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## **Diet and physical activity during the COVID-19 lockdown (March-May 2020): results from the French NutriNet-Santé cohort study**

Mélanie Deschasaux-Tanguy, Nathalie Druesne-Pecollo, Younes Esseddik, Fabien Szabo de Edelenyi, Benjamin Allès, Valentina A. Andreeva, Julia Baudry, Hélène Charreire, Valérie Deschamps, Manon Egnell, Leopold K. Fezeu, Pilar Galan, Chantal Julia, Emmanuelle Kesse-Guyot, Paule Latino-Martel, Jean-Michel Oppert, Sandrine Péneau, Charlotte Verdout, Serge Hercberg, Mathilde Touvier

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**Running head:** Nutrition during the COVID-19 lockdown

**Study registration:** ClinicalTrials.gov #NCT03335644

**Data availability statement:** Data described in the manuscript will be made available upon request to the study’s operational manager, Nathalie Druesne-Pecollo ([n.pecollo@eren.smbh.univparis13.fr](mailto:n.pecollo@eren.smbh.univparis13.fr)), and review by the steering committee of the NutriNet-Santé study.

**Conflict of interest statement:** The authors report no conflicts of interest.

**Abbreviations:** AHEI, Alternative Healthy Eating Index; BMI, Body mass index; BW, body weight; COVID-19, coronavirus disease 2019; GAD, General Anxiety Disorder; IPAQ, International Physical Activity Questionnaire; MET, Metabolic Equivalent of Task; PHQ, Patient Health Questionnaire; PA, physical activity; ST, sedentary time; SARS CoV-2, severe acute respiratory syndrome coronavirus 2

## 1 ABSTRACT

2 **Background:** Since December 2019, the coronavirus disease (COVID-19) has been spreading  
3 steadily, resulting in overwhelmed health care systems and numerous deaths worldwide. To counter  
4 these outcomes, many countries, including France, put in place strict lockdown measures, requiring  
5 the temporary closure of all but essential places and causing an unprecedented disruption of daily life.

6 **Objective:** Our objective was to explore potential changes in dietary intake, physical activity, body  
7 weight, and food supply during the COVID-19 lockdown and how these differed according to  
8 individual characteristics.

9 **Design:** 37,252 adults from the French web-based NutriNet-Santé cohort who completed lockdown-  
10 specific questionnaires in April-May 2020 were included in the analyses. Nutrition-related changes  
11 and their sociodemographic, lifestyle and health status correlates were investigated using  
12 multivariable logistic regression models. Clusters of participants were defined using ascending  
13 hierarchical classification of change profiles derived from multiple correspondence analysis.

14 **Results:** During the lockdown, trends of unfavorable changes were observed: decreased physical  
15 activity (reported by 53% of the participants), increased sedentary time (reported by 63%), increased  
16 snacking, decreased consumption of fresh food (especially fruit and fish), and increased consumption  
17 of sweets, cookies and cakes. Yet, the opposite trends were also observed: increased home-cooking  
18 (reported by 40%) and increased physical activity (reported by 19%). Besides, 35% of the participants  
19 gained weight (mean (SD) weight gain in these individuals: 1.8kg (1.3)) and 23% lost weight (2kg  
20 (1.4) weight loss). All of these trends displayed associations with various individual characteristics.

21 **Conclusions:** These results suggest that nutrition-related changes occurred during the lockdown in  
22 both unfavorable and favorable directions. The observed unfavorable changes should be considered  
23 in the event of a future lockdown, and should also be monitored to prevent an increase in the nutrition-  
24 related burden of disease, should these diet/physical activity changes be maintained in the long run.  
25 Understanding the favorable changes may help extend them on a broader scale.

26 **Keywords:** nutrition; COVID-19 lockdown; diet; physical activity; sedentariness; body weight;  
27 cohort study

## 28 INTRODUCTION

29 After first being reported in Wuhan, China, in December 2019, the outbreak of the coronavirus  
30 disease (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS CoV-2)  
31 was characterized as a pandemic by the World Health Organization on March 11, 2020, following its  
32 worldwide spread (1). Considering the numerous unknowns surrounding the SARS CoV-2 as well as  
33 the absence of treatment, several countries successively opted for strict lockdown measures in order  
34 to curtail the fast-growing transmission of the disease and the associated overload of hospitals and  
35 health care systems.

36 In France, such lockdown measures came into effect on March 17, 2020; they were partially lifted on  
37 May 11 and June 2, 2020. These measures required the temporary closure of all but the most essential  
38 public places, businesses and services. The population was required to stay at home: going outdoors  
39 was monitored by police and was allowed only if the activity took place in the vicinity of the home  
40 and was related to meeting essential needs (e.g., grocery shopping, medical care, legal obligations  
41 and quick recreational physical activity). Only employees in “essential” sectors (e.g., healthcare, food  
42 and drug manufacturers and suppliers, waste collection) were allowed to maintain their usual work  
43 activities. As a result, the majority of the working population was required to work from home or was  
44 placed on partial/technical unemployment. Distance learning was implemented by schools and  
45 universities, and parents actually became teacher substitutes. This unprecedented situation resulted in  
46 a sudden disruption of daily routines, accompanied by uncertainties and worries related both to the  
47 pandemic and to the professional and familial organization during and after the lockdown.  
48 Nonetheless, the experience was not uniform for the entire population but rather dependent on a  
49 variety of circumstances according to sociodemographic and economic status and the area of  
50 residence. Overall, the lockdown likely resulted in disruptions of food-related practices and physical  
51 activity, as well as body weight changes and increased sedentariness, as suggested by reports from  
52 surveys in other countries (2–14). Indeed, the lockdown measures altered access to food, prevented  
53 mobility and use of green spaces and sports clubs, and impacted daily rhythm and activities.

54 Given the unprecedented nature of such lockdown measures as well as the real possibility of future  
55 lockdowns, it is important to assess health behavior changes during the lockdown especially as  
56 regards food-related practices, physical activity and weight status. It is likewise necessary to  
57 investigate whether these changes cluster across individual characteristics and whether they are  
58 associated with sociodemographic and economic inequalities. The obtained knowledge could be of  
59 critical importance for future public health measures in extreme situations nationally and/or  
60 internationally and could also help inform future prevention efforts should changes persist post-  
61 lockdown.

62 Indeed, nutrition (i.e., diet, physical activity, weight status) is one of the main modifiable factors  
63 regarding chronic disease risk (e.g., cardiovascular diseases, type 2 diabetes, cancer) (15,16).  
64 Moreover, the mounting evidence showing the importance of nutritional factors in immune function  
65 (17,18) suggests that nutrition may directly impact risk of SARS CoV-2 infection and its prognosis  
66 (19–22).

67 The NutriNet-Santé web platform offered a unique opportunity to collect a large amount of nutrition,  
68 behavior and health status data during the lockdown from >37,000 French adults using online  
69 questionnaires and validated dietary records. The primary aim of the present study was to characterize  
70 and cluster changes in diet-related practices, physical activity, and body weight during the COVID-  
71 19 lockdown in France. The secondary objective was to explore the sources of food supply that were  
72 used during that period.

## 73 **METHODS**

### 74 **Study population: the NutriNet-Santé cohort**

75 The NutriNet-Santé cohort was launched in France in 2009 with the objective to examine the  
76 associations between nutrition and health, as well as the determinants of nutrition-related behaviors  
77 (23). Recruitment of participants [adults aged  $\geq 18$  years (2009-2019); individuals aged  $>15$  years  
78 (since 2020)] is still ongoing. The study uses a secure and flexible online platform for recruitment  
79 and data collection. It allows for the rapid implementation of ad hoc research protocols. The NutriNet-

80 Santé study is conducted in accordance with the Declaration of Helsinki, and all procedures were  
81 approved by the Institutional Review Board of the French Institute for Health and Medical Research  
82 (IRB INSERM 0000388FWA00005831) and by the National Commission on Informatics and Liberty  
83 (CNIL 908,450 and 909,216). All participants provided informed consent and an electronic signature;  
84 this study is registered in ClinicalTrials.gov (#NCT03335644).

#### 85 **Data collection in the NutriNet-Santé cohort**

86 Upon inclusion, NutriNet-Santé participants are asked to complete a set of five validated self-  
87 administered web-based questionnaires related to 1) sociodemographic and lifestyle characteristics  
88 (24), 2) health status, 3) dietary intake (25–27), 4) physical activity (short form of the International  
89 Physical Activity Questionnaire, IPAQ (28)), and 5) anthropometrics (29,30). These questionnaires  
90 are re-administered every 6 to 12 months during follow-up.

