	7% (189)	
Recent loss: No	2665	90% (1194)	89% (584)	88% (606)	89% (2384)	0.277
Yes		10% (127)	11% (73)	12% (81)	11% (281)	
Living alone: No	4145	89% (1937)	89% (937)	86% (778)	88% (3652)	0.029
Yes		11% (242)	11% (120)	14% (131)	12% (493)	
Pet: No	4145	54% (1179)	53% (565)	52% (470)	53% (2214)	0.475
Yes		46% (1000)	47% (492)	48% (439)	47% (1931)	

Physical activity: No	3991	53% (1123)	56% (573)	61% (531)	56% (2227)	0.001
Yes		47% (981)	44% (445)	39% (338)	44% (1764)	
<i>Dietary habits (weekly consumption)</i>						
Pasta, Rice, Cereals	3987	5/7/10	5/7/10	5/7/10	5/7/10	0.182
Cereal-based products	3984	3/7/7	4/7/7	4/7/7	3/7/7	0.135
Raw meat	3985	2/3/4	2/3/4	2/3/4	2/3/4	0.418
Cured meat	3981	1/2/3	1/2/3	1/2/3	1/2/3	0.243
Fish	3985	1/2/2	1/2/2	1/2/2	1/2/2	0.003
Milk and yogurt	3982	1/7/7	2/7/7	2/7/7	2/7/7	0.309
Milk-based products	3984	2/3/5.25	2/3/5	1/3/5	2/3/5	<0.001
Fruit	3985	5/7/12	3/7/10	3/7/10	4/7/10	<0.001
Dried fruit	3981	0/2/5	0/2/5	0/1/4	0/2/5	<0.001
Vegetables	3984	6/7/14	5/7/14	5/7/14	6/7/14	0.013
Legumes	3982	1/3/4	2/3/4	1/2/4	1/3/4	0.059
Eggs	3984	1/2/2	1/2/2	1/2/2	1/2/2	0.442
Food high in fat and sugar	3980	1/3/6	2/4/7	2/4/7	2/3/7	0.008
Soft drinks	3979	0/0/1	0/0/1	0/0/1	0/0/1	0.002
Alcoholic drinks (e.g., wine, beer, spirits)	3981	0/2/5	0/1/4	0/1/3	0/1/4	<0.001

Table 3. Respondents characteristics and habits according to IESD-R score; 0–23 (normal), 24–32 (mild psychological impact), 33–36 (moderate psychological impact), and >=37 (severe psychological impact)

	N	0-23	24-32	33-36	>=37	Combined	P-value
		(N=2463)	(N=827)	(N=242)	(N=762)	(N=4294)	
Age	4294	27/40/55	26/37/53	25/33/49	25/33/33	26/37/53	<0.001
Gender: Female	4294	52% (1279)	73% (600)	85% (205)	83% (205)	63% (2717)	<0.001
Male		48% (1184)	27% (227)	15% (37)	17% (157)	37% (1577)	
Nationality: Other	4294	1% (30)	1% (12)	1% (3)	1% (1)	1% (55)	0.965
Italian		99% (2433)	99% (815)	99% (239)	99% (209)	99% (4239)	
Region: High COVID-19 incidence	4284	44% (1090)	47% (385)	48% (115)	47% (100)	45% (1947)	0.377
Low COVID-19 incidence		56% (1370)	53% (440)	52% (127)	53% (109)	55% (2337)	
Educational level: Secondary education	4294	44% (1087)	48% (397)	50% (121)	51% (121)	46% (1995)	0.009
University education		56% (1368)	52% (430)	50% (120)	48% (109)	53% (2287)	
Primary education		0% (8)	0% (0)	0% (1)	0% (3)	0% (12)	
Working status: Active employee	4294	70% (1720)	66% (543)	62% (151)	65% (154)	68% (2908)	0.001
Unemployed/Retired/Homemaker		14% (349)	14% (115)	14% (34)	13% (100)	14% (598)	
Student		16% (394)	20% (169)	24% (57)	22% (68)	18% (788)	
House type: Multi-family house	4294	64% (1586)	65% (538)	76% (183)	67% (122)	66% (2819)	0.003
Single room apartment		2% (49)	2% (19)	1% (2)	3% (2)	2% (95)	
Single-family house		34% (828)	33% (270)	24% (57)	30% (25)	32% (1380)	
Garden: No	4294	38% (935)	43% (355)	52% (126)	49% (75)	42% (1791)	<0.001
Yes		62% (1528)	57% (472)	48% (116)	51% (87)	58% (2503)	
Nasopharyngeal swab: No	2774	93% (1482)	92% (454)	93% (151)	95% (191)	93% (2578)	0.418
Yes		7% (120)	8% (37)	7% (11)	5% (28)	7% (196)	
Recent loss: No	2759	91% (1458)	87% (423)	88% (139)	87% (452)	90% (2472)	0.004
Yes		9% (137)	13% (64)	12% (19)	13% (67)	10% (287)	
Living alone: No	4294	88% (2170)	89% (737)	88% (214)	87% (663)	88% (3784)	0.635
Yes		12% (293)	11% (90)	12% (28)	13% (99)	12% (510)	
Pet: No	4294	54% (1332)	52% (426)	63% (152)	52% (397)	54% (2307)	0.014

Yes		46% (1131)	48% (401)	37% (90)	48% (65)	46% (1987)	
Physical activity: No	3991	53% (1220)	58% (443)	59% (132)	61% (332)	56% (2227)	<0.001
Yes		47% (1081)	42% (317)	41% (93)	39% (73)	44% (1764)	
Dietary habits (weekly consumption)							
Pasta, Rice, Cereals	3987	5/7/10	6/7/10	5/7/10	5/7/10	5/7/10	0.56
Cereal-based products	3984	3/7/7	4/7/7	4/7/7	4/7/7	3/7/7	0.018
Raw meat	3985	2/3/4	2/3/4	2/3/4	2/3/4	2/3/4	0.15
Cured meat	3981	1/2/3	1/2/3	1/2/3	1/2/3	1/2/3	0.404
Fish	3985	1/2/2	1/2/2	1/1/2	1/2/2	1/2/2	0.443
Milk and yogurt	3982	2/7/7	2/6/7	2/7/7	2/6/7	2/7/7	0.398
Milk-based products	3984	2/3/5	2/3/5	1/3/5	2/3/5	2/3/5	0.002
Fruit	3985	4/7/10	4/7/10	3/7/14	3/7/8	4/7/10	0.003
Dried fruit	3981	0/2/5	0/2/5	0/1/5	0/2/4	0/2/5	0.061
Vegetables	3984	6/7/14	6/7/14	6/7/14	5/7/11	6/7/14	0.043
Legumes	3982	1/3/4	1/2/4	1/2/4	1/2/4	1/3/4	0.71
Eggs	3984	1/2/2	1/2/2	1/2/2	1/2/3	1/2/2	0.836
Food high in fat and sugar	3980	1/3/6	2/3/6	2/4/7	2/4/7	2/3/7	0.012
Soft drinks	3979	0/0/1	0/0/1	0/0/1	0/0/2	0/0/1	<0.001
Alcoholic drinks (e.g., wine, beer, spirits)	3981	0/2/4	0/1/3	0/1/3	0/1/3	0/1/4	<0.001

Table 4. Results of the multivariable models (proportional odds model for the ordinal responses with more than two categories, i.e., CES-D and IES-R, logistic regression model the binary response variable, i.e., GHQ-12). For continuous variables, the effect is reported on the interquartile range (IQR); i.e., 26-54 for age, 3-20 for days from the starting of the survey). Results are reported as Odds Ratio (logistic regression) or Proportional OR (proportional odds models), 95% Confidence Interval (C.I.), P-value

Supplementary Material

	OR	Lower 0.95	Upper 0.95
<i>GHQ</i>			
Days from the starting of the survey	1.19	0.95	1.49
Gender: Male vs. Female	0.77	0.63	0.94
Region: Low-incidence vs. High-incidence	0.87	0.72	1.06
Working status: Unemployed/Retired/Homemaker vs. Active employee	1.99	1.4	2.85
Working status: Student vs. Active employee	1.10	0.85	1.43
Physical activity: Yes vs. No	0.56	0.46	0.69
<i>CES-D</i>			
Days from the starting of the survey	1.38	1.00	1.89
Age	0.39	0.32	0.48
Gender: Male vs. Female	0.46	0.39	0.55
Working status: Unemployed/Retired/Homemaker vs. Active employee	1.57	1.22	2.02
Working status: Student vs. Active employee	1.73	1.31	2.28
Garden: No vs. Yes	1.72	1.46	2.01
Recent Loss: Yes vs. No	1.35	1.05	1.72
Living alone: Yes vs. No	1.50	1.17	1.91
Physical activity: Yes vs. No	0.64	0.55	0.75
<i>IES-R</i>			
Days from the starting of the survey	1.03	0.75	1.42
Age	0.67	0.58	0.78
Gender: Male vs. Female	0.30	0.25	0.37
Educational level: Secondary vs. University	1.29	1.10	1.52

Educational level: Primary vs. University	0.48	0.05	4.55
Garden: No vs. Yes	1.55	1.33	1.82
Recent Loss: Yes vs. No	1.63	1.28	2.09
Physical activity: Yes vs. No	0.72	0.61	0.84

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Table S1. Respondents characteristics and habits according to residency; high incidence of COVID-19 regions (i.e., Piemonte, Veneto, Lombardia, Emilia-Romagna) and low incidence COVID-19 regions.

	N	Low COVID-19 Incidence (N=2301)	High COVID-19 Incidence (N=2677)	Combined (N=4978)	P-value
Age	4978	25/36/53	27/39/55	26/38/54	<0.001
Gender: Female	4974	63% (1454)	63% (1676)	63% (3130)	0.614
Male		37% ( 43)	37% (1001)	37% (1844)	
Nationality: Other	4977	2% (42)	1% (31)	1% (73)	0.051
Italian		98% (2259)	99% (2645)	99% (4904)	
Educational level: Secondary education	4973	51% (1175)	45% (1193)	48% (2368)	<0.001
University education		48% (1113)	55% (1475)	52% (2588)	
Primary education		0% (10)	0% (7)	0% (17)	
Working status: Active employee	4972	63% (1442)	70% (1877)	67% (3319)	<0.001
Unemployed/Retired/Homemaker		16% (376)	13% (360)	15% (736)	
Student		21% (481)	16% (436)	18% (917)	
House type: Multi-family house	4969	72% (1660)	60% (1603)	66% (3263)	<0.001
Single room apartment		3% (60)	2% (51)	2% (111)	
Single-family house		25% (579)	38% (1016)	32% (1595)	
Garden: No	4967	50% (1150)	35% (932)	42% (2082)	<0.001
Yes		50% (1147)	65% (1738)	58% (2885)	
Nasopharyngeal swab: No	3221	97% (1371)	90% (1623)	95% (2994)	<0.001
Yes		3% (39)	10% (188)	7% (227)	
Recent loss: No	3208	90% (1267)	89% (1604)	89% (2871)	0.186
Yes		10% (136)	11% (201)	11% (337)	
Living alone: No	4870	89% (1995)	88% (2315)	89% (4310)	0.196
Yes		11% (243)	12% (317)	11% (560)	
Physical activity: No	3981	55% (971)	57% (1251)	56% (2222)	0.159
Yes		45% (808)	43% (951)	44% (1759)	
<i>Dietary habits (weekly consumption)</i>					

Pasta, Rice, Cereals	3977	5/7/10	5/7/10	5/7/10	0.215
Cereal-based products	3974	3/7/7	4/7/7	4/7/7	<0.001
Raw meat	3975	2/3/4.25	2/3/4	2/3/4	0.005
Cured meat	3971	1/2/3	1/2/3	1/2/3	<0.001
Fish	3975	1/2/3	1/1/2	1/1/2	<0.001
Milk and yogurt	3972	2/7/7	2/7/7	2/7/7	0.782
Milk-based products	3974	2/3/5	2/3/5	2/3/5	0.017
Fruit	3975	4/7/10	4/7/12	4/7/10	<0.001
Dried fruit	3971	0/2/5	0/2/5	0/2/5	0.25
Vegetables	3974	5/7/14	6/7/14	6/7/14	<0.001
Legumes	3972	2/3/4	1/2/4	1/2/4	0.005
Eggs	3974	1/2/3	1/2/2	1/2/2	0.014
Food high in fat and sugar	3970	1/3/6	2/4/7	2/4/7	0.241
Soft drinks	3969	0/0/1	0/0/1	0/0/1	0.969
Alcoholic drinks (e.g., wine, beer, spirits)	3971	0/1/4	0/1/4	0/1/4	0.001

Figure S1. Survey response report. The weekly response rate over the website accesses has been reported in panel A where the dotted line represents the overall response rate (84.5%). Panel B represents the number of responses per day; Panel C reports the number of website accesses per day. The Number of responses per region is shown in panel D where the regions with a colour that comes close to blue are more represented in the survey.

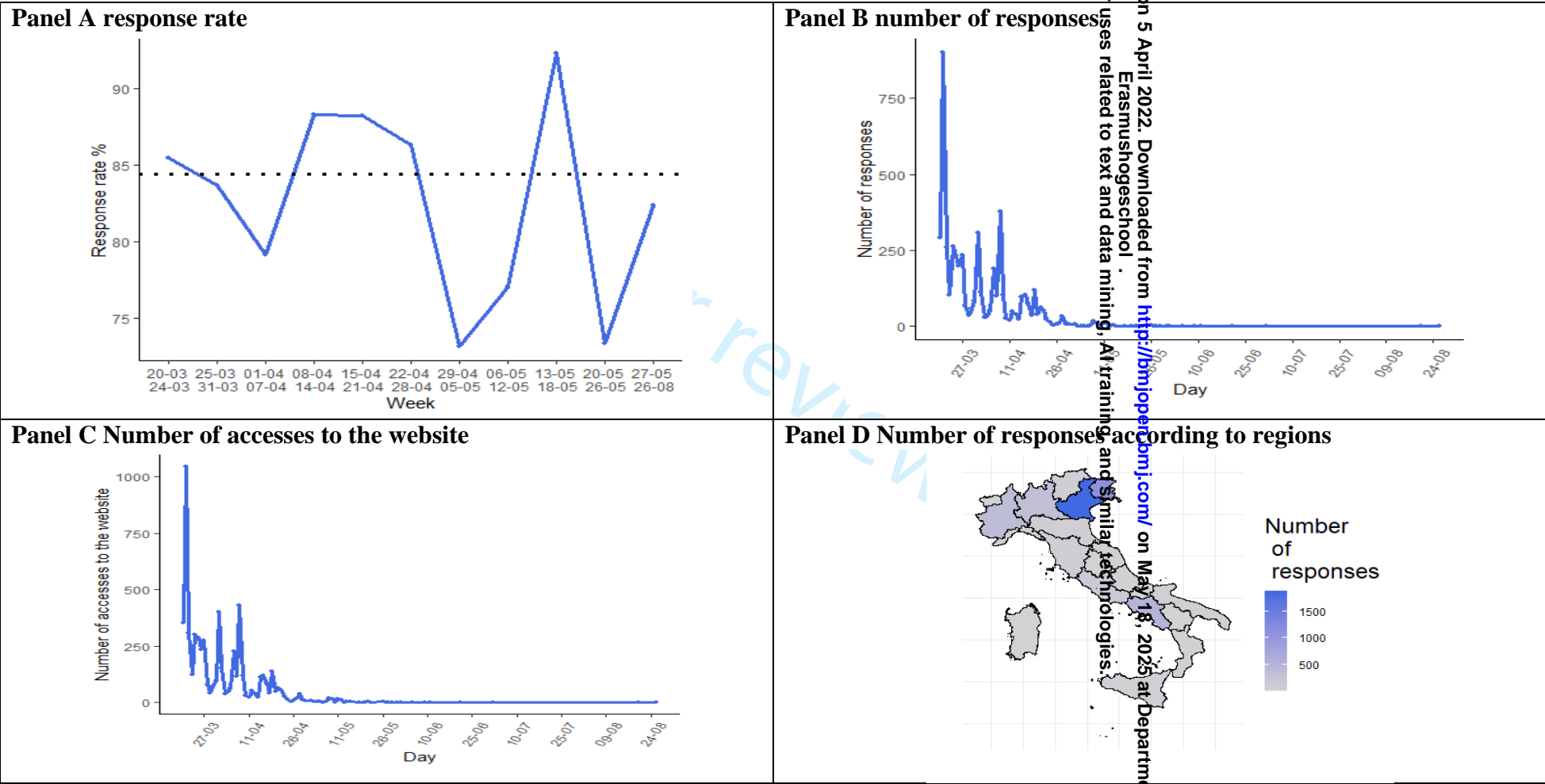
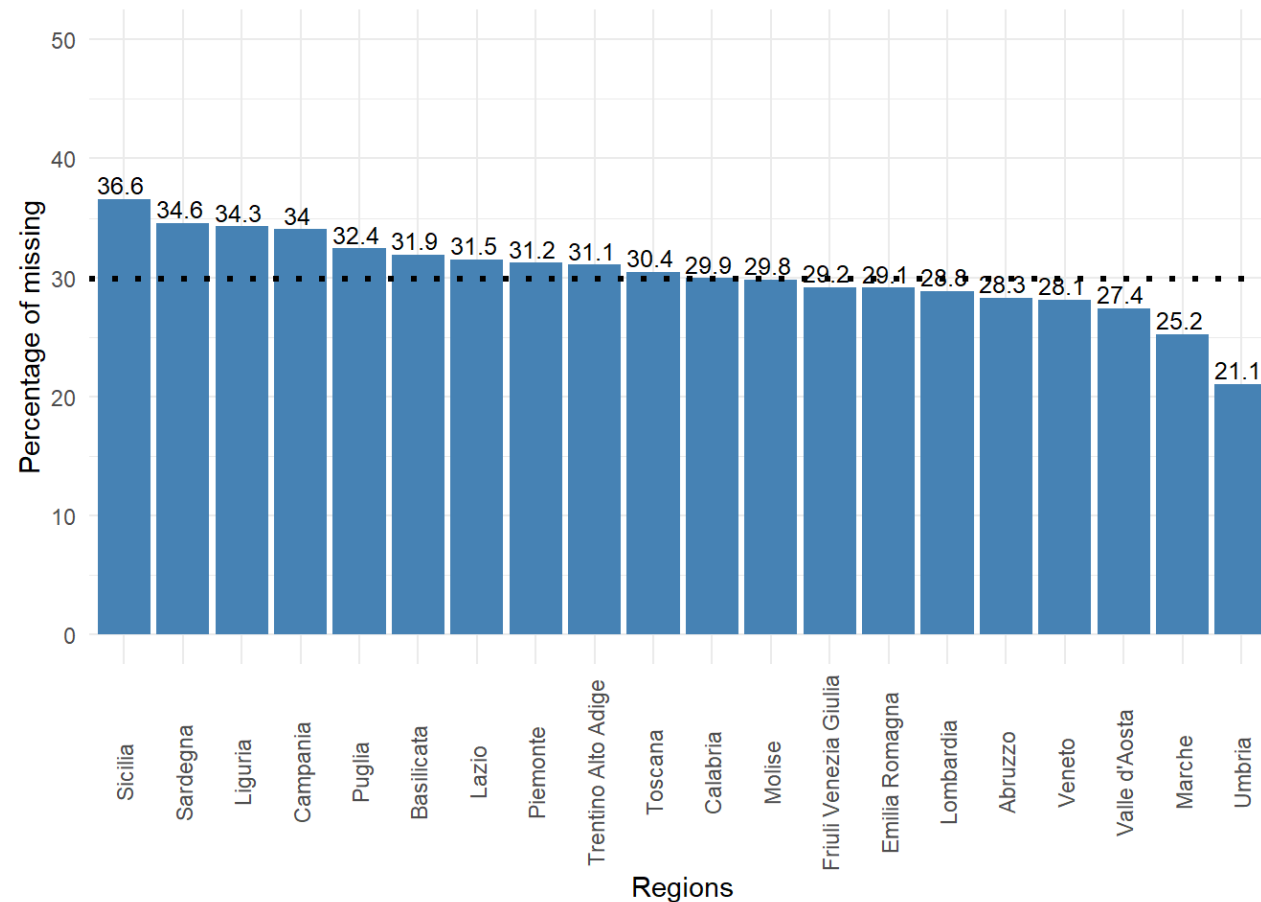


Figure S2. Missing Responses report. Percentage of missing responses per region. The dotted line represents the overall survey missing rate computed as a percentage (29.9%) of complete responses over the survey questionnaire



STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1-3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	NA
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	NA
		(c) Explain how missing data were addressed	7
		(d) If applicable, describe analytical methods taking account of sampling strategy	7
		(e) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8
		(b) Report category boundaries when continuous variables were categorized	7-8
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Impact of the COVID-19 lockdown on psychological health and nutritional habits in Italy: results from the #PRESTOinsieme study

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# Impact of the COVID-19 lockdown on psychological health and nutritional habits in Italy: results from the #PRESTOinsieme study

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## Abstract

**Objectives.** The present work aims to present the results of the "*PRESTOinsieme*" (which is "*we'll be together soon*" in English). The web-based survey ([www.prestoinsieme.com](http://www.prestoinsieme.com)) describes changes in lifestyle habits and symptoms of psychological discomfort in the Italian population during the COVID-19 lockdown and characterizes participants presenting with impaired psychological statuses.

