

Eating habits and lifestyle Changes during COVID-19 lockdown: an Italian survey

Laura Di Renzo

Section of Clinical Nutrition and Nutrigenomic, Department of Biomedicine and Prevention, University of Tor Vergata, Via Montpellier 1, 00133 Rome, Italy

Paola Gualtieri

Section of Clinical Nutrition and Nutrigenomic, Department of Biomedicine and Prevention, University of Tor Vergata, Via Montpellier 1, 00133 Rome, Italy

Francesca Pivari (✉ francesca.pivari@unimi.it)

Department of Health Sciences, University of Milan, Via A. Di Rudinì, 8, 20142, Milan, Italy

Laura Soldati

Department of Health Sciences, University of Milan, Via A. Di Rudinì, 8, 20142, Milan, Italy

Alda Attinà

School of Specialization in Food Sciences, University of Rome Tor Vergata, Via Montpellier 1, 00133 Rome, Italy

Giulia Cinelli

School of Specialization in Food Sciences, University of Rome Tor Vergata, Via Montpellier 1, 00133 Rome, Italy; Predictive and Preventive Medicine Research Unit, "Bambino Gesù" Children Hospital IRCCS, 00165, Rome, Italy

Claudia Leggeri

School of Specialization in Food Sciences, University of Rome Tor Vergata, Via Montpellier 1, 00133 Rome, Italy

Giovanna Caparello

School of Specialization in Food Sciences, University of Rome Tor Vergata, Via Montpellier 1, 00133 Rome, Italy

Luigi Barrea

Dipartimento di Medicina Clinica e Chirurgia, Unit of Endocrinology, Federico II University Medical School of Naples, 80131, Naples, Italy

Francesco Scerbo

Doctoral School in Public Health and Nursing, "Policlinico Tor Vergata" Foundation, Rome - Italy

Ernesto Esposito

General Directorate for the Department of Human Policies, Basilicata Region, Italy

Antonino De Lorenzo

Section of Clinical Nutrition and Nutrigenomic, Department of Biomedicine and Prevention, University of Tor Vergata, Via Montpellier 1, 00133 Rome, Italy

Research Article

Keywords: COVID-19, Coronavirus, Mediterranean Diet, Eating habits, Lifestyle.

Posted Date: May 28th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-30403/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Version of Record: A version of this preprint was published at Journal of Translational Medicine on June 8th, 2020. See the published version at <https://doi.org/10.1186/s12967-020-02399-5>.

Abstract

Background: On December 12, 2019 a new coronavirus (SARS-Cov2) emerged in Wuhan, China, sparking a pandemic of acute respiratory syndrome in humans (COVID-19). At 24th of April 2020, the number of COVID-19 deaths in the world, according to the COVID-Case Tracker by Johns Hopkins University, was 195,313 and the number of Covid-19 confirmed cases was 2,783,512. The COVID-19 pandemic represents a massive impact on human health, causing sudden lifestyle changes, through social distancing and isolation at home, with social and economic consequences. Optimizing public health during this pandemic requires not only knowledge from the medical and biological sciences, but also of all human sciences related to lifestyle, social and behavioural studies, including dietary habits and lifestyle.

Methods: Our study aimed to investigate the immediate impact of the COVID-19 pandemic on eating habits and lifestyle changes among Italian population aged ≥ 12 years. The study instrument comprised a structured questionnaire packet that inquired demographic information (age, gender, place of residence, current employment); anthropometrics data (reported weight and height); dietary habits information (Adherence to the Mediterranean Diet, daily intake of certain foods, food frequency, number of meals/day); lifestyle habits information (grocery shopping, smoke habit, sleep quality and physical activity). The survey was conducted from 5th to 24th of April 2020.

Results: the perception of weight gain was observed in 48.6% of the population; 3.3% of smokers decided to quit smoking; a slight increased physical activity has been reported, especially for bodyweight training, in 38.3% of respondents; the population group aged 18-30 years resulted to have a higher adherence to the Mediterranean Diet when compared to the youngers and the olders ($p=0.000$; $p=0.000$); 15% of respondents turned to farmers or organic purchasing groups for fruit and vegetables, especially in North and Center Italy, where BMI values were lower.

Conclusions: In the present study, we provided for the first time data on the Italian population lifestyle, eating habits and adherence to the Mediterranean Diet pattern during the COVID-19 lockdown. However, as the COVID-19 pandemic is ongoing, our data need to be confirmed and investigated in future larger population studies.

Background

The 2019 Coronavirus Disease or, as it is now called, COVID-19, is a severe acute respiratory syndrome caused by SARS coronavirus 2 (SARS-CoV-2). It was supposed that in December 2019 SARS-CoV-2 apparently transit from animals to humans on the Huanan seafood market and rapidly spread from Wuhan City of Hubei, Province of China, to the rest of the world[1]. Due to the growing case notification rates at Chinese and international locations, on 30th January 2020, the WHO Emergency Committee declared a global health emergency[2]. In order to contrast and contain the spread of the new COVID-19, at the beginning of March 2020, the Italian Government decided for more stringent containment measures: the [ban on gatherings](#) and demonstrations, as well as the ban on hanging out for no urgent reasons were issued on the entire national territory[3]. Due to the [#iorestoacasa](#) decree[4], a sudden and radical change has occurred in the habits and lifestyles of the population, with a drastic reduction of any form of sociality. Physical distancing and self-isolation strongly impacted citizens' lives, affecting in particular eating habits and everyday behaviours.

There are two major influences: staying at home (which includes digital-education, smart-working, limitation of outdoors and in-gym physical activity) and stockpiling food, due to the restriction in grocery shopping. In addition,

the interruption of the work routine associated to the quarantine, could be result in boredom, which in turn is associated with a greater energy intake[5]. In addition to boredom, to hear or read continuously on the COVID-19 from media, can be stressful. Stress leads subjects toward overeating, especially 'comfort foods' rich in sugar, defined as "food craving"[6,7]. The foods rich in carbohydrate can reduce stress as these encourages serotonin production with a positive effect on mood. However, this food craving effect of carbohydrates is proportional to the glycemic index of foods that is associated with the increased risk of developing obesity and cardiovascular diseases, beyond a chronic state of inflammation, that have been demonstrated to increase the risk for more serious complications of COVID-19[8,9].

This new condition may compromise maintaining a healthy and varied diet, as well as a regular physical activity. For example, limited access to a daily grocery shopping may lead to reduce the consumption of fresh foods in favour of highly processed ones, which tend to be high in fats, sugars and salt. Moreover, psychological and emotional responses to the COVID-19 outbreak[10,11], may bring to a major risk of dysfunctional eating behaviors. It is well known how the experience of negative emotions can lead to overeating, the so called "emotional eating"[12,13]. In order to contrast and respond to the negative experience of self-isolation, people could be more prone to look for reward and gratification physiologically associated with food consumption, even overriding other signals of satiety and hunger[14]. In addition, boredom feelings, which may rise staying home for a long period, are often related to overeating as means to escape monotony[15,16]. On the other hand, negative experience may lead to eating restriction, due to the physiological stress reactions mimic the internal sensations associated with feeding-induced satiety.

Finally, lifestyle may be substantially changed due to the containment measures, with the consequent risk of sedentary behaviours and modification in smoking and sleeping habits. Low physical activity levels have been suggested to interact both with body fat and appetite dysregulation[17].

Eating habits and lifestyle modification may threaten our health. Maintain a good nutrition status is crucial, above all in a period when the immune system might need to fight back. In fact, subjects with severe obesity (body mass index, BMI, of 40 or higher) are one of the groups with the higher risk for COVID-19 complications[18]. Obesity is actually an expansion of the adipose tissue, which produces cytokines and contributes to a proinflammatory milieu[19]. Moreover, in regarding of pulmonary physiology, subjects with obesity have decreased expiratory reserve volume, functional capacity and respiratory system compliance. In patients with high abdominal fat, pulmonary function is further compromised in supine position by decreased diaphragmatic excursion, making ventilation more difficult[20]. In parallel, the inflammatory state is also one of the most important mechanism of the severity of lung disease in COVID-19, which leads to the famous "*cytokine storm*" associated with to the acute respiratory distress syndrome and a multiple organ failure[9]. In this complex *scenario* the inflammatory state characteristic of the individuals with obesity could further exacerbate the inflammation in patients with COVID-19 exposing these patients to higher concentration of pro-inflammatory cytokines compared to normal weight individuals[9].