91 As part of the usual cohort follow-up, dietary intake is assessed every 6 months, each time using a set  
92 of three non-consecutive 24h dietary records, randomly distributed over two weeks including two  
93 weekdays and one weekend day. These web-based 24h dietary records have been validated against  
94 dietary records completed via interviews with a dietitian and against plasma/urine biomarkers (25–  
95 27). Portion sizes are estimated using validated photographs, standard food/beverage containers or  
96 directly in g/L. Mean daily energy, alcohol and macro- and micro-nutrient intakes are estimated using  
97 a published French food composition table comprising >3,500 food items (31). Amounts consumed  
98 from composite dishes are estimated using French recipes validated by food and nutrition  
99 professionals. Dietary energy under-reporters are detected via the method proposed by Black (32).  
100 Usual dietary intakes were calculated as the average intakes per day over all 24h dietary records  
101 available for the period of interest (i.e., pre-lockdown or during the lockdown). In addition, dietary  
102 data are weighted in order to account for week day and weekend consumption. In turn, the short-form  
103 IPAQ is administered annually, assessing physical activity level (vigorous, moderate or walking) and  
104 time spent seated on an average day (outside mealtimes and sleep) during the past 7 days. Physical

105 activity levels for each participant are computed as Metabolic Equivalent of Task (MET) minutes per  
106 week.

### 107 **Data collection during the COVID-19 lockdown**

108 In April 2020, a set of ad hoc questionnaires was sent to all eligible NutriNet-Santé participants  
109 (N=152,000) to collect extensive data on diet-related practices and physical activity during the  
110 lockdown. The set included a specific questionnaire on perceived changes in dietary habits (along  
111 with associated reasons), consumption of major food groups, snacking, food supply preferences,  
112 physical activity and sedentary time (details are provided in Supplementary Material 1); a series of  
113 three 24h dietary records randomly assigned over two weeks during the strict lockdown period  
114 (covering two weekdays and one weekend day); and the short-form IPAQ (permitting the  
115 computation of MET-min/week). The 24h dietary records and the short-form IPAQ were the same as  
116 those regularly sent to participants as part of their follow-up (described above).

117 Next, body weight measures at the beginning and at the end of the strict lockdown period were  
118 collected from self-reports in early April and early May 2020. These anthropometric questionnaires  
119 also asked about body weight just before the lockdown. Participants were specifically asked if they  
120 had been able to measure their weight with a scale and to provide measured data. Only data from  
121 participants who reported that they had used a scale were taken into account when calculating weight  
122 changes. The web-based self-reported body weight measures had been validated in the cohort by  
123 means of comparisons with standardized clinical measurements (29). Body mass index (BMI) was  
124 computed as weight [kilograms] / height<sup>2</sup> [meters]. The following categories of body weight status  
125 were defined: obese (BMI  $\geq 30$  kg/m<sup>2</sup>), overweight (BMI  $\geq 25$  to  $< 30$  kg/m<sup>2</sup>), normal weight (BMI  
126  $\geq 18.5$  to  $< 25$  kg/m<sup>2</sup>), and underweight (BMI  $< 18.5$  kg/m<sup>2</sup>).

127 Finally, a questionnaire assessing participants' exposure to SARS-CoV-2, COVID-19  
128 infection/diagnosis and experience of the lockdown was sent in April 2020 as part of a nationwide  
129 multi-cohort project (*Health, practices, relationships and social inequalities in the general*  
130 *population during the COVID-19 crisis, SAPRIS*). That questionnaire was used to derive

131 demographic, physical and mental health information during the lockdown (professional status,  
132 presence at home of children and/or grandchildren aged < 18 years), presence of depressive symptoms  
133 (Patient Health Questionnaire (PHQ)-9 scale (33)) and anxiety (Generalized Anxiety Disorder  
134 (GAD)-7 scale (34)). Details about the PHQ-9 and the GAD-7 are provided in Supplementary  
135 Material 2.

### 136 **Statistical analyses**

137 A total of 37,252 participants residing in metropolitan France completed the specific questionnaire  
138 related to nutrition during the COVID-19 lockdown: those data served as a basis for the main analyses  
139 ('full sample'). In that sample, 27,658 participants had valid data regarding dietary intake before the  
140 lockdown ('usual dietary intake (DI) sample'); 30,032 had valid data from the short-form IPAQ on  
141 physical activity levels ('physical activity (PA) sample') and 30,022 had valid data regarding  
142 sedentary time ('sedentary time (ST) sample') before and during the lockdown; 22,042 participants  
143 reported having access to a body weight scale and provided measured values of body weight before  
144 the lockdown and on May 2020 ('body weight (BW) sample'). In addition, in the full sample, valid  
145 dietary intake data from 24h dietary records consistently completed during the month of April during  
146 the three years preceding the lockdown were available for N=1,264 (2017), N=1,075 (2018), and  
147 N=991 (2019); dietary intake data from 24h dietary records completed in April 2020 during the  
148 lockdown were available for N=10,617. Overall, 1,548 participants had valid dietary intake data from  
149 24h dietary records from two time points, one of them being in April 2020 during the lockdown and  
150 one of them being during the month of April in the previous three years (2017-2019). More details  
151 are available in the flowchart provided as Supplementary Figure 1.

152 Two indicators of diet quality were calculated based on the dietary intakes of food and nutrients  
153 before and during the lockdown. The Alternative Healthy Eating Index (AHEI)-2010 score (35) was  
154 calculated, taking into account intake of vegetables, fruit, whole grains, sugar-sweetened beverages,  
155 nuts and legumes, red/processed meat, long-chain (n-3) polyunsaturated fatty acids, total  
156 polyunsaturated fatty acids, sodium and alcohol (details are available in Supplementary Material 3).

157 The percentage (by relative weight) of ultra-processed foods in the diet was assessed using the NOVA  
158 classification, as previously described (36).

159 Overall, the collected data were summarized using numbers and percentages for categorical variables  
160 and mean values and standard deviations (or median values and interquartile ranges) for continuous  
161 variables. Student paired-samples t-tests were used to compare quantitative variables before and  
162 during the lockdown (i.e., dietary intake of food groups, macro- and micronutrients in g/day, AHEI-  
163 2010 score in points, proportion of ultra-processed foods in %, physical activity in MET-min/week  
164 and sedentary time in hours). Changes in continuous variable values (during versus before the  
165 lockdown) were computed as raw values and as percentage change ((value during lockdown – value  
166 before lockdown)/value before lockdown). Increased or decreased dietary intakes were defined as  
167 change of at least 10% between the average intake as reported in April 2020 (i.e., during the  
168 lockdown) and the average intake as reported during the month of April before the lockdown (2017-  
169 2019).

170 A multiple correspondence analysis was carried out in the BW sample (N=22,042) using the  
171 following parameters assessed during the lockdown: change in body weight, perceived change in  
172 sedentary time and physical activity level, main reasons for modifying diet-related practices,  
173 perceived change in diet quality, perceived change in the types of food consumed (fresh products:  
174 fruit, vegetables, fish and red meat, potatoes, sandwiches/pizzas/savory pies, cheese,  
175 sweets/chocolate, cookies/cakes, alcohol, tea), food-storing behavior, snacking, and stress related to  
176 a potential food shortage. Two dimensions (i.e., latent factors) were retained (respectively explaining  
177 10.6% and 6.4% of the variance) after considering eigenvalues, scree test results and the  
178 relevance/interpretability of the profiles of nutrition-related changes during the lockdown as reflected  
179 by the two dimensions (37,38). The coordinates of the nutrition-related changes along these two  
180 dimensions are shown in Supplementary Table 1. An ascending hierarchical classification was then  
181 applied on the individual scores along these two dimensions to identify clusters of participants  
182 displaying similar nutrition-related changes during the lockdown. The characteristics of participants

183 associated with each cluster (modeled as dummy variables, i.e., cluster X vs. all others combined)  
184 were studied using multivariable logistic regression models including the following characteristics  
185 (the variable categories are detailed in Table 1): age, sex, current weight status (in April 2020),  
186 smoking status, educational level, household monthly income, professional activity during the  
187 lockdown, marital status during the lockdown, presence of children and/or grandchildren aged < 18  
188 years at home during the lockdown, region of residence during the lockdown, urban or rural  
189 residential area during the lockdown, depressive symptoms during the lockdown (PHQ-9 score),  
190 anxiety during the lockdown (GAD-7 score), and self-reported chronic disease. For participants for  
191 whom data on usual dietary intake pre-lockdown were available (N=16,562), the adjusted models  
192 additionally included the AHEI-2010 score and the proportion of ultra-processed foods in the usual  
193 diet.

