

# Did social isolation during the SARS-CoV-2 epidemic have an impact on the lifestyles of citizens?

L'isolamento sociale durante l'epidemia da SARS-CoV-2 ha avuto un impatto sugli stili di vita dei cittadini?

Gianluigi Ferrante, Elisa Camussi, Cristiano Piccinelli, Carlo Senore, Paola Armaroli, Andrea Ortale, Francesca Garena, Livia Giordano

SSD Epidemiologia screening, CPO-AOU Città della salute e della scienza di Torino (Italy)

Corresponding author: Gianluigi Ferrante; gianluigi.ferrante@cpo.it

## ABSTRACT

**OBJECTIVES:** to study the impact of social isolation, related to the SARS-CoV-2 epidemic, on lifestyles in Italy, with particular reference to physical activity, alcohol consumption, smoking, and eating habits. Moreover, to investigate the association between lifestyle changes during the pandemic and sociodemographic characteristics.

**DESIGN:** epidemiological investigation based on a cross-sectional study.

**SETTING AND PARTICIPANTS:** between April 21<sup>st</sup> and June 7<sup>th</sup> 2020, an electronic questionnaire to collect information on physical activity, alcohol consumption, smoking, and eating habits during the period of home containment was made available on the web. Respondents were recruited through non-probabilistic snowball sampling. The link to the electronic questionnaire was disseminated through institutional websites, social networks (Facebook, Twitter), and messaging systems such as WhatsApp, Telegram, and SMS. A total of 10,758 interviews were collected, of which 7,847 (73%) were complete for a minimum set of indicators (age, gender, and area of residence).

**MAIN OUTCOME MEASURES:** reduction of physical activity, increase in alcohol consumption, increase in cigarette smoking, increase in consumption of unhealthy foods (processed meat, red meat or desserts) without increasing healthy foods (vegetables, legumes or whole grains) and, vice versa, increase in consumption of healthy foods without increasing unhealthy foods.

**RESULTS:** the population under study consists of 7,847 people with a mean age of 48.6 years (standard deviation: 13.9). Most of respondents are women (71.3%), 92.5% have a high school or university degree and 91% live in Northern Italy. During home containment, 56% of interviewees reported they had reduced the time devoted to physical activity. In particular, this happened among older people and those living in large cities. More than 17% of respondents increased their alcohol consumption, especially men, those highly educated and those living in large urban centres. Older age and residence in the Southern Italy represent, instead, protective factors for this outcome. Among smokers, 30% increased cigarette consumption during the period of home containment, on average of 5.6 cigarettes per day. A small proportion of former smokers (0.6%) resumed smoking. With regard to eating habits, 3 out of 10 respondents (29.9%) reported an inappropriate eating behaviour (increasing unhealthy food without increasing healthy ones). This behaviour was less frequent among men (adjusted Prevalence Ratio 0.80,  $p=0.005$ ). A lower percentage of respondents (24.5%)

## WHAT IS ALREADY KNOWN

- Many studies assessing the association between lifestyles and sociodemographic characteristics can be found in the literature.
- Some papers investigating lifestyles during the SARS-CoV-2 pandemic have been published recently, but the literature evidence available to date is still few and not always consistent.

## WHAT THIS PAPER ADDS

- This work contributes to a greater understanding of individual behaviours in the population by measuring their change during the SARS-CoV-2 pandemic.
- The survey allows to identify population subgroups most likely to be exposed to unfavorable behaviours during the pandemic, providing policy makers with useful information for planning targeted and effective public health interventions.

increased the consumption of healthy foods without increasing the consumption of unhealthy ones.

**CONCLUSIONS:** the results of this survey show that social isolation during the SARS-CoV-2 pandemic has had an impact on citizens' behaviours. In particular, it was found a noteworthy increase in sedentariness, alcohol consumption, and tobacco smoking. A meaningful proportion of respondents reported a worsening of eating habits, especially among women. However, for each of the behavioural risk factors investigated, small proportions of respondents with resilient attitudes were also found, namely, capable of taking advantage of social isolation for improving their daily habits. Studying changes in lifestyles during a pandemic, identifying population groups most at risk of adopting unfavourable behaviours, is a useful tool for policy makers to plan targeted and effective public health interventions.

**Keywords:** COVID-19, SARS-CoV-2, lifestyles, social isolation, web-based survey

## RIASSUNTO

**OBIETTIVI:** studiare l'impatto dell'isolamento sociale, legato all'epidemia da SARS-CoV-2, sugli stili di vita dei cittadini, con particolare riferimento ad attività fisica, consumo di alcol, abitudine al fumo e abitudini alimentari. Investigare, inoltre, l'associazione tra cambiamento degli stili di vita durante la pandemia e caratteristiche sociodemografiche.

**DISEGNO:** indagine epidemiologica basata su uno studio trasversale.

**SETTING E PARTECIPANTI:** tra il 21 aprile e il 7 giugno 2020 è stato reso disponibile sul web un questionario elettronico per raccogliere informazioni su attività fisica, consumo di alcol, abitudine al fumo e abitudini alimentari durante il periodo di isolamento sociale legato alla pandemia. Gli inter-

vistati sono stati reclutati attraverso un campionamento non probabilistico a valanga (*snowball sampling*). Il link al questionario elettronico è stato diffuso attraverso siti web istituzionali, social network (Facebook, Twitter) e sistemi di messaggistica quali WhatsApp, Telegram e SMS. In totale sono state raccolte 10.758 interviste, di cui 7.847 (73%) complete per un set minimo di indicatori (età, genere e area di residenza).