**Design:** Online survey disseminated by messaging apps (i.e., WhatsApp and Telegram) and social networks (i.e., Instagram, Facebook, and LinkedIn).

**Setting:** Italy

**Participants:** Italian population older than 16 years of age

**Exposure:** COVID-19 lockdown

**Main Outcomes and Measures:** Survey respondents filled out a set of validated questionnaires aimed at assessing lifestyle habits and psychological health, i.e., the General Health Questionnaire (GHQ-12) to screen for psychological distress, the Impact of Event Scale-Revised (IES-R) to screen for posttraumatic stress, and the Center for Epidemiologic Studies Depression Scale (CES-D).

**Results:** Survey respondents totaled 5008. Moderate or severe psychological distress was reported in 25.5% and 22% of survey respondents, respectively. Lower age, female gender, being unemployed (OR 1.57, 95% C.I. 1.217-2.024) or being a student (OR 1.726, 95% C.I. 1.306-2.28) were predictors of more severe depressive symptoms.

**Conclusions.** The present study is one of the largest population-based surveys conducted in Italy during the first COVID-19 lockdown, providing valuable data about the Italian population's psychological health. Further studies should be conducted to understand whether psychological distress persists after the end of the lockdown.

**Keywords.** Italy; COVID-19; Lockdown; Dietary habits; Psychological distress

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**Strengths and limitations of this study**

- The study is a web-based survey consisting of a set of validated questionnaires to assess the Italian population's psychological wellbeing and lifestyle habits during the COVID-19 lockdown.
- The survey involved 5008 participants over age 16, and it represents one of the largest surveys conducted during the first COVID-19 lockdown in Italy, the European country most severely affected by the first wave of the COVID-19 outbreak.
- The survey provides a characterization of those individuals most vulnerable to the side effects of the lockdown, who might require public health support programs.
- Further studies should be conducted to understand the long-term consequences of the COVID-19 lockdown affecting psychological health and lifestyle habits.

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## Introduction

Containment measures (e.g., social distancing and a national lockdown) are crucial public health strategies in the fight against COVID-19 [1]. Even though such actions are essential to contain the COVID-19 pandemic, it is worth noting that they might adversely affect physical [2] and psychological [3] health and seem to be associated with an increased risk of domestic accidents [4]. Mental health changes during the lockdown have been detected, showing an increased prevalence/severity of anxiety and depressive symptoms together with an impairment of psychological functions involving memory and attention [5–7]. Furthermore, changes in lifestyle habits in response to COVID-19 and the lockdown have been reported. Studies have found a decrease in physical activity frequency, an impairment of sleep habits, and unhealthy eating habits [8,9]. It appears to be of extreme importance to take appropriate public health actions to mitigate the adverse effects of lockdowns [10] and to identify groups more vulnerable to the potential side effects of lockdowns to develop public health actions explicitly meant for these vulnerable populations [10]. Italy is the first European country where the COVID-19 outbreak occurred [11], causing an excess of mortality with severe overloads for the healthcare system [12]. The first containment measures were introduced on the 23<sup>rd</sup> of February 2020 in the two Italian regions where the coronavirus first spread (Veneto and Lombardia) [13]. However, over a short time, the disease also spread to other Italian regions, so the Italian government introduced new containment measures at the national level on the 11<sup>th</sup> of March 2020. Finally, on the 22<sup>nd</sup> of March 2020, a nationwide lockdown was implemented. Data on the Italian population during the lockdown show impaired emotional wellbeing and unhealthy lifestyle changes [14].

The present work aims to present the results of the "*PRESTOinsieme*" (imPact of quaRantine mEasures againST cOvid19, which is known as "we will be together soon" in English) project, a web-based survey conducted in Italy. The study aims to describe changes in lifestyle habits and the prevalence of psychological discomfort symptoms in the Italian population during the COVID-19 lockdown and characterize participants presenting with impaired psychological statuses. The reason for analyzing and presenting data on both psychological wellbeing and lifestyle habits is the strict relationship documented between these two dimensions. An example of such a relationship is represented by emotional eating. Individuals experiencing anxiety and depressive symptoms are prone to emotional eating habits, i.e., eating to relieve stress instead of physical hunger, and this phenomenon was reported during the lockdown [15,16].

## Methods

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The *PRESTOinsieme* project is a web-based survey open to volunteers older than 16 years of age ([www.prestoinsieme.com](http://www.prestoinsieme.com)). The project began in Italy on the 20<sup>th</sup> of March 2020 to assess the effects of the national lockdown on the population's psychological health and lifestyle habits.

*Sampling strategy*

The survey was web-based via Lime Survey [17] and disseminated by messaging apps (i.e., WhatsApp and Telegram) and social networks (i.e., Instagram, Facebook, and LinkedIn). Survey respondents were encouraged to spread the survey to their contacts, i.e., virtual snowball sampling. Five-thousand nine hundred-thirty survey accesses were registered during the study period; 5008 responded, i.e., 84.5%. The response rate, calculated as the proportion of survey responses over the number of accesses to the survey website, ranged between 70% and 95% during the study period (Figure S1, Panel A). The analysis included all survey responses collected until the 24<sup>th</sup> of August 2020; however, 73% of survey responses were recorded until the end of the lockdown, i.e., the 3<sup>rd</sup> of May 2020 (Figure S1, Panel B, and C). The regions most affected by the outbreak (i.e., Lombardia, Veneto, Piemonte, and Emilia-Romagna) provided the highest number of responses, except for Campania and Friuli Venezia Giulia (Figure S1, Panel D). Figure S2 reports the proportion of responses with missing data for each region, ranging from 36.6% to 21.1%, with an average of 29.9%.

*Questionnaires*

The survey consisted of validated questionnaires examining participants' personal and household characteristics, psychological health, and lifestyle habits. Regarding psychological health, three screening instruments for psychological distress, depression, and posttraumatic stress were administered. The General Health Questionnaire (GHQ-12) was used to screen for psychological distress. The GHQ-12 was scored using the 4-point Likert method (0-1-2-3), with a threshold of 14 points to indicate psychological distress [18]. The Center for Epidemiologic Studies Depression Scale (CES-D) was used to screen for depression, considering three classes of symptom severity: 0-15 (no/mild depressive symptoms), 16-23 (moderate depressive symptoms), and 24-60 (severe depressive symptoms). Finally, the Impact of Event Scale-Revised (IES-R) was used to screen for posttraumatic stress. According to a recent publication in the field [19], the total score of the IES-R was classified as follows: 0–23 (normal), 24–32 (mild psychological impact), 33–36 (moderate psychological impact), and ≥37 (severe psychological impact). Finally, lifestyle habits were assessed using a routine, validated questionnaire that is used in the Italian Food Consumption Survey (INRAN) [20], which inquires about weekly food intake and physical activity frequency.

*Patient and Public Involvement*

Not applicable

### *Statistical analysis*

Continuous data are reported as medians (quartiles I and III); categorical data are summarized as percentages and absolute frequencies. Wilcoxon-type tests were performed for continuous variables, and the Pearson chi-squared test or Fisher exact test was performed for categorical variables. The Pearson chi-squared test was performed when the number of observations per cell was above five; otherwise, Fisher's exact test was performed.

Multivariable regression models were estimated to identify predictors of psychological distress, depression, and posttraumatic stress. The categorized version of the three instruments' scores was used in the analyses. A proportional odds model was estimated for ordinal responses with more than two categories (CES-D and IES-R). A logistic regression model was estimated for the binary response variable (GHQ-12). The variables included in the model were selected via the backward elimination method and Akaike information criterion (AIC). All the models were adjusted by time from the start of the survey, which was computed as the difference between the start date of the survey and each participant response date. The time was entered in the models to account for potential confounding since the COVID-19 restrictions changed over the survey timespan. The nonlinear effects on the study outcome (i.e., respondents' age and time effect) were included in the model using restricted cubic splines (RCS). The model estimated odds ratios (ORs) together with the 95% confidence interval (CI), and p-values were reported.

The computations were performed using the software R 4.0.2 [21] with the rms [22] package.

### **Results**

There were 5008 survey respondents. The median age was 38 years, and the female gender was the most prevalent (63%). Concerning socioeconomic status, approximately half of the sample has attained a secondary education (48%), and two-thirds were actively employed (67%).

Table S1 (Supplementary Material) reports the analysis of respondents' sociodemographic characteristics according to the place where they lived. Participants living in areas with high numbers of COVID-19 infections were significantly older and had a higher socioeconomic status than residents of regions with low rates of COVID-19. Furthermore, most participants from high COVID-19 incidence areas were found to have university educations, and they were more likely to have a job and to live in a single-family house with a garden.

Tables 1-2-3 present respondents' characteristics according to the scores obtained at the screening tools for psychological distress, depression, and posttraumatic stress.



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3 *Psychological distress*  
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5 Most of the survey respondents (88.6%) suffered from psychological distress (GHQ score  $\geq 14$ ). The  
6 prevalence of psychological distress was significantly higher in females ( $p = 0.049$ ), unemployed  
7 individuals ( $p = 0.001$ ), and those who did not engage in physical activity ( $p < 0.001$ ) (Table 1). The  
8 results were confirmed by multivariable analysis (Table 4). Unemployed/retired/homemakers were  
9 found to be at significantly higher risk for psychological distress than active employees (OR 1.99,  
10 95% CI 1.4-2.85), together with females (OR 0.77 95% CI 0.63-0.94, male vs. female).  
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16 *Depression*  
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18 Half of the sample suffered from moderate (25.5%, 1057 participants) or severe (22%, 909  
19 participants) depressive symptoms. In the univariable analysis (Table 2), young women (median age  
20 of 29 years) were significantly more likely to report severe depressive symptoms, while participants  
21 with no or moderate depressive symptoms had median ages of 43 and 34, respectively ( $p < 0.001$ ). In  
22 addition, participants living in multifamily houses/single-room apartments without a garden were  
23 significantly more likely to exhibit frequent moderate to severe symptoms of depression. In line with  
24 univariable analysis, lower age (OR 0.39 for interquartile range (IQR) 26-54, 95% CI 0.32-0.48),  
25 female gender, being unemployed/retired/homemaker (OR 1.57, 95% CI 1.22-2.02) or being students  
26 (OR 1.73, 95% CI 1.31-2.28) were found to be significant predictors of more severe depressive  
27 symptoms (Table 4). Additionally, participants who lived alone (OR 1.50 95% CI 1.17-1.91) and  
28 experienced a loss (OR 1.35, 95% CI 1.05-1.72) were found to be significantly more likely to suffer  
29 from depressive symptoms. Conversely, engaging in physical activity was found to be protective  
30 against the worst depressive symptoms (OR 0.64, 95% CI 0.55-0.75).  
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42 *Posttraumatic stress*  
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44 The prevalence of moderate and severe psychological effects was 5.6% and 17.7%, respectively. For  
45 moderate/severe depressive symptoms, the impact was significantly higher in females, young  
46 respondents, and participants living in multifamily houses (Table 3). The multivariable analysis  
47 confirmed these results (Table 4).  
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51 *Dietary habits*  
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53 Overall, participants reported eating pasta/rice/cereals and cereal-based products a median of 7 times  
54 per week. Meat was reported more frequently than fish (median of 3 times per week vs. median of 2  
55 times per week), while the consumption of legumes was reported to be a median of 3 times per week.  
56 The consumption of fruits and vegetables was a median of 7 times per week each.  
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The analysis of the distribution of weekly food frequency according to the categorized scores of the psychological health screening tools (Tables 1-2-3) shows no statistically significant differences for GHQ scores, except for consumption of vegetables and legumes (significantly lower for participants with psychological distress,  $p = 0.003$  and  $p = 0.002$ ). Participants with moderate/severe depressive symptoms were found to consume milk-based products less frequently ( $p < 0.001$ ), fruit ( $p < 0.001$ ), dried fruit ( $p < 0.001$ ), and vegetables ( $p = 0.013$ ). Conversely, they were significantly more likely to eat foods high in fat and sugar more frequently ( $p = 0.008$ ). Similarly, participants with moderate/severe psychological impact showed a lower consumption of fruit ( $p = 0.003$ ). At the same time, they were more likely to frequently eat foods high in fat and sugar ( $p = 0.012$ ).

## Discussion

The present findings show a high prevalence of moderate to severe depressive symptoms during the lockdown. The characterization of survey respondents showed that female students and unemployed/retired/homemaker individuals living in a multifamily house without a garden were at higher risk. Conversely, only a small proportion of participants reported moderate to severe psychological impact, and, again, young females and unemployed/retired/homemaker individuals were the most affected.

A recent review in the field has shown that over a short-term period, quarantine is associated with an increased prevalence of anxiety, depression, and posttraumatic stress symptoms [23]. Such findings are confirmed by surveys conducted in the most affected countries during the COVID-19 lockdown, showing that the population presented with increased feelings of anxiety and depression [14,19]. Furthermore, emotional eating has been frequently reported [15], highlighting the strong and direct association between psychological wellbeing and lifestyle habits, which have been recently documented in college students during lockdown [24]. Surveyed individuals have reported doing less physical activity and snacking more frequently during the lockdown, with consequent weight gain [25,26]. Disturbingly, such changes have also been shown to affect children [27] with potentially detrimental long-term consequences for their health since such lifestyle changes could result in an increased risk for noncommunicable diseases over the life course.

A recent meta-analysis showed a 33.7% prevalence of depression [3], while in the present study, the proportion of subjects reporting moderate to severe depressive symptoms was 47.5%. However, when only severe depressive symptoms are considered, the prevalence is consistent with previous studies in the field [3]. Conversely, the prevalence of moderate to severe symptoms of posttraumatic stress was not consistent with reports in the literature [19,28], especially when only severe psychological impact was considered. In discussing such data, it is worth noting that studies in the field have

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employed different tools to ascertain the prevalence of depression, anxiety, and posttraumatic stress, making it difficult to compare results across studies.

Regarding the characterization of depressed participants, in line with the literature, female gender, low socioeconomic status [5], younger age, and being a student [29] were found to be significant predictors of depression.

*Dietary habits*

The study of dietary habits during the lockdown showed that participants were not compliant with the Mediterranean pyramid targets [30]. Half of the sample reported eating fruits and vegetables only twice a day, even though their recommended consumption is five times a day. In addition, participants reported eating foods high in fat and sugars (e.g., cakes) a median of 3 times a week (interquartile range 2-7), meaning that 25% of the sample ate such foods once a day, even though their consumption is recommended to be occasional. Such findings are in line with the literature, demonstrating that participants tended to snack more frequently during lockdown [25]. Fish consumption is recommended three times per week, but participants report eating fish a median of 2 times per week. We cannot rule out that lockdown might pose difficulties in the purchase of fish.

Interestingly, dietary patterns were found to be even worse among participants with symptoms of depression and psychological impact. They reported frequently eating foods high in fat and sugar and fruits and vegetables less frequently than participants without symptoms of depression and psychological impact. Such a finding could be interpreted as emotional eating, which has been reported during lockdown [15]. However, we can also hypothesize that participants with psychological discomfort had worse eating habits because of a worse socioeconomic status since they were more likely not to have a job and to live in a smaller house without a garden. However, we cannot clarify the issue because we did not investigate eating habits before lockdown.

The fact that no data about participants' habits before lockdown were available represents a study limitation. Another limitation is the nonnegligible proportion of survey responses presenting with missing data and the higher proportion of responses from high-incidence COVID-19 regions compared with those from regions with a low incidence of COVID-19. Furthermore, the analysis of missing data showed that the proportion varied across regions, with the lowest proportion in regions with a high COVID-19 incidence. We cannot rule out that such limits might lead to an overestimation of psychological distress prevalence; however, when only the proportion of severe depressive symptoms was considered, it was in line with the literature. More responses came from high-incidence COVID-19 regions because residents of those regions were more prone to respond to the survey. Further, that fact is related to the sampling technique employed, i.e., snowball sampling. The

technique may result in a selection bias by including individuals who belong to a specific social network and excluding individuals not in that social network. However, snowball sampling is a well-known and widely used sampling technique in the social sciences.

The present work presents several strengths. First, it is one of the largest population-based surveys conducted in Italy during the first COVID-19 lockdown, providing valuable data about the Italian population's psychological health. Furthermore, the results provide a characterization of individuals who are most vulnerable to the side effects of lockdown.

These results have relevant implications for future research and public health. First, they provide insight into the need to understand the long-term consequences of lockdowns on psychological health and lifestyle habits, which need to be investigated further since data in the field are lacking. Further, if the long-term effects of lockdowns are confirmed, the present results help identify vulnerable populations that potentially benefit from follow-up programs of psychological support in the case of persistent psychological distress.

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**Author contributions.** DG conception of the work; DG, EM, MS design of the work; SG, SB, and MG data acquisition; DA data analysis; GL interpretation of results and draft of the work; PB and MCG substantial revision of the work.