194 In a secondary analysis, individual characteristics associated with specific nutrition-related changes  
195 were studied using multivariable-adjusted logistic regression models (binary or multinomial) for  
196 categorical variables and ANCOVA models for variations in continuous variables. These models  
197 included the same covariables as those detailed above and additionally included perceived changes  
198 in sedentary behaviors and physical activity during the lockdown.

199 A two-level weighting scheme was developed to take into account and correct for potential bias owing  
200 to differences in the sociodemographic variables distribution (sex, age, area of residence,  
201 occupational category) between the study sample (n=37,252) and 1) the entire NutriNet-Santé cohort,  
202 and 2) the general French population, using the SAS macro %CALMAR and French national Census  
203 data (INSEE, 2016). The calculated weights were then applied in all analyses in order to allow for  
204 some extrapolation of the results to the general French adult population.

205 All tests were two-sided and  $P < 0.05$  was considered statistically significant. Analyses were carried  
206 out using SAS 9.4 (SAS Institute Inc., USA).

## 207 **RESULTS**

208 After weighting, our study population was composed of 37,252 participants (52.3% women) with a  
209 mean age of 52.1 y (SD: 16.6). Descriptive characteristics of the participants are shown in Table 1.

### 210 **Diet-related practices during the lockdown**

211 Overall, 56.2% of the participants ('full sample') reported that they modified their diet-related  
212 practices during lockdown. The main reasons for these modifications (shown in Supplementary  
213 Figure 2) were related to inherent lifestyle changes during the lockdown (change in routine: 47.6%,  
214 spending more time cooking homemade meals: 40.4%, no longer eating out: 20.5%, trouble keeping  
215 a regular mealtime schedule: 10.1%), to alterations in food supply (buying less fresh products: 27.4%,  
216 difficulty going to usual stores: 25.9%, difficulty finding preferred products: 13.7%, difficulty buying  
217 organic food: 12.3%), to voluntary behavior changes (trying to avoid weight gain: 21.1%,  
218 compensating for the decrease in physical activity: 16.9%, opportunity to balance diet: 14.2%), and  
219 to emotional reasons (eating out of boredom: 18.2%, eating due to anxiety: 10.8%). Regarding  
220 perceived diet quality during the lockdown compared to before, 74.4% reported that their diet quality  
221 had not changed, 14.1% reported that it was improved and 10.5% reported that it had deteriorated  
222 ('full sample'). During the lockdown, 5.6% of participants ('full sample') reported snacking at least  
223 three times a day, every day (vs. 3.1% in a previous study dealing with snacking behaviors in the  
224 NutriNet-Santé cohort, although not in the same sample (39)), 22.3% once or twice a day, every day  
225 (vs. 18.6%), 11.4% four to six times a week (vs. 11.5%), 22.7% once to three times a week (vs.  
226 29.6%), 17% less than once a week (vs. 21.8%) and 21.1% never (vs. 15.4%). Snacking more than  
227 usual was reported by 21.1% of participants ('full sample'), among which 18.9% reported snacking  
228 at least 3 times a day, every day. In turn, snacking less than usual was reported by 9.4% of the sample  
229 while 69.5% reported snacking as usual. Moreover, 27.1% of participants reported that they felt  
230 stressed by the hypothetical possibility of lacking some food during the lockdown ('full sample').  
231 However, only 3.3% of participants reported that they stored more food than usual to prevent food  
232 shortages, while 45% stored more food due to a reduced frequency of grocery shopping.  
233 Characteristics of participants associated with perceived changes in diet-related practices during the

234 lockdown along with the associated reasons for these changes are shown respectively in  
235 Supplementary Tables 2 and 3 ('full sample').

236 Perceived changes in the consumption of major food groups during the lockdown are reported in  
237 Figure 1 ('full sample'). An overall decrease in the consumption of fresh products was observed: 17%  
238 of participants reported a decrease for fresh fruit and 18% - for fresh vegetables, 22% - for fresh red  
239 meat and 31% - for fresh fish. In parallel, 14% of participants reported having increased their  
240 consumption of frozen or canned vegetables (that proportion was much lower for frozen or canned  
241 fruit, fish or red meat). In addition, we noted an increased consumption of other products with a long  
242 shelf-life, such as potatoes (reported by 15% of the participants), legumes (15%) and nuts (12%).  
243 Other noteworthy results include an increased consumption of sweets and chocolate (reported by 22%  
244 of the participants), cookies and cakes (20%), and cheese (18%), and a decreased consumption of  
245 sandwiches, pizzas or savory pies (17%). As regards beverage products, 15% of the participants  
246 reported an increased and 12% reported a decreased alcohol consumption, 20% reported an increased  
247 consumption of tea, and 13% – an increased consumption of tap water.

248 Quantitative dietary intakes reported in April 2020 (via 24h dietary records completed during the  
249 lockdown, N=10,617) were compared to the quantitative dietary intakes reported during the month  
250 of April over the past three years (via repeated 24h dietary records completed in 2017: N=1,264;  
251 2018: N=1,075; and 2019: N=991). We observed relatively stable intakes between 2017 and 2019  
252 and a drop in 2020 for total energy, carbohydrates, fish and vitamin B12; a trend towards decreasing  
253 protein intakes during 2017-2019 (reflecting the current decrease in consumption of animal products  
254 in France) and a further drop in 2020. Few changes between 2017 and 2020 were found regarding the  
255 AHEI score, the proportion of ultra-processed foods in the diet, or for dietary fat, fiber, fruit and  
256 vegetables. These results are summarized in Figure 2 and a detailed account of dietary intakes as  
257 regards macro- and micronutrients, food groups, AHEI score and proportion of ultra-processed foods  
258 in the diet is provided in Supplementary Table 4. Overall, the quantitative estimates reflected most of  
259 the perceived changes, with the few discrepancies likely owing to the profile of participants who

260 completed the dietary records during the lockdown (N=10,617) compared to the ‘full sample’ (more  
261 likely to be older, men, normal-weight, to have a higher income and no professional activity pre-  
262 lockdown; details are provided in Supplementary Table 5). When comparing energy intakes in April  
263 2020 to those reported in April 2017-2019 (N=1,548), an increase was observed for 25% of  
264 participants, with +468 Kcal/day (SD: 274) on average, i.e., +26%. On the other hand, a decrease in  
265 energy intake was observed for 33% of participants, with -510 Kcal/day (SD: 267) on average, i.e., -  
266 23% (Figure 3). Comparisons between April 2020 and April 2017-2019 regarding dietary intakes  
267 (N=1,548) are presented in Supplementary Table 6. Details about the participant characteristics  
268 associated with changes in energy intake are shown in Supplementary Table 7.

### 269 **Physical activity and sedentary behavior during the lockdown**

270 A majority (52.8%) of participants perceived a decrease in their level of physical activity during the  
271 lockdown (‘full sample’). Among these participants, a quantitative assessment using the IPAQ (‘PA  
272 sample’) revealed median physical activity levels of 1752 MET-min/week (IQR: 742.5-3519), which  
273 is 38% lower than before the lockdown (paired Student t-test:  $P < 0.0001$ ). In contrast, a lower  
274 proportion (18.7%; ‘full sample’) perceived an increase in their level of physical activity during the  
275 lockdown (median: 2832 MET-min/week, IQR: 1632-4944; +18% as compared to before the  
276 lockdown;  $P < 0.0001$ , ‘PA sample’). In addition, 63.2% of participants perceived an increase in their  
277 sedentary time (‘full sample’). Among them (‘ST sample’), a quantitative assessment highlighted an  
278 average of 7.0 h/day spent seated during the lockdown (SD: 3.2), which is 21% higher than the  
279 average time spent sitting before the lockdown (paired Student t-test:  $P < 0.0001$ ). In turn, 28.5% (‘full  
280 sample’) reported no change in sedentary time (mean: 5.8 h/day spent seated, SD: 3.3; +4%;  
281  $P < 0.0001$ , ‘ST sample’). Participants reporting that they decreased their level of physical activity  
282 (‘full sample’) were also those reporting the longest time spent seated (mean: 6.9 h/day, SD: 3.3, ‘ST’  
283 sample) and the largest increase in sitting time (+18% compared to before the lockdown;  $P < 0.0001$ ,  
284 ‘ST’ sample). Likewise, participants reporting that they increased their sedentary time (‘full sample’)  
285 were also those reporting the lowest physical activity levels (median: 1857 MET-min/wk, IQR: 840-

286 3570, 'PA' sample) and the largest decrease in physical activity (-30%;  $P < 0.0001$ , 'PA' sample).  
287 These results are summarized in Figure 3 and displayed in Supplementary Table 8. Details about the  
288 participant characteristics associated with changes in physical activity levels and sedentary time are  
289 shown in Supplementary Table 7.