**PRINCIPALI MISURE DI OUTCOME:** riduzione dell'attività fisica, aumento del consumo di alcol, aumento del consumo di sigarette, aumento del consumo di cibi non salutari (affettati, carni rosse o dolci) senza aumentare cibi salutari (verdure, legumi o cereali integrali) e, viceversa, aumento del consumo di cibi salutari senza aumentare cibi non salutari.

**RISULTATI:** la popolazione sotto studio è costituita da 7.847 persone con un'età media di 48,6 anni (deviazione standard 13,9). Il 71,3% è rappresentato da donne. Il 92,5% degli intervistati ha un titolo di studio di scuola media superiore o universitario. Il 91% dei rispondenti risiede nel Nord Italia. Durante l'isolamento sociale, il 56% dei rispondenti ha dichiarato di aver ridotto il tempo dedicato all'attività fisica. In particolare, ciò è successo nella fascia di popolazione più anziana e in quella residente nelle grandi città. Più del 17% degli intervistati ha aumentato il consumo di alcol, soprattutto gli uomini, le persone più istruite e quelle residenti nei grandi centri urbani, mentre è diminuito nelle persone più anziane e in quelle residenti nel Sud Italia. Tra gli intervistati che fumavano al momento dell'intervista, il 30% ha aumentato il consumo di sigarette nel periodo di isolamento sociale, in media

di 5,6 sigarette al giorno. Una piccola quota di ex-fumatori (0,6%) ha ripreso a fumare. Per quel che riguarda le abitudini alimentari, tre intervistati su 10 (29,9%) hanno riportato un aumento del consumo di cibi non salutari senza aumentare quelli salutari. Tale comportamento è stato meno frequente tra gli uomini (*adjusted Prevalence Ratio* 0,80,  $p=0,005$ ). Una percentuale più bassa di rispondenti (24,5%) ha, invece, aumentato il consumo di alimenti salutari senza aumentare quelli non salutari.

**CONCLUSIONI:** i risultati di questa indagine mostrano che il periodo di isolamento sociale legato all'epidemia da SARS-CoV-2 ha avuto un impatto sui comportamenti dei cittadini. In particolare, si osserva un importante aumento della sedentarietà, un consumo maggiore di alcol e un aumento del consumo sigarette. Un peggioramento delle abitudini alimentari è stato riportato da una consistente proporzione di intervistati, specialmente tra le donne. Di contro, per ciascuno dei fattori di rischio investigati, abbiamo trovato anche piccole percentuali di rispondenti con atteggiamento resiliente, ovvero, capaci di sfruttare il periodo di isolamento sociale per migliorare le proprie abitudini quotidiane. Studiare i cambiamenti degli stili di vita nel corso di una pandemia, individuando le fasce di popolazione maggiormente a rischio di adottare comportamenti sfavorevoli, rappresenta per i decisori politici uno strumento utile a programmare interventi di sanità pubblica mirati ed efficaci.

**Parole chiave:** COVID-19, SARS-CoV-2, stili di vita, isolamento sociale, indagine on-line

## INTRODUCTION

From December 2019, a new Coronavirus (SARS-CoV-2) epidemic has spread in China, expanding from the densely populated region of Wuhan.<sup>1</sup> SARS-CoV-2 has been recognized as part of zoonotic coronaviruses, able to spread rapidly from person to person<sup>1,2</sup> and it is responsible of the 2019 Coronavirus Disease (COVID-19), a severe acute respiratory syndrome, with potential fatal outcomes especially in elderly and people with multiple comorbidities.<sup>1</sup> From China, the infection quickly spread globally.<sup>1</sup> Thus, the World Health Organization (WHO) indicated the SARS-CoV-2 state as pandemic on 11 March 2020.<sup>3</sup> From the end of February and the beginning of March 2020, growing numbers of cases were reported in Italy, becoming, in the aforementioned period, the second most affected country globally.<sup>4</sup> In order to effectively face the epidemic, starting from the end of February, the Italian Government enacted a chain of stringent measures, escalated in a complete national lockdown from 10 March.<sup>5</sup> The lockdown started from sport, leisure events, and school activities, but progressively broadened to several business activities and non-essential services. During this period, all citizens were required to stay home, unless proved (motivated in a written form) and imperative reasons of work, health or shopping for basic necessities.<sup>5</sup> These arrangements, never seen before in Italy, were intended to limit the epidemic, after a large increase in COVID-19-related deaths in the previous weeks.<sup>5</sup> Dur-

ing the lockdown all non-urgent outpatient services were closed, while hospitals faced the management of growing amounts of infected patients,<sup>6</sup> with a consistent distress for the entire healthcare system, especially in the most affected areas of Northern Italy.<sup>7</sup> During the outbreak, the availability of hospital beds, especially in intensive care units (ICUs), had to deal with a continuous flowing of patients.<sup>4</sup> Moreover, the entire situation was exacerbated by both the necessity to assure adequate isolation to inpatients and the spread of the infection among healthcare professionals.<sup>4</sup> Despite all these arrangements were essential in order to slow down the national epidemic trend, the extended social isolation, experienced during the outbreak, significantly influenced daily habits, including eating behaviours and physical activity (PA).<sup>8</sup> Indeed, home containment could translate in reduced level of PA as well as in stress related to the reduction in overall social contacts with friends and families and to the concomitant impossibility to perform working and daily activities.<sup>9</sup> Moreover, the lockdown affected also dietary habits, as the forceful switch from eating out to in-house meal consumption could impact the alimentary patterns of communities.<sup>10</sup> In addition, the impeding chance of job losses and incomes uncertainties can be related to a reduction in family expenditures, with a decrease in overall food quality.<sup>10</sup> On the other side, the discontinuation of working and leisure activities can result in boredom, frequently coupled with higher energy intake.<sup>11</sup>