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**Competing interests.** None declared

**Data sharing.** The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Patient consent.** Not applicable

**Ethical approval.** Not applicable

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Table 1. Respondents' characteristics and habits according to GHQ score;  $\geq 14$  (psychological distress)

	N	0-13 (N=507)	14-36 (N=3931)	Combined (N=4438)	P-value
Age	4438	26/34/48	26/38/53	26/37/53	<0.001
Gender: Female	4438	59% (300)	64% (2502)	63% (2802)	0.049
Male		41% (207)	36% (1429)	37% (1636)	
Nationality: Other	4438	2% (8)	1% (53)	1% (61)	0.676
Italian		98% (499)	99% (3878)	99% (4377)	
Region: High COVID-19 incidence	4427	48% (242)	45% (1780)	46% (2022)	0.282
Low COVID-19 incidence		52% (263)	55% (2142)	54% (2405)	
Educational level: Secondary education	4438	49% (249)	47% (1831)	47% (2080)	0.493
University education		50% (256)	53% (2089)	53% (2345)	
Primary education		0% (2)	0% (11)	0% (13)	
Working status: Active employee	4438	71% (360)	67% (2630)	67% (2990)	0.001
Unemployed/Retired/Homemaker		8% (42)	14% (568)	14% (610)	
Student		21% (105)	19% (733)	19% (838)	
House type: Multi-family house	4438	64% (325)	66% (2589)	66% (2914)	0.221
Single room apartment		3% (16)	2% (79)	2% (95)	
Single-family house		33% (166)	32% (1263)	32% (1429)	
Garden: No	4438	39% (198)	42% (1658)	42% (1856)	0.180
Yes		61% (309)	58% (2273)	58% (2582)	
Nasopharyngeal swab: No	2873	96% (278)	93% (2391)	93% (2669)	0.038
Yes		4% (12)	7% (192)	7% (204)	
Recent loss: No	2858	91% (266)	89% (2289)	89% (2555)	0.240
Yes		9% (25)	11% (278)	11% (303)	
Living alone: No	4438	88% (448)	88% (3469)	88% (3917)	0.939
Yes		12% (59)	12% (462)	12% (521)	
Pet: No	4438	54% (274)	54% (2112)	54% (2386)	0.893
Yes		46% (233)	46% (1819)	46% (2052)	
Physical activity: No	3991	44% (203)	57% (2024)	56% (2227)	<0.001

Yes		56% (259)	43% (1505)	44% (1764)	2021-048916 on 5 April 2022. Downloaded from <a href="http://bmjopen.bmj.com/">http://bmjopen.bmj.com/</a> . Erasmushogeschool . t, including for uses related to text and data mining, AI training	
Dietary habits (weekly consumption)						
Pasta, Rice, Cereals	3987	5/7/10	5/7/10	5/7/10		0.705
Cereal-based products	3984	3/7/7	4/7/7	3/7/7		0.214
Raw meat	3985	2/3/4	2/3/4	2/3/4		0.299
Cured meat	3981	1/2/3	1/2/3	1/2/3		0.050
Fish	3985	1/2/2	1/2/2	1/2/2		0.864
Milk and yogurt	3982	2/7/7	2/7/7	2/7/7		0.971
Milk-based products	3984	2/3/5	2/3/5	2/3/5		0.675
Fruit	3985	4/7/10	4/7/10	4/7/10		0.699
Dried fruit	3981	0/2/5	0/2/5	0/2/5		0.249
Vegetables	3984	6/7/14	6/7/14	6/7/14		0.003
Legumes	3982	1/2/5	1/2/4	1/2/4		0.002
Eggs	3984	1/2/3	1/2/2	1/2/2		0.100
Foods high in fat and sugar	3980	1/3/6	2/4/7	2/3/7		0.158
Soft drinks	3979	0/0/1	0/0/1	0/0/1		0.478
Alcoholic drinks (e.g., wine, beer, spirits)	3981	0/1/3	0/1/4	0/1/4		0.080



Table 2. Respondents' characteristics and habits according to CES-D score; 0-15 (no/mild depressive symptoms), 16-23 (moderate depressive symptoms), and 24-60 (severe depressive symptoms)

	N	0-15 (N=2179)	16-23 (N=1057)	24-60 (N=909)	Combined (N=4145)	P-value
Age	4145	29/43/57	25/34/50	23/29/44	26/37/53	<0.001
Gender: Female	4145	53% (1165)	70% (740)	80% (729)	64% (2634)	<0.001
Male		47% (1014)	30% (317)	20% (180)	36% (1511)	
Nationality: Other	4145	1% (27)	2% (17)	1% (9)	1% (53)	0.464
Italian		99% (2152)	98% (1040)	99% (900)	99% (4092)	
Region: High COVID-19 incidence	4135	45% (976)	44% (464)	48% (431)	45% (1871)	0.258
Low COVID-19 incidence		55% (1200)	56% (589)	52% (475)	55% (2264)	
Educational level: Secondary education	4145	45% (976)	44% (464)	52% (476)	46% (1916)	<0.001
University education		55% (1196)	56% (593)	47% (431)	54% (2220)	
Primary education		0% (7)	0% (0)	0% (2)	0% (9)	
Working status: Active employee	4145	73% (1583)	67% (709)	57% (521)	68% (2813)	<0.001
Unemployed/Retired/Homemaker		16% (338)	12% (130)	12% (111)	14% (579)	
Student		12% (258)	21% (218)	30% (277)	18% (753)	
House type: Multi-family house	4145	63% (1369)	68% (715)	69% (628)	65% (2712)	0.001
Single room apartment		2% (40)	2% (23)	3% (25)	2% (88)	
Single-family house		35% (770)	30% (319)	28% (256)	32% (1345)	
Garden: No	4145	36% (781)	44% (467)	52% (475)	42% (1723)	<0.001
Yes		64% (1398)	56% (590)	48% (434)	58% (2422)	
Nasopharyngeal swab: No	2684	92% (1223)	92% (612)	95% (660)	93% (2495)	0.023
Yes		8% (106)	8% (50)	5% (33)	7% (189)	
Recent loss: No	2665	90% (1194)	89% (584)	88% (606)	89% (2384)	0.277
Yes		10% (127)	11% (73)	12% (81)	11% (281)	
Living alone: No	4145	89% (1937)	89% (937)	86% (778)	88% (3652)	0.029
Yes		11% (242)	11% (120)	14% (131)	12% (493)	
Pet: No	4145	54% (1179)	53% (565)	52% (470)	53% (2214)	0.475
Yes		46% (1000)	47% (492)	48% (439)	47% (1931)	

Physical activity: No	3991	53% (1123)	56% (573)	61% (531)	56% (2227)	0.001
Yes		47% (981)	44% (445)	39% (338)	44% (1764)	
<i>Dietary habits (weekly consumption)</i>						
Pasta, Rice, Cereals	3987	5/7/10	5/7/10	5/7/10	5/7/10	0.182
Cereal-based products	3984	3/7/7	4/7/7	4/7/7	3/7/7	0.135
Raw meat	3985	2/3/4	2/3/4	2/3/4	2/3/4	0.418
Cured meat	3981	1/2/3	1/2/3	1/2/3	1/2/3	0.243
Fish	3985	1/2/2	1/2/2	1/2/2	1/2/2	0.003
Milk and yogurt	3982	1/7/7	2/7/7	2/7/7	2/7/7	0.309
Milk-based products	3984	2/3/5.25	2/3/5	1/3/5	2/3/5	<0.001
Fruit	3985	5/7/12	3/7/10	3/7/10	4/7/10	<0.001
Dried fruit	3981	0/2/5	0/2/5	0/1/4	0/2/5	<0.001
Vegetables	3984	6/7/14	5/7/14	5/7/14	6/7/14	0.013
Legumes	3982	1/3/4	2/3/4	1/2/4	1/3/4	0.059
Eggs	3984	1/2/2	1/2/2	1/2/2	1/2/2	0.442
Foods high in fat and sugar	3980	1/3/6	2/4/7	2/4/7	2/3/7	0.008
Soft drinks	3979	0/0/1	0/0/1	0/0/1	0/0/1	0.002
Alcoholic drinks (e.g., wine, beer, spirits)	3981	0/2/5	0/1/4	0/1/3	0/1/4	<0.001

Table 3. Respondents' characteristics and habits according to IESD-R score; 0–23 (normal), 24–32 (mild psychological impact), 33–36 (moderate psychological impact), and ≥37 (severe psychological impact)

	N	0-23 (N=2463)	24-32 (N=827)	33-36 (N=242)	≥37 (N=762)	Combined (N=4294)	P- value
Age	4294	27/40/55	26/37/53	25/33/49	25/33/49	26/37/53	<0.001
Gender: Female	4294	52% (1279)	73% (600)	85% (205)	83% (205)	63% (2717)	<0.001
Male		48% (1184)	27% (227)	15% (37)	17% (41)	37% (1577)	
Nationality: Other	4294	1% (30)	1% (12)	1% (3)	1% (3)	1% (55)	0.965
Italian		99% (2433)	99% (815)	99% (239)	99% (239)	99% (4239)	
Region: High COVID-19 incidence	4284	44% (1090)	47% (385)	48% (115)	47% (115)	45% (1947)	0.377
Low COVID-19 incidence		56% (1370)	53% (440)	52% (127)	53% (127)	55% (2337)	
Educational level: Secondary education	4294	44% (1087)	48% (397)	50% (121)	51% (121)	46% (1995)	0.009
University education		56% (1368)	52% (430)	50% (120)	48% (120)	53% (2287)	
Primary education		0% (8)	0% (0)	0% (1)	0% (1)	0% (12)	
Working status: Active employee	4294	70% (1720)	66% (543)	62% (151)	65% (151)	68% (2908)	0.001
Unemployed/Retired/Homemaker		14% (349)	14% (115)	14% (34)	13% (34)	14% (598)	
Student		16% (394)	20% (169)	24% (57)	22% (57)	18% (788)	
House type: Multi-family house	4294	64% (1586)	65% (538)	76% (183)	67% (183)	66% (2819)	0.003
Single room apartment		2% (49)	2% (19)	1% (2)	3% (2)	2% (95)	
Single-family house		34% (828)	33% (270)	24% (57)	30% (57)	32% (1380)	
Garden: No	4294	38% (935)	43% (355)	52% (126)	49% (126)	42% (1791)	<0.001
Yes		62% (1528)	57% (472)	48% (116)	51% (116)	58% (2503)	
Nasopharyngeal swab: No	2774	93% (1482)	92% (454)	93% (151)	95% (151)	93% (2578)	0.418
Yes		7% (120)	8% (37)	7% (11)	5% (28)	7% (196)	
Recent loss: No	2759	91% (1458)	87% (423)	88% (139)	87% (139)	90% (2472)	0.004
Yes		9% (137)	13% (64)	12% (19)	13% (67)	10% (287)	
Living alone: No	4294	88% (2170)	89% (737)	88% (214)	87% (214)	88% (3784)	0.635
Yes		12% (293)	11% (90)	12% (28)	13% (99)	12% (510)	
Pet: No	4294	54% (1332)	52% (426)	63% (152)	52% (152)	54% (2307)	0.014

Yes		46% (1131)	48% (401)	37% (90)	48% (65)	46% (1987)	
Physical activity: No	3991	53% (1220)	58% (443)	59% (132)	61% (332)	56% (2227)	<0.001
Yes		47% (1081)	42% (317)	41% (93)	39% (73)	44% (1764)	
Dietary habits (weekly consumption)							
Pasta, Rice, Cereals	3987	5/7/10	6/7/10	5/7/10	5/7/10	5/7/10	0.560
Cereal-based products	3984	3/7/7	4/7/7	4/7/7	4/7/7	3/7/7	0.018
Raw meat	3985	2/3/4	2/3/4	2/3/4	2/3/4	2/3/4	0.150
Cured meat	3981	1/2/3	1/2/3	1/2/3	1/2/3	1/2/3	0.404
Fish	3985	1/2/2	1/2/2	1/1/2	1/2/2	1/2/2	0.443
Milk and yogurt	3982	2/7/7	2/6/7	2/7/7	2/6/7	2/7/7	0.398
Milk-based products	3984	2/3/5	2/3/5	1/3/5	2/3/5	2/3/5	0.002
Fruit	3985	4/7/10	4/7/10	3/7/14	3/7/8	4/7/10	0.003
Dried fruit	3981	0/2/5	0/2/5	0/1/5	0/2/4	0/2/5	0.061
Vegetables	3984	6/7/14	6/7/14	6/7/14	5/7/11	6/7/14	0.043
Legumes	3982	1/3/4	1/2/4	1/2/4	1/2/4	1/3/4	0.710
Eggs	3984	1/2/2	1/2/2	1/2/2	1/2/3	1/2/2	0.836
Foods high in fat and sugar	3980	1/3/6	2/3/6	2/4/7	2/4/7	2/3/7	0.012
Soft drinks	3979	0/0/1	0/0/1	0/0/1	0/0/2	0/0/1	<0.001
Alcoholic drinks (e.g., wine, beer, spirits)	3981	0/2/4	0/1/3	0/1/3	0/1/3	0/1/4	<0.001

Table 4. Results of the multivariable models (proportional odds model for the ordinal responses with more than two categories, i.e., CES-D and IES-R, logistic regression model for the binary response variable, i.e., GHQ-12). For continuous variables, the effect is reported on the interquartile range (IQR), i.e., 26-54 for age and 3-20 for days from the start of the survey). Results are reported as odds ratios (logistic regression) or proportional odds (proportional odds model), 95% confidence intervals (CI), P-value

#### Supplementary Material

	OR	Lower 0.95	Upper 0.95
<i>GHQ</i>			
Days from the start of the survey	1.19	0.95	1.49
Gender: Male vs. Female	0.77	0.63	0.94
Region: Low-incidence vs. High-incidence	0.87	0.72	1.06
Working status: Unemployed/Retired/Homemaker vs. Active employee	1.99	1.4	2.85
Working status: Student vs. Active employee	1.10	0.85	1.43
Physical activity: Yes vs. No	0.56	0.46	0.69
<i>CES-D</i>			
Days from the start of the survey	1.38	1.00	1.89
Age	0.39	0.32	0.48
Gender: Male vs. Female	0.46	0.39	0.55
Working status: Unemployed/Retired/Homemaker vs. Active employee	1.57	1.22	2.02
Working status: Student vs. Active employee	1.73	1.31	2.28
Garden: No vs. Yes	1.72	1.46	2.01
Recent Loss: Yes vs. No	1.35	1.05	1.72
Living alone: Yes vs. No	1.50	1.17	1.91
Physical activity: Yes vs. No	0.64	0.55	0.75
<i>IES-R</i>			
Days from the start of the survey	1.03	0.75	1.42
Age	0.67	0.58	0.78
Gender: Male vs. Female	0.30	0.25	0.37
Educational level: Secondary vs. University	1.29	1.10	1.52

Educational level: Primary vs. University	0.48	0.05	4.55
Garden: No vs. Yes	1.55	1.33	1.82
Recent Loss: Yes vs. No	1.63	1.28	2.09
Physical activity: Yes vs. No	0.72	0.61	0.84

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Table S1. Respondents' characteristics and habits according to residency; high COVID-19 incidence regions (i.e., Piemonte, Veneto, Lombardia, Emilia-Romagna) and low COVID-19 incidence regions.

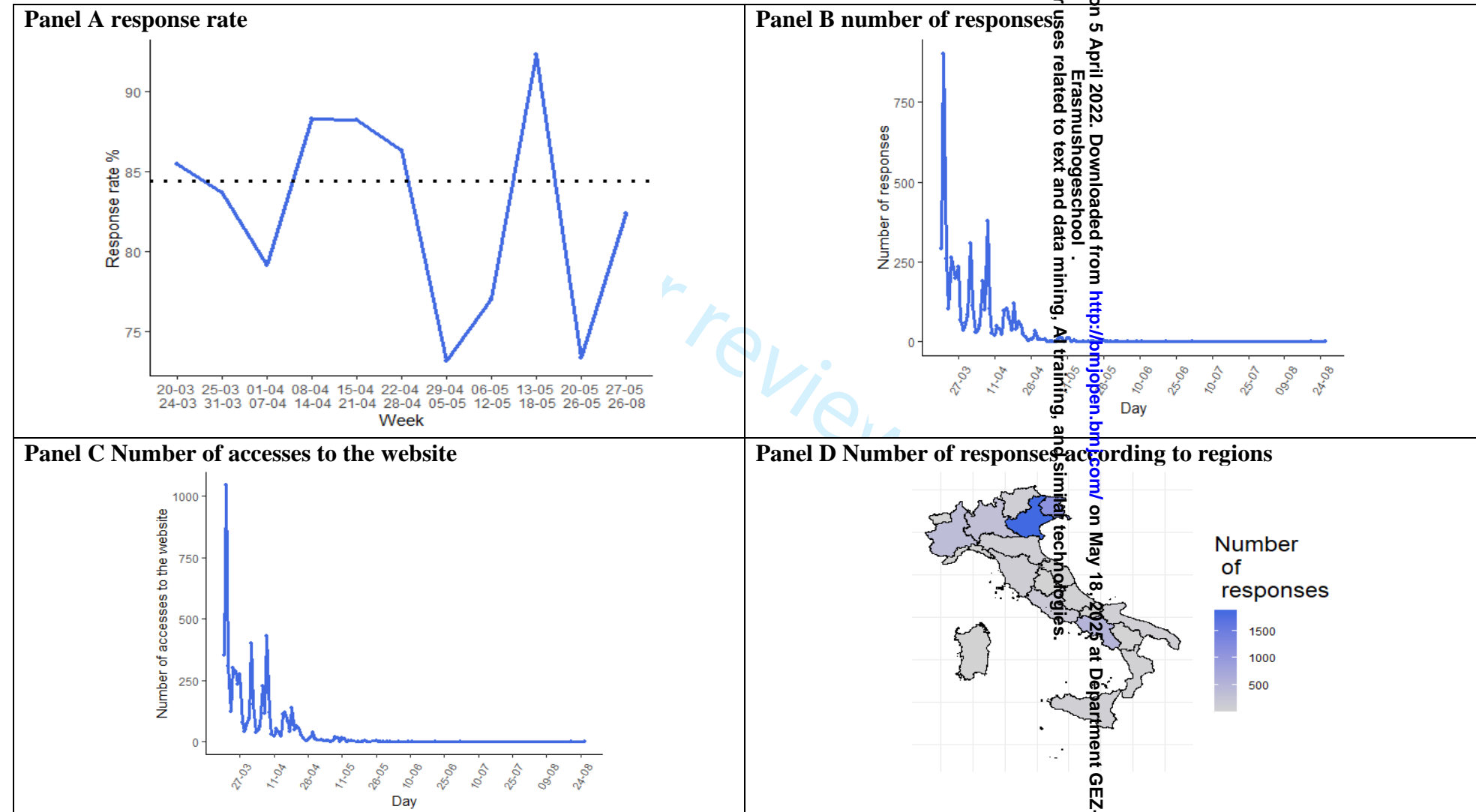
	N	Low COVID-19 Incidence (N=2301)	High COVID-19 Incidence (N=2677)	Combined (N=4978)	P-value
Age	4978	25/36/53	27/39/55	26/38/54	<0.001
Gender: Female	4974	63% (1454)	63% (1676)	63% (3130)	0.614
Male		37% (43)	37% (1001)	37% (1844)	
Nationality: Other	4977	2% (42)	1% (31)	1% (73)	0.051
Italian		98% (2259)	99% (2645)	99% (4904)	
Educational level: Secondary education	4973	51% (1175)	45% (1193)	48% (2368)	<0.001
University education		48% (1113)	55% (1475)	52% (2588)	
Primary education		0% (10)	0% (7)	0% (17)	
Working status: Active employee	4972	63% (1442)	70% (1877)	67% (3319)	<0.001
Unemployed/Retired/Homemaker		16% (376)	13% (360)	15% (736)	
Student		21% (481)	16% (436)	18% (917)	
House type: Multi-family house	4969	72% (1660)	60% (1603)	66% (3263)	<0.001
Single room apartment		3% (60)	2% (51)	2% (111)	
Single-family house		25% (579)	38% (1016)	32% (1595)	
Garden: No	4967	50% (1150)	35% (932)	42% (2082)	<0.001
Yes		50% (1147)	65% (1738)	58% (2885)	
Nasopharyngeal swab: No	3221	97% (1371)	90% (1623)	95% (2994)	<0.001
Yes		3% (39)	10% (188)	7% (227)	
Recent loss: No	3208	90% (1267)	89% (1604)	89% (2871)	0.186
Yes		10% (136)	11% (201)	11% (337)	
Living alone: No	4870	89% (1995)	88% (2315)	89% (4310)	0.196
Yes		11% (243)	12% (317)	11% (560)	
Physical activity: No	3981	55% (971)	57% (1251)	56% (2222)	0.159
Yes		45% (808)	43% (951)	44% (1759)	
<i>Dietary habits (weekly consumption)</i>					