Following a healthy diet is important also because gene expression levels of all the cytokines are influenced by food[21] and are capable of modulating the processes of inflammation and oxidative stress[21]. Several studies confirmed an inverse association between the adherence to the Mediterranean Diet (MD) and overall cancer-related mortality. The healthy MD[22] is made of a proper combination of quality foods, evaluated both on the basis of the macro and micronutrients content, but also on the absence of contaminating substances. According to current knowledge, the MD is the key factor against immune-mediated inflammatory responses, such as those occurring in cancer. In particular, their potential clinical applications are on one side low cholesterol levels and, on the other, high

levels of antioxidants contained in fruits and vegetables, and monounsaturated fatty acid (MUFA) present in fish, nuts and olive oil[23]. Particularly, it is well known that the MD, one of the healthiest dietetic pattern in the world, is linked to lower mortality and reduction in obesity, type 2 diabetes mellitus, low-grade inflammation, cancer, Alzheimer's disease, depression, and Crohn's disease[23,24].

In light of the above, the "Eating Habits and Lifestyle Changes in COVID19 lockdown" (EHLC-COVID19) project began, using a web-survey. The main aim of the project, in a diachronic perspective, is to explore and analyse the changes of eating behavior, adherence to the MD and lifestyle during lockdown, among the Italian population, according to the regional distribution of the COVID-19 epidemic and according to age. Secondly, it allows to achieve nutritional interventions in supporting the health status of different target groups of the population.

Materials And Methods

Survey methodology

The EHLC-COVID19 project was carried out by the Section of Clinical Nutrition and Nutrigenomic, Department of Biomedicine and Prevention of the University of Rome Tor Vergata, using a web-survey to obtain data among population from every region of Italy about eating habits and lifestyle during the Covid-19 pandemic period.

The survey was conducted from the 5th to 24th of April 2020, among the Italian population.

The survey was carried out using an online platform, which can be accessed through any device with an Internet connection. The survey was disseminated through institutional and private social networks (Twitter, Facebook and Instagram), the "PATTO in cucina Magazine" website[25], and institutional mailing list. This method of administration provides a statistical collective whose population parameters cannot be controlled as it is the case for probabilistic sampling. However, for the research objectives, it was completely effective because it facilitated the wide dissemination of the survey questionnaire without any type of barrier, not even the territorial one. On the other hand, the latest data reported by the annual Italian report on the use of the internet shows that Internet penetration stood at 82% in January 2020; in particular, 94% of internet users, aged 16 to 64, use their smartphone to connect and 99% of them visited or used a social network or messaging services[26].

EHLC-COVID19 Questionnaire

The EHLC-COVID19 questionnaire was specifically built by using Google Form by the Section of Clinical Nutrition and Nutrigenomic, Department of Biomedicine and Prevention of the University of Rome Tor Vergata. It includes 43 questions divided into four different sections: 1) personal data (4 questions: age, gender, hometown, current employment); 2) anthropometrics information (2 questions: reported weight and height); 3) dietary habits information: a) Adherence to the MD, using the validated 14-items Mediterranean Diet Adherence Screener (MEDAS), which score ranges from 0 to 14 points[27], b) structured questionnaire packet (11 questions: daily consumption of certain foods, food frequency, number of meals/day); 4) lifestyle habits information (12 questions: grocery shopping, smoke habit, hours of sleep and physical activity). The full version of the questionnaire is available as Appendix A. The score of the adherence to the MD was assessed using MEDAS questionnaire[27], and then total population sample was divided as follows: score 0–5, low adherence; score 6–9, medium adherence; and score >10, high adherence.

The study was conducted in full agreement with the national and international regulations and the Declaration of Helsinki (2000). All participants were fully informed about the study requirements and were required to accept the

data sharing and privacy policy before participating in the study. Participants completed the questionnaire directly connected to the Google platform. Participant personal information including names was anonymized to maintain and protect confidentiality. Once completed, each questionnaire was transmitted to the Google platform and the final database was downloaded as a Microsoft Excel sheet.

Statistical analyses

Data are represented as number and percentage in parentheses (%) for categorical variables, or median and interquartile range in square brackets [IQR] for continuous variables. The Shapiro-Wilk test was performed in order to evaluate variables distribution. All the variables had skewed distribution. The Spearman correlation coefficient was calculated in order to evaluate the correlation between continuous variables. Chi-square test was employed to assess the association between categorical variables while McNeman analysis was used to investigate the difference between categorical variables pre- and during the COVID-emergency. Mann-Whitney U and Kruskal-Wallis tests were, instead, performed in order to compare continuous variables among two or more groups, respectively. Finally, binary and multinomial logistic regression analyses were conducted to investigate the association between categorical variables (dependent) and continuous or categorical ones (independent). Results were significant for p-value < 0.05. Statistical analysis was performed using SPSS ver. 21.0 (IBM, Chicago, IL, USA).

Results

Participants

At the 24th of April 2020, the web-survey was stopped, and the collected data were analysed. A total of 4,500 participants completed the questionnaire, and after a validation of the data, 3,533 respondents have been included in the study, aged between 12 and 86 years. The female respondents represent the 76.1% of the population..

According to gender and age distribution, the sample reflects the population of the Italian Internet users (i.e., 91.4 % of people older than 20 years)[28]. Territorial coverage spreads over all Italian Regions: 15.5% of respondents lives in Northern Italy, 56.9% in Center Italy and 27.6% in Southern Italy and Islands. General characteristics and anthropometrics of the population are reported in Table 1. The Kruskal-Wallis test showed a statistically significant difference in BMI among the three Italian areas, and in particular in the post-hoc analysis South and Islands resulted to have a population with higher BMI when compared to North and Center Italy (p=0.007, p=0.008). In terms of employment status, 1042 (29.5 %) participants have a full-time job in smart working, 429 (12.1 %) go to the workplace, 674 (19.1 %) are students, 289 (8.2 %) are unemployed, 940 (26.6 %) suspended work and 159 (4.5 %) are retired.

Lifestyle changes during COVID-19 emergency

About lifestyle changes during the COVID-19 lockdown, most of the population declares not to have changed its habits (46.1%), while 16.7% and 37.2% feels to have improved them or made them worse, respectively. In particular, smoking habit has been reduced during the lockdown (McNemar value=101.484, p=0.000), while sleep hours increased (McNemar value=330.851, p=0.000) as shown in table 2, equally considering North, Center and South of Italy (data not shown).

Concerning physical activity, no significant difference between the percentage of people that did not train before (37.7%) and do not during (37.4%) the COVID-19 lockdown was observed (p=0.430). On the contrary, a higher

frequency of training during the emergency was found when compared to the previous period (McNemar value=259.529, $p=0.000$). Data about frequency and type of training are reported in figure 1.

Eating habits changes during COVID-19 emergency

Considering eating habits more than half of the participants feels a change in their hunger/satiety perception: 627 (17.7%), and 1214 (34.4%) of them have less or more appetite, respectively. The multinomial logistic regression showed that changed work habits (suspension or smart working) in comparison to unchanged ones, and female gender are associated to modified appetite both in negative and positive (job: OR=1.791, $p=0.000$; OR=1.431, $p=0.000$; sex: OR=1.521, $p=0.000$; OR=1.738, $p=0.000$). Moreover, North and Center Italy are both inversely associated to appetite increase when compared to the South and Islands (OR=0.527, $p=0.000$; OR=0.582, $p=0.000$). The Kruskal-wallis analysis and the post hoc test also showed a significant difference in age among the three groups ($p=0.000$). People who declare an increased appetite are younger than those with unchanged or reduced one. No difference was found for BMI. Notably, 1199 (33.9%) subjects declare to feel hungry before the main meals, 807 (22.8%) between them and 395 (11.2%) after dinner. As expected, the binary logistic regression showed after-dinner hungry to be associated to the habit of having a break before going to bed (OR=4.067, $p=0.000$). Moreover, BMI and age were found to be positively and inversely associated to the increased appetite and night snacks, respectively (OR=1.073, $p=0.000$; OR=0.972, $p=0.000$). Living in Center and Southern Italy and Islands resulted to be associated to the after dinner snack in comparison to the Northern region (OR=1.843, $p=0.009$; OR=2.128, $p=0.002$). No difference was found for gender. Interestingly, more than half of the subjects has not changed the number of their daily meals (57.8%), while 17.5% and 23.5% declares to skip or introduce a break or a main meal, respectively.