This phenomenon, joined to the fear of the contagion, could have a strong impact on people's wellbeing with increased anxiety, leading to overeating, with a major preference for non-healthy foods rich in fats and sugars.<sup>12</sup> Eventually, the association of decrease in PA and diet variations, due to social isolation, could generate vicious circles, increasing the negative health effect of sedentariness.<sup>10</sup> Otherwise, home containment could be associated to potential improvement in daily habits, related to the greater availability of time for cooking and/or home exercises. Finally, the lockdown could potentially impact on smoking habits and alcohol consumption.<sup>8,13</sup> Concerning smoking, proved associations have been demonstrated between this habit and the severity of respiratory symptoms in case of contagion.<sup>14</sup> Even concerning smoking habits, the association between quarantine and this behaviour is not necessarily negative, in terms of cigarettes smoked daily, with a potential decrease during the lock-down period.<sup>8</sup>

Since psychological and health impacts related to COVID-19 lockdown could potentially continue in more or less restrictive forms, even beyond home containment,<sup>15</sup> it seems important to analyze the impact of this confinement on general population. Indeed, it is clear that the COVID-19 pandemic will present far-reaching health, social, and economic implications. In particular, the variation in daily lifestyles (e.g., diet, PA, smoking, alcohol consumption) is a major topic of research, since these habits are proven as predominant contributing factors to health.<sup>16</sup> At this regard, growing studies analysing the potential impact of social isolation on health and lifestyles have been recently published.<sup>8,10</sup> However, further investigations are needed in order to provide an in-depth description of this phenomenon.

The aim of the present study was to investigate and analyse the impact of COVID-19 lockdown on daily habits through a lifestyle survey, with a particular focus on PA, nutrition, alcohol intake, and smoking, taking into account potential differences related to sociodemographic characteristics.

## METHODS

### STUDY DESIGN

A survey investigating lifestyles during COVID-19 emergency was conducted between 21 April and 7 June by the Reference Centre for Epidemiology and Cancer Prevention in Piedmont (CPO Piemonte). It was a cross-sectional study based on a web-survey to collect information on lifestyles in the population resident in Italy during the lockdown period.

### STUDY POPULATION

The population under study was that of respondents who reported a minimum set of information (age, gender, and residence) allowing a basic characterization of the sample, in order to ensure its comparability with the general population.

### SURVEY METHODOLOGY

To recruit respondents a non-probabilistic snowball sampling approach was used, disseminating the weblink of the online survey through institutional websites, social networks (i.e., Facebook, Twitter), and messaging systems such as WhatsApp, Telegram, and SMS. Data were collected through an online electronic questionnaire, accessible from smartphones, tablets and personal computers.

### QUESTIONNAIRE AND MAIN INDICATORS

The questionnaire was specifically designed for the survey, referring to a questionnaire on lifestyles already used in the ANDROMEDA cohort study.<sup>17</sup> It consists of 59 questions, divided into 7 sections

1. sociodemographic characteristics and housing conditions (11 questions);
2. occupational information (4 questions);
3. PA in leisure time (5 questions);
4. eating habits and anthropometric data (20 questions);
5. cigarette smoking habit (5 questions);
6. health status (5 questions);
7. mental well-being (9 questions).

None of the survey questions were mandatory (see Appendix 1, on-line supplementary materials).

Lifestyles were specifically investigated with reference to the time period corresponding to the lockdown due to the COVID-19, which in Italy began on March 10 and was gradually mitigated starting from 4 May 2020.

The information on lifestyles changes was collected asking whether, during the period of interest, the amount of time devoted to PA, consumption of tobacco products, and consumption of alcohol, increased, decreased or remained unchanged. From these variables, two dichotomous indicators have been created for each lifestyle and used as outcome variables: increase and reduction of PA, increase and reduction in alcohol consumption, and increase and reduction in cigarette smoking.

In addition to assessing the variation in the intake of certain foods, the proportion of respondents who worsened or improved their eating habits was assessed. Thus, two indicators have been created: the first one «exclusive increase in unhealthy food» identifies respondents who increased their consumption of processed meat and/or red meat and/or sweets without increasing consumption of vegetables, legumes or whole grains. On the contrary, the second indicator «exclusive increase in healthy food» identifies those who increased their consumption of vegetables and/or legumes and/or whole grains without increasing consumption of processed meat, red meat or sweets.

The data collected were completely anonymous and no personal information allowing the recognition of participants was gathered. Therefore, no informed consent was required, neither approval by ethics committee. However, all participants were adequately informed about the rationale, the objectives and the requirements of the study in the

introductory page of the questionnaire. All collected data have been registered in a central server administered by the CPO's information technology manager.

### STATISTICAL ANALYSIS

Descriptive statistics were presented through absolute numbers and percentages for categorical variables, and through means and standard deviation for continuous variables. Chi-squared tests were used to evaluate differences in proportions between categorical variables.