#### 290 **Body weight change during the lockdown**

291 A weight gain between the weight just before the lockdown and the weight in May 2020 (after about  
292 2 months of lockdown, 'BW sample') was observed in 35% of participants, with an average gain of  
293 1.8 kg (SD: 1.3). In turn, a weight loss was observed in 23% of participants, with an average loss of  
294 2.0 kg (SD: 1.4). Meanwhile, body weight remained stable (no difference in reported values) for 42%  
295 of the participants. Details about the participant characteristics associated with weight change are  
296 shown in Supplementary Table 7.

#### 297 **Profiles of nutrition-related changes during the lockdown**

298 Two main latent factors (i.e., dimensions) of nutrition-related changes during the lockdown were  
299 identified using multiple correspondence analysis ('BW sample'). The ascending hierarchical  
300 classification performed on these two dimensions led to the subsequent identification of three clusters  
301 of participants. Cluster 1 (42.9% of participants) corresponded to those with stable diet-related  
302 practices, physical activity and body weight during the lockdown (Supplementary Table 9). This "no  
303 change" cluster was associated with older age, male gender, normal-weight, current smoking, a lower  
304 level of education, working outside the home during the lockdown or not having a professional  
305 activity before the lockdown (i.e., unemployed, homemaker, retired), being in a relationship (married  
306 or not), living in cities with  $< 100,000$  inhabitants or in rural areas, living in regions other than the  
307 Paris Region or the Eastern part of France (i.e., the regions where the epidemic was the most severe),  
308 with less anxiety and/or fewer depressive symptoms, and a higher diet quality before the lockdown  
309 (higher AHEI-2010 score and lower proportion of ultra-processed foods in the diet) (Table 2).

310 In turn, Cluster 2 (37.4%) included participants who exhibited unfavorable nutrition-related changes  
311 during the lockdown: increased weight, decreased physical activity and increased sedentary time,

312 trouble keeping a regular mealtime schedule, buying less fresh products, snacking more than once a  
313 day, more likely to eat out of boredom and/or due to anxiety, reporting a perceived increase in the  
314 consumption of cookies/cakes, sweets/chocolate, sandwiches/pizza/savory pies, potatoes, cheese, and  
315 alcoholic drinks, and a decrease in their consumption of fresh products (fruit, vegetables, meat), likely  
316 to report difficulties regarding grocery shopping in preferred stores and/or of preferred food products  
317 including organic foods, experiencing stress related to potential food shortages, and accumulation of  
318 food products. In this cluster, participants also reported spending more time cooking homemade meals  
319 and that their diet quality did not change (Supplementary Table 9). This cluster was associated with  
320 younger age, female gender, non-smoking, a higher level of education but a lower income, working  
321 from home during the lockdown, the presence of children aged under 18 y at home, more anxiety and  
322 depressive symptoms, and with pre-lockdown diets featuring a higher proportion of ultra-processed  
323 foods (Table 2).

324 Finally, Cluster 3 (19.8%) included participants who reported favorable nutrition-related changes  
325 during the lockdown, such as perceived decrease in the consumption of cookies/cakes,  
326 sweets/chocolate, sandwiches/pizza/savory pies and alcoholic drinks, and an increased consumption  
327 of fresh fruit, vegetables and fish, a better self-perceived diet quality, avoidance of some foods or  
328 drinks for weight management purposes, a willingness to balance their diets, and spending more time  
329 than usual cooking homemade meals (Supplementary Table 9). This cluster was associated with  
330 younger age, overweight/obesity, smoking, a higher level of education and income, being  
331 partially/technically unemployed, being a student or working from home during the lockdown, having  
332 no children aged under 18 y in the household, experiencing more anxiety but fewer depressive  
333 symptoms, and displaying a lower usual diet quality (lower AHEI-2010 score) (Table 2).

### 334 **Sources of food supply**

335 During the lockdown, individuals ('full sample') used on average 3.6 (SD: 1.7) different sources of  
336 food supply, which is 1.1 less than usual (paired Student t-test:  $P < 0.0001$ ). The top 3 sources of supply  
337 during the lockdown (Figure 4) were the supermarket (66%), the bakery (60.3%) and the local grocery

338 store (41.3%), the latter owing its third place due to decreased visits (compared to usual) of local  
339 outdoor food markets (which showed the sharpest reduction, especially in cities with >20,000  
340 inhabitants, as such markets were prohibited during the lockdown), hypermarkets, and local shops  
341 such as the butcher's, fishmonger's or greengrocer's. Contrary to the observed overall reduction in  
342 the number of sources of food supply, slight increases were observed for Internet, phone and/or mail-  
343 order purchases and for orders of food baskets from local farmers or associations supporting small  
344 local farming. Only a slight decrease was observed for use of organic food stores. Finally, 6.3% of  
345 participants reported that they did not live in their usual home during the lockdown, which may have  
346 impacted the sources of food supply available to them.

## 347 **DISCUSSION**

348 This study, conducted in a sample of >37,000 adults, provided an overview of diet-related changes  
349 during the COVID-19 nationwide lockdown from March to May 2020. Overall, our results  
350 highlighted divergent changes in food-related practices, physical activity, sedentary time, and body  
351 weight. Specifically, we observed expected "unfavorable" changes but also some "favorable" changes  
352 as well as no change for some groups of individuals. Overall, these patterns reflected socioeconomic  
353 inequalities.

354 The cluster displaying "unfavorable changes" during the lockdown (Cluster 2) was characterized by  
355 decreased physical activity levels and increased sedentary time. Such a pattern, also observed in other  
356 countries (2–5), was largely automatically induced by the "stay-at-home" measures, including the  
357 prohibition of daily work-related or leisure-related mobility. In line with prior reports (6–10), our  
358 results also showed increased snacking behaviors and a consistent trend reflecting an increased  
359 consumption of sweets, chocolate, cookies or cakes, alcoholic drinks and total energy. Individuals in  
360 that cluster also reported buying fewer fresh products, likely due to less frequent grocery shopping  
361 and/or difficulties accessing their usual food stores or finding their preferred food products. Likewise,  
362 and as observed elsewhere (6,11), participants reported a decreased consumption in fresh vegetables,  
363 fruit and fish, i.e., food groups for which pre-lockdown consumption by the French population was

364 already below the national dietary recommendations (40). Even though an increased consumption of  
365 frozen and/or canned vegetables was reported, which likely partly compensated for the decrease in  
366 fresh vegetable consumption, such a compensation did not appear for fruit (although there may have  
367 been a compensation with fruit purées) or fish. As a result of changes in physical activity and food  
368 consumption during the lockdown, weight gain expectedly occurred during the lockdown: this  
369 outcome was also reported in other countries (2,6,8,9,12,41). Although not fully comparable, studies  
370 dealing with the health effects of vacation periods, i.e., periods of disrupted daily habits, especially  
371 regarding physical activity and food consumption, have similarly shown weight gain over short  
372 periods of time; such weight gain may become permanent in some individuals, and if the unfavorable  
373 trends regarding insufficient physical activity and unhealthy food consumption are not reversed, and  
374 might even lead to more weight gain in the future (42). Other studies focusing on the impact of several  
375 weeks of decreased physical activity and modified food consumption have shown metabolic  
376 consequences (increased insulin resistance, inflammation, fat accumulation) even over such a short  
377 period of time (43). In our study, these “unfavorable changes” seemed associated with being female,  
378 working from home and with the presence of children at home, i.e., parents who maintained their  
379 work activities while taking care of their children. The pattern was also associated with lower income,  
380 a higher pre-lockdown consumption of ultra-processed foods and more depressive symptoms. This  
381 profile suggests less opportunity (e.g., time, financial or technical means) to engage in health  
382 behaviors and may explain the observed snacking behaviors and consumption of “comfort” foods  
383 (sweets, cookies, cakes) (44,45). In particular, the lockdown situation may have led to overeating and  
384 snacking in response to the accumulation of working, teaching and child care (46) responsibilities. In  
385 fact, having children in the household has been associated with both healthier and unhealthier  
386 nutritional profiles for parents (47–50).