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2	Pasta, Rice, Cereals	3977	5/7/10	5/7/10	5/7/10	0.215
3	Cereal-based products	3974	3/7/7	4/7/7	4/7/7	<0.001
4	Raw meat	3975	2/3/4.25	2/3/4	2/3/4	0.005
5	Cured meat	3971	1/2/3	1/2/3	1/2/3	<0.001
6	Fish	3975	1/2/3	1/1/2	1/1/2	<0.001
7	Milk and yogurt	3972	2/7/7	2/7/7	2/7/7	0.782
8	Milk-based products	3974	2/3/5	2/3/5	2/3/5	0.017
9	Fruit	3975	4/7/10	4/7/12	4/7/10	<0.001
10	Dried fruit	3971	0/2/5	0/2/5	0/2/5	0.250
11	Vegetables	3974	5/7/14	6/7/14	6/7/14	<0.001
12	Legumes	3972	2/3/4	1/2/4	1/2/4	0.005
13	Eggs	3974	1/2/3	1/2/2	1/2/2	0.014
14	Food high in fat and sugar	3970	1/3/6	2/4/7	2/4/7	0.241
15	Soft drinks	3969	0/0/1	0/0/1	0/0/1	0.969
16	Alcoholic drinks (e.g., wine, beer, spirits)	3971	0/1/4	0/1/4	0/1/4	0.001
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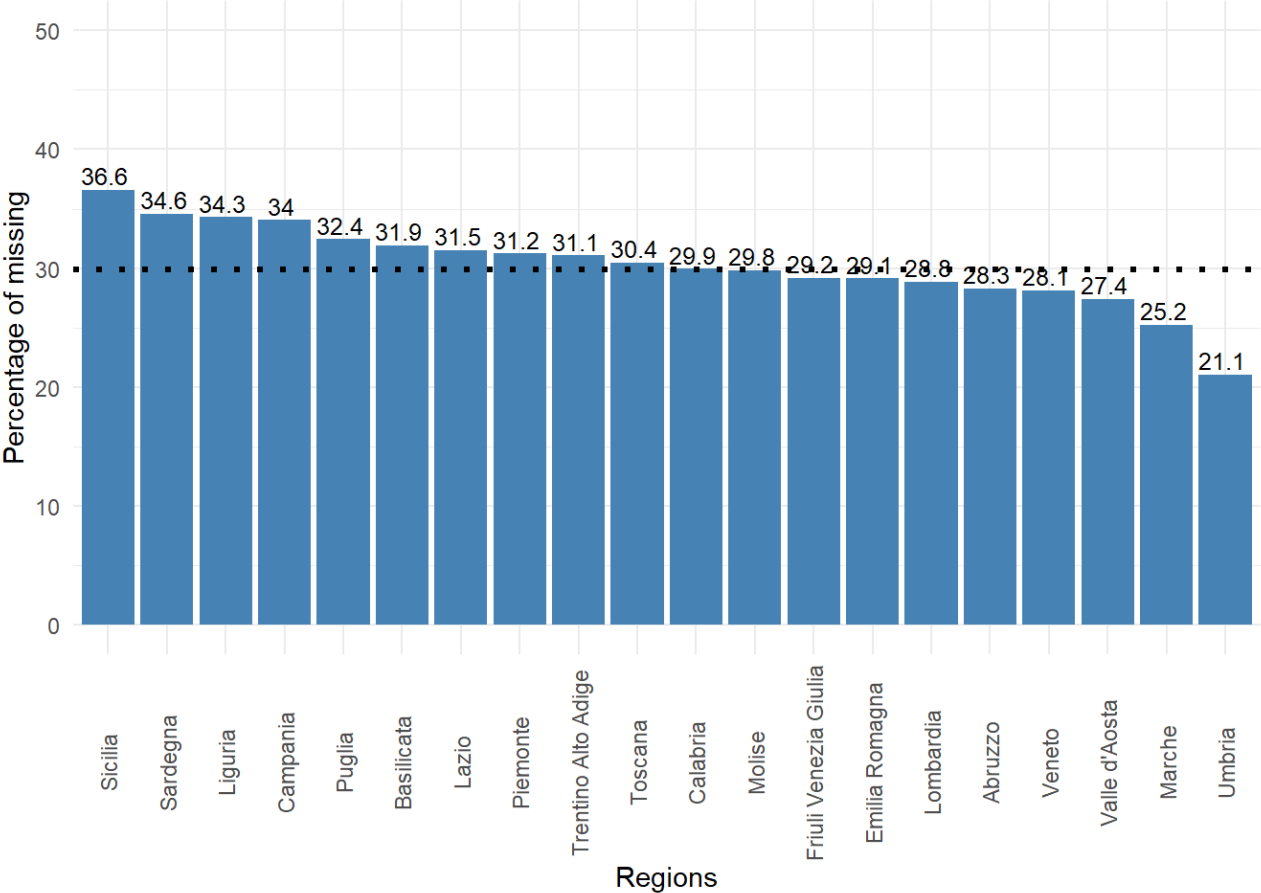


Figure S1. Survey response report. The weekly response rate over the website accesses has been reported in panel A where the dotted line represents the overall response rate (84.5%). Panel B represents the number of responses per day; Panel C reports the number of website accesses per day. The Number of responses per region is shown in panel D.



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Figure S2. Missing Responses report. Percentage of responses presenting with missing data per region. The dotted line represents the percentage of responses with missing data overall (29.9%).



## STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1-3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	NA
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	NA
		(c) Explain how missing data were addressed	7
		(d) If applicable, describe analytical methods taking account of sampling strategy	7
		(e) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8
		(b) Report category boundaries when continuous variables were categorized	7-8
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Impact of the COVID-19 lockdown on psychological health and nutritional habits in Italy: results from the #PRESTOinsieme study

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<b>Primary Subject Heading</b>:	Public health
Secondary Subject Heading:	Epidemiology
Keywords:	COVID-19, NUTRITION & DIETETICS, Anxiety disorders < PSYCHIATRY, Public health < INFECTIOUS DISEASES

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# Impact of the COVID-19 lockdown on psychological health and nutritional habits in Italy: results from the #PRESTOinsieme study

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**Word count:** 2641



## Abstract

**Objectives.** The present work aims to present the results of the “*PRESTOinsieme*” (which is “*we'll be together soon*” in English). The web-based survey ([www.prestoinsieme.com](http://www.prestoinsieme.com)) describes changes in lifestyle habits and symptoms of psychological discomfort in the Italian population during the COVID-19 lockdown.

**Design:** Cross-sectional online survey disseminated by messaging apps (i.e., WhatsApp and Telegram) and social networks (i.e., Instagram, Facebook, and LinkedIn).

**Setting:** Italy

**Participants:** Italian population older than 16 years of age

**Exposure:** COVID-19 lockdown

**Main Outcomes and Measures:** Survey respondents filled out a set of validated questionnaires aimed at assessing lifestyle habits and psychological health, i.e., the General Health Questionnaire (GHQ-12) to screen for psychological distress, the Impact of Event Scale-Revised (IES-R) to screen for posttraumatic stress, and the Center for Epidemiologic Studies Depression Scale (CES-D).

**Results:** Survey respondents totaled 5008. Moderate or severe psychological distress was reported in 25.5% and 22% of survey respondents, respectively. Lower age, female gender, being unemployed (OR 1.57, 95% C.I. 1.217-2.024) or being a student (OR 1.726, 95% C.I. 1.306-2.28) were predictors of more severe depressive symptoms.

**Conclusions.** The present study is one of the largest population-based surveys conducted in Italy during the first COVID-19 lockdown, providing valuable data about the Italian population's psychological health. Further studies should be conducted to understand whether psychological distress persists after the end of the lockdown.

**Keywords.** Italy; COVID-19; Lockdown; Dietary habits; Psychological distress

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**Strengths and limitations of this study**

- The study is a web-based survey consisting of a set of validated questionnaires to assess the Italian population's psychological wellbeing and lifestyle habits during the COVID-19 lockdown.
- The survey involved 5008 participants over age 16, and it represents one of the largest surveys conducted during the first COVID-19 lockdown in Italy, the European country most severely affected by the first wave of the COVID-19 outbreak.
- The survey identifies predictors of psychological distress during the lockdown, helping identify individuals most vulnerable to the psychological effects of lockdown.
- Further studies should be conducted to understand the long-term consequences of the COVID-19 lockdown affecting psychological health and lifestyle habits.

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## Introduction

Containment measures (e.g., social distancing and a national lockdown) are crucial public health strategies in the fight against COVID-19 [1]. Even though such actions are essential to contain the COVID-19 pandemic, it is worth noting that they might adversely affect physical [2] and psychological [3] health and seem to be associated with an increased risk of domestic accidents [4]. Mental health changes during the lockdown have been detected by studies conducted in the U.S. and Italy, showing an increased prevalence/severity of anxiety and depressive symptoms together with an impairment of psychological functions involving memory and attention [5–7]. Furthermore, changes in lifestyle habits in response to COVID-19 and the lockdown have been reported. Italian studies have found a decrease in physical activity frequency, an impairment of sleep habits, and unhealthy eating habits [8,9]. It appears to be of extreme importance to take appropriate public health actions to mitigate the adverse effects of lockdowns [10] and to identify groups more vulnerable to the potential side effects of lockdowns to develop public health actions explicitly meant for these vulnerable populations [10].

Italy is the first European country where the COVID-19 outbreak occurred [11], causing an excess of mortality with severe overloads for the healthcare system [12]. The first containment measures were introduced on the 23<sup>rd</sup> February 2020 in the two Italian regions where the coronavirus first spread (Veneto and Lombardia) [13]. However, over a short time, the disease also spread to other Italian regions, so the Italian government introduced new containment measures at the national level on the 11<sup>th</sup> March 2020. Finally, on the 22<sup>nd</sup> March 2020, a nationwide full lockdown was implemented. Data on the Italian population during the lockdown show impaired emotional wellbeing and unhealthy lifestyle changes [14].

The present work aims to present the results of the "*PRESTOinsieme*" (imPact of quaRantine mEasures againST cOvid19, which is known as "we will be together soon" in English) project, a web-based survey conducted in Italy. The study aims to describe changes in lifestyle habits and the prevalence of psychological discomfort symptoms in the Italian population during the COVID-19 lockdown. The reason for analyzing and presenting data on both psychological wellbeing and lifestyle habits is the strict relationship documented between these two dimensions. An example of such a relationship is represented by emotional eating. Individuals experiencing anxiety and depressive symptoms are prone to emotional eating habits, i.e., eating to relieve stress instead of physical hunger, and this phenomenon was reported during the lockdown [15,16].

Several studies have been conducted so far with the aim of describing the relationship between the COVID-19 lockdown and psychological wellbeing in China, European countries, and the U.S. The value added by the present study refers to the fact that it was conducted in Italy, one of the countries

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most severely affected by the pandemic, at the very beginning of the first COVID-19 lockdown, when only little information was available about the prevention and treatment of the infection and the only previous experience in the management of the outbreak was that of the city of Wuhan, in China.

**Methods**

The *PRESTOinsieme* project is a cross-sectional web-based survey open to volunteers older than 16 years of age ([www.prestoinsieme.com](http://www.prestoinsieme.com)). The project began in Italy on the 20<sup>th</sup> March 2020 to assess the effects of the national lockdown on the population's psychological health and lifestyle habits.

*Sampling strategy*

The survey was web-based via Lime Survey [17] and disseminated by messaging apps (i.e., WhatsApp and Telegram) and social networks (i.e., Instagram, Facebook, and LinkedIn). Survey respondents were encouraged to spread the survey to their contacts, i.e., virtual snowball sampling. Five-thousand nine hundred-thirty survey accesses were registered during the study period (from 20<sup>th</sup> March to 24<sup>th</sup> August 2020); 5008 responded, i.e., 84.5%. The response rate, calculated as the proportion of survey responses over the number of accesses to the survey website, ranged between 70% and 95% during the study period (Figure S1, Panel A). The analysis included all survey responses collected until the 24<sup>th</sup> August 2020; however, 73% of survey responses were recorded until the end of the full lockdown, i.e., the 3 May 2020 (Figure S1, Panel B, and C). The regions most affected by the outbreak (i.e., Lombardia, Veneto, Piemonte, and Emilia-Romagna) provided the highest number of responses, except for Campania and Friuli Venezia Giulia (Figure S1, Panel D). Figure S2 reports the proportion of responses with missing data for each region, ranging from 36.6% to 21.1%, with an average of 29.9%.

*Questionnaires*

The survey consisted of validated questionnaires examining participants' personal and household characteristics, psychological health, and lifestyle habits. Regarding psychological health, three validated screening instruments for psychological distress, depression, and posttraumatic stress were administered. The General Health Questionnaire (GHQ-12) was used to screen for psychological distress. The GHQ-12 was scored using the 4-point Likert method (0-1-2-3), with a threshold of 14 points to indicate psychological distress [18]. The Center for Epidemiologic Studies Depression Scale (CES-D) was used to screen for depression, considering three classes of symptom severity: 0-15 (no/mild depressive symptoms), 16-23 (moderate depressive symptoms), and 24-60 (severe depressive symptoms). Finally, the Impact of Event Scale-Revised (IES-R) was used to screen for posttraumatic stress. According to a recent publication in the field [19], the total score of the IES-R

was classified as follows: 0–23 (normal), 24–32 (mild psychological impact), 33–36 (moderate psychological impact), and  $\geq 37$  (severe psychological impact). All the instruments were validated in the Italian language and showed good psychometric properties [20–22].

Finally, lifestyle habits were assessed using a routine, validated questionnaire that is used in the Italian Food Consumption Survey (INRAN) [23], which inquiries about weekly food intake and physical activity frequency.

### *Patient and Public Involvement*

Not applicable

### *Statistical analysis*

Continuous data are reported as medians (quartiles I and III); categorical data are summarized as percentages and absolute frequencies. Wilcoxon-type tests were performed for continuous variables, and the Pearson chi-squared test or Fisher exact test was performed for categorical variables. The Pearson chi-squared test was performed when the number of observations per cell was above five; otherwise, Fisher's exact test was performed.

Multivariable regression models were estimated to identify predictors of psychological distress, depression, and posttraumatic stress. The categorized version of the three instruments' scores was used in the analyses. A proportional odds model was estimated for ordinal responses with more than two categories (CES-D and IES-R). A logistic regression model was estimated for the binary response variable (GHQ-12). The variables included in the model were selected via the backward elimination method and Akaike information criterion (AIC). All the models were adjusted by time from the start of the survey, which was computed as the difference between the start date of the survey and each participant response date. The time was entered in the models to account for potential confounding since the COVID-19 restrictions changed over the survey timespan, i.e., the full lockdown ended on 3 May 2020, but restrictions' removal was progressive. The nonlinear effects on the study outcome (i.e., respondents' age and time effect) were included in the model using restricted cubic splines (RCS). The model estimated odds ratios (ORs) together with the 95% confidence interval (CI), and p-values were reported.

The computations were performed using the software R 4.0.2 [24] with the rms [25] package.

## **Results**

There were 5008 survey respondents. The median age was 38 years, and the proportion of females was 63%. Concerning socioeconomic status, approximately half of the sample has attained a secondary education (48%), and two-thirds were actively employed (67%).

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Table S1 (Supplementary Material) reports the analysis of respondents' sociodemographic characteristics according to the place where they lived. Participants living in areas with high numbers of COVID-19 infections were significantly older and had a higher socioeconomic status than residents of regions with low rates of COVID-19. Furthermore, most participants from high COVID-19 incidence areas were found to have university educations, and they were more likely to have a job and to live in a single-family house with a garden.

Tables 1-2-3 present respondents' characteristics according to the scores obtained at the screening tools for psychological distress, depression, and posttraumatic stress.

*Psychological distress*

Most of the survey respondents (88.6%) suffered from psychological distress (GHQ score  $\geq 14$ ). The prevalence of psychological distress was significantly higher in females ( $p = 0.049$ ), unemployed individuals ( $p = 0.001$ ), and those who did not engage in physical activity ( $p < 0.001$ ) (Table 1). The results were confirmed by multivariable analysis (Table 4). Unemployed/retired/homemakers were found to be at significantly higher risk for psychological distress than active employees (OR 1.99, 95% CI 1.4-2.85), together with females (OR 0.77 95% CI 0.63-0.94, male vs. female).

*Depression*

Half of the sample suffered from moderate (25.5%, 1057 participants) or severe (22%, 909 participants) depressive symptoms. In the univariable analysis (Table 2), young women (median age of 29 years) were significantly more likely to report severe depressive symptoms, while participants with no or moderate depressive symptoms had median ages of 43 and 34, respectively ( $p < 0.001$ ). In addition, participants living in multifamily houses/single-room apartments without a garden were significantly more likely to exhibit frequent moderate to severe symptoms of depression. In line with univariable analysis, lower age (OR 0.39 for interquartile range (IQR) 26-54, 95% CI 0.32-0.48), female gender, being unemployed/retired/homemaker (OR 1.57, 95% CI 1.22-2.02) or being students (OR 1.73, 95% CI 1.31-2.28) were found to be significant predictors of more severe depressive symptoms (Table 4). Additionally, participants who lived alone (OR 1.50 95% CI 1.17-1.91) and experienced a loss (OR 1.35, 95% CI 1.05-1.72) were found to be significantly more likely to suffer from depressive symptoms. Conversely, engaging in physical activity was found to be protective against the worst depressive symptoms (OR 0.64, 95% CI 0.55-0.75).

*Posttraumatic stress*

The prevalence of moderate and severe psychological effects was 5.6% and 17.7%, respectively. For moderate/severe depressive symptoms, the impact was significantly higher in females, young



respondents, and participants living in multifamily houses (Table 3). The multivariable analysis confirmed these results (Table 4).

### *Dietary habits*

Overall, participants reported eating pasta/rice/cereals and cereal-based products a median of 7 times per week. Meat was reported more frequently than fish (median of 3 times per week vs. median of 2 times per week), while the consumption of legumes was reported to be a median of 3 times per week. The consumption of fruits and vegetables was a median of 7 times per week each.

The analysis of the distribution of weekly food frequency according to the categorized scores of the psychological health screening tools (Tables 1-2-3) shows no statistically significant differences for GHQ scores, except for consumption of vegetables and legumes (significantly lower for participants with psychological distress,  $p = 0.003$  and  $p = 0.002$ ). Participants with moderate/severe depressive symptoms were found to consume milk-based products less frequently ( $p < 0.001$ ), fruit ( $p < 0.001$ ), dried fruit ( $p < 0.001$ ), and vegetables ( $p = 0.013$ ). Conversely, they were significantly more likely to eat foods high in fat and sugar more frequently ( $p = 0.008$ ). Similarly, participants with moderate/severe psychological impact showed a lower consumption of fruit ( $p = 0.003$ ). At the same time, they were more likely to frequently eat foods high in fat and sugar ( $p = 0.012$ ).