Multivariate Poisson regression models with robust variance estimation were used to investigate the association between lifestyle changes/eating habits and sociodemographic characteristics and living conditions. Prevalence ratios adjusted (Adj PR) for gender, age, marital status, educational level household members, house size, hometown size, and geographical area of residence, were calculated along with respective p-values. Statistical significance was set at  $\alpha=0.05$ . All the analyses were conducted through Stata15.1 statistical software.

### RESULTS

Overall, 10,758 interviews were collected between 21 April and 7 June. However, only 7,847 (72.9%) observations were considered for the following analyses as they were complete for a minimum set of indicators (i.e., age, gender, and province of residence), allowing to characterize the sociodemographic profile of respondents. The average time to complete the questionnaire was 11 minutes (SD 5). Most of these interviews (86.0%) were collected between 21 April and 3 May (figure 1). The mean age of respondents was 48.6 years (SD 13.9) and the most represented age groups were 30-49 years (39.1%) and 50-69 years (44.9%). Considering the educational level, 0.2%, 6.2%, 40.9%, and 52.7% of respondents had none/elementary, junior high school, high

school diploma, and university degree, respectively. Foreigners were only a small proportion of participants (3.2%). As far as employment is concerned, 75% of respondents were employed or self-employed, while the remaining participants were retired, housewives, students or unemployed. A higher proportion of self-employed workers was observed among men compared to women (20% vs 13.6%,  $p<0.001$ ). About 15% of respondents lived alone, while almost 60% shared the house with 3 or more people. The percentage of people living in large- and medium-sized cities is roughly similar (34% and 37%, respectively), while there are slightly fewer people living in small towns (29%). More than 90% of respondents lived in Northern Italy (91%) (table 1).

The analyses on lifestyles were conducted exclusively on the 6,281 (80%) respondents stating to be free of COVID-19, considering both confirmed and suspected contagions.

During the lockdown, 56% of respondents reported a significant decrease in time spent for PA. This reduction was greater in older people compared to younger (14-29 years), especially in the age class 50-69 years (61.7% vs 45.0%; adj PR 1.37,  $p<0.001$ ), in those more educated compared to those less educated (56.8% vs 47.5%; adj PR 1.16,  $p=0.047$ ) and among people living in larger cities compared to those living in small towns (58.8% vs 52.6%; adj PR 1.10,  $p=0.021$ ). On the contrary, a smaller proportion of respondents (15.4%) increased the amount of time devoted to PA in the same period (table 2).

The increase in alcohol consumption was reported by 17.3% of respondents. It was observed especially among men (23.0% vs 15.1%; adj PR 1.45,  $p<0.001$ ), in those with a higher educational level (17.9 vs 7.7; adj PR 1.91,  $p=0.012$ ) and those living in larger cities (22.3% vs 13.1%; adj PR 1.57,  $p<0.001$ ). Older age and residence in Central and Southern Italy seemed to act as protective conditions concerning this outcome (table 2).

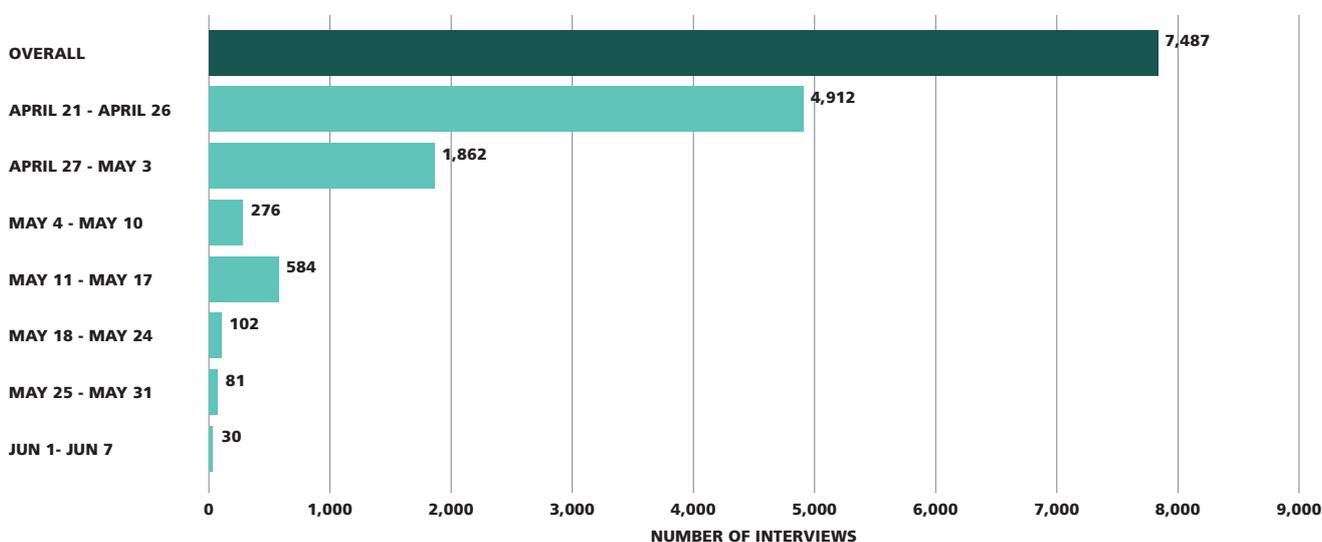


Figure 1. Number of interviews collected, by period.

Figura 1. Numero di interviste raccolte, per periodo.