The survey investigated the variation in food intake during the COVID-19 emergency (figure 2). Data show an increase of homemade recipes (i.g. sweets, pizza and bread), cereals, legumes, white meat and hot beverages consumption and a decrease of fresh fish, packaging sweets and baked products, delivery food and alcoholics intake.

During the COVID-19 lockdown, 37.4% and 35.8% of the study population declares to eat more or less healthy food (fruits and vegetables, nuts, legumes), respectively. No difference between the two groups was found. People who decrease the junk food (packaged sweets and baked products, sweet beverages, salted snacks and dressing sauces) consumption (29.8%) were significantly more representative than those who increase it (25.6%) ($r^2=9.560$, $p=0.002$). Binary logistic regression analysis showed that a higher BMI, as well as a lower age, were associated to an increase of junk food consumption (packaged sweets and baked products, sweet beverages, salted snacks and dressing sauces) (OR=1.025, $p=0.005$; OR=0.979, $p=0.000$). An enhanced appetite and after dinner hunger were both associated with an increased risk of junk food intake (OR=4.044, $p=0.000$; OR=1.558, $p=0.000$). In the multivariable model the association remains significant for all the variables, except for after dinner hunger. On the contrary, no association was found between BMI, age and the increase of healthy food intake ($p=0.381$, $p=0.053$). Moreover, a reduced appetite was related to a major consumption of healthy foods (OR=1.718, $p=0.000$). Perception of weight gain has been detected to be positively and inversely associated to the increase consumption of junk food or healthy food, respectively (OR=3.122, $p=0.000$; OR=0.805, $p=0.002$), to a higher BMI (OR=1.073, $p=0.000$) and to the female gender (OR=1.234, $p=0.008$). Moreover, people who suspending their usual job or start smart working have a greater perception of having increased their weight when compared to subjects who did not change their job routine (OR=1.250, $p=0.037$). Finally, people who declare to train during the lockdown, as well as people from North and Center of Italy in comparison to those from the Southern and Islands, resulted to have a minor perception of weight

gain (OR=0.660, p=0.000; OR=786, p=0.024; OR=0.747, p=0.000). No association was found with the age of the population (p=0.340).

Most of the population purchases food at the supermarket (75.8%), 26.0 % at the grocery shops, 14.8% at farmers, organic or local markets or using [Solidal Purchasing Groups](#), and 9.0% uses online delivery. Finally, 11.8% of participants declares not to purchase food and to delegate shopping to third parties. More than half of population (54.0%) declares to use the leftover food more than 30% of times. The binary logistic regression showed that shopping at farmers, organic markets, local markets or using [Solidal Purchasing Groups](#) was associated to the habit of recycling the leftover food (OR=1.468, p=0.000). Moreover, people from Northern and Center of Italy appeared to be more prone to this behavior when compared to Southern and Islands population (OR=2.109, p=0.000; OR=1.735, p=0.000). No association was found with age and gender.

Adherence to the MD

To assess the compliance to the MD recommendations during the COVID-19 lockdown, the MEDAS questionnaire was included in the survey.

On the basis of the MEDAS values, participants were divided in three classes: 1) low (score ≤ 5), 2) medium (score 6–9) and 3) high (score ≥ 10) adherence to the MD and differences in the compliance rates for each food were calculated and depicted in radar charts which illustrate the gap between the current state (percentage of participants currently adherent to each dietary recommendation) and the ideal situation (100% compliance) (Figure 2). As expected, among the three classes of adherence to the MD there were significant differences for most of items. In particular, in the highest adherence to the MD, the intake of fruits, vegetables, nuts, legumes and fish was respectively: 58.7%, 93.7%, 75.9%, 80.9% and 63.3% (Figure 2), underlining the improvement of the consumption of typical components of the dietary pattern in our Mediterranean population. Moreover, the consumption of foods not included in the MD profile seems to be reduced.

In Table 3, results of positive answers to MEDAS questionnaire and the adherence to MD are reported. The Kruskal-Wallis test showed a significant difference of MEDAS score among the three Italian area (p=0.004), with significant higher scores in Northern and Southern Italy and Islands when compared to Center Italy (post hoc analysis p=0.011, p=0.048). Moreover, an inverse correlation was found between MEDAS score and BMI and age (r=0.096, p=0.000; r=0.066, p=0.000). In particular, the population group aged 18-30 years resulted to have a higher MEDAS score when compared to the youngers and the olders (p=0.000; p=0.000). Moreover, normal weight people have a significant greater level of adherence to MD in comparison to overweight and obese one (p=0.000; p=0.000). No difference was found among the other classes of BMI. Finally, no difference among gender and employment status groups was found for the MEDAS score. Moreover, participants were asked to indicate how many daily/weekly servings of food groups not included in MEDAS they consumed. Results are shown in Figure 3 and Figure 4.

Discussion

This population-based study provides a snapshot of the eating habits and lifestyle of Italian residents, participating in the survey between 5th and 24th of April 2020, after seven weeks of lockdown.

To our knowledge, this study was among one of the first to investigate the immediate impact of lockdown due to the COVID-19 pandemic on eating habits and lifestyle changes among Italian residents. The web-survey was stopped on 24th of April 2020, because it was the first day in Italy with the same number of newly infected and cured people. To

those data, according to National Civil Protection Service data[29], the total number of assessed cases in Italy was 192,994: 106,527 people have tested positive; 60,498 patients have recovered; 25,969 died as confirmed only upon certification of cause of death by the Istituto Superiore di Sanità (ISS). In detail, there were in the North of Italy: 34,368 positive cases in Lombardy, 12,509 in Emilia-Romagna, 15,391 in Piedmont, 9,679 in Veneto, 2,920 in Trentino Alto Adige, 1,320 in Friuli Venezia Giulia, 3,437 in Liguria, 354 in the autonomous province of Aosta Valley. In Central Italy: 6,133 in Tuscany, 4,492 in Lazio, 3,273 in Marche, 322 in Umbria. In South Italy: 2,943 in Campania, 2,933 in Apulia, 2,079 in Abruzzo, 821 in Calabria, 229 in Basilicata and 200 in Molise. In Islands: 2,320 in Sicily and 804 in Sardinia (Figure 5).

Therefore, we decided to analyse the eligible data by dividing the population according to the geographical areas that group the regions of Northern Italy (Piedmont, Aosta Valley, Lombardy, Liguria, Emilia-Romagna, Veneto, Friuli Venezia Giulia, Trentino Alto Adige), the Center (Tuscany, Lazio, Marche, Umbria, Abruzzo, Molise and San Marino Republic) the South (Campania, Basilicata, Calabria, Apulia) and the Islands (Sicily and Sardinia), so that we can evaluate the weight of the individual responses also based on the emotional state not dependent only by the individual, but also by the severity of the epidemic and the number of sick and dead. Territorial coverage of our web survey extends to all Italian Regions, and ranges from a minimum of 15.48% (Northern Italy) to a maximum of 56.86% (Center Italy). Female respondents are about triple that of male respondents. The strategy adopted by many countries, including Italy, to reduce the spread of COVID-19 has been "social distancing". If the positive effect of the slowdown of the epidemic curve due to the lockdown was a good incentive to maintain the social rules imposed, the fear of disease and death, together with the restrictions of individual freedom, the stress remained resilient, loneliness and social isolation worsens the stress load and produces alteration of habitual behaviors. It is not surprising that lifestyle and eating habits changed during the COVID-19 pandemic period, as lifestyle and eating habits in changed in 37.3% of respondents, but only 16.7% of respondents improved their behaviors.

During the COVID-19 lockdown period, the sense of hunger and satiety changed for more than half of population: 17.8% of responders had less appetite, while 34.4% of responders increased appetite. The increased sense of hunger and the consequent change in eating habits could justify the perception of weight gain observed in 48.6% of the population. In fact, 40.3% think they have slightly increased their weight, while 8.3% of the studied population think they have increased their weight a lot. On the other hand, 3.3% of smokers in this period put out the last cigarette, and have quit smoking. It is interesting to note that the number of those who smoked more than 10 cigarettes per day has decreased by 0.5%. This phenomenon could be explained by the fear induced in smokers of the increased risk of respiratory distress and mortality from COVID-19[30]. Those who did not use to play sports before COVID-19 lockdown, did not take the opportunity to start. However, the most interesting fact is that among those who already took part in sports, training frequency has increased. Those who previously managed to practice it only occasionally, now have more time for the exercises to do at home. The percentage of those who train five or more days a week has gone from 6 to 16%, with an average increase of 9.9%. Anyway, a slight increased physical activity has been reported, especially for bodyweight training (38.3% of respondents).