### **Discussion**

The present findings show a high prevalence of moderate to severe depressive symptoms during the lockdown. The analysis of predictors of psychological distress among survey respondents identified a significant association with female gender, being student or unemployed/retired/homemaker, and living in a multifamily house without a garden. Conversely, only a small proportion of participants reported moderate to severe psychological impact, and, again, young females and unemployed/retired/homemaker individuals were the most affected. For what concerns sample characteristics, they were found to be representative of national trends. Respondents from high COVID-19 incidence regions were found to have higher socio-economic status compared to those from other regions. High COVID-19 incidence regions were mainly located in Northern Italy, which is characterized by higher socio-economic level than Southern Italy, according to the official data of the Italian National Institute of Health.

A recent review in the field has shown that over a short-term period, quarantine is associated with an increased prevalence of anxiety, depression, and posttraumatic stress symptoms [26]. Such findings are confirmed by surveys conducted in the most affected countries during the COVID-19 lockdown, showing that the population presented with increased feelings of anxiety and depression [14,19].

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Furthermore, emotional eating has been frequently reported [15], highlighting the strong and direct association between psychological wellbeing and lifestyle habits, which have been recently documented in college students during lockdown [27]. Surveyed individuals have reported doing less physical activity and snacking more frequently during the lockdown, with consequent weight gain [28,29]. Disturbingly, such changes have also been shown to affect children [30] with potentially detrimental long-term consequences for their health since such lifestyle changes could result in an increased risk for noncommunicable diseases over the life course.

A recent meta-analysis showed a 33.7% prevalence of depression [3], while in the present study, the proportion of subjects reporting moderate to severe depressive symptoms was 47.5%. However, when only severe depressive symptoms are considered, the prevalence is consistent with previous studies in the field [3]. Conversely, the prevalence of moderate to severe symptoms of posttraumatic stress was not consistent with reports in the literature [19,31], especially when only severe psychological impact was considered. In discussing such data, it is worth noting that studies in the field have employed different tools to ascertain the prevalence of depression, anxiety, and posttraumatic stress, making it difficult to compare results across studies.

Regarding the characterization of depressed participants, in line with the literature, female gender, low socioeconomic status [5], younger age, and being a student [32] were found to be significant predictors of depression.

*Dietary habits*

The study of dietary habits during the lockdown showed that participants were not compliant with the Mediterranean pyramid targets [33]. Half of the sample reported eating fruits and vegetables only twice a day, even though their recommended consumption is five times a day. In addition, participants reported eating foods high in fat and sugars (e.g., cakes) a median of 3 times a week (interquartile range 2-7), meaning that 25% of the sample ate such foods once a day, even though their consumption is recommended to be occasional. Such findings are in line with the literature, demonstrating that participants tended to snack more frequently during lockdown [28]. Fish consumption is recommended three times per week, but participants report eating fish a median of 2 times per week. We cannot rule out that lockdown might pose difficulties in the purchase of fish.

Interestingly, dietary patterns were found to be even worse among participants with symptoms of depression and psychological impact. They reported frequently eating foods high in fat and sugar and fruits and vegetables less frequently than participants without symptoms of depression and psychological impact. Such a finding could be interpreted as emotional eating, which has been reported during lockdown [15]. However, we can also hypothesize that participants with



psychological discomfort had worse eating habits because of a worse socioeconomic status since they were more likely not to have a job and to live in a smaller house without a garden. However, we cannot clarify the issue because we did not investigate eating habits before lockdown.

The fact that no data about participants' habits before lockdown were available represents a study limitation. Since no measures were taken before the lockdown started, the present study results can only provide a characterization of survey respondents during the lockdown, without making reference to changes in psychological distress symptoms as a result of COVID-19 restrictions. Another limitation is the nonnegligible proportion of survey responses presenting with missing data and the higher proportion of responses from high-incidence COVID-19 regions compared with those from regions with a low incidence of COVID-19. Furthermore, the analysis of missing data showed that the proportion varied across regions, with the lowest proportion in regions with a high COVID-19 incidence. We cannot rule out that such limits might lead to an overestimation of psychological distress prevalence; however, when only the proportion of severe depressive symptoms was considered, it was similar to that reported in the literature. More responses came from high-incidence COVID-19 regions because residents of those regions were more prone to respond to the survey. Further, that fact is related to the sampling technique employed, i.e., snowball sampling. The technique may result in a selection bias by including individuals who belong to a specific social network and excluding individuals not in that social network, since it was based on personal social networks. However, snowball sampling is a well-known and widely used sampling technique in the social sciences.

The present work presents several strengths. First, it is one of the largest population-based surveys conducted in Italy during the first COVID-19 lockdown, providing valuable data about the Italian population's psychological health. Furthermore, the results provide an analysis of predictors of psychological distress, depression, and posttraumatic stress, helping identify individuals most vulnerable to the psychological effects of lockdown.

These results have relevant implications for future research and public health. First, they provide insight into the need to understand the long-term consequences of lockdowns on psychological health and lifestyle habits, which need to be investigated further since data in the field are lacking. As an example, did depression symptoms persist after the end of the full lockdown? If yes, did they worsen? Further, for what concerns the public health perspective, if the long-term effects of lockdowns are confirmed, the present results help identify vulnerable populations that potentially benefit from follow-up programs of psychological support in the case of persistent psychological distress.

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**Competing interests.** None declared

**Data sharing.** The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Patient consent.** Not applicable

**Ethical approval.** Not applicable

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Table 1. Respondents' characteristics and habits according to GHQ score; 0-13 (no psychological distress) 14-36 (psychological distress). Data are percentages (absolute numbers) for categorical variables and I quartile/Median/III quartile for continuous variables.

	N	0-13 (N=507)	14-36 (N=3931)	Combined (N=4438)	P-value
Age	4438	26/34/48	26/38/53	26/37/53	<0.001
Gender: Female	4438	59% (300)	64% (2502)	63% (2802)	0.049
Male		41% (207)	36% (1429)	37% (1636)	
Nationality: Other	4438	2% (8)	1% (53)	1% (61)	0.676
Italian		98% (499)	99% (3878)	99% (4377)	
Region: High COVID-19 incidence	4427	48% (242)	45% (1780)	46% (2022)	0.282
Low COVID-19 incidence		52% (263)	55% (2142)	54% (2405)	
Educational level: Secondary education	4438	49% (249)	47% (1831)	47% (2080)	0.493
University education		50% (256)	53% (2089)	53% (2345)	
Primary education		0% (2)	0% (11)	0% (13)	
Working status: Active employee	4438	71% (360)	67% (2630)	67% (2990)	0.001
Unemployed/Retired/Homemaker		8% (42)	14% (568)	14% (610)	
Student		21% (105)	19% (733)	19% (838)	
House type: Multi-family house	4438	64% (325)	66% (2589)	66% (2914)	0.221
Single room apartment		3% (16)	2% (79)	2% (95)	
Single-family house		33% (166)	32% (1263)	32% (1429)	
Garden: No	4438	39% (198)	42% (1658)	42% (1856)	0.180
Yes		61% (309)	58% (2273)	58% (2582)	
Nasopharyngeal swab: No	2873	96% (278)	93% (2391)	93% (2669)	0.038
Yes		4% (12)	7% (192)	7% (204)	
Recent loss: No	2858	91% (266)	89% (2289)	89% (2555)	0.240
Yes		9% (25)	11% (278)	11% (303)	
Living alone: No	4438	88% (448)	88% (3469)	88% (3917)	0.939
Yes		12% (59)	12% (462)	12% (521)	
Pet: No	4438	54% (274)	54% (2112)	54% (2386)	0.893
Yes		46% (233)	46% (1819)	46% (2052)	

Physical activity: No	3991	44% (203)	57% (2024)	56% (2227)	<0.001
Yes		56% (259)	43% (1505)	44% (1764)	
Dietary habits (weekly consumption)					
Pasta, Rice, Cereals	3987	5/7/10	5/7/10	5/7/10	0.705
Cereal-based products	3984	3/7/7	4/7/7	3/7/7	0.214
Raw meat	3985	2/3/4	2/3/4	2/3/4	0.299
Cured meat	3981	1/2/3	1/2/3	1/2/3	0.050
Fish	3985	1/2/2	1/2/2	1/2/2	0.864
Milk and yogurt	3982	2/7/7	2/7/7	2/7/7	0.971
Milk-based products	3984	2/3/5	2/3/5	2/3/5	0.675
Fruit	3985	4/7/10	4/7/10	4/7/10	0.699
Dried fruit	3981	0/2/5	0/2/5	0/2/5	0.249
Vegetables	3984	6/7/14	6/7/14	6/7/14	0.003
Legumes	3982	1/2/5	1/2/4	1/2/4	0.002
Eggs	3984	1/2/3	1/2/2	1/2/2	0.100
Foods high in fat and sugar	3980	1/3/6	2/4/7	2/3/7	0.158
Soft drinks	3979	0/0/1	0/0/1	0/0/1	0.478
Alcoholic drinks (e.g., wine, beer, spirits)	3981	0/1/3	0/1/4	0/1/4	0.080



Table 2. Respondents' characteristics and habits according to CES-D score; 0-15 (no/mild depressive symptoms), 16-23 (moderate depressive symptoms), and 24-60 (severe depressive symptoms). Data are percentages (absolute numbers) for categorical variables and I quartile/Median/III quartile for continuous variables.

	N	0-15 (N=2179)	16-23 (N=1057)	24-60 (N=909)	Combined (N=4145)	P-value
Age	4145	29/43/57	25/34/50	23/29/44	26/37/53	<0.001
Gender: Female	4145	53% (1165)	70% (740)	80% (729)	64% (2634)	<0.001
Male		47% (1014)	30% (317)	20% (180)	36% (1511)	
Nationality: Other	4145	1% (27)	2% (17)	1% (9)	1% (53)	0.464
Italian		99% (2152)	98% (1040)	99% (900)	99% (4092)	
Region: High COVID-19 incidence	4135	45% (976)	44% (464)	48% (431)	45% (1871)	0.258
Low COVID-19 incidence		55% (1200)	56% (589)	52% (475)	55% (2264)	
Educational level: Secondary education	4145	45% (976)	44% (464)	52% (476)	46% (1916)	<0.001
University education		55% (1196)	56% (593)	47% (431)	54% (2220)	
Primary education		0% (7)	0% (0)	0% (2)	0% (9)	
Working status: Active employee	4145	73% (1583)	67% (709)	57% (521)	68% (2813)	<0.001
Unemployed/Retired/Homemaker		16% (338)	12% (130)	12% (111)	14% (579)	
Student		12% (258)	21% (218)	30% (277)	18% (753)	
House type: Multi-family house	4145	63% (1369)	68% (715)	69% (628)	65% (2712)	0.001
Single room apartment		2% (40)	2% (23)	3% (25)	2% (88)	
Single-family house		35% (770)	30% (319)	28% (256)	32% (1345)	
Garden: No	4145	36% (781)	44% (467)	52% (475)	42% (1723)	<0.001
Yes		64% (1398)	56% (590)	48% (434)	58% (2422)	
Nasopharyngeal swab: No	2684	92% (1223)	92% (612)	95% (660)	93% (2495)	0.023
Yes		8% (106)	8% (50)	5% (33)	7% (189)	
Recent loss: No	2665	90% (1194)	89% (584)	88% (606)	89% (2384)	0.277
Yes		10% (127)	11% (73)	12% (81)	11% (281)	
Living alone: No	4145	89% (1937)	89% (937)	86% (778)	88% (3652)	0.029
Yes		11% (242)	11% (120)	14% (131)	12% (493)	



Pet: No	4145	54% (1179)	53% (565)	52% (470)	53% (2214)	0.475
Yes		46% (1000)	47% (492)	48% (439)	47% (1931)	
Physical activity: No	3991	53% (1123)	56% (573)	61% (531)	56% (2227)	0.001
Yes		47% (981)	44% (445)	39% (338)	44% (1764)	
<i>Dietary habits (weekly consumption)</i>						
Pasta, Rice, Cereals	3987	5/7/10	5/7/10	5/7/10	5/7/10	0.182
Cereal-based products	3984	3/7/7	4/7/7	4/7/7	3/7/7	0.135
Raw meat	3985	2/3/4	2/3/4	2/3/4	2/3/4	0.418
Cured meat	3981	1/2/3	1/2/3	1/2/3	1/2/3	0.243
Fish	3985	1/2/2	1/2/2	1/2/2	1/2/2	0.003
Milk and yogurt	3982	1/7/7	2/7/7	2/7/7	2/7/7	0.309
Milk-based products	3984	2/3/5.25	2/3/5	1/3/5	2/3/5	<0.001
Fruit	3985	5/7/12	3/7/10	3/7/10	4/7/10	<0.001
Dried fruit	3981	0/2/5	0/2/5	0/1/4	0/2/5	<0.001
Vegetables	3984	6/7/14	5/7/14	5/7/14	6/7/14	0.013
Legumes	3982	1/3/4	2/3/4	1/2/4	1/3/4	0.059
Eggs	3984	1/2/2	1/2/2	1/2/2	1/2/2	0.442
Foods high in fat and sugar	3980	1/3/6	2/4/7	2/4/7	2/3/7	0.008
Soft drinks	3979	0/0/1	0/0/1	0/0/1	0/0/1	0.002
Alcoholic drinks (e.g., wine, beer, spirits)	3981	0/2/5	0/1/4	0/1/3	0/1/4	<0.001

Table 3. Respondents' characteristics and habits according to IESD-R score; 0–23 (normal), 24–32 (mild psychological impact), 33–36 (moderate psychological impact), and >=37 (severe psychological impact). Data are percentages (absolute numbers) for categorical variables and I quartile/Median/III quartile for continuous variables.

	N	0-23	24-32	33-36	>=37	Combined	P-value
		(N=2463)	(N=827)	(N=242)	(N=710)	(N=4294)	
Age	4294	27/40/55	26/37/53	25/33/49	25/33/49	26/37/53	<0.001
Gender: Female	4294	52% (1279)	73% (600)	85% (205)	83% (589)	63% (2717)	<0.001
Male		48% (1184)	27% (227)	15% (37)	17% (121)	37% (1577)	
Nationality: Other	4294	1% (30)	1% (12)	1% (3)	1% (7)	1% (55)	0.965
Italian		99% (2433)	99% (815)	99% (239)	99% (703)	99% (4239)	
Region: High COVID-19 incidence	4284	44% (1090)	47% (385)	48% (115)	47% (337)	45% (1947)	0.377
Low COVID-19 incidence		56% (1370)	53% (440)	52% (127)	53% (400)	55% (2337)	
Educational level: Secondary education	4294	44% (1087)	48% (397)	50% (121)	51% (390)	46% (1995)	0.009
University education		56% (1368)	52% (430)	50% (120)	48% (369)	53% (2287)	
Primary education		0% (8)	0% (0)	0% (1)	0% (3)	0% (12)	
Working status: Active employee	4294	70% (1720)	66% (543)	62% (151)	65% (494)	68% (2908)	0.001
Unemployed/Retired/Homemaker		14% (349)	14% (115)	14% (34)	13% (100)	14% (598)	
Student		16% (394)	20% (169)	24% (57)	22% (168)	18% (788)	
House type: Multi-family house	4294	64% (1586)	65% (538)	76% (183)	67% (487)	66% (2819)	0.003
Single room apartment		2% (49)	2% (19)	1% (2)	3% (21)	2% (95)	
Single-family house		34% (828)	33% (270)	24% (57)	30% (225)	32% (1380)	
Garden: No	4294	38% (935)	43% (355)	52% (126)	49% (375)	42% (1791)	<0.001
Yes		62% (1528)	57% (472)	48% (116)	51% (387)	58% (2503)	
Nasopharyngeal swab: No	2774	93% (1482)	92% (454)	93% (151)	95% (491)	93% (2578)	0.418
Yes		7% (120)	8% (37)	7% (11)	5% (28)	7% (196)	
Recent loss: No	2759	91% (1458)	87% (423)	88% (139)	87% (452)	90% (2472)	0.004
Yes		9% (137)	13% (64)	12% (19)	13% (67)	10% (287)	
Living alone: No	4294	88% (2170)	89% (737)	88% (214)	87% (663)	88% (3784)	0.635
Yes		12% (293)	11% (90)	12% (28)	13% (99)	12% (510)	

Pet: No	4294	54% (1332)	52% (426)	63% (152)	52% (397)	54% (2307)	0.014
Yes		46% (1131)	48% (401)	37% (90)	48% (65)	46% (1987)	
Physical activity: No	3991	53% (1220)	58% (443)	59% (132)	61% (332)	56% (2227)	<0.001
Yes		47% (1081)	42% (317)	41% (93)	39% (73)	44% (1764)	
Dietary habits (weekly consumption)							
Pasta, Rice, Cereals	3987	5/7/10	6/7/10	5/7/10	5/7/10	5/7/10	0.560
Cereal-based products	3984	3/7/7	4/7/7	4/7/7	4/7/7	3/7/7	0.018
Raw meat	3985	2/3/4	2/3/4	2/3/4	2/3/4	2/3/4	0.150
Cured meat	3981	1/2/3	1/2/3	1/2/3	1/2/3	1/2/3	0.404
Fish	3985	1/2/2	1/2/2	1/1/2	1/2/2	1/2/2	0.443
Milk and yogurt	3982	2/7/7	2/6/7	2/7/7	2/6/7	2/7/7	0.398
Milk-based products	3984	2/3/5	2/3/5	1/3/5	2/3/5	2/3/5	0.002
Fruit	3985	4/7/10	4/7/10	3/7/14	3/7/8	4/7/10	0.003
Dried fruit	3981	0/2/5	0/2/5	0/1/5	0/2/4	0/2/5	0.061
Vegetables	3984	6/7/14	6/7/14	6/7/14	5/7/14	6/7/14	0.043
Legumes	3982	1/3/4	1/2/4	1/2/4	1/2/4	1/3/4	0.710
Eggs	3984	1/2/2	1/2/2	1/2/2	1/2/3	1/2/2	0.836
Foods high in fat and sugar	3980	1/3/6	2/3/6	2/4/7	2/4/7	2/3/7	0.012
Soft drinks	3979	0/0/1	0/0/1	0/0/1	0/0/2	0/0/1	<0.001
Alcoholic drinks (e.g., wine, beer, spirits)	3981	0/2/4	0/1/3	0/1/3	0/1/3	0/1/4	<0.001

Table 4. Results of the multivariable models (proportional odds model for the ordinal responses with more than two categories, i.e., CES-D and IES-R, logistic regression model for the binary response variable, i.e., GHQ-12). For continuous variables, the effect is reported on the interquartile range (IQR), i.e., 26-54 for age and 3-20 for days from the start of the survey). Results are reported as odds ratios (logistic regression) or proportional odds (proportional odds model), 95% confidence intervals (CI), P-value

Supplementary Material

	OR	Lower 0.95	Upper 0.95
<i>GHQ</i>			
Days from the start of the survey	1.19	0.95	1.49
Gender: Male vs. Female	0.77	0.63	0.94
Region: Low-incidence vs. High-incidence	0.87	0.72	1.06
Working status: Unemployed/Retired/Homemaker vs. Active employee	1.99	1.4	2.85
Working status: Student vs. Active employee	1.10	0.85	1.43
Physical activity: Yes vs. No	0.56	0.46	0.69
<i>CES-D</i>			
Days from the start of the survey	1.38	1.00	1.89
Age	0.39	0.32	0.48
Gender: Male vs. Female	0.46	0.39	0.55
Working status: Unemployed/Retired/Homemaker vs. Active employee	1.57	1.22	2.02
Working status: Student vs. Active employee	1.73	1.31	2.28
Garden: No vs. Yes	1.72	1.46	2.01
Recent Loss: Yes vs. No	1.35	1.05	1.72
Living alone: Yes vs. No	1.50	1.17	1.91
Physical activity: Yes vs. No	0.64	0.55	0.75
<i>IES-R</i>			
Days from the start of the survey	1.03	0.75	1.42
Age	0.67	0.58	0.78
Gender: Male vs. Female	0.30	0.25	0.37
Educational level: Secondary vs. University	1.29	1.10	1.52

Educational level: Primary vs. University	0.48	0.05	4.55
Garden: No vs. Yes	1.55	1.33	1.82
Recent Loss: Yes vs. No	1.63	1.28	2.09
Physical activity: Yes vs. No	0.72	0.61	0.84

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Table S1. Respondents characteristics and habits according to residency; high incidence of COVID-19 regions (i.e., Piemonte, Veneto, Lombardia, Emilia-Romagna) and low incidence COVID-19 regions.