SOCIODEMOGRAPHIC CHARACTERISTICS	OVERALL		MALES		FEMALES		P-CHI <sup>2</sup>
	No.	%	No.	%	No.	%	
<b>AGE GROUP</b>							
14-29 years	811	10.3	286	12.7	525	9.4	<0.001
30-49 years	3,069	39.1	846	37.6	2,223	39.7	
50-69 years	3,521	44.9	948	42.1	2,573	46.0	
70+ years	446	5.7	171	7.6	275	4.9	
<b>MARITAL STATUS</b>							
Married	4,999	66.2	1,416	64.7	3,583	66.8	<0.001
Single	1,635	21.7	591	27.0	1,044	19.5	
Separated	717	9.5	155	7.1	562	10.5	
Widowed	200	2.7	27	1.2	173	3.2	
<b>EDUCATION LEVEL</b>							
None/elementary school	8	0.1	4	0.2	4	0.1	<0.001
Junior high school	559	7.4	135	6.2	424	7.9	
High school	2,801	37.2	890	40.9	1,911	35.7	
University	4,168	55.3	1,149	52.8	3,019	56.4	
<b>NATIONALITY</b>							
Italian	7,096	96.8	2,071	97.6	5,025	96.5	0.014
Foreign	234	3.2	51	2.4	183	3.5	
<b>OCCUPATION</b>							
Employee	4,396	59.2	1,203	56.5	3,193	60.3	<0.001
Self-employed	1,147	15.4	425	20.0	722	13.6	
Retired	1,033	13.9	320	15.0	713	13.5	
Housewife	248	3.3	1	0.1	247	4.7	
Student	357	4.8	118	5.5	239	4.5	
Unemployed	248	3.3	62	2.9	186	3.5	
<b>HOUSEHOLD MEMBERS</b>							
3 or more people	4,383	58.6	1,234	57.1	3,149	59.2	0.097
2 people	2,000	26.7	584	27.0	1,416	26.6	
1 person	1,098	14.7	345	16.0	753	14.2	
<b>HOUSE SIZE</b>							
Less than 3 rooms	831	11.3	259	12.2	572	11.0	0.127
3 or more rooms	6,503	88.7	1,861	87.8	4,642	89.0	
<b>TOWN OF RESIDENCE SIZE</b>							
Less than 10,000 inhab.	2,158	28.7	544	24.7	1,614	30.3	<0.001
Between 10,000 and 100,000 inhab.	2,778	36.9	808	36.7	1,970	37.0	
Over 100,000 inhab.	2,589	34.4	847	38.5	1,742	32.7	
<b>GEOGRAPHICAL AREA OF RESIDENCE</b>							
Northern Italy	7,157	91.2	1,969	87.5	5,188	92.7	<0.001
Central Italy	313	4.0	132	5.9	181	3.2	
Southern Italy and Islands	377	4.8	150	6.7	227	4.1	
Total	7,847	100.0	2,251	28.7%	5,596	71.3	

**Table 1.** Distribution of sociodemographic characteristics and housing conditions of respondents, overall and by gender.

**Tabella 1.** Distribuzione delle caratteristiche sociodemografiche e delle condizioni abitative dei rispondenti, totali e per genere.

SOCIODEMOGRAPHIC CHARACTERISTICS	REDUCTION OF PHYSICAL ACTIVITY No. 5,970			INCREASE IN ALCOHOL CONSUMPTION No. 3,035			INCREASE IN CIGARETTE SMOKING No. 1,099		
	%	ADJ PR	P	%	ADJ PR	P	%	ADJ PR	P
<b>TOTAL</b>	56.2			17.3			29.5		
<b>GENDER</b>									
Female	55.7	1		15.1	1		30.9	1	
Male	57.1	1.03	0.461	23.0	1.45	<0.001	26.8	0.90	0.411
<b>AGE GROUP</b>									
14-29 years	45.0	1		14.1	1		25.9	1	
30-49 years	52.7	1.17	0.030	22.3	1.28	0.146	31.1	1.22	0.338
50-69 years	61.7	1.37	<0.001	13.9	0.78	0.182	28.5	1.19	0.433
70+ years	56.7	1.23	0.049	4.8	0.31	0.006	36.0	1.36	0.466
<b>MARITAL STATUS</b>									
Married	58.8	1		18.0	1		27.5	1	
Single	51.2	0.95	0.392	16.4	0.79	0.101	31.8	1.09	0.616
Separated	61.5	1.01	0.926	17.9	1.12	0.460	32.0	1.04	0.853
Widowed	61.5	1.04	0.698	6.2	0.68	0.399	38.9	0.98	0.971
<b>EDUCATION LEVEL</b>									
Low	47.5	1		7.7	1		29.6	1	
High	56.8	1.16	0.047	17.9	1.91	0.012	29.4	0.89	0.614
<b>HOUSEHOLD MEMBERS</b>									
3 or more people	53.5	1		16.8	1		26.5	1	
2 people	59.5	1.07	0.073	18.3	1.13	0.232	30.4	1.10	0.511
1 person	60.3	1.07	0.273	17.6	1.14	0.401	37.3	1.21	0.325
<b>HOUSE SIZE</b>									
Less than 3 rooms	59.2	1		18.6	1		39.6	1	
3 or more rooms	55.9	0.93	0.163	17.2	1.09	0.504	27.8	0.75	0.074
<b>TOWN OF RESIDENCE SIZE</b>									
Less than 10,000 inhab.	52.6	1		13.1	1		27.8	1	
Between 10,000 and 100,000 inhab.	56.2	1.05	0.209	15.7	1.11	0.393	28.5	1.01	0.935
Over 100,000 inhab.	58.8	1.10	0.021	22.3	1.57	<0.001	31.3	1.06	0.693
<b>GEOGRAPHICAL AREA OF RESIDENCE</b>									
Northern Italy	56.0	1		18.0	1		30.3	1	
Central Italy	61.0	1.08	0.340	12.6	0.63	0.041	22.0	0.78	0.422
Southern Italy and Islands	54.7	1.03	0.712	10.1	0.54	0.020	19.1	0.70	0.315
Total	56.2			17.3			29.5		

Table 2. Reported lifestyle changes during the COVID-19 social isolation period, by sociodemographic characteristics and housing conditions.