387 On the other hand, the cluster of “favorable changes” during the lockdown (Cluster 3) reflected  
388 increased consumption of fruit and vegetables, and decreased consumption of sandwiches, savory  
389 pies and pizza, sweets and chocolate, cookies and cakes, and alcoholic drinks. Participants in that

390 cluster reported that they worked on balancing their diet during the lockdown to improve its quality  
391 or to compensate for the loss of physical activity. Reports from other countries (3,6,11,13) also  
392 showed improved diet quality during the lockdown in certain population subgroups. These changes  
393 in food consumption may be attributed either to a willingness to improve one's diet or to a disruption  
394 of eating habits related to the temporary closure of workplace cafeteria and restaurants (hence reduced  
395 eating out). Increased physical activity levels were also observed in our study and elsewhere (4,5,11).  
396 This may have resulted from increased at-home training. It should be noted, however, that in France,  
397 individuals were allowed to engage in outdoor physical activity (within a 1-km radius for 1h) during  
398 the lockdown, which may have encouraged some people to do so. Finally, some participants also lost  
399 some weight, echoing the conscious striving for a more balanced diet and physical activity. These  
400 "favorable changes" were associated with a higher level of education and income, partial/technical  
401 unemployment or working from home during the lockdown. Yet, in contrast to Cluster 2, individuals  
402 in Cluster 3 were less likely to have children at home. Overall, these characteristics outline a profile  
403 of individuals more likely to have the financial means, knowledge and time to invest in health-  
404 promoting behaviors. It should be noted that some individuals experiencing partial/technical  
405 unemployment during the lockdown maintained their work position and part of their salary while  
406 being at home. The temporary nature of the unemployment may partly explain why it was associated  
407 with favorable nutrition-related changes in our study while typical unemployment is usually  
408 associated with poorer nutritional profiles (51–53). In addition, the cluster of favorable nutrition-  
409 related changes was associated with unhealthy pre-lockdown characteristics, such as  
410 overweight/obesity, smoking and a lower diet quality. Although prior reports have suggested that  
411 overweight or obese individuals tended to adopt unfavorable diet-related changes during the  
412 lockdown (8,14,54), our results suggested a profile of individuals with an increased potential for  
413 improvement, an awareness regarding the need to adopt healthier lifestyles (including diet), or  
414 experiencing concerns regarding the risk of COVID-19 infection or prognosis (55).

415 Spending more time cooking homemade meals during the lockdown was observed in our study and  
416 in prior reports (11,12). Interestingly, this behavior was associated with both Cluster 2 and Cluster 3.  
417 Even though cooking is considered a favorable food-related practice (e.g., suggesting a better  
418 knowledge of food, avoidance of ultra-processed foods) recommended by health authorities (56), it  
419 may not necessarily lead to healthy dietary intakes. As reflected by our results, cooking likely led to  
420 an increased consumption of cheese, potatoes, cookies and cakes in Cluster 2, while it may have  
421 contributed to achieving a more balanced diet in Cluster 3. In addition, home-cooking might have  
422 been practiced due to having more free time or it might have been viewed as a constraint, given the  
423 absence of other options (e.g., cafeterias, restaurants).

424 Finally, Cluster 1 displayed stable diet-related practices, physical activity and body weight during the  
425 lockdown. This “no change” cluster was associated with older age, living in small cities or rural areas,  
426 and unchanged professional activity during the lockdown, i.e., individuals with no professional  
427 activity pre-lockdown (i.e., unemployed, housemaker, retired) or those who maintained their regular  
428 work outside the home (i.e., “essential” sectors). This profile represented individuals with probably  
429 less lifestyle/environment disruption during the lockdown or those with well-established habits.

430 Strengths of our study pertained to the flexibility of the NutriNet-Santé web platform which allowed  
431 the administration of ad hoc questionnaires and the collection of a large amount of data regarding  
432 multiple aspects of the lockdown experience. Further, we studied a large sample of participants for  
433 whom in-depth characterization pre-lockdown was available and for whom the health behavior  
434 trajectories post-lockdown will be monitored (contrary to “one-shot” surveys). However, some  
435 limitations should be acknowledged. First, a number of changes reported here were based on self-  
436 perceptions and misreporting may therefore have occurred. Still, quantitative comparisons between  
437 data collected before and during the lockdown (e.g., food intakes, body weight, physical activity and  
438 sedentary time) were carried out and confirmed the perceived changes. Second, NutriNet-Santé is a  
439 long-term prospective cohort focusing on nutrition and health. This implies an over-representation of  
440 women and individuals of overall higher socioeconomic status compared to the general French

441 population (57,58). To account for this bias, all analyses were weighted to correct for the differences  
442 in sociodemographic and economic distributions, although this cannot lead to complete  
443 representativeness. In particular, our study does not accurately capture the experience of more  
444 disadvantaged subgroups (e.g., immigrants, students) who may have suffered from additional diet-  
445 related distress during the lockdown (59). Overall, NutriNet-Santé participants are likely to display  
446 healthier nutritional profiles compared to the general French population. Hence, the observed trends  
447 of unfavorable nutrition-related changes were likely underestimated in this “health-conscious”  
448 sample, which raises even more concerns for the general population.

449 In conclusion, our study provides divergent results regarding the nutrition consequences of the  
450 COVID-19 lockdown in France. Even though unhealthy nutrition-related changes were observed,  
451 they nonetheless coexisted with no nutrition-related changes (evidenced in the majority of our  
452 sample), as well as favorable changes in some subgroups. These different experiences of the  
453 lockdown were linked to specific individual characteristics, echoing socioeconomic inequalities in  
454 nutrition (60–63). Future studies are needed to better understand the mechanisms behind the observed  
455 nutrition-related changes. Meanwhile, the present findings are consistent with changes observed in  
456 other national lockdown settings, and can inform public health authorities about the consequences of  
457 a lockdown on the population level, should such exceptional measures be needed again in the future.  
458 Considering the importance of nutrition in the prevention of chronic diseases (15) and in the immune  
459 response (17,18), unfavorable nutrition-related changes should be monitored post-lockdown to  
460 prevent them from becoming established habits in the long run. The leverages behind the favorable  
461 nutrition-related changes should be studied to help improve the nutritional status on a global scale.  
462 As a research perspective, data collected as part of the SAPRIS project, combined with the detailed  
463 characterization of participants in the NutriNet-Santé cohort, will permit the investigation of the link  
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**Table 1. Characteristics of the study population after weighting (N=37,252), NutriNet-Santé cohort, March-May 2020**

	<b>% or Mean (SD)</b>
<b>Sex</b>	
Women	52.3
Men	47.7
<b>Age, years</b>	
[18-25]	4.4
]25-50]	42.5
]50-65]	26.3
]65-80]	25.0
> 80	1.8
<b>Current weight status<sup>1</sup></b>	
Underweight	4.0
Normal	58.9
Overweight	26.0
Obesity	11.1
<b>Smoking status</b>	
Never smoker	45.1
Former smoker	40.6
Current smoker	14.2
<b>Educational level</b>	
< High-school degree	17.2
High-school degree	15.2
Undergraduate degree	32.7
Graduate degree	34.2
Unknown	0.7
<b>Monthly income, € per household</b>	
< 1430	8.5
[1430 – 2700[	24.5
2700 to < 4800	39.1
> 4800	14.5
Unknown	3.3
Did not wish to answer	10.1
<b>Professional activity during the lockdown</b>	
No professional activity prior to lockdown: unemployed, retired, homemaker	40.4
Working outside home	12.3
Partially unemployed	15.7
Working from home (full-time)	19.8
Working from home (part-time)	5.2
Student, trainee	3.2

Other	3.4
<b>Marital status during the lockdown</b>	
Never married	16.3
In a relationship	16.3
Married or registered partnership	56.7
Divorced or separated	7.6
Widowed	3.1
<b>Children and/or grandchildren aged under 18 y at home during the lockdown? [Yes]</b>	24.6
<b>Residential area (city size, number of inhabitants) during the lockdown</b>	
Rural area	35.4
City < 20,000	23.1
City ≥ 20,000 to 100,000	21.6
City > 100,000	19.8
<b>Regional residential area during the lockdown<sup>2</sup></b>	
Paris Basin	15.8
Center-East	12.9
East	9.2
Mediterranean	13.5
North	5.7
West	14.1
Paris region	17.4
Southwest	11.3
<b>GAD-7 (anxiety disorders)<sup>3</sup></b>	3.2 (4.0)
<b>PHQ-9 (depressive symptoms)<sup>4</sup></b>	3.8 (4.4)
<b>Chronic disease<sup>5</sup>, [Yes]</b>	27.9

<sup>1</sup> Calculated from current weight reported in April, 2020

<sup>2</sup> Regional Zones for Study and Development (ZEAT) as defined by the French Census Bureau (INSEE): PARIS REGION - Ile de France; PARIS BASIN - Burgundy, Center, Champagne-Ardenne, Lower and Upper Normandy, Picardie; NORTH - Nord Pas-de-Calais; EAST - Alsace, Franche-Comté, Lorraine; WEST- Brittany, Pays de la Loire, Poitou-Charentes; SOUTH-WEST - Aquitaine, Limousin, Midi-Pyrénées; CENTER-EAST - Auvergne, Rhône-Alpes; MEDITERRANEAN- Languedoc-Roussillon, Provence-Alpes-Côte d'Azur, Corsica.