	N	Low COVID-19 Incidence (N=2301)	High COVID-19 Incidence (N=2677)	Combined (N=4978)	P-value
Age	4978	25/36/53	27/39/55	26/38/54	<0.001
Gender: Female	4974	63% (1454)	63% (1676)	63% (3130)	0.614
Male		37% (43)	37% (1001)	37% (1844)	
Nationality: Other	4977	2% (42)	1% (31)	1% (73)	0.051
Italian		98% (2259)	99% (2645)	99% (4904)	
Educational level: Secondary education	4973	51% (1175)	45% (1193)	48% (2368)	<0.001
University education		48% (1113)	55% (1475)	52% (2588)	
Primary education		0% (10)	0% (7)	0% (17)	
Working status: Active employee	4972	63% (1442)	70% (1877)	67% (3319)	<0.001
Unemployed/Retired/Homemaker		16% (376)	13% (360)	15% (736)	
Student		21% (481)	16% (436)	18% (917)	
House type: Multi-family house	4969	72% (1660)	60% (1603)	66% (3263)	<0.001
Single room apartment		3% (60)	2% (51)	2% (111)	
Single-family house		25% (579)	38% (1016)	32% (1595)	
Garden: No	4967	50% (1150)	35% (932)	42% (2082)	<0.001
Yes		50% (1147)	65% (1738)	58% (2885)	
Nasopharyngeal swab: No	3221	97% (1371)	90% (1623)	95% (2994)	<0.001
Yes		3% (39)	10% (188)	7% (227)	
Recent loss: No	3208	90% (1267)	89% (1604)	89% (2871)	0.186
Yes		10% (136)	11% (201)	11% (337)	
Living alone: No	4870	89% (1995)	88% (2315)	89% (4310)	0.196
Yes		11% (243)	12% (317)	11% (560)	
Physical activity: No	3981	55% (971)	57% (1251)	56% (2222)	0.159
Yes		45% (808)	43% (951)	44% (1759)	
<i>Dietary habits (weekly consumption)</i>					

Pasta, Rice, Cereals	3977	5/7/10	5/7/10	5/7/10	0.215
Cereal-based products	3974	3/7/7	4/7/7	4/7/7	<0.001
Raw meat	3975	2/3/4.25	2/3/4	2/3/4	0.005
Cured meat	3971	1/2/3	1/2/3	1/2/3	<0.001
Fish	3975	1/2/3	1/1/2	1/1/2	<0.001
Milk and yogurt	3972	2/7/7	2/7/7	2/7/7	0.782
Milk-based products	3974	2/3/5	2/3/5	2/3/5	0.017
Fruit	3975	4/7/10	4/7/12	4/7/10	<0.001
Dried fruit	3971	0/2/5	0/2/5	0/2/5	0.25
Vegetables	3974	5/7/14	6/7/14	6/7/14	<0.001
Legumes	3972	2/3/4	1/2/4	1/2/4	0.005
Eggs	3974	1/2/3	1/2/2	1/2/2	0.014
Food high in fat and sugar	3970	1/3/6	2/4/7	2/4/7	0.241
Soft drinks	3969	0/0/1	0/0/1	0/0/1	0.969
Alcoholic drinks (e.g., wine, beer, spirits)	3971	0/1/4	0/1/4	0/1/4	0.001

Figure S1. Survey response report. Panel A reports the weekly response rate, calculated as the proportion of survey responses over the number of accesses to the survey website. The dotted line represents the overall response rate (84.5%). Panel B represents the number of responses per day. Panel C reports the number of website accesses per day. Panel D reports the number of accesses per region.

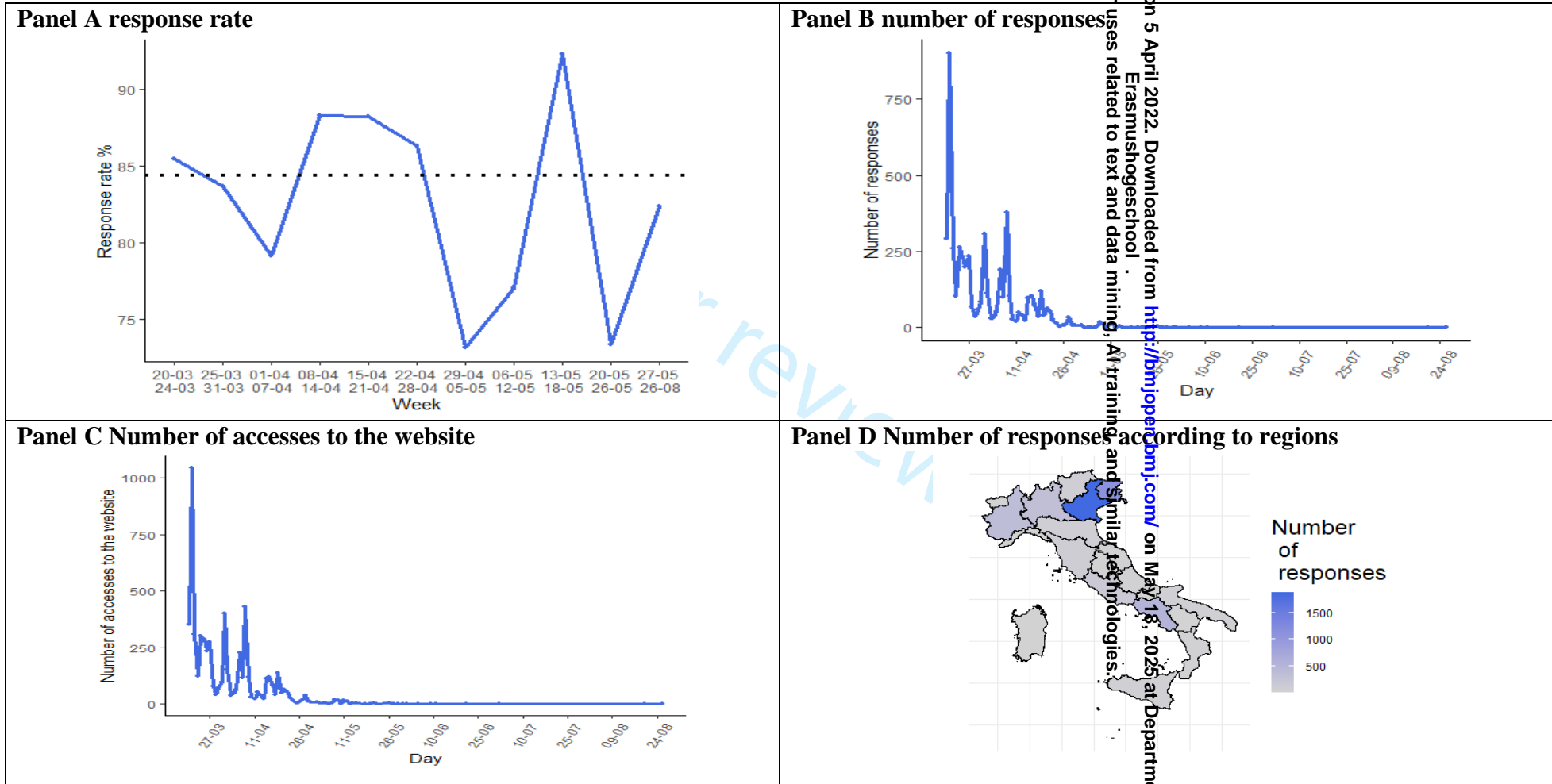
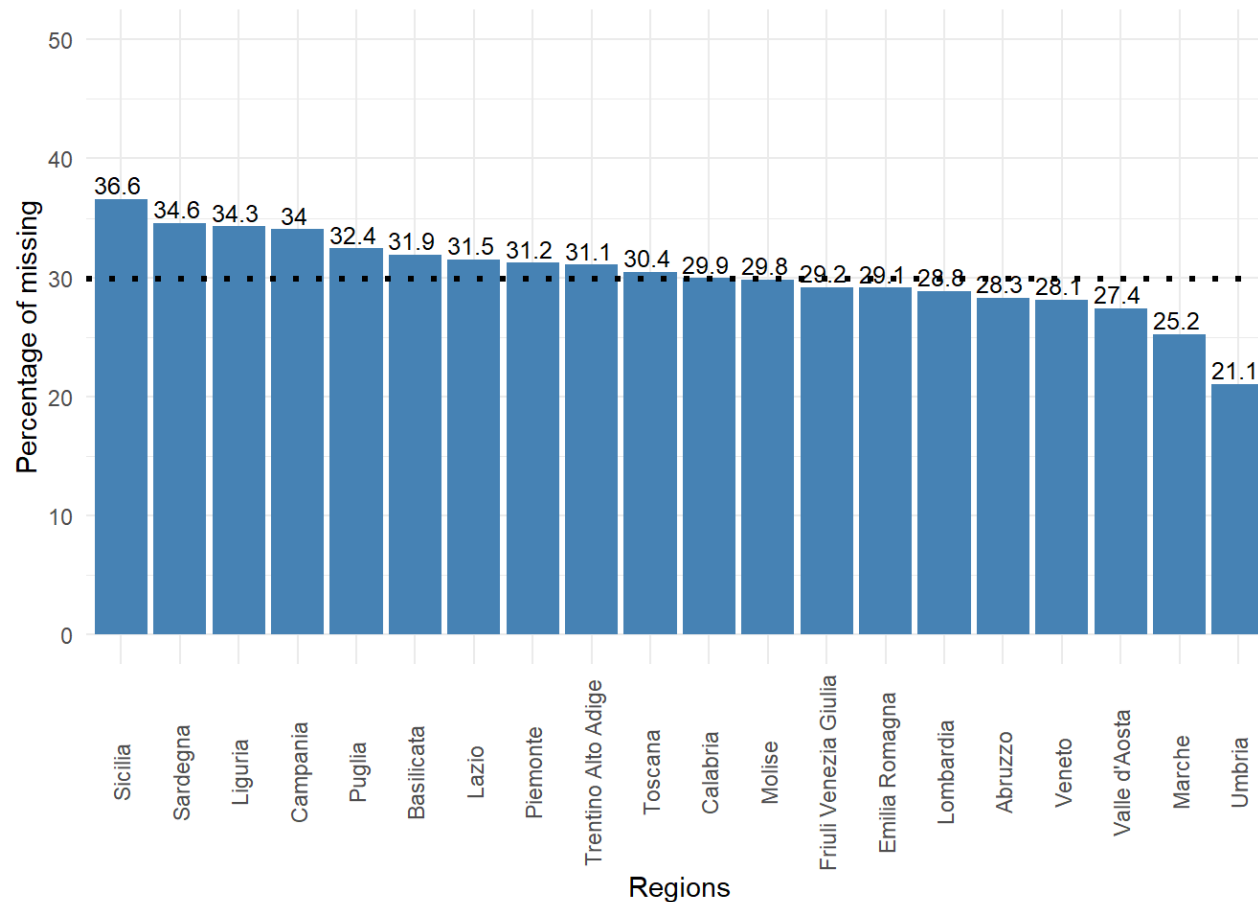




Figure S2. Missing Responses report. Percentage of missing responses per region. The dotted line represents the overall survey missing rate computed as a percentage (29.9%) of complete responses over the survey questionnaire



STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1-3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	NA
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	NA
		(c) Explain how missing data were addressed	7
		(d) If applicable, describe analytical methods taking account of sampling strategy	7
		(e) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8
		(b) Report category boundaries when continuous variables were categorized	7-8
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Impact of the COVID-19 lockdown on psychological health and nutritional habits in Italy: results from the #PRESTOinsieme study

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Secondary Subject Heading:	Epidemiology
Keywords:	COVID-19, NUTRITION & DIETETICS, Anxiety disorders < PSYCHIATRY, Public health < INFECTIOUS DISEASES

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# Impact of the COVID-19 lockdown on psychological health and nutritional habits in Italy: results from the #PRESTOinsieme study

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**Word count:** 2641

## Abstract

**Objectives.** The present work aims to present the results of the “*PRESTOinsieme*” (which is “*we'll be together soon*” in English). The web-based survey ([www.prestoinsieme.com](http://www.prestoinsieme.com)) describes changes in lifestyle habits and symptoms of psychological discomfort in the Italian population during the COVID-19 lockdown.

**Design:** Cross-sectional online survey disseminated by messaging apps (i.e., WhatsApp and Telegram) and social networks (i.e., Instagram, Facebook, and LinkedIn).

**Setting:** Italy

**Participants:** Italian population older than 16 years of age

**Exposure:** COVID-19 lockdown

**Main Outcomes and Measures:** Survey respondents filled out a set of validated questionnaires aimed at assessing lifestyle habits and psychological health, i.e., the General Health Questionnaire (GHQ-12) to screen for psychological distress, the Impact of Event Scale-Revised (IES-R) to screen for posttraumatic stress, and the Center for Epidemiologic Studies Depression Scale (CES-D).

**Results:** Survey respondents totaled 5008. Moderate or severe psychological distress was reported in 25.5% and 22% of survey respondents, respectively. Lower age, female gender, being unemployed (OR 1.57, 95% C.I. 1.217-2.024) or being a student (OR 1.726, 95% C.I. 1.306-2.28) were predictors of more severe depressive symptoms.

**Conclusions.** The present study is one of the largest population-based surveys conducted in Italy during the first COVID-19 lockdown, providing valuable data about the Italian population's psychological health. Further studies should be conducted to understand whether psychological distress persists after the end of the lockdown.

**Keywords.** Italy; COVID-19; Lockdown; Dietary habits; Psychological distress



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**Strengths and limitations of this study**

- The study is a web-based survey consisting of a set of validated questionnaires to assess the Italian population's psychological wellbeing and lifestyle habits during the COVID-19 lockdown.
- The survey involved 5008 participants over age 16, and it represents one of the largest surveys conducted during the first COVID-19 lockdown in Italy, the European country most severely affected by the first wave of the COVID-19 outbreak.
- The survey identifies predictors of psychological distress during the lockdown, helping identify individuals most vulnerable to the psychological effects of lockdown.
- Further studies should be conducted to understand the long-term consequences of the COVID-19 lockdown affecting psychological health and lifestyle habits.

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## Introduction

Containment measures (e.g., social distancing and a national lockdown) are crucial public health strategies in the fight against COVID-19 [1]. Even though such actions are essential to contain the COVID-19 pandemic, it is worth noting that they might adversely affect physical [2] and psychological [3] health and seem to be associated with an increased risk of domestic accidents [4]. Mental health changes during the lockdown have been detected by studies conducted in the U.S. and Italy, showing an increased prevalence/severity of anxiety and depressive symptoms together with an impairment of psychological functions involving memory and attention [5–7]. Furthermore, changes in lifestyle habits in response to COVID-19 and the lockdown have been reported. Italian studies have found a decrease in physical activity frequency, an impairment of sleep habits, and unhealthy eating habits [8,9]. It appears to be of extreme importance to take appropriate public health actions to mitigate the adverse effects of lockdowns [10] and to identify groups more vulnerable to the potential side effects of lockdowns to develop public health actions explicitly meant for these vulnerable populations [10].

Italy is the first European country where the COVID-19 outbreak occurred [11], causing an excess of mortality with severe overloads for the healthcare system [12]. The first containment measures were introduced on the 23<sup>rd</sup> February 2020 in the two Italian regions where the coronavirus first spread (Veneto and Lombardia) [13]. However, over a short time, the disease also spread to other Italian regions, so the Italian government introduced new containment measures at the national level on the 11<sup>th</sup> March 2020. Finally, on the 22<sup>nd</sup> March 2020, a nationwide full lockdown was implemented. Data on the Italian population during the lockdown show impaired emotional wellbeing and unhealthy lifestyle changes [14].

The present work aims to present the results of the "*PRESTOinsieme*" (imPact of quaRantine mEasures againST cOvid19, which is known as "we will be together soon" in English) project, a web-based survey conducted in Italy. The study aims to describe changes in lifestyle habits and the prevalence of psychological discomfort symptoms in the Italian population during the COVID-19 lockdown. The reason for analyzing and presenting data on both psychological wellbeing and lifestyle habits is the strict relationship documented between these two dimensions. An example of such a relationship is represented by emotional eating. Individuals experiencing anxiety and depressive symptoms are prone to emotional eating habits, i.e., eating to relieve stress instead of physical hunger, and this phenomenon was reported during the lockdown [15,16].

Several studies have been conducted so far with the aim of describing the relationship between the COVID-19 lockdown and psychological wellbeing in China, European countries, and the U.S. The value added by the present study refers to the fact that it was conducted in Italy, one of the countries

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most severely affected by the pandemic, at the very beginning of the first COVID-19 lockdown, when only little information was available about the prevention and treatment of the infection and the only previous experience in the management of the outbreak was that of the city of Wuhan, in China.

**Methods**

The *PRESTOinsieme* project is a cross-sectional web-based survey open to volunteers older than 16 years of age ([www.prestoinsieme.com](http://www.prestoinsieme.com)). The project began in Italy on the 20<sup>th</sup> March 2020 to assess the effects of the national lockdown on the population's psychological health and lifestyle habits.

*Sampling strategy*

The survey was web-based via Lime Survey [17] and disseminated by messaging apps (i.e., WhatsApp and Telegram) and social networks (i.e., Instagram, Facebook, and LinkedIn). Survey respondents were encouraged to spread the survey to their contacts, i.e., virtual snowball sampling. Five-thousand nine hundred-thirty survey accesses were registered during the study period (from 20<sup>th</sup> March to 24<sup>th</sup> August 2020); 5008 responded, i.e., 84.5%. The response rate, calculated as the proportion of survey responses over the number of accesses to the survey website, ranged between 70% and 95% during the study period (Figure S1, Panel A). The analysis included all survey responses collected until the 24<sup>th</sup> August 2020; however, 73% of survey responses were recorded until the end of the full lockdown, i.e., the 3 May 2020 (Figure S1, Panel B, and C). The regions most affected by the outbreak (i.e., Lombardia, Veneto, Piemonte, and Emilia-Romagna) provided the highest number of responses, except for Campania and Friuli Venezia Giulia (Figure S1, Panel D). Figure S2 reports the proportion of responses with missing data for each region, ranging from 36.6% to 21.1%, with an average of 29.9%.