Tabella 2. Cambiamenti riportati degli stili di vita durante il periodo di isolamento sociale, per caratteristiche sociodemografiche e condizioni abitative.

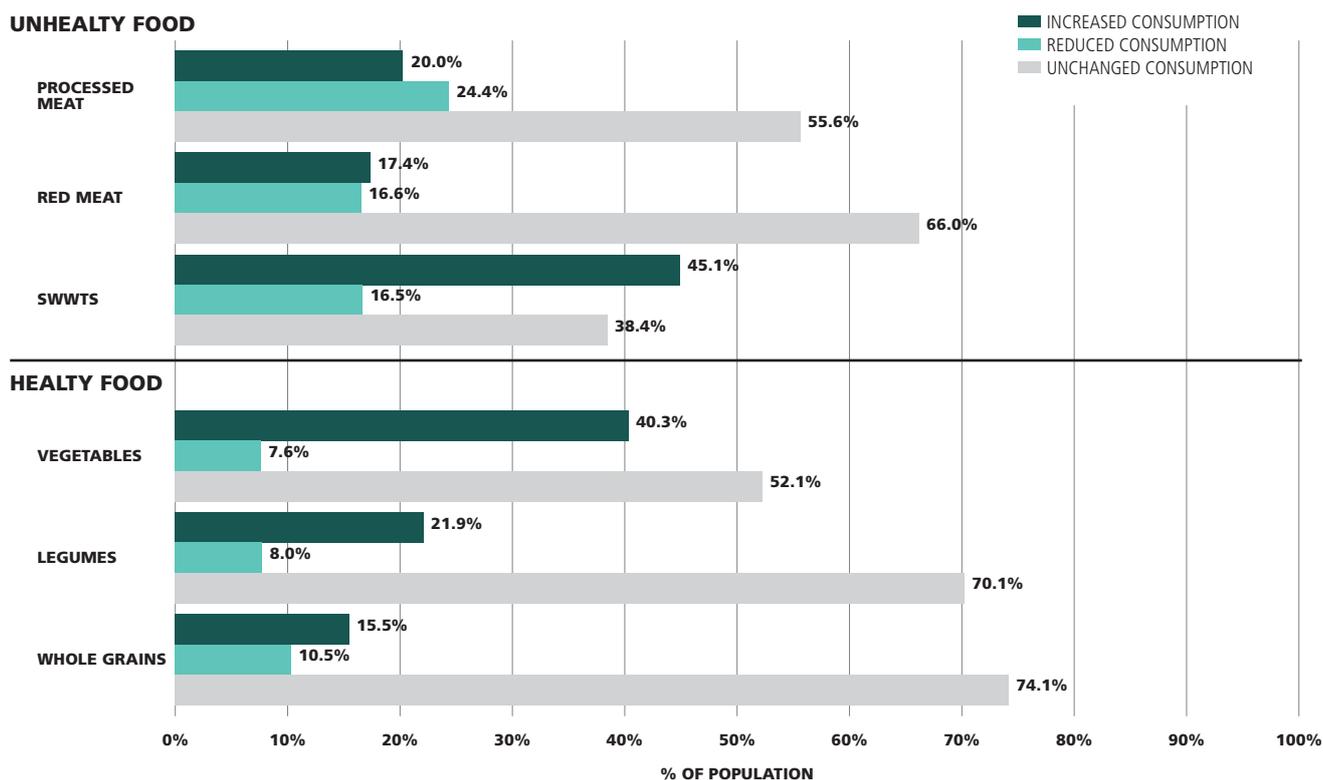


Figure 2. Reported variation of unhealthy and healthy food consumption during the COVID-19 social isolation period.

Figura 2. Variazione riportata del consumo di cibi non salutari e salutari durante il periodo di isolamento sociale da COVID-19.

Among respondents who smoke traditional cigarettes regularly (15.8%) or occasionally (5.6%), almost one in three (30%) reported an increase in the number of cigarettes smoked per day. The average number of extra smoked cigarettes is 5.6 (SD 5.1). No statistically significant associations between increase in cigarette smoking and main sociodemographic variables have been found (table 2). A small percentage of former smokers (0.6%) resumed smoking. In contrast, a group of smokers reducing the number of cigarettes smoked during confinement (18%), on average of 4.2 cigarettes per day (SD 4.1), was also identified.

Respondents who increased the consumption of processed meat (20.0%) are less than those who reduced it (24.4%). As regard the intake of red meat, the percentage of those who increased its consumption (17.4%) is roughly similar to that of those who decreased it (16.6%). On the other hand, the amount of people who increased sweets intake (45%) is almost three-fold that of those who reduced them (16.5%). For healthy foods (i.e., vegetables, legumes, and whole grains), the percentage of people who increase their consumption (40.3%, 21.9%, and 15.5%, respectively) is always greater than the proportion of people who decrease them (7.6%, 8.0%, and 10.5%, respectively) (figure 2).