Interestingly, more than half of the subjects has not change the number of their daily meals (57.8%), while 17.5% and 23.5% declares to skip or introduce a break or a main meal, respectively.

15% of those interviewed turned to farmers or organic purchasing groups for fruit and vegetables, whose consumption did not decrease despite the enormous difficulties of the agricultural supply chain. During the lockdown, the Italians have more desire to cook, and above all to knead. In fact, the consumption of homemade

desserts, bread and pizza has increased. On the other hand, the consumption of salty snacks, snacks, processed meat, carbonated and sugary drinks has decreased.

It was expected that during the quarantine there would be a reduction of the consumption of fresh food, accompanied by vitamins and minerals deficiency, including vitamin C and vitamin E and beta-carotene with antioxidants and anti-inflammatory properties. The deficiency of these micronutrients is associated both obesity and impaired immune responses, thus making more susceptible to viral infections[31,32]. However, during the lockdown, the Italians have paid attention to Mediterranean food, and nutritional quality has remained high, especially in Northern and Central Italy, areas in which there is also a lower BMI than in areas of Southern Italy and the Islands ($p < 0.05$)[33]. We suggest that MD could represent one of the best food models to restore innate and adaptive immunity and may be an adjuvant therapeutic choice of COVID-19.

Obesity is a state of chronic low-grade inflammation, dependent on the adipokine secretion by the adipose tissue with immunomodulatory effects[34], as well as contributing to the onset of several metabolic diseases, including insulin resistance and type 2 diabetes mellitus, dyslipidemia, and hypertension that, making the immune system more vulnerable to infections due to down regulation of the innate and adaptive immune responses, resulting in patients being less responsive to vaccinations, antivirals and antimicrobial drugs[35]. These immunomodulatory effects may contribute to aggravate respiratory viral infections[9]. Therefore, even if to date there are no data in the evidence reporting that individuals with obesity have a higher risk of getting COVID-19, it is known that more severe forms of respiratory failure are present in patients with obesity. In this context, it could be hypothesized that individuals with obesity could be at higher risk of serious illness, if infected.

The survey explored the perception of body weight changes: 37.4% of the study population declares a stable weight, 13.9% believes to have lost weight, 40.3% feels to have a slight weight gain, and 8.3% to have gained a lot of weight. The perception of weight gain resulted to be present in people who started the smart working, and especially in the North and Center of Italy, the same zone in which an increase of physical activity was observed. Therefore, it is strongly recommended to reduce the consumption of junk food that, by increasing "obesogenic environment" which predisposes to weight gain and susceptibility to COVID-19[36,37].

In the present study, we provided for the first time data on the Italian population adherence to the MD pattern during the COVID-19 lockdown, observing that there has not been a deterioration. According to our previous data obtained from a survey conducted to identify clusters of eating patterns among the Italian population aged 15-64 years, three clusters were identified: "Mediterranean-like", "Western-like" and "low fruit/vegetables". Among the 5,278 subjects, the "Mediterranean-like" patterns was more common among females and elderly; the other clusters were significantly associated with obesity[38]. Indeed, with great surprise we realized that the most careful to eat Mediterranean were the young people of the 18-30 age group ($p = 0.000$; $p = 0.000$). Results from the MEDAS questionnaire (7-20) in our population sample, classified according to the degree of adherence to the MD demonstrated that subjects with low, medium and high adherence to the MD, had adequate consumption, more than 50% of some typical MD food such as olive oil (94.7% in Northern Italy, 96.6% in the Center Italy and 95% in Southern Italy and Island), vegetables (68.8% in Northern Italy, 72.2% in the Center Italy and 69.5% in Southern Italy and Island), legumes (51.7% in Northern Italy, and 60.7% in Southern Italy and Island). In all the three zones there is an adequate use of slightly fried, known as "soffritto". Nutritional status is an important form of protection against the emergence of new viral pathogens[39]. Therefore, a correct diet rich in nutrients with antioxidant and anti-inflammatory activities, such as that suitable for MD, helps to reduce virulence of SARS-Cov-2[40].

An inadequate intake of Mediterranean foods exposes the whole population to specific oxidative damage[22], and, thus, to susceptibility to COVID-19.

Our results comfort the fact that if the inflammation and oxidative damage, dependent on the consumption of junk and ultra-processed food, in the postprandial period contribute significantly to a greater susceptibility to develop chronic diseases that cannot be communicated, the consumption of seasonal foods and rich in antioxidants is highly protective[41].

The main limitation of the present study is represented by a self-reported questionnaire, and this may lead to the actual misreporting of data. However, our web-survey was similar to others that have been frequently employed. A strength of our study was represented by the fact that the survey was conducted quickly in the most critical period of the epidemic in Italy, less than three weeks after the lockdown.

Conclusions

In the present study, we provided for the first time data on the Italian population lifestyle, eating habits and adherence to the Mediterranean Diet pattern during the COVID-19 lockdown. The perception of weight gain was observed in 48.6% of the population, whereas a slight increased physical activity has been reported, especially for bodyweight training, in 38.3% of respondents. Interestingly, the population group aged 18-30 years resulted to have a higher adherence to the MD when compared to the youngers and the olders. Moreover, 15% of respondents turned to farmers or organic purchasing groups for fruit and vegetables, especially in North and Center Italy, where BMI values were lower. Another positive result is the percentage reduction in smokers by 3%. However, as the COVID-19 pandemic is ongoing, our data need to be confirmed and investigated in future larger population studies.

List Of Abbreviations

BMI, Body Mass Index

MD, Mediterranean Diet

MUFA, Monounsaturated Fatty Acid

EHLC-COVID19, Eating Habits and Lifestyle Changes in COVID19 lockdown

MEDAS, Mediterranean Diet Adherence Screener

ISS, Istituto Superiore di Sanità

Declarations

Ethics approval and consent to participate: The study was conducted in full agreement with the national and international regulations and the Declaration of Helsinki (2000). All participants were fully informed about the study requirements and were required to accept the data sharing and privacy policy before participating in the study. The study was not a clinical trial on drugs, supplements or foods, but a surveillance on population's habits. All the participants gave their consent to the data treatment at the beginning of the web-survey. If any participant had not given his/her consent, the web-survey automatically stopped. The anonymous nature of the web-survey does not

allow to trace in any way sensitive personal data. Therefore, the present web-survey study does not require approval by Ethics Committee.

Consent for publication: Not applicable.

Availability of data and materials: All data generated or analysed during this study are included in this published article.

Competing Interests: The authors declare no conflict of interest.

Funding: This research does not received external funding.

Authors' Contributions: LDR, PG draft the manuscript; LDR, conceived and designed the web-survey; AA, GC, CL, GC, designed the web-survey and collected data; LB, FS, EE collected data; GC analyzed the data; FP, LS reviewed the text; ADL had primary responsibility for the final content. All the authors read and approved the final manuscript. All the authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

Acknowledgement: not applicable.