<sup>3</sup> The GAD-7 scale ranges from 0 to 21 points and measures an increasing severity of anxiety (minimal: 0-4, mild: 5-9, moderate: 10-14, severe: 15-21).

<sup>4</sup> The PHQ-9 scale ranges from 0 to 27 points and measures an increasing presence and severity of depressive symptoms (minimal: 0-4, mild: 5-9, moderate: 10-14, moderately severe: 15-19, severe: 20-27).

<sup>5</sup> Includes diabetes, cardiovascular diseases, hypertension, dyslipidemia, cancer, liver diseases, kidney diseases, thyroid diseases, digestive disorders, gynecological disorders, arthritis, immune system disorders.

<sup>6</sup> The AHEI-2010 score ranges from 0 to 100 points and measures an increasing diet quality.

**Table 2. Individual characteristics of participants belonging to each cluster of diet-related changes during the lockdown period, multivariable logistic regression models<sup>1</sup>**

	Cluster 1 "no change" (N=8,813, 42.9%)				Cluster 2 "unfavorable changes" (N=7,679, 37.4%)				Cluster 3 "favorable changes" (N=4,065, 19.8%)			
	% or Mean (SD)	Difference	OR <sup>2</sup>	95%CI	% or Mean (SD)	Difference	OR	95%CI	% or Mean (SD)	Difference	OR	95%CI
<b>Age, years</b> (ref: ]25-50]	18.5	ref	1.00	ref	55.0	ref	1.00	ref	26.5	ref	1.00	ref
[18-25]	28.3	+9.9	0.92	(0.69,1.24)	46.2	-8.9	1.41	(1.11,1.79)	25.5	-1.0	0.80	(0.60,1.05)
]50-65]	42.9	+24.5	1.40	(1.27,1.55)	35.6	-19.4	0.92	(0.83,1.00)	21.4	-5.1	0.74	(0.67,0.83)
]65-80]	58.3	+39.8	2.02	(1.78,2.30)	29.1	-25.9	0.76	(0.67,0.86)	12.6	-13.9	0.50	(0.43,0.58)
> 80	57.3	+38.8	2.10	(1.67,2.64)	31.1	-24.0	0.76	(0.60,0.97)	11.6	-14.9	0.47	(0.34,0.64)
<b>Sex</b> (ref: Women)	38.7	ref	1.00	ref	42.0	ref	1.00	ref	19.3	ref	1.00	ref
Men	47.3	+8.6	1.31	(1.23,1.40)	32.4	-9.6	0.76	(0.71,0.81)	20.3	+1.0	0.99	(0.92,1.07)
<b>Current weight status<sup>3</sup></b> (ref: Normal)	44.8	ref	1.00	ref	37.3	ref	1.00	ref	18.0	ref	1.00	ref
Obesity	34.0	-10.8	0.63	(0.56,0.70)	41.7	+4.5	1.09	(0.99,1.21)	24.3	+6.3	1.62	(1.44,1.81)
Overweight	42.3	-2.5	0.73	(0.68,0.79)	35.7	-1.6	1.06	(0.99,1.14)	22.0	+4.0	1.43	(1.32,1.56)
Underweight	43.8	-1.0	1.58	(1.33,1.87)	38.6	+1.4	0.72	(0.61,0.84)	17.6	-0.4	0.89	(0.72,1.08)
<b>Smoking status</b> (ref: Never smoker)	41.6	ref	1.00	ref	39.2	ref	1.00	ref	19.2	ref	1.00	ref
Former smoker	45.1	+3.5	0.86	(0.80,0.92)	35.6	-3.7	1.03	(0.97,1.10)	19.4	+0.2	1.19	(1.10,1.29)
Current smoker	39.4	-2.2	1.16	(1.05,1.29)	37.4	-1.9	0.77	(0.69,0.85)	23.2	+4.0	1.16	(1.04,1.30)
<b>Educational level</b> (ref: < High-school degree)	54.9	ref	1.00	ref	29.5	ref	1.00	ref	15.6	ref	1.00	ref
High-school degree	42.6	-12.4	0.75	(0.68,0.84)	37.4	+8.0	1.22	(1.10,1.36)	20.0	+4.4	1.21	(1.06,1.38)
Undergraduate degree	40.2	-14.7	0.74	(0.68,0.81)	38.0	+8.5	1.15	(1.05,1.26)	21.8	+6.2	1.35	(1.21,1.51)
Graduate degree	38.3	-16.7	0.71	(0.64,0.78)	41.6	+12.2	1.31	(1.19,1.45)	20.1	+4.5	1.20	(1.07,1.35)
Unknown	42.1	-12.8	0.65	(0.43,0.97)	31.2	+1.8	0.94	(0.61,1.42)	26.7	+11.1	2.16	(1.38,3.37)
<b>Monthly income, € per household</b> (ref: < 1430)	32.1	ref	1.00	ref	47.6	ref	1.00	ref	20.3	ref	1.00	ref
[1430 – 2700[	42.0	+9.9	1.03	(0.89,1.20)	38.8	-8.8	0.87	(0.76,0.99)	19.2	-1.1	1.15	(0.98,1.35)
[2700 – 4800[	44.5	+12.4	1.03	(0.89,1.19)	35.9	-11.7	0.83	(0.73,0.95)	19.6	-0.7	1.23	(1.04,1.45)
≥ 4800	41.3	+9.2	0.95	(0.81,1.13)	36.1	-11.5	0.75	(0.64,0.88)	22.6	+2.3	1.57	(1.30,1.89)
Unknown	40.0	+7.8	1.40	(1.09,1.81)	42.0	-5.6	0.79	(0.63,1.00)	18.1	-2.2	0.90	(0.67,1.21)
Did not wish to answer	47.8	+15.7	1.15	(0.98,1.36)	34.5	-13.1	0.77	(0.66,0.90)	17.7	-2.6	1.15	(0.95,1.39)
<b>Professional activity during lockdown</b> (ref: no professional activity prior to lockdown <sup>4</sup> )	54.5	ref	1.00	ref	31.7	ref	1.00	ref	13.8	ref	1.00	ref
Working outside home	51.9	-2.6	1.40	(1.23,1.58)	35.1	+3.4	0.92	(0.81,1.04)	12.9	-0.9	0.68	(0.58,0.80)
Partially unemployed	26.2	-28.3	0.43	(0.38,0.48)	39.6	+7.9	1.06	(0.95,1.19)	34.2	+20.4	2.51	(2.21,2.85)
Working from home (ful-time)	24.7	-29.8	0.47	(0.42,0.53)	49.1	+17.4	1.44	(1.29,1.61)	26.2	+12.4	1.59	(1.39,1.81)
Working from home (part-time)	29.3	-25.2	0.58	(0.49,0.69)	46.7	+14.9	1.33	(1.14,1.56)	24.1	+10.3	1.39	(1.16,1.67)
Student, trainees	11.2	-43.3	0.24	(0.16,0.36)	52.6	+20.9	1.06	(0.80,1.41)	36.3	+22.5	2.96	(2.18,4.02)
Other	42.6	-11.9	0.96	(0.78,1.17)	37.9	+6.2	0.95	(0.78,1.16)	19.5	+5.7	1.15	(0.91,1.46)
<b>Marital status</b>	30.8	ref	1.00	ref	45.5	ref	1.00	ref	23.7	ref	1.00	ref