*Questionnaires*

The survey consisted of validated questionnaires examining participants' personal and household characteristics, psychological health, and lifestyle habits. Regarding psychological health, three validated screening instruments for psychological distress, depression, and posttraumatic stress were administered. The General Health Questionnaire (GHQ-12) was used to screen for psychological distress. The GHQ-12 was scored using the 4-point Likert method (0-1-2-3), with a threshold of 14 points to indicate psychological distress [18]. The Center for Epidemiologic Studies Depression Scale (CES-D) was used to screen for depression, considering three classes of symptom severity: 0-15 (no/mild depressive symptoms), 16-23 (moderate depressive symptoms), and 24-60 (severe depressive symptoms). Finally, the Impact of Event Scale-Revised (IES-R) was used to screen for posttraumatic stress. According to a recent publication in the field [19], the total score of the IES-R

was classified as follows: 0–23 (normal), 24–32 (mild psychological impact), 33–36 (moderate psychological impact), and  $\geq 37$  (severe psychological impact). All the instruments were validated in the Italian language and showed good psychometric properties [20–22].

Finally, lifestyle habits were assessed using a routine, validated questionnaire that is used in the Italian Food Consumption Survey (INRAN) [23], which inquiries about weekly food intake and physical activity frequency.

### *Patient and Public Involvement*

Not applicable

### *Statistical analysis*

Continuous data are reported as medians (quartiles I and III); categorical data are summarized as percentages and absolute frequencies. Wilcoxon-type tests were performed for continuous variables, and the Pearson chi-squared test or Fisher exact test was performed for categorical variables. The Pearson chi-squared test was performed when the number of observations per cell was above five; otherwise, Fisher's exact test was performed.

Multivariable regression models were estimated to identify predictors of psychological distress, depression, and posttraumatic stress. The categorized version of the three instruments' scores was used in the analyses. A proportional odds model was estimated for ordinal responses with more than two categories (CES-D and IES-R). A logistic regression model was estimated for the binary response variable (GHQ-12). The variables included in the model were selected via the backward elimination method and Akaike information criterion (AIC). All the models were adjusted by time from the start of the survey, which was computed as the difference between the start date of the survey and each participant response date. The time was entered in the models to account for potential confounding since the COVID-19 restrictions changed over the survey timespan, i.e., the full lockdown ended on 3 May 2020, but restrictions' removal was progressive. The nonlinear effects on the study outcome (i.e., respondents' age and time effect) were included in the model using restricted cubic splines (RCS). The model estimated odds ratios (ORs) together with the 95% confidence interval (CI), and p-values were reported.

The computations were performed using the software R 4.0.2 [24] with the rms [25] package.

## **Results**

There were 5008 survey respondents. The median age was 38 years, and the proportion of females was 63%. Concerning socioeconomic status, approximately half of the sample has attained a secondary education (48%), and two-thirds were actively employed (67%).

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Table S1 (Supplementary Material) reports the analysis of respondents' sociodemographic characteristics according to the place where they lived. Participants living in areas with high numbers of COVID-19 infections were significantly older and had a higher socioeconomic status than residents of regions with low rates of COVID-19. Furthermore, most participants from high COVID-19 incidence areas were found to have university educations, and they were more likely to have a job and to live in a single-family house with a garden.

Tables 1-2-3 present respondents' characteristics according to the scores obtained at the screening tools for psychological distress, depression, and posttraumatic stress.

*Psychological distress*

Most of the survey respondents (88.6%) suffered from psychological distress (GHQ score  $\geq 14$ ). The prevalence of psychological distress was significantly higher in females ( $p = 0.049$ ), unemployed individuals ( $p = 0.001$ ), and those who did not engage in physical activity ( $p < 0.001$ ) (Table 1). The results were confirmed by multivariable analysis (Table 4). Unemployed/retired/homemakers were found to be at significantly higher risk for psychological distress than active employees (OR 1.99, 95% CI 1.4-2.85), together with females (OR 0.77 95% CI 0.63-0.94, male vs. female).

*Depression*

Half of the sample suffered from moderate (25.5%, 1057 participants) or severe (22%, 909 participants) depressive symptoms. In the univariable analysis (Table 2), young women (median age of 29 years) were significantly more likely to report severe depressive symptoms, while participants with no or moderate depressive symptoms had median ages of 43 and 34, respectively ( $p < 0.001$ ). In addition, participants living in multifamily houses/single-room apartments without a garden were significantly more likely to exhibit frequent moderate to severe symptoms of depression. In line with univariable analysis, lower age (OR 0.39 for interquartile range (IQR) 26-54, 95% CI 0.32-0.48), female gender, being unemployed/retired/homemaker (OR 1.57, 95% CI 1.22-2.02) or being students (OR 1.73, 95% CI 1.31-2.28) were found to be significant predictors of more severe depressive symptoms (Table 4). Additionally, participants who lived alone (OR 1.50 95% CI 1.17-1.91) and experienced a loss (OR 1.35, 95% CI 1.05-1.72) were found to be significantly more likely to suffer from depressive symptoms. Conversely, engaging in physical activity was found to be protective against the worst depressive symptoms (OR 0.64, 95% CI 0.55-0.75).

*Posttraumatic stress*

The prevalence of moderate and severe psychological effects was 5.6% and 17.7%, respectively. For moderate/severe depressive symptoms, the impact was significantly higher in females, young

respondents, and participants living in multifamily houses (Table 3). The multivariable analysis confirmed these results (Table 4).

### *Dietary habits*

Overall, participants reported eating pasta/rice/cereals and cereal-based products a median of 7 times per week. Meat was reported more frequently than fish (median of 3 times per week vs. median of 2 times per week), while the consumption of legumes was reported to be a median of 3 times per week. The consumption of fruits and vegetables was a median of 7 times per week each.

The analysis of the distribution of weekly food frequency according to the categorized scores of the psychological health screening tools (Tables 1-2-3) shows no statistically significant differences for GHQ scores, except for consumption of vegetables and legumes (significantly lower for participants with psychological distress,  $p = 0.003$  and  $p = 0.002$ ). Participants with moderate/severe depressive symptoms were found to consume milk-based products less frequently ( $p < 0.001$ ), fruit ( $p < 0.001$ ), dried fruit ( $p < 0.001$ ), and vegetables ( $p = 0.013$ ). Conversely, they were significantly more likely to eat foods high in fat and sugar more frequently ( $p = 0.008$ ). Similarly, participants with moderate/severe psychological impact showed a lower consumption of fruit ( $p = 0.003$ ). At the same time, they were more likely to frequently eat foods high in fat and sugar ( $p = 0.012$ ).

### **Discussion**

The present findings show a high prevalence of moderate to severe depressive symptoms during the lockdown. The analysis of predictors of psychological distress among survey respondents identified a significant association with female gender, being student or unemployed/retired/homemaker, and living in a multifamily house without a garden. Conversely, only a small proportion of participants reported moderate to severe psychological impact, and, again, young females and unemployed/retired/homemaker individuals were the most affected. For what concerns sample characteristics, they were found to be representative of national trends. Respondents from high COVID-19 incidence regions were found to have higher socio-economic status compared to those from other regions. High COVID-19 incidence regions were mainly located in Northern Italy, which is characterized by higher socio-economic level than Southern Italy, according to the official data of the Italian National Institute of Health.

A recent review in the field has shown that over a short-term period, quarantine is associated with an increased prevalence of anxiety, depression, and posttraumatic stress symptoms [26]. Such findings are confirmed by surveys conducted in the most affected countries during the COVID-19 lockdown, showing that the population presented with increased feelings of anxiety and depression [14,19].



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Furthermore, emotional eating has been frequently reported [15], highlighting the strong and direct association between psychological wellbeing and lifestyle habits, which have been recently documented in college students during lockdown [27]. Surveyed individuals have reported doing less physical activity and snacking more frequently during the lockdown, with consequent weight gain [28,29]. Disturbingly, such changes have also been shown to affect children [30] with potentially detrimental long-term consequences for their health since such lifestyle changes could result in an increased risk for noncommunicable diseases over the life course.

A recent meta-analysis showed a 33.7% prevalence of depression [3], while in the present study, the proportion of subjects reporting moderate to severe depressive symptoms was 47.5%. However, when only severe depressive symptoms are considered, the prevalence is consistent with previous studies in the field [3]. Conversely, the prevalence of moderate to severe symptoms of posttraumatic stress was not consistent with reports in the literature [19,31], especially when only severe psychological impact was considered. In discussing such data, it is worth noting that studies in the field have employed different tools to ascertain the prevalence of depression, anxiety, and posttraumatic stress, making it difficult to compare results across studies.

Regarding the characterization of depressed participants, in line with the literature, female gender, low socioeconomic status [5], younger age, and being a student [32] were found to be significant predictors of depression.

*Dietary habits*

The study of dietary habits during the lockdown showed that participants were not compliant with the Mediterranean pyramid targets [33]. Half of the sample reported eating fruits and vegetables only twice a day, even though their recommended consumption is five times a day. In addition, participants reported eating foods high in fat and sugars (e.g., cakes) a median of 3 times a week (interquartile range 2-7), meaning that 25% of the sample ate such foods once a day, even though their consumption is recommended to be occasional. Such findings are in line with the literature, demonstrating that participants tended to snack more frequently during lockdown [28]. Fish consumption is recommended three times per week, but participants report eating fish a median of 2 times per week. We cannot rule out that lockdown might pose difficulties in the purchase of fish.

Interestingly, dietary patterns were found to be even worse among participants with symptoms of depression and psychological impact. They reported frequently eating foods high in fat and sugar and fruits and vegetables less frequently than participants without symptoms of depression and psychological impact. Such a finding could be interpreted as emotional eating, which has been reported during lockdown [15]. However, we can also hypothesize that participants with



psychological discomfort had worse eating habits because of a worse socioeconomic status since they were more likely not to have a job and to live in a smaller house without a garden. However, we cannot clarify the issue because we did not investigate eating habits before lockdown.

The fact that no data about participants' habits before lockdown were available represents a study limitation. Since no measures were taken before the lockdown started, the present study results can only provide a characterization of survey respondents during the lockdown, without making reference to changes in psychological distress symptoms as a result of COVID-19 restrictions. Another limitation is the nonnegligible proportion of survey responses presenting with missing data and the higher proportion of responses from high-incidence COVID-19 regions compared with those from regions with a low incidence of COVID-19. Furthermore, the analysis of missing data showed that the proportion varied across regions, with the lowest proportion in regions with a high COVID-19 incidence. We cannot rule out that such limits might lead to an overestimation of psychological distress prevalence; however, when only the proportion of severe depressive symptoms was considered, it was similar to that reported in the literature. More responses came from high-incidence COVID-19 regions because residents of those regions were more prone to respond to the survey. Further, that fact is related to the sampling technique employed, i.e., snowball sampling. The technique may result in a selection bias by including individuals who belong to a specific social network and excluding individuals not in that social network, since it was based on personal social networks. However, snowball sampling is a well-known and widely used sampling technique in the social sciences.

The present work presents several strengths. First, it is one of the largest population-based surveys conducted in Italy during the first COVID-19 lockdown, providing valuable data about the Italian population's psychological health. Furthermore, the results provide an analysis of predictors of psychological distress, depression, and posttraumatic stress, helping identify individuals most vulnerable to the psychological effects of lockdown.

These results have relevant implications for future research and public health. First, they provide insight into the need to understand the long-term consequences of lockdowns on psychological health and lifestyle habits, which need to be investigated further since data in the field are lacking. As an example, did depression symptoms persist after the end of the full lockdown? If yes, did they worsen? Further, for what concerns the public health perspective, if the long-term effects of lockdowns are confirmed, the present results help identify vulnerable populations that potentially benefit from follow-up programs of psychological support in the case of persistent psychological distress.

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**Competing interests.** None declared

**Data sharing.** The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Patient consent.** Not applicable

**Ethical approval.** Not applicable

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ErasmusHogeschool

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Table 1. Respondents' characteristics and habits according to GHQ score; 0-13 (no psychological distress) 14-36 (psychological distress). Data are percentages (absolute numbers) for categorical variables and I quartile/Median/III quartile for continuous variables.

	N	0-13 (N=507)	14-36 (N=3931)	Combined (N=4438)	P-value
Age	4438	26/34/48	26/38/53	26/37/53	<0.001
Gender: Female	4438	59% (300)	64% (2502)	63% (2802)	0.049
Male		41% (207)	36% (1429)	37% (1636)	
Nationality: Other	4438	2% (8)	1% (53)	1% (61)	0.676
Italian		98% (499)	99% (3878)	99% (4377)	
Region: High COVID-19 incidence	4427	48% (242)	45% (1780)	46% (2022)	0.282
Low COVID-19 incidence		52% (263)	55% (2142)	54% (2405)	
Educational level: Secondary education	4438	49% (249)	47% (1831)	47% (2080)	0.493
University education		50% (256)	53% (2089)	53% (2345)	
Primary education		0% (2)	0% (11)	0% (13)	
Working status: Active employee	4438	71% (360)	67% (2630)	67% (2990)	0.001
Unemployed/Retired/Homemaker		8% (42)	14% (568)	14% (610)	
Student		21% (105)	19% (733)	19% (838)	
House type: Multi-family house	4438	64% (325)	66% (2589)	66% (2914)	0.221
Single room apartment		3% (16)	2% (79)	2% (95)	
Single-family house		33% (166)	32% (1263)	32% (1429)	
Garden: No	4438	39% (198)	42% (1658)	42% (1856)	0.180
Yes		61% (309)	58% (2273)	58% (2582)	
Nasopharyngeal swab: No	2873	96% (278)	93% (2391)	93% (2669)	0.038
Yes		4% (12)	7% (192)	7% (204)	
Recent loss: No	2858	91% (266)	89% (2289)	89% (2555)	0.240
Yes		9% (25)	11% (278)	11% (303)	
Living alone: No	4438	88% (448)	88% (3469)	88% (3917)	0.939
Yes		12% (59)	12% (462)	12% (521)	
Pet: No	4438	54% (274)	54% (2112)	54% (2386)	0.893
Yes		46% (233)	46% (1819)	46% (2052)	

Physical activity: No	3991	44% (203)	57% (2024)	56% (2227)	<0.001
Yes		56% (259)	43% (1505)	44% (1764)	
Dietary habits (weekly consumption)					
Pasta, Rice, Cereals	3987	5/7/10	5/7/10	5/7/10	0.705
Cereal-based products	3984	3/7/7	4/7/7	3/7/7	0.214
Raw meat	3985	2/3/4	2/3/4	2/3/4	0.299
Cured meat	3981	1/2/3	1/2/3	1/2/3	0.050
Fish	3985	1/2/2	1/2/2	1/2/2	0.864
Milk and yogurt	3982	2/7/7	2/7/7	2/7/7	0.971
Milk-based products	3984	2/3/5	2/3/5	2/3/5	0.675
Fruit	3985	4/7/10	4/7/10	4/7/10	0.699
Dried fruit	3981	0/2/5	0/2/5	0/2/5	0.249
Vegetables	3984	6/7/14	6/7/14	6/7/14	0.003
Legumes	3982	1/2/5	1/2/4	1/2/4	0.002
Eggs	3984	1/2/3	1/2/2	1/2/2	0.100
Foods high in fat and sugar	3980	1/3/6	2/4/7	2/3/7	0.158
Soft drinks	3979	0/0/1	0/0/1	0/0/1	0.478
Alcoholic drinks (e.g., wine, beer, spirits)	3981	0/1/3	0/1/4	0/1/4	0.080



Table 2. Respondents' characteristics and habits according to CES-D score; 0-15 (no/mild depressive symptoms), 16-23 (moderate depressive symptoms), and 24-60 (severe depressive symptoms). Data are percentages (absolute numbers) for categorical variables and I quartile/Median/III quartile for continuous variables.

	N	0-15 (N=2179)	16-23 (N=1057)	24-60 (N=909)	Combined (N=4145)	P-value
Age	4145	29/43/57	25/34/50	23/29/44	26/37/53	<0.001
Gender: Female	4145	53% (1165)	70% (740)	80% (729)	64% (2634)	<0.001
Male		47% (1014)	30% (317)	20% (180)	36% (1511)	
Nationality: Other	4145	1% (27)	2% (17)	1% (9)	1% (53)	0.464
Italian		99% (2152)	98% (1040)	99% (900)	99% (4092)	
Region: High COVID-19 incidence	4135	45% (976)	44% (464)	48% (431)	45% (1871)	0.258
Low COVID-19 incidence		55% (1200)	56% (589)	52% (475)	55% (2264)	
Educational level: Secondary education	4145	45% (976)	44% (464)	52% (476)	46% (1916)	<0.001
University education		55% (1196)	56% (593)	47% (431)	54% (2220)	
Primary education		0% (7)	0% (0)	0% (2)	0% (9)	
Working status: Active employee	4145	73% (1583)	67% (709)	57% (521)	68% (2813)	<0.001
Unemployed/Retired/Homemaker		16% (338)	12% (130)	12% (111)	14% (579)	
Student		12% (258)	21% (218)	30% (277)	18% (753)	
House type: Multi-family house	4145	63% (1369)	68% (715)	69% (628)	65% (2712)	0.001
Single room apartment		2% (40)	2% (23)	3% (25)	2% (88)	
Single-family house		35% (770)	30% (319)	28% (256)	32% (1345)	
Garden: No	4145	36% (781)	44% (467)	52% (475)	42% (1723)	<0.001
Yes		64% (1398)	56% (590)	48% (434)	58% (2422)	
Nasopharyngeal swab: No	2684	92% (1223)	92% (612)	95% (660)	93% (2495)	0.023
Yes		8% (106)	8% (50)	5% (33)	7% (189)	
Recent loss: No	2665	90% (1194)	89% (584)	88% (606)	89% (2384)	0.277
Yes		10% (127)	11% (73)	12% (81)	11% (281)	
Living alone: No	4145	89% (1937)	89% (937)	86% (778)	88% (3652)	0.029
Yes		11% (242)	11% (120)	14% (131)	12% (493)	



Pet: No	4145	54% (1179)	53% (565)	52% (470)	53% (2214)	0.475
Yes		46% (1000)	47% (492)	48% (439)	47% (1931)	
Physical activity: No	3991	53% (1123)	56% (573)	61% (531)	56% (2227)	0.001
Yes		47% (981)	44% (445)	39% (338)	44% (1764)	
<i>Dietary habits (weekly consumption)</i>						
Pasta, Rice, Cereals	3987	5/7/10	5/7/10	5/7/10	5/7/10	0.182
Cereal-based products	3984	3/7/7	4/7/7	4/7/7	3/7/7	0.135
Raw meat	3985	2/3/4	2/3/4	2/3/4	2/3/4	0.418
Cured meat	3981	1/2/3	1/2/3	1/2/3	1/2/3	0.243
Fish	3985	1/2/2	1/2/2	1/2/2	1/2/2	0.003
Milk and yogurt	3982	1/7/7	2/7/7	2/7/7	2/7/7	0.309
Milk-based products	3984	2/3/5.25	2/3/5	1/3/5	2/3/5	<0.001
Fruit	3985	5/7/12	3/7/10	3/7/10	4/7/10	<0.001
Dried fruit	3981	0/2/5	0/2/5	0/1/4	0/2/5	<0.001
Vegetables	3984	6/7/14	5/7/14	5/7/14	6/7/14	0.013
Legumes	3982	1/3/4	2/3/4	1/2/4	1/3/4	0.059
Eggs	3984	1/2/2	1/2/2	1/2/2	1/2/2	0.442
Foods high in fat and sugar	3980	1/3/6	2/4/7	2/4/7	2/3/7	0.008
Soft drinks	3979	0/0/1	0/0/1	0/0/1	0/0/1	0.002
Alcoholic drinks (e.g., wine, beer, spirits)	3981	0/2/5	0/1/4	0/1/3	0/1/4	<0.001

Table 3. Respondents' characteristics and habits according to IESD-R score; 0–23 (normal), 24–32 (mild psychological impact), 33–36 (moderate psychological impact), and >=37 (severe psychological impact). Data are percentages (absolute numbers) for categorical variables and I quartile/Median/III quartile for continuous variables.