References

1. Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. *Lancet*. Lancet Publishing Group; 2020. p. 470–3.
2. Velavan TP, Meyer CG. The COVID-19 epidemic. *Trop. Med. Int. Heal.* Blackwell Publishing Ltd; 2020. p. 278–80.
3. FAQ - Covid-19, domande e risposte [Internet]. [cited 2020 May 7]. Available from: <http://www.salute.gov.it/portale/nuovocoronavirus/dettaglioFaqNuovoCoronavirus.jsp?lingua=italiano&id=228#11>
4. Gazzetta Ufficiale [Internet]. [cited 2020 May 7]. Available from: <https://www.gazzettaufficiale.it/eli/id/2020/03/09/20A01558/sg>
5. Moynihan AB, van Tilburg WAP, Igou ER, Wisman A, Donnelly AE, Mulcaire JB. Eaten up by boredom: Consuming food to escape awareness of the bored self. *Front Psychol*. Frontiers Research Foundation; 2015;6.
6. Yılmaz C, Gökmen V. Neuroactive compounds in foods: Occurrence, mechanism and potential health effects. *Food Res. Int.* Elsevier Ltd; 2020.
7. Rodríguez-Martín BC, Meule A. Food craving: New contributions on its assessment, moderators, and consequences. *Front. Psychol*. Frontiers Research Foundation; 2015.
8. Wu C, Chen X, Cai Y, Xia J, Zhou X, Xu S, et al. Risk Factors Associated with Acute Respiratory Distress Syndrome and Death in Patients with Coronavirus Disease 2019 Pneumonia in Wuhan, China. *JAMA Intern Med.* American Medical Association; 2020;
9. Muscogiuri G, Pugliese G, Barrea L, Savastano S, Colao A. Obesity: The “Achilles heel” for COVID-19? *Metabolism*. W.B. Saunders; 2020;108.
10. Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS, et al. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int J Environ Res Public Health*. MDPI AG; 2020;17.

11. Montemurro N. The emotional impact of COVID-19: From medical staff to common people. *Brain. Behav. Immun.* Academic Press Inc.; 2020.
12. van Strien T. Causes of Emotional Eating and Matched Treatment of Obesity. *Curr. Diab. Rep.* 2018.
13. Evers C, Dingemans A, Junghans AF, Boevé A. Feeling bad or feeling good, does emotion affect your consumption of food? A meta-analysis of the experimental evidence. *Neurosci. Biobehav. Rev.* 2018.
14. Singh M. Mood, food and obesity. *Front Psychol.* Frontiers Research Foundation; 2014;5:1–35.
15. Havermans RC, Vancleef L, Kalamatianos A, Nederkoorn C. Eating and inflicting pain out of boredom. *Appetite.* Academic Press; 2015;85:52–7.
16. Crockett AC, Myhre SK, Rokke PD. Boredom proneness and emotion regulation predict emotional eating. *J Health Psychol.* SAGE Publications Ltd; 2015;20:670–80.
17. Panahi S, Tremblay A. Sedentariness and Health: Is Sedentary Behavior More Than Just Physical Inactivity? *Front Public Heal.* Frontiers Media SA; 2018;6.
18. People Who Are at Higher Risk for Severe Illness | Coronavirus | COVID-19 | CDC [Internet]. [cited 2020 May 7]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/groups-at-higher-risk.html>
19. Hauner H. Secretory factors from human adipose tissue and their functional role. *Proc Nutr Soc.* Cambridge University Press (CUP); 2005;64:163–9.
20. Dietz W, Santos-Burgoa C. Obesity and its Implications for COVID-19 Mortality. *Obesity.* Blackwell Publishing Inc.; 2020.
21. Di Renzo L, Gualtieri P, Romano L, Marrone G, Noce A, Pujia A, et al. Role of personalized nutrition in chronic-degenerative diseases. *Nutrients.* MDPI AG; 2019.
22. De Lorenzo A, Bernardini S, Gualtieri P, Cabibbo A, Perrone MA, Giambini I, et al. Mediterranean meal versus Western meal effects on postprandial ox-LDL, oxidative and inflammatory gene expression in healthy subjects: a randomized controlled trial for nutrigenomic approach in cardiometabolic risk. *Acta Diabetol.* Springer-Verlag Italia s.r.l.; 2017;54:141–9.
23. Soldati L, Di Renzo L, Jirillo E, Ascierio PA, Marincola FM, De Lorenzo A. The influence of diet on anti-cancer immune responsiveness. *J. Transl. Med.* BioMed Central Ltd.; 2018.
24. Cani PD, Van Hul M. Mediterranean diet, gut microbiota and health: When age and calories do not add up! *Gut.* BMJ Publishing Group; 2020.
25. - PATTO in cucina Magazine [Internet]. [cited 2020 May 7]. Available from: <https://www.pattoincucina.it/>
26. We Are Social & Hootsuite. Digital 2020. Data Reportal. 2020.
27. Schröder H, Fitó M, Estruch R, Martínez-González MA, Corella D, Salas-Salvadó J, et al. A Short Screener Is Valid for Assessing Mediterranean Diet Adherence among Older Spanish Men and Women. *J Nutr.* Oxford University Press (OUP); 2011;141:1140–5.
28. Istat.it | Multiscopo sulle famiglie: aspetti della vita quotidiana - parte generale [Internet]. [cited 2020 May 7]. Available from: <https://www.istat.it/it/archivio/217037>
29. COVID-19 ITALIA - Desktop [Internet]. [cited 2020 May 7]. Available from: <http://opendatadpc.maps.arcgis.com/apps/opsdashboard/index.html#/b0c68bce2cce478eaac82fe38d4138b1>
30. Brake SJ, Barnsley K, Lu W, McAlinden KD, Eapen MS, Sohal SS. Smoking Upregulates Angiotensin-Converting Enzyme-2 Receptor: A Potential Adhesion Site for Novel Coronavirus SARS-CoV-2 (Covid-19). *J Clin Med.* MDPI AG; 2020;9:841.
31. García OP, Long KZ, Rosado JL. Impact of micronutrient deficiencies on obesity. *Nutr. Rev.* 2009. p. 559–72.

32. Childs CE, Calder PC, Miles EA. Diet and immune function. *Nutrients*. MDPI AG; 2019.
33. Costa de Miranda R, Di Renzo L, Cupertino V, Romano L, De Lorenzo A, Salimei C, et al. Secular trend of childhood nutritional status in Calabria (Italy) and the United States: the spread of obesity. *Nutr Res*. Elsevier Inc.; 2019;62:23–31.
34. De Lorenzo A, Gratteri S, Gualtieri P, Cammarano A, Bertucci P, Di Renzo L. Why primary obesity is a disease? *J. Transl. Med.* BioMed Central Ltd.; 2019.
35. Dhurandhar N V., Bailey D, Thomas D. Interaction of obesity and infections. *Obes. Rev.* Blackwell Publishing Ltd; 2015. p. 1017–29.
36. De Lorenzo A, Romano L, Di Renzo L, Di Lorenzo N, Cennamo G, Gualtieri P. Obesity: A preventable, treatable, but relapsing disease. *Nutrition*. Elsevier Inc.; 2020.
37. Nappi F, Barrea L, Di Somma C, Savanelli MC, Muscogiuri G, Orio F, et al. Endocrine aspects of environmental “obesogen” pollutants. *Int. J. Environ. Res. Public Health*. MDPI AG; 2016.
38. Denoth F, Scalese M, Siciliano V, Di Renzo L, De Lorenzo A, Molinaro S. Clustering eating habits: frequent consumption of different dietary patterns among the Italian general population in the association with obesity, physical activity, sociocultural characteristics and psychological factors. *Eat Weight Disord*. Springer International Publishing; 2016;21:257–68.
39. Beck MA, Handy J, Levander OA. Host nutritional status: The neglected virulence factor. *Trends Microbiol.* 2004. p. 417–23.
40. Romano L, Bilotta F, Dauri M, Macheda S, Pujia A, De Santis GL, et al. Short Report – Medical nutrition therapy for critically ill patients with COVID-19. *Eur. Rev. Med. Pharmacol. Sci.* 2020.
41. Di Renzo L, Merra G, Botta R, Gualtieri P, Manzo A, Perrone MA, et al. Post-prandial effects of hazelnut-enriched high fat meal on LDL oxidative status, oxidative and inflammatory gene expression of healthy subjects: a randomized trial. *Eur Rev Med Pharmacol Sci.* 2017;21:1610–26.
42. Ministero della Sanità Classificazione statistica internazionale delle malattie e dei problemi sanitari correlati DECIMA REVISIONE [Internet]. Available from: http://www.salute.gov.it/imgs/C_17_pubblicazioni_1929_allegato.pdf

Tables

Table 1. Participants’ general characteristics and anthropometrics.