(ref: Never married)												
In a relationship	38.0	+7.2	1.14	(1.00,1.30)	38.5	-7.0	0.87	(0.77,0.98)	23.5	-0.2	1.04	(0.91,1.20)
Married or registered partnership	46.6	+15.8	1.14	(1.01,1.27)	34.7	-10.8	0.96	(0.86,1.07)	18.7	-5.0	0.91	(0.80,1.03)
Divorced or separated	40.6	+9.8	0.89	(0.77,1.03)	42.2	-3.3	1.15	(1.00,1.32)	17.2	-6.5	1.01	(0.85,1.20)
Widowed	46.6	+15.7	0.87	(0.72,1.04)	37.7	-7.8	1.10	(0.92,1.32)	15.7	-8.0	1.22	(0.97,1.54)
<b>Children and/or grandchildren under 18 y at home during the lockdown</b> (ref: No)	45.8	ref	1.00	ref	35.1	ref	1.00	ref	19.1	ref	1.00	ref
Yes	31.8	-14.0	0.93	(0.84,1.02)	45.8	+10.6	1.38	(1.26,1.52)	22.4	+3.4	0.71	(0.64,0.79)
<b>Residential area (city size, number of inhabitants) during the lockdown</b> (ref : City > 100,000)	35.4	ref	1.00	ref	42.5	ref	1.00	ref	22.2	ref	1.00	ref
City ≥ 20,000 to 100,000	39.4	+4.0	1.15	(1.04,1.27)	40.6	-1.9	0.92	(0.84,1.01)	20.1	-2.1	0.94	(0.84,1.05)
City < 20,000	43.7	+8.3	1.28	(1.16,1.41)	38.3	-4.2	0.92	(0.84,1.01)	18.1	-4.1	0.82	(0.73,0.92)
Rural area	48.2	+12.8	1.47	(1.34,1.61)	32.3	-10.2	0.73	(0.67,0.80)	19.5	-2.7	0.91	(0.82,1.02)
<b>Regional residential area during the lockdown<sup>5</sup></b> (ref : Paris Basin)	44.4	ref	1.00	ref	35.1	ref	1.00	ref	20.4	ref	1.00	ref
Center-East	43.6	-0.8	0.91	(0.82,1.02)	35.5	+0.4	1.04	(0.93,1.17)	20.8	+0.4	1.06	(0.93,1.21)
East	36.3	-8.1	0.76	(0.67,0.86)	38.1	+2.9	1.10	(0.98,1.25)	25.6	+5.2	1.24	(1.08,1.42)
Mediterranean	48.7	+4.3	1.11	(0.99,1.24)	33.9	-1.2	0.98	(0.88,1.10)	17.4	-3.1	0.88	(0.76,1.00)
North	41.7	-2.8	1.09	(0.93,1.27)	39.0	+3.9	1.01	(0.87,1.17)	19.4	-1.1	0.90	(0.75,1.07)
West	46.8	+2.3	1.07	(0.96,1.20)	36.5	+1.3	1.06	(0.94,1.18)	16.8	-3.7	0.83	(0.73,0.95)
Paris region	35.8	-8.6	0.82	(0.73,0.92)	43.4	+8.2	1.24	(1.12,1.39)	20.8	+0.4	0.97	(0.85,1.10)
Southwest	45.2	+0.7	0.98	(0.87,1.10)	37.1	+2.0	1.12	(1.00,1.26)	17.8	-2.7	0.87	(0.76,1.00)
<b>GAD-7 scale (anxiety disorders)<sup>6</sup></b>	2.0 (3.1)	/	0.97	(0.96,0.98)	3.9 (4.2)	/	1.01	(1.00,1.02)	3.2 (4.0)	/	1.03	(1.02,1.04)
<b>PHQ-9 scale (depressive symptoms)<sup>7</sup></b>	2.1 (3.1)	/	0.89	(0.88,0.90)	4.8 (4.5)	/	1.12	(1.11,1.13)	3.6 (4.0)	/	0.97	(0.96,0.98)
<b>Chronic disease<sup>8</sup></b> (ref: No)	42.4	ref	1.00	ref	37.3	ref	1.00	ref	20.4	ref	1.00	ref
Yes	44.0	-1.6	0.89	(0.83,0.96)	37.5	-0.2	1.14	(1.06,1.22)	18.5	+1.8	1.00	(0.92,1.09)
<b>Diet quality before the lockdown (N=16,562)</b>												
<b>AHEI-2010 score<sup>9</sup>, per 10-point increment</b>	52.7 (11.8)	/	1.06	(1.03,1.10)	50.0 (11.4)	/	0.99	(0.96,1.03)	48.9 (12.0)	/	0.92	(0.89,0.96)
<b>Ultra-processed foods, per 10% increment</b>	15.2% (6.4%)	/	0.93	(0.88,0.99)	16.8% (7.3%)	/	1.06	(1.01,1.12)	16.8% (7.4%)	/	0.99	(0.93,1.05)

<sup>1</sup> Models included all variables presented in the table, with corresponding categories. For participants for whom such data was available, variables relating to the diet quality before the lockdown were additionally included in the models

<sup>2</sup> OR are for each cluster as dummy variable (i.e., cluster X vs. all others combined)

<sup>3</sup> Calculated from current weight reported in April, 2020

<sup>4</sup> Unemployed, retired, housemaker

<sup>5</sup> Regional Zones for Study and Development (ZEAT) as defined by the French Census Bureau (INSEE): PARIS REGION - Ile de France; PARIS BASIN - Burgundy, Center, Champagne-Ardenne, Lower and Upper Normandy, Picardie; NORTH - Nord Pas-de-Calais; EAST - Alsace, Franche-Comté, Lorraine; WEST- Brittany, Pays de la Loire, Poitou-Charentes; SOUTHWEST - Aquitaine, Limousin, Midi-Pyrénées; CENTER-EAST - Auvergne, Rhône-Alpes; MEDITERRANEAN- Languedoc-Roussillon, Provence-Alpes-Côte d'Azur, Corsica.

<sup>6</sup> The GAD-7 scale ranges from 0 to 21 points and measures an increasing severity of anxiety (minimal: 0-4, mild: 5-9, moderate: 10-14, severe: 15-21).

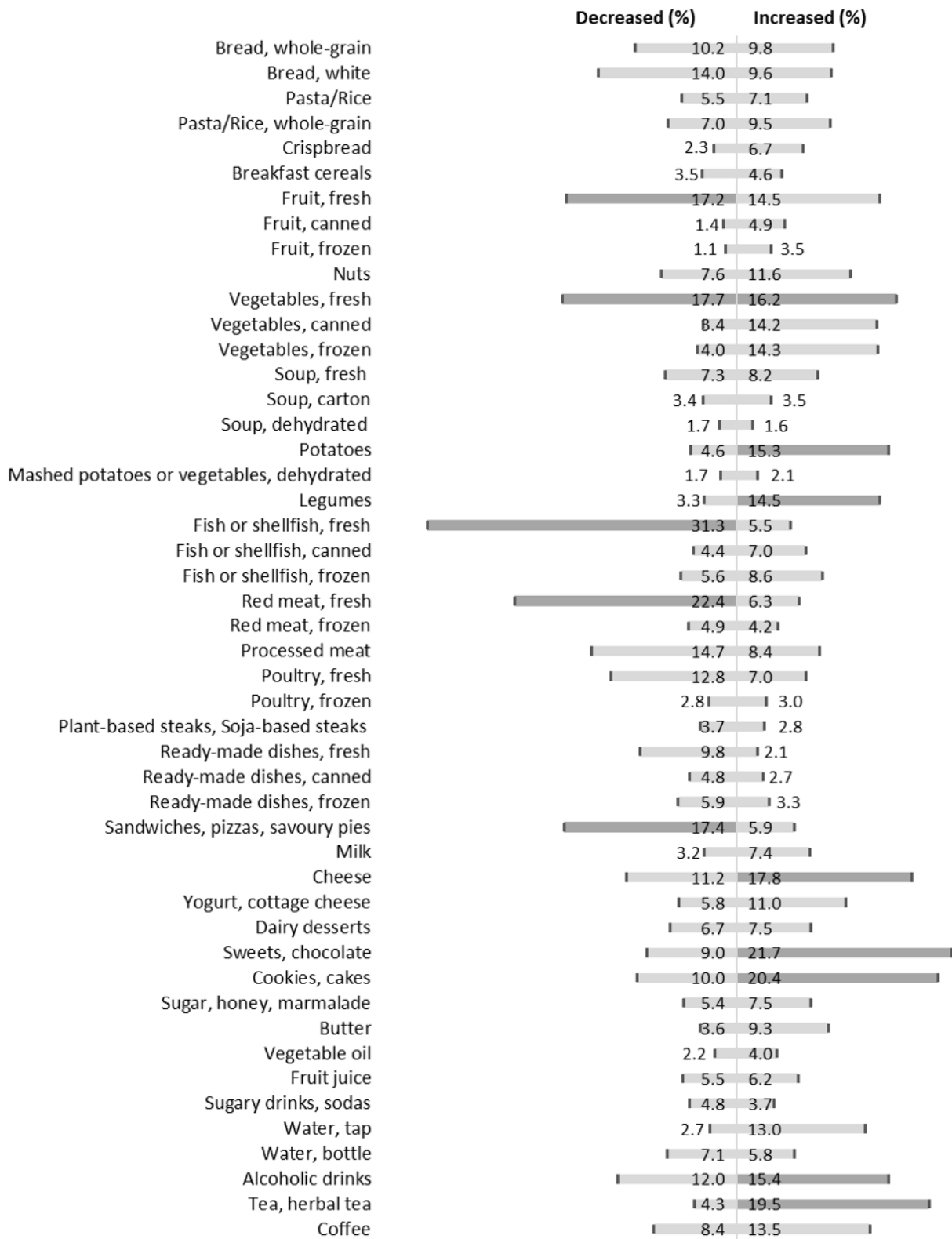
<sup>7</sup> The PHQ-9 scale ranges from 0 to 27 points and measures an increasing presence and severity of depressive symptoms (minimal: 0-4, mild: 5-9, moderate: 10-14, moderately severe: 15-19, severe: 20-27)