During the lockdown, 30% of respondents reported an exclusive increase in unhealthy food intake. On the contrary, about 1 respondent out of 4 (24.5%) reported an exclusive increase in healthy food consumption. With borderline statistical significance, this favourable behaviour was ob-

served more frequently in men (27.8% vs 23.3%; adj PR 1.16,  $p=0.068$ ), widowed compared to married respondents (39.4% vs 22.8%; adj PR 1.50,  $p=0.072$ ), and those living in larger cities compared to people living in smaller towns (26.6% vs 22.1%; adj PR 1.19,  $p=0.079$ ). Instead, respondents in the 30-49 age group compared to younger ones (14-29 years) adopted less this positive behaviour (21.5% vs 28.8%; adj PR 0.71,  $p=0.011$ ) as well as and those resident Southern compared to Northern Italy (15.6% vs 24.9%; adj PR 0.65,  $p=0.039$ ) (table 3).

Sensitivity analyses were conducted to investigate whether the main results presented in this study varied over 21 April-3 May and 4 May-7 June. No statistically significant differences were found for the main outcome indicators between these two periods.

## DISCUSSION

The results of the present study showed that social isolation, adopted as a measure to reduce SARS-CoV-2 contagions during the pandemic, had a meaningful impact on citizens' lifestyle. Although this result was, at least, partially expected, this study provides further information for quantifying the extent of this change and for identifying the groups at higher risk.

In a nutshell, during the period of social isolation, for each behavioural risk factor considered, two population attitudes have been identified: on one hand, there is the difficulty of reacting positively to the emergency event,

SOCIODEMOGRAPHIC CHARACTERISTICS	EXCLUSIVE INCREASE IN UNHEALTHY FOOD* No. 3,150			EXCLUSIVE INCREASE IN HEALTHY FOOD** No. 3,150		
	%	ADJ PR	P	%	ADJ PR	P
<b>TOTAL</b>	29.9			24.5		
<b>GENDER</b>						
Female	31.9	1.00		23.3	1.00	
Male	24.8	0.80	0.005	27.8	1.16	0.068
<b>AGE GROUP</b>						
14-29 years	27.1	1.00		28.8	1.00	
30-49 years	31.2	1.09	0.546	21.5	0.71	0.011
50-69 years	30.2	1.10	0.528	26.3	0.83	0.177
70+ years	21.7	0.81	0.386	26.6	0.76	0.277
<b>MARITAL STATUS</b>						
Married	31.1	1.00		22.8	1.00	
Single	26.6	0.89	0.325	27.0	1.01	0.907
Separated	32.5	1.07	0.570	26.2	0.97	0.826
Widowed	21.1	0.77	0.348	39.4	1.50	0.072
<b>EDUCATION LEVEL</b>						
Low	24.9	1.00		25.9	1.00	
High	30.4	1.18	0.268	24.4	0.97	0.861
<b>HOUSEHOLD MEMBERS</b>						
3 or more people	31.4	1.00		21.9	1.00	
2 people	28.0	0.91	0.273	27.7	0.22	0.027
1 person	26.8	0.90	0.437	29.4	1.23	0.112
<b>HOUSE SIZE</b>						
Less than 3 rooms	27.7	1.00		28.5	1.00	
3 or more rooms	30.2	1.01	0.899	23.9	0.90	0.366
<b>TOWN OF RESIDENCE SIZE</b>						
Less than 10,000 inhab.	30.5	1.00		22.1	1.00	
Between 10,000 and 100,000 inhab.	29.4	0.97	0.690	23.7	1.10	0.357
Over 100,000 inhab.	30.1	0.99	0.935	26.6	1.19	0.079
<b>GEOGRAPHICAL AREA OF RESIDENCE</b>						
Northern Italy	29.7	1.00		24.9	1.00	
Central Italy	28.3	1.02	0.902	24.3	0.93	0.681
Southern Italy and Islands	36.4	1.26	0.109	15.6	0.65	0.039
Total	29.9			24.5		

\* increased consumption of processed meat and/or red meat and/or sweets, without increasing consumption of vegetables or legumes or whole grain / aumento del consumo di carne lavorata e/o carne rossa e/o cibi zuccherati non associato all'aumento di consumo di frutta/verdura o legumi o farina integrale

\*\* increased consumption of vegetables and/or legumes and/or whole grain, without increasing consumption of processed, red meat or sweet / aumento del consumo di frutta/verdura e/o legume e/o farina integrale non associato all'aumento di consumo di carne rossa lavorata o cibi zuccherati

**Table 3.** Reported exclusive increase of unhealthy and healthy food during the COVID-19 social isolation period, by sociodemographic characteristics and housing conditions.  
**Tabella 3.** Aumento esclusivo di cibo non salutare e di cibo salutare, riportati, durante il periodo di isolamento sociale da COVID-19, per caratteristiche sociodemografiche e condizioni abitative.

while, on the other hand, it is possible to observe a form of resilience that make people able of taking advantage of social isolation for improving their daily habits. Unfortunately, this last attitude is the least recurrent in the sample considered in this study for almost all the investigated lifestyles.