	Whole sample (n=3533)	Northern Italy (n=547)	Center Italy (n=2009)	Southern Italy and Islands (n=977)
Age	36.0 [27.0-49.0]*	36.0 [29.0-52.0]	37.0 [27.0-50.5]	35.0 [26.0-45.0]
Age groups				
< 18 years	180 (5.1)	2 (0.4)	67 (3.3)	111 (11.4)
18-30 years	1048 (29.7)	177 (32.4)	616 (30.7)	255 (26.1)
31-50 years	1492 (42.2)	217 (39.7)	824 (41.0)	451 (46.2)
51-65 years	693 (19.6)	135 (24.7)	420 (20.9)	138 (14.1)
>65 years	120 (3.4)	16 (2.9)	82 (4.1)	22 (2.3)
Gender (F)	2689 (76.1)	435 (79.5)	1313 (76.4)	738 (75.5)
Weight (kg)	65.0 [57.0-75.0]*	65.0 [57.0-75.0]	65.0 [57.0-75.0]	65.0 [56.8-76.0]
Height (cm)	166.0 [160.0-172.0]*	167.0 [162.0-173.0]	167.0 [161.0-173.0]	165.0 [160.0-170.0]
BMI (kg/cm ²)	23.23 [21.01-26.01]*	22.89 [20.83-25.47]	23.15 [20.94-25.87]	23.53 [21.26-26.57]
Class of BMI				
Underweight	142 (4.0)	19 (3.5)	97 (4.8)	26 (2.7)
Normal weight	2243 (63.5)	368 (67.3)	1273 (63.4)	602 (61.6)
Overweight	814 (23.0)	108 (19.7)	469 (23.3)	237 (24.3)
Obesity I	251 (7.1)	42 (7.7)	126 (6.3)	83 (8.5)
Obesity II	66 (1.9)	8 (1.5)	32 (1.6)	26 (2.7)
Obesity III	17 (0.5)	2 (0.4)	12 (0.6)	3 (0.3)

Values are expressed as median and IQR in square brackets (M [IQR]) for continuous variables or as number and percentage (n (%)) for categorical variables.

The Shapiro-Wilk test was performed to evaluate variables distribution. Variables are considered non-normally distributed for $p < 0.05$.

BMI, body mass index.

Table 2. Smoking and sleep habits before and during COVID-19 emergency.

	Smoking pre-COVID-19	Smoking during COVID-19
No	2646 (74.9)	2762 (78.2)
< 5 cigarettes/day	313 (8.9)	289 (8.2)
5-10 cigarettes/day	295 (8.3)	223 (6.3)
>10 cigarettes/day	279 (7.9)	259 (7.3)
	Sleep habits pre-COVID-19	Sleep habits during COVID-19
<7 hours/night	1722 (48.7)	1275 (36.1)
7-9 hours/night	1763 (49.9)	1935 (54.8)
>9 hours/night	48 (1.4)	323 (9.1)

Values are expressed as number and percentage (n(%)).

Table 3. Positive answers to MEDAS questionnaire and adherence to the MD.

	Whole sample (n=3533)	Northern Italy (n=547)	Center Italy (n=2009)	Southern Italy and Islands (n=977)
Olive oil, main dressing	3368 (95.8)	518 (94.7)	1940 (96.6)	928 (95.0)
Olive oil, >= 4 ts/day	1827 (51.7)	257 (47.0)	1076 (53.6)	494 (50.6)
Vegetables, >= 2s/day	2430 (68.8)	398 (72.8)	1396 (69.5)	636 (65.1)
Fruits, >= 3s/day	1202 (34.0)	180 (32.9)	666 (33.2)	356 (36.4)
Red meat, <1s/day	1854 (52.5)	307 (56.1)	1039 (51.7)	508 (52.0)
Butter, <1s/day	1668 (47.2)	301 (55.0)	888 (44.2)	479 (49.0)
Sweet beverage, <1s/day	1676 (47.4)	293 (53.6)	916 (45.6)	467 (47.8)
Wine, 7s/week	396 (11.2)	60 (11.0)	245 (12.2)	91 (9.3)
Legumes, >=3 s/week	1826 (51.7)	267 (48.8)	966 (48.1)	593 (60.7)
Fish and seafood, >= 3s/week	1376 (38.9)	198 (36.2)	750 (37.3)	428 (43.8)
Sweets, <3s/week	1753 (49.6)	280 (51.2)	970 (48.3)	503 (51.5)
Nuts, >= 3/week	1675 (47.4)	281 (51.4)	909 (45.2)	485 (49.6)
White meat over red	2653 (75.1)	427 (78.1)	1515 (75.4)	711 (72.8)
"Soffritto"	1890 (53.5)	309 (56.5)	1067 (53.1)	514 (52.6)
MEDAS SCORE	7 [6-9]*	7 [6-9]	7 [6-9]	7 [6-9]
ADHERENCE TO THE MD				
Low	765 (21.7)	108 (19.7)	463 (23.0)	194 (19.9)
Medium	2228 (63.1)	344 (62.9)	1261 (62.8)	623 (63.8)
High	540 (15.3)	95 (17.4)	285 (14.2)	160 (16.4)

Positive answers to MEDAS questionnaire. Compliance rates of at least 50% are indicated in bold. Data are expressed as number and percentage in parenthesis (n (%)) for categorical variables or median and IQR in square brackets (M [IQR]) for continuous variables. Vegetables daily serving: 1 medium portion = 200g. Fruit daily serving: 1 serving = 100-150g portion. Red meat/ hamburgers/ other meat daily serving: 1 medium portion = 100-150g. Butter, margarine or cream daily serving: 1 medium portion = 12g. Sweet or sugar sweetened carbonated beverages daily serving: 1 medium portion = 200ml. Wine daily serving: 1 medium portion =125 ml. Legumes weekly serving: 1 portion = 150g. Fish daily serving: 1 medium portion =100-150g. Seafood daily serving: 1 medium portion =200g. Nuts weekly serving: 1 portion of dairy product = 30g. MEDAS, Mediterranean diet adherence screener; MD, Mediterranean diet; s, serving; ts, tablespoon.

*The Shapiro-Wilk test was performed to evaluate variables distribution. Variables are considered non-normally distributed for $p < 0.05$.

Appendix

Appendix A: Questionnaire

	<i>Questions</i>	<i>Answers</i>
Personal Data	1. Age	Age in number
	1. Gender	Female/Male
	1. Hometown	Province
	1. Current employment	Unemployed/ Retiree/ Student/ I work in smartworking at home/ I go to the work as usual/ I have currently suspended my job
Anthropometrics	1. Weight	Weight in kg
	1. Height	Height in cm
MEDAS	1. Is olive oil the main culinary fat used?	Yes/No
	1. Are ≥ 4 tablespoons of olive oil used each day?	Yes/No
	1. Are ≥ 2 servings (of 200g each) of vegetables eaten each day?	Yes/No
	1. Are ≥ 3 servings of fruit (of 80g each) eaten each day?	Yes/No
	1. Is < 1 serving (100-150g) of red meat/ hamburgers/ other meat products eaten each day?	Yes/No
	1. Is < 1 serving (12g) of butter, margarine or cream eaten each day?	Yes/No
	1. Is < 1 serving (330ml) of sweet or sugar sweetened carbonated beverages consumed each day?	Yes/No
	1. Are ≥ 3 glasses (of 125ml) of wine consumed each week?	Yes/No
	1. Are ≥ 3 servings (of 150g) of legumes consumed each week?	Yes/No
	1. Are ≥ 3 servings of fish (100-150g) or seafood (200g) eaten each week?	Yes/No