	N	0-23	24-32	33-36	>=37	Combined	P-value
		(N=2463)	(N=827)	(N=242)	(N=710)	(N=4294)	
Age	4294	27/40/55	26/37/53	25/33/49	25/33/49	26/37/53	<0.001
Gender: Female	4294	52% (1279)	73% (600)	85% (205)	83% (589)	63% (2717)	<0.001
Male		48% (1184)	27% (227)	15% (37)	17% (121)	37% (1577)	
Nationality: Other	4294	1% (30)	1% (12)	1% (3)	1% (7)	1% (55)	0.965
Italian		99% (2433)	99% (815)	99% (239)	99% (693)	99% (4239)	
Region: High COVID-19 incidence	4284	44% (1090)	47% (385)	48% (115)	47% (337)	45% (1947)	0.377
Low COVID-19 incidence		56% (1370)	53% (440)	52% (127)	53% (373)	55% (2337)	
Educational level: Secondary education	4294	44% (1087)	48% (397)	50% (121)	51% (360)	46% (1995)	0.009
University education		56% (1368)	52% (430)	50% (120)	48% (349)	53% (2287)	
Primary education		0% (8)	0% (0)	0% (1)	0% (3)	0% (12)	
Working status: Active employee	4294	70% (1720)	66% (543)	62% (151)	65% (464)	68% (2908)	0.001
Unemployed/Retired/Homemaker		14% (349)	14% (115)	14% (34)	13% (96)	14% (598)	
Student		16% (394)	20% (169)	24% (57)	22% (168)	18% (788)	
House type: Multi-family house	4294	64% (1586)	65% (538)	76% (183)	67% (481)	66% (2819)	0.003
Single room apartment		2% (49)	2% (19)	1% (2)	3% (21)	2% (95)	
Single-family house		34% (828)	33% (270)	24% (57)	30% (215)	32% (1380)	
Garden: No	4294	38% (935)	43% (355)	52% (126)	49% (351)	42% (1791)	<0.001
Yes		62% (1528)	57% (472)	48% (116)	51% (359)	58% (2503)	
Nasopharyngeal swab: No	2774	93% (1482)	92% (454)	93% (151)	95% (491)	93% (2578)	0.418
Yes		7% (120)	8% (37)	7% (11)	5% (28)	7% (196)	
Recent loss: No	2759	91% (1458)	87% (423)	88% (139)	87% (452)	90% (2472)	0.004
Yes		9% (137)	13% (64)	12% (19)	13% (67)	10% (287)	
Living alone: No	4294	88% (2170)	89% (737)	88% (214)	87% (663)	88% (3784)	0.635
Yes		12% (293)	11% (90)	12% (28)	13% (99)	12% (510)	

Pet: No	4294	54% (1332)	52% (426)	63% (152)	52% (397)	54% (2307)	0.014
Yes		46% (1131)	48% (401)	37% (90)	48% (65)	46% (1987)	
Physical activity: No	3991	53% (1220)	58% (443)	59% (132)	61% (32)	56% (2227)	<0.001
Yes		47% (1081)	42% (317)	41% (93)	39% (73)	44% (1764)	
Dietary habits (weekly consumption)							
Pasta, Rice, Cereals	3987	5/7/10	6/7/10	5/7/10	5/7/10	5/7/10	0.560
Cereal-based products	3984	3/7/7	4/7/7	4/7/7	4/7/7	3/7/7	0.018
Raw meat	3985	2/3/4	2/3/4	2/3/4	2/3/4	2/3/4	0.150
Cured meat	3981	1/2/3	1/2/3	1/2/3	1/2/3	1/2/3	0.404
Fish	3985	1/2/2	1/2/2	1/1/2	1/2/2	1/2/2	0.443
Milk and yogurt	3982	2/7/7	2/6/7	2/7/7	2/6/7	2/7/7	0.398
Milk-based products	3984	2/3/5	2/3/5	1/3/5	2/3/5	2/3/5	0.002
Fruit	3985	4/7/10	4/7/10	3/7/14	3/7/8	4/7/10	0.003
Dried fruit	3981	0/2/5	0/2/5	0/1/5	0/2/4	0/2/5	0.061
Vegetables	3984	6/7/14	6/7/14	6/7/14	5/7/14	6/7/14	0.043
Legumes	3982	1/3/4	1/2/4	1/2/4	1/2/4	1/3/4	0.710
Eggs	3984	1/2/2	1/2/2	1/2/2	1/2/3	1/2/2	0.836
Foods high in fat and sugar	3980	1/3/6	2/3/6	2/4/7	2/4/7	2/3/7	0.012
Soft drinks	3979	0/0/1	0/0/1	0/0/1	0/0/2	0/0/1	<0.001
Alcoholic drinks (e.g., wine, beer, spirits)	3981	0/2/4	0/1/3	0/1/3	0/1/3	0/1/4	<0.001

Table 4. Results of the multivariable models (proportional odds model for the ordinal responses with more than two categories, i.e., CES-D and IES-R, logistic regression model for the binary response variable, i.e., GHQ-12). For continuous variables, the effect is reported on the interquartile range (IQR), i.e., 26-54 for age and 3-20 for days from the start of the survey). Results are reported as odds ratios (logistic regression) or proportional odds (proportional odds model), 95% confidence intervals (CI), P-value

Supplementary Material

	OR	Lower 0.95	Upper 0.95
<i>GHQ</i>			
Days from the start of the survey	1.19	0.95	1.49
Gender: Male vs. Female	0.77	0.63	0.94
Region: Low-incidence vs. High-incidence	0.87	0.72	1.06
Working status: Unemployed/Retired/Homemaker vs. Active employee	1.99	1.4	2.85
Working status: Student vs. Active employee	1.10	0.85	1.43
Physical activity: Yes vs. No	0.56	0.46	0.69
<i>CES-D</i>			
Days from the start of the survey	1.38	1.00	1.89
Age	0.39	0.32	0.48
Gender: Male vs. Female	0.46	0.39	0.55
Working status: Unemployed/Retired/Homemaker vs. Active employee	1.57	1.22	2.02
Working status: Student vs. Active employee	1.73	1.31	2.28
Garden: No vs. Yes	1.72	1.46	2.01
Recent Loss: Yes vs. No	1.35	1.05	1.72
Living alone: Yes vs. No	1.50	1.17	1.91
Physical activity: Yes vs. No	0.64	0.55	0.75
<i>IES-R</i>			
Days from the start of the survey	1.03	0.75	1.42
Age	0.67	0.58	0.78
Gender: Male vs. Female	0.30	0.25	0.37
Educational level: Secondary vs. University	1.29	1.10	1.52

Educational level: Primary vs. University	0.48	0.05	4.55
Garden: No vs. Yes	1.55	1.33	1.82
Recent Loss: Yes vs. No	1.63	1.28	2.09
Physical activity: Yes vs. No	0.72	0.61	0.84

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Table S1. Respondents characteristics and habits according to residency; high incidence of COVID-19 regions (i.e., Piemonte, Veneto, Lombardia, Emilia-Romagna) and low incidence COVID-19 regions.

	N	Low COVID-19 Incidence (N=2301)	High COVID-19 Incidence (N=2677)	Combined (N=4978)	P-value
Age	4978	25/36/53	27/39/55	26/38/54	<0.001
Gender: Female	4974	63% (1454)	63% (1676)	63% (3130)	0.614
Male		37% ( 43)	37% (1001)	37% (1844)	
Nationality: Other	4977	2% (42)	1% (31)	1% (73)	0.051
Italian		98% (2259)	99% (2645)	99% (4904)	
Educational level: Secondary education	4973	51% (1175)	45% (1193)	48% (2368)	<0.001
University education		48% (1113)	55% (1475)	52% (2588)	
Primary education		0% (10)	0% (7)	0% (17)	
Working status: Active employee	4972	63% (1442)	70% (1877)	67% (3319)	<0.001
Unemployed/Retired/Homemaker		16% (376)	13% (360)	15% (736)	
Student		21% (481)	16% (436)	18% (917)	
House type: Multi-family house	4969	72% (1660)	60% (1603)	66% (3263)	<0.001
Single room apartment		3% (60)	2% (51)	2% (111)	
Single-family house		25% (579)	38% (1016)	32% (1595)	
Garden: No	4967	50% (1150)	35% (932)	42% (2082)	<0.001
Yes		50% (1147)	65% (1738)	58% (2885)	
Nasopharyngeal swab: No	3221	97% (1371)	90% (1623)	95% (2994)	<0.001
Yes		3% (39)	10% (188)	7% (227)	
Recent loss: No	3208	90% (1267)	89% (1604)	89% (2871)	0.186
Yes		10% (136)	11% (201)	11% (337)	
Living alone: No	4870	89% (1995)	88% (2315)	89% (4310)	0.196
Yes		11% (243)	12% (317)	11% (560)	
Physical activity: No	3981	55% (971)	57% (1251)	56% (2222)	0.159
Yes		45% (808)	43% (951)	44% (1759)	
<i>Dietary habits (weekly consumption)</i>					

Pasta, Rice, Cereals	3977	5/7/10	5/7/10	5/7/10	0.215
Cereal-based products	3974	3/7/7	4/7/7	4/7/7	<0.001
Raw meat	3975	2/3/4.25	2/3/4	2/3/4	0.005
Cured meat	3971	1/2/3	1/2/3	1/2/3	<0.001
Fish	3975	1/2/3	1/1/2	1/1/2	<0.001
Milk and yogurt	3972	2/7/7	2/7/7	2/7/7	0.782
Milk-based products	3974	2/3/5	2/3/5	2/3/5	0.017
Fruit	3975	4/7/10	4/7/12	4/7/10	<0.001
Dried fruit	3971	0/2/5	0/2/5	0/2/5	0.25
Vegetables	3974	5/7/14	6/7/14	6/7/14	<0.001
Legumes	3972	2/3/4	1/2/4	1/2/4	0.005
Eggs	3974	1/2/3	1/2/2	1/2/2	0.014
Food high in fat and sugar	3970	1/3/6	2/4/7	2/4/7	0.241
Soft drinks	3969	0/0/1	0/0/1	0/0/1	0.969
Alcoholic drinks (e.g., wine, beer, spirits)	3971	0/1/4	0/1/4	0/1/4	0.001

Figure S1. Survey response report. Panel A reports the weekly response rate, calculated as the proportion of survey responses over the number of accesses to the survey website. The dotted line represents the overall response rate (84.5%). Panel B represents the number of responses per day. Panel C reports the number of website accesses per day. Panel D reports the number of accesses per region.

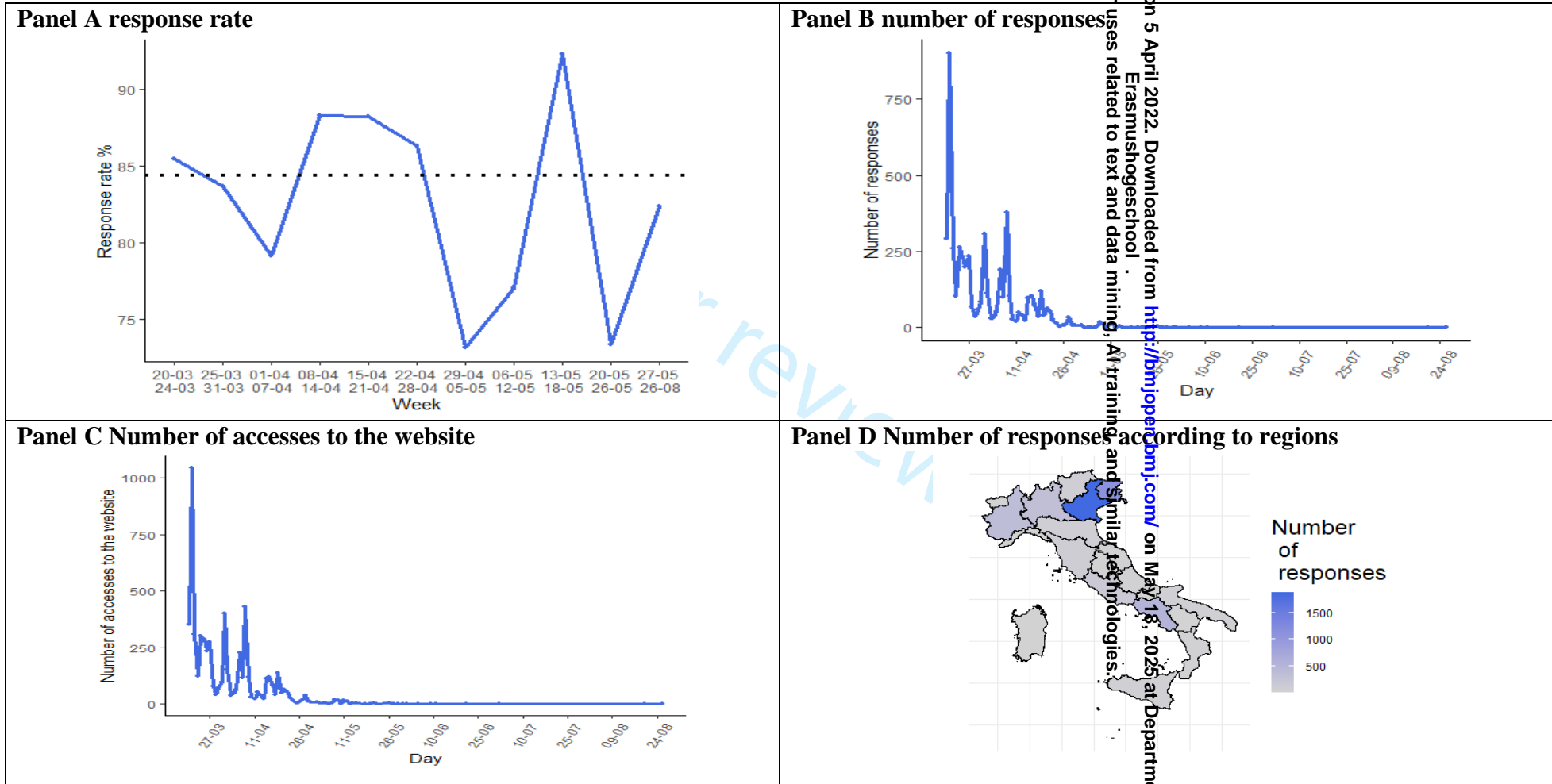
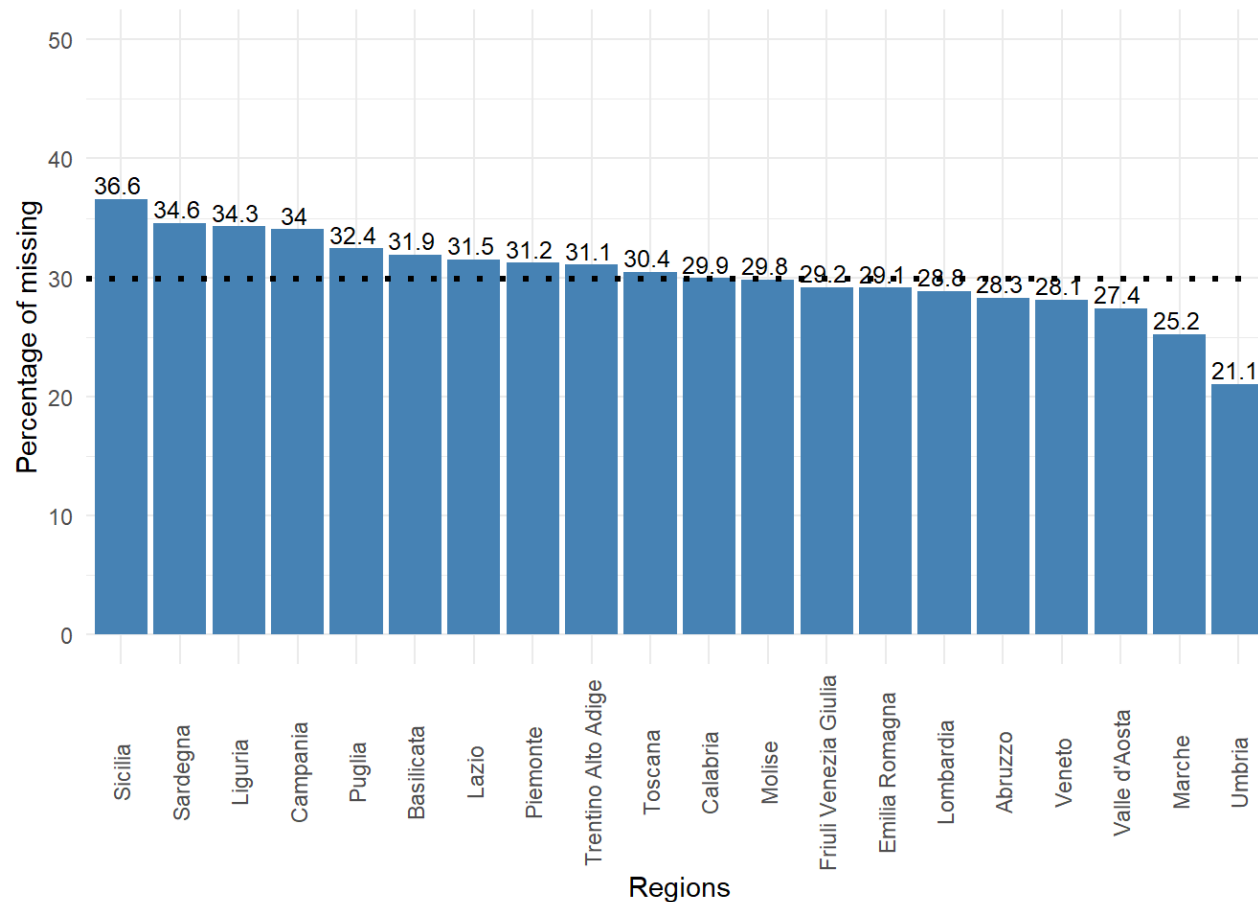




Figure S2. Missing Responses report. Percentage of missing responses per region. The dotted line represents the overall survey missing rate computed as a percentage (29.9%) of complete responses over the survey questionnaire



STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1-3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	NA
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7
		(b) Describe any methods used to examine subgroups and interactions	NA
		(c) Explain how missing data were addressed	7
		(d) If applicable, describe analytical methods taking account of sampling strategy	7
		(e) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
Outcome data	15*	Report numbers of outcome events or summary measures	7
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8
		(b) Report category boundaries when continuous variables were categorized	7-8
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).