More than half of respondents reported a reduction in the time spent on PA during social isolation, especially in large urban centres, while only about 15% of respondents increased the amount of time devoted to PA during lockdown. It is likely that housing conditions and minor access to green areas in big cities represented environmental conditions discouraging people from practicing PA.

A reduction in the level of PA was also reported in a Canadian survey finding that 40.5% of physically inactive individuals reduced their inactivity level, and 22.4% of active individuals became less active during the period of restrictions due to SARS-CoV-2 pandemic.<sup>18</sup>

On the contrary, in the Italian survey conducted by Di Renzo et al., no decrease in PA was reported among people usually inactive, while a considerable increase in training time was found among those who used to train more than 4 times a week.<sup>8</sup>

About one fifth of respondents (17.3%) reported an increase in alcohol consumption during lockdown. This finding is coherent with that published in a Polish study, reporting a 19% increase, excluding abstainers from the denominator, as in the present analysis.<sup>19</sup> The reasons for this increase could be found both in the stress condition associated with the pandemic and in the habit of sharing playful moments online consuming alcoholic beverages, a widespread phenomenon during home containment. Interestingly, the profile of those increasing alcohol consumption (young men, with high educational level, living in large urban centres and in Northern Italy) matches the profile of binge drinkers, in accordance with the hypothesis of an increase related to recreational use of alcoholics.<sup>20</sup> Concerning smoking, Di Renzo et. al. estimated a 3.3% reduction in the percentage of smokers during the pandemic,<sup>8</sup> while a Doxa survey, whose results were presented in May 2020, highlighted a decline of 1.4% in the percentage of smokers in the Italian general population.<sup>21</sup> The survey did not allow estimating the percentage of those quitting smoking. However, in agreement with the results presented above, 18% of the considered sample reported a reduction of the number of cigarettes smoked daily. This phenomenon could be explained by the fear among smokers of an increased risk of respiratory distress and mortality from COVID-19. On the other hand, 1 out of 3 smokers (29.5%) increased their cigarette consumption, on average of 5.6 cigarettes per day, and a small percentage of former smokers who resumed smoking was even found. The reasons for these negative changes may be due to the stress of home confinement and to the daily difficulties exacerbated by the ongoing pandemic.

With regard to changes in eating habits, the proportion of respondents who reported an increase in the consumption of sweets (45%) was three times higher compared to those who reduced the intake (16.5%). Also, about one third of respondents (30%) worsened their eating behaviours (increasing unhealthy food without increasing healthy ones). An increased consumption of unhealthy foods, overeating, more snacking between meals and an overall higher number of main meals during home confinement was also observed in a global survey.<sup>22</sup> Negative changes in most eating behaviours could be attributed to anxiety and/or boredom, two conditions strictly influencing food preferences.<sup>23</sup>

On the other hand, for all healthy foods investigated (i.e., vegetables, legumes, and whole grains) the percentage of respondents who increased their consumption is higher than that of people who reduced it. Overall, about a quarter of the sample (24.5%) improved their diet during lockdown, increasing the intake of healthy foods, without increasing that of unhealthy foods. This result is consistent with the findings of a survey reporting a closer approach to the MedDiet-style eating patterns<sup>24</sup> among Spanish adults during the COVID-19 confinement.

Men and subjects residing in Northern Italy were more likely to report an improvement in their diet, while unhealthy dietary habits were more frequent among women. The main limitation of this survey is the lack of representativeness of the considered sample. In fact, comparing it with the Italian general population, according to the data of the National Institute of Statistics,<sup>25</sup> an over-representation of women (71.3% vs 51.4%), people in the age group 30-69 years (84% vs 62.8%), individuals with a higher education level (92.5% vs 51.4%), and persons living in Northern Italy (91.2% vs 46.1%) was observed. Therefore, it is not possible to expand the results to the Italian population. Moreover, all data collected are self-reported and this could make them not completely reliable, especially when it comes to reporting behaviours for which there may be a social stigma (as alcohol consumption, cigarette smoking, etc.). Lastly, a small number of interviews (14%) was collected after May 3<sup>rd</sup>, the date marking the end of the most rigid period of social isolation. These interviews were kept in the analyses, because although in the following weeks there was a gradual loosening of the lockdown restrictions, practically most of the limitations remained until the first week of June. Furthermore, a sensitivity analysis on the main outcomes between the two periods, before and after May 3<sup>rd</sup>, confirmed no major differences.

As major strength of the present work, this survey was designed and implemented in a short time during the social isolation phase. Moreover, information on lifestyles and eating habits was collected for a large sample, allowing to study, during a pandemic, how behavioural risk factors relate to health changes and which subgroups are more exposed to negative changes.

## CONCLUSIONS

The results of this survey showed that the social isolation during the SARS-CoV-2 pandemic had a significant impact on citizens' behaviours. In particular, a noteworthy increase in sedentariness, alcohol consumption, and tobacco smoking was found. A meaningful proportion of respondents reported a worsening of eating habits, especially among women. However, for each of the behavioural risk factors investigated, small proportions of respondents with resilient attitudes were also found, namely, capable of taking advantage of social isolation for improving their

daily habits. Studying lifestyle changes during a pandemic, concomitantly identifying the population groups at higher risk, represents a valuable tool for policymakers to plan targeted and effective public health interventions.

**Conflict of interests:** none declared.

**Acknowledgments:** thanks to Fulvio Ricceri (University of Turin) for his valuable advice and inputs.

**Data di submission:** 23.07.2020

**Data di accettazione:** 31.08.2020

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