<sup>8</sup> Includes diabetes, cardiovascular diseases, hypertension, dyslipidemia, cancer, liver diseases, kidney diseases, thyroid diseases, digestive disorders, gynecological disorders, arthritis, immune system disorders

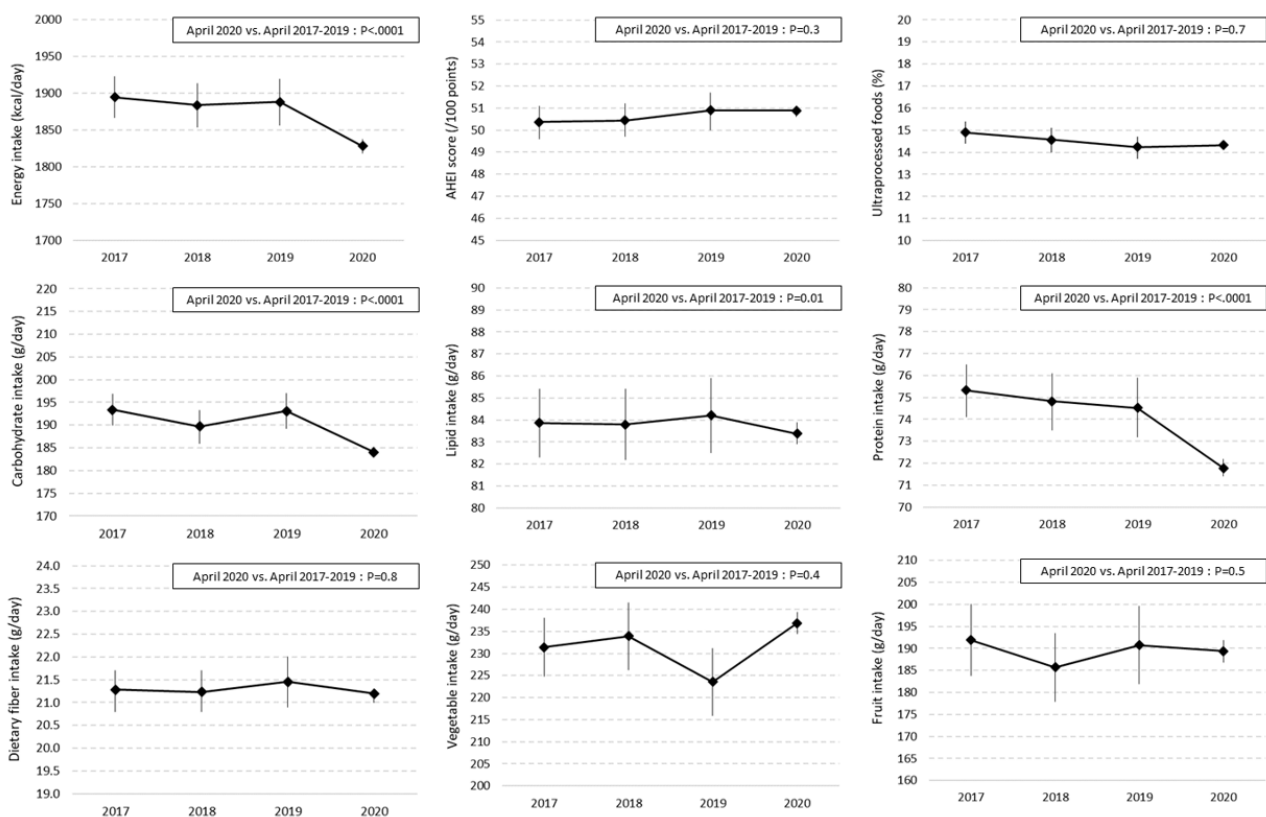
<sup>9</sup> The AHEI-2010 score ranges from 0 to 100 points and measures an increasing diet quality.

**FIGURE LEGENDS**

**Figure 1. Modifications in the consumption of major food groups during lockdown, NutriNet-Santé cohort study (N=37,252), March-May 2020.** Bars indicate the % of participants who reported having increased or decreased the consumption of the food group of interest during lockdown (corresponding number shown on the respective bars); darker colors represent % above 15% and/or a difference of % between those who increased and those who decreased of more than 10%. 95% confidence intervals are displayed at the extremity of the bars.



**Figure 2. Dietary intakes reported in the month of April from 2017 to 2020, NutriNet-Santé cohort study, France, March-May 2020.** Quantitative dietary intakes reported in April 2020 (via 24h dietary records completed during the lockdown, N=10,617) and during the month of April over the past three years (repeated 24h dietary records completed in 2017: N=1,264; 2018: N=1,075; and 2019: N=991), shown as mean values (diamond) and 95% confidence intervals (vertical bar). P-values from Student paired t-tests are provided for the comparison between intakes in April 2020 and the average intakes reported during the month of April in the previous three years (2017-2019; N=1,548).



**Figure 3. Physical activity, sedentary time, energy intake and body weight change during the lockdown. NutriNet-Santé cohort study, March-May 2020.** At the top: weight change between the weight just before the lockdown and the weight in May 2020, after about 2 months of lockdown (N=22,042); values are mean (SD) change in participants who gained (respectively lost) weight during the lockdown. At the bottom right, daily energy intakes in April 2020 during the lockdown (N=10,617) and comparisons with intakes observed at the same period of the year before the lockdown (April 2017-2019) (N=1,548); increase and decrease were defined as change (respectively positive or negative) in energy intake of at least 10%; values are mean (SD) change in participants who increased (respectively decreased) their energy intake during the lockdown. At the bottom left, modifications in physical activity and sedentary time: perceived changes (N=36,917) shown as a bar graph, with 95% confidence intervals displayed at the extremity of the bars; quantitative assessments of changes in physical activity levels (in MET-min/week) and sedentary time (time spent seated outside sleeping hours) between before and during the lockdown were available for subsamples of participants (N=29,798 for physical activity, N=29,788 for sedentary time), and are shown next to each bar as median physical activity levels and mean sedentary time; corresponding interquartile ranges and standard deviations are detailed in Supplementary Table 3. Changes in quantitative values are also expressed as % change compared to the value before the lockdown. Pregnant women (N=335) were excluded from these analyses. PA, physical activity; ST, sedentary time.



Body weight during the lockdown (N=22,042)

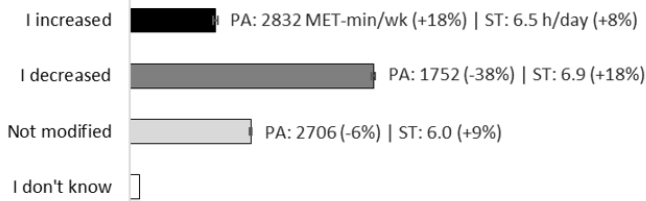
Weight loss for 23% : - 2.0 kg (SD: 1.4)

Weight gain for 35% : + 1.8 kg (SD: 1.3)

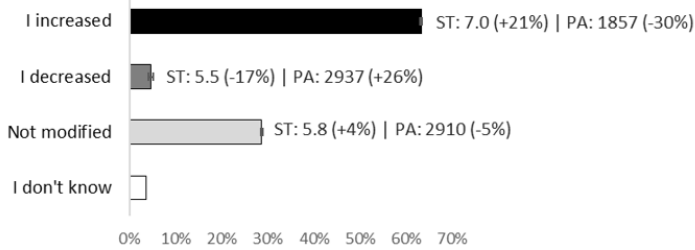


Physical activity (PA) and sedentary time (ST) during the lockdown  
(perceived changes: N=36,917 and quantitative estimation: PA, N=29,798 / ST, N=29,788)

**Physical activity level**



**Sedentary time**



Energy intake in April 2020 during the lockdown  
(N=10,617)

**1828 kcal/day (SD: 474)**

Compared to energy intakes in April in 2017-2019  
(Δ% compared to usual > 10%, N=1,548)

↑ **Increase for 25% :**  
+ 468 kcal/day (SD: 274), i.e. + 26%

↓ **Decrease for 33% :**  
- 510 kcal/day (SD: 267), i.e. - 23%

**Figure 4. Usual and lockdown-specific sources of food supply, according to the urban level of the residential area during the lockdown. NutriNet-Santé cohort study (N=37,252), March-May 2020.** <sup>1</sup> AMAP: associations supporting small farming; <sup>2</sup> followed by delivery or drive-by pick-up; <sup>3</sup> meals, packages, subsidized grocery stores. 95% confidence intervals are displayed at the extremity of the bars.