	1. Is < 3 servings of commercial sweets/pastries eaten each week?	Yes/No
	1. Is ≥ 1 serving (of 30g) of nuts consumed each week?	Yes/No
	1. Is chicken, turkey or rabbit routinely eaten instead of veal, pork, hamburger or sausage?	Yes/No
	1. Are pasta, vegetable or rice dishes flavoured with garlic, tomato, leek or onion eaten \geq twice a week?	Yes/No
Dietary Habit	1. How many portions of pasta, rice or other cereals (spelled, barley, oats, quinoa) do you consume per day? (1 medium portion = 80g)	None/Half portions/ 1 portion/ 2 portions/ >2 portions
	1. How many portions of bread do you consume per day? (1 medium portion = 80g or 2 slices)	None/Half portions/ 1 portion/ 2 portions/ >2 portions
	1. How many portions of milk or yogurt do you consume per day? (1 serving = 150 ml in a cup or 125 g a jar)	None/Half portions/ 1 portion/ 2 portions/ >2 portions
	1. How many portions of cheese or dairy products do you consume per week? (1 portion of dairy product = 100g; 1 portion of matured cheese = 50g)	None/Half portions/ 1 portion/ 2 portions/ >2 portions
	1. How many eggs do you consume per week?	None/ 1 egg/ 2 eggs/ 4 eggs/> 4 eggs
	1. Did your lifestyle and eating habits changed during the COVID-19 pandemic period ?	No, they didn't/ yes, it get worse/ yes, it improved
	1. During this period, which of these foods are you consuming MORE than before?	None/ fruits/fresh vegetables/frozen vegetables/nuts/pasta and cereals/bread/homemade pizza /homemade pastries/ industrial bakery products/ sweets/ham and processed meat/dairy products/ cheese/ cow's milk and yogurt/ vegetable drinks/eggs/fish/frozen fish/canned fish/ legumes/white meat/red meat/coffee, tè, herb tea/sugar or sweeteners/ sugary and sparkling drinks/wine, beer/alcoholic drinks/snacks/seasoning sauces/other
	1. During this period, which of these foods are you consuming LESS than before?	None/ fruits/fresh vegetables/frozen vegetables/nuts/pasta and cereals/bread/homemade pizza /homemade pastries/ industrial bakery products/ sweets/processed meat/dairy products/ cheese/ cow's milk and yogurt/ vegetable drinks/eggs/fish/frozen fish/canned fish/ legumes/white meat/red meat/coffee, tè,herb tea/sugar or sweeteners/

		sugary and sparkling drinks/wine, beer/alcoholic drinks/snacks/seasoning sauces/other
	1. Did you change the number of daily meals, during this period ?	No, it didn't/Yes, I skip 1 or more of the main meals (breakfast, lunch, dinner)/Yes, I skip 1 or more of snacks between meals/Yes I added 1 or more of the main meals/Yes,I added 1 or more of the snacks between meals/ Yes, I eat out of the meals
	1. How much water do you drink per day?	< 1 L/ 1L-2L/> 2L
	1. Do you eat the leftover food?	Never/ < 10% /10-30% / 30-50%/> 50% of the time
Lifestyle Habits Changes	1. where do you buy your food and essentials during this period?	I do not go out for shopping/ supermarket/ grocery store/ Local street market/ farmer's market/organic food shop/fairtrade market/other
	1. Did you smoke before COVID-19 pandemic period? (cigarettes, cigarillos, cigars, electronic cigarette)	No/ Yes, <5 cigarettes/ Yes, 5-10 cigarettes/Yes, >10 cigarettes
	1. Do you currently smoke?	No/ Yes, <5 cigarettes/ Yes, 5-10 cigarettes/Yes, >10 cigarettes
	1. How many hours did you sleep before the COVID-19?	<7 hours per night/7-9 hours per night/>9 hours per night
	1. How many hours do you currently sleep?	<7 hours per night/7-9 hours per night/>9 hours per night
	1. Did you play sport before the COVID-19 emergency?	No/gym/run/swimming/ soccer/volleyball/basket/crossfit/dance/yoga/aerobic fitness/martial arts/ tennis/aerial gymnastics/ other
	1. How many times did you play sport?	I didn't practice any sport/1-2 times a week/ 3-4 times a week/ >5 times a week
	1. Are you currently playing sport at home?	No/weightless workout/ weight training at home/tapis roulant/ functional training/yoga/postural gymnastics/other
	1. How many times do you play sport at home?	I don't practice any sport/1-2 times a week/3-4 times a week/ >5 times a week
	1. What is the time of the day when you are particularly hungry?	Before main meals/between main meals/After dinner
	1. Did your sense of hunger and satiety change during the period at home for the COVID19 emergency?	No/ Yes, less appetite/Yes, more appetite
	1. Did you gain weight during the COVID-19?	No, my weight is stable; No, I think I lose weight/Yes, I think I gain not so much weight/Yes, I think I gain a lot of weight

Figures

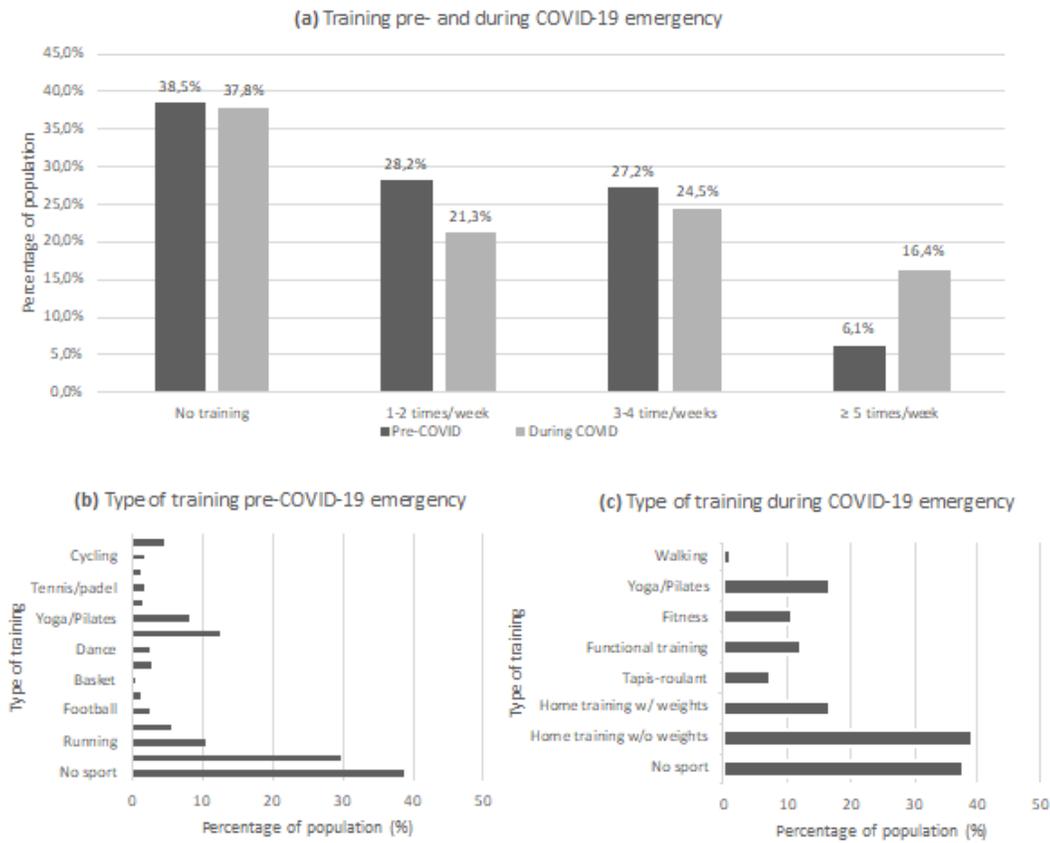


Figure 1

Frequency (a) and type of training (b, c) before and during the COVID-19 emergency.

Variation in food intake during the COVID-19 emergency

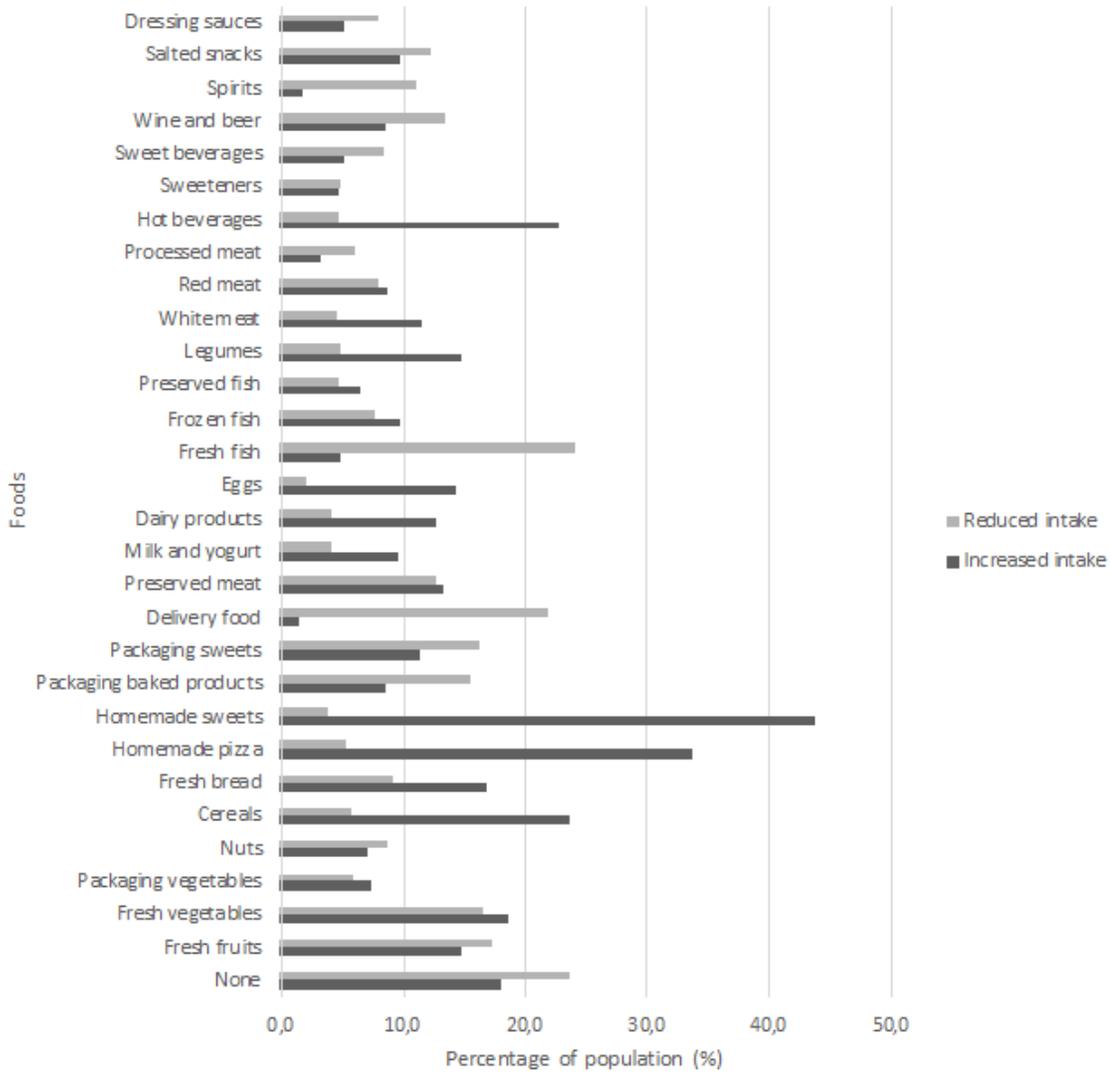


Figure 2

Variation in food intake during the COVID-19 emergency.

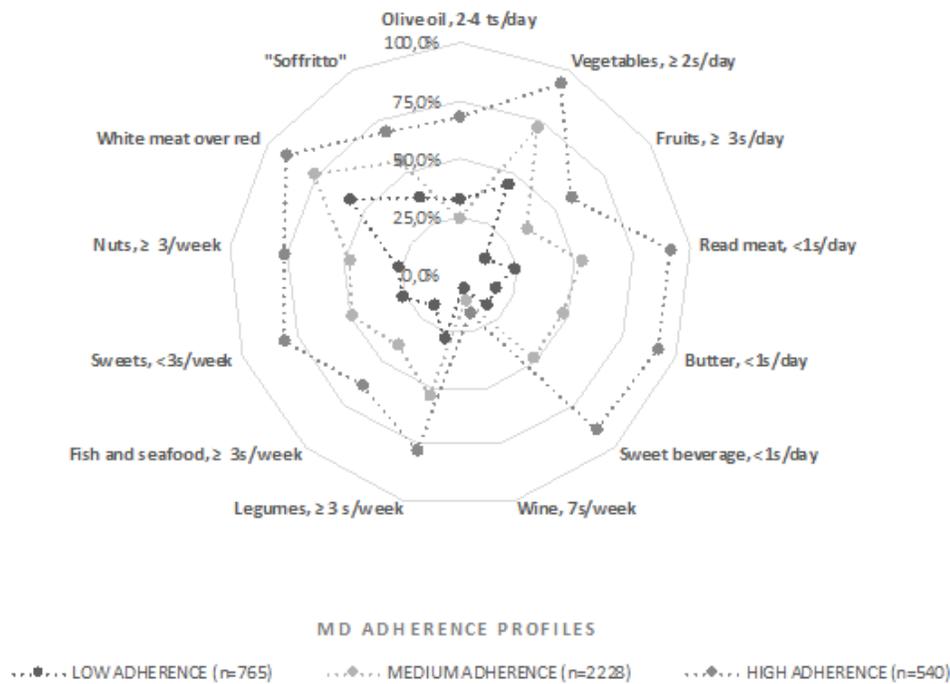


Figure 3

Compliance with items from MEDAS according to high, medium and low adherence to the Mediterranean Diet (MD). The radar chart plots the values of each item of MEDAS score along a separate axis that starts in the centre of the chart (0% compliance) and ends at the outer ring (100% compliance). The values are the percentage of the population adherent to each recommendation.

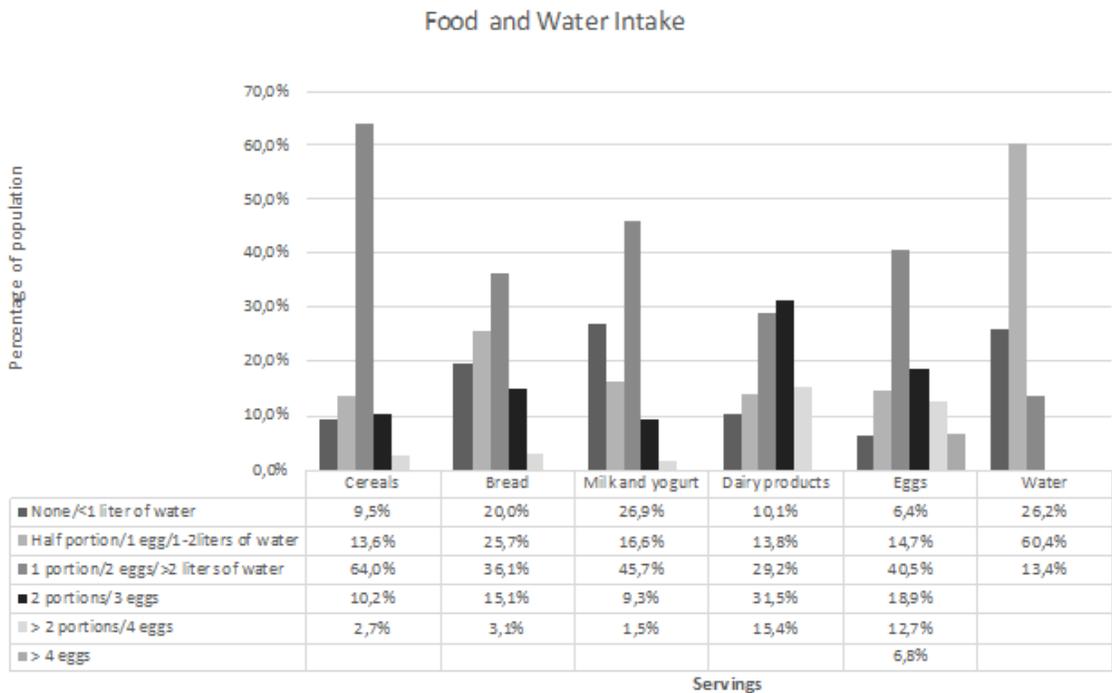


Figure 4

Food and water intake during COVID-19 lockdown. The ordinate axis represents the percentage of population. The abscissa axis represents the daily/weekly portions for each category of foods. None, half, 1, 2 and > 2 represent the number of daily servings of cereals, bread, milk and yogurt and dairy products. None, 1, 2, 3, 4 and > 4 represent the number of weekly servings of eggs. < 1 liter, 1-2 liters and > 2 liters represent the daily intake of water. Pasta, rice or other cereals (spelled, barley, oats, quinoa) daily serving: 1 medium serving= 80g. Bread daily serving: 1 medium serving= 80g or 2 slices. Milk or yogurt daily serving: 1 serving = 150 ml in a cup or 125 g a jar. Cheese or dairy products weekly serving: 1 portion of dairy product = 100g; 1 portion of matured cheese = 50g.



Figure 5

Geographical distribution of COVID-19 total positive cases in Italy on April 24th 2020. Data derived from the Health Ministry of Italy[42].