

Article

Behavioral Changes During COVID-19 Confinement in France: A Web-Based Study

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Abstract: (1) Background: A global pandemic due to COVID-19 emerged in November 2019 and hit France in early March 2020. It not only resulted in a loss of lives but also in very strict confinement measures. The objective of this study was to understand what the determinants of the change in participants' behavior and mental state were during the confinement. (2) Methods: An online survey was launched on 23 April 2020 and closed on 7 May 2020. The final sample included 1454 participants from 24 to 65 years old. Descriptive and multivariate analyses were then performed. (3) Results: 28.7% reported having a more balanced diet, against 17.1% with a less balanced diet. 22.7% of respondents reported an increased alcohol consumption, as opposed to only 12.2% declaring a decrease and 11.2% of respondents increased their tobacco consumption, while 6.3% decreased it. 50.6% of the participants reported being more depressed, stressed, or irritable since the beginning of the lockdown. Confinement had a negative effect on every behavior studied in this survey, except for nutrition. We also found that negative mental state changes were strongly associated with nutrition, sleep, physical activity, and alcohol consumption changes.

Keywords: COVID-19 ¹; behavioral change ²; public health ³; Sars-CoV-2 ⁴; alcohol consumption ⁵;

1. Introduction

In November 2019 the novel severe acute respiratory syndrome coronavirus 2 (SARS- CoV-2), which causes the coronavirus disease 2019 (COVID-19), emerged in Wuhan, China. Since then, COVID-19 has rapidly spread around the world leading to a pandemic that caused half of humanity to be on lockdown[1]. It thus not only resulted in medical complications and loss of lives but has also led to the largest global economic impact and transformation to daily life in modern times[2]. As of 28 May 2020 there have been 145 746 confirmed cases and 28 596 confirmed deaths in France[3]. Confinement measures started on 17 March 2020 and were partially lifted on 11 May 2020. They consisted of a strong restriction on travel to only what was strictly necessary (food shopping, medications purchase, care and work when remote work is not possible), outings close to home (limited individual sports activities, pets' hygiene), as well as closing the borders of the Schengen area and postponing the second round of municipal elections. Any breach in those rules could immediately be penalized by a fine or prison in case of multiple repetitions of an infraction.

The WHO defined in 2008 the social determinants of health (SDOH) as " the circumstances in which people are born, grow up, live, work and age, and the systems put in place to deal with illness. These circumstances are in turn shaped by a wider set of forces: economics, social policies, and politics." The literature[4-6] has demonstrated the existing correlation between social, environmental and context-related factors and living conditions on the health and wellbeing of individuals and the associated risk factors. In our model, we have in particular analyzed the impact of economic factors

(with the evolution of employment at the moment of the survey and the expectations in the near future), the neighborhood and the physical environment (housing or household conditions, access to outdoor leisure/sport area, physical activity), the education (diploma), the food (diet) and the community and social context (relations with relatives, stress, anxiety, depression, irritability). Our hypothesis here is the presence of a direct impact of the preventive measures associated with the lockdown on living conditions, themselves strongly correlated with individual behaviours.

This is the first time that a quarantine to control a pandemic has been implemented on the entirety of the French territory. Therefore, a lack of data exists on how this measure can impact the health and well-being of the adult population living in the country. A review of literature on the psychological impact of quarantine during other outbreaks such as Ebola or SARS has found that it previously has resulted in deleterious mental health outcomes, including higher levels of depression[7], anxiety[8], irritability[8], post-traumatic stress symptoms[9], anger[10], and fear[11, 12]. Stressors included longer quarantine duration[7], infection fears, frustration, boredom, inadequate supplies, inadequate information, financial loss[13, 14], and stigma[11]. Deterioration of mental state could have consequences on the adoption of negative lifestyle habits (consumption of alcohol[15] or other psychoactive substances, sleep issues, nutrition[16], physical activity...).

Existing research testifies to the reciprocal nature of interactions between physical well-being, chronic disease and mortality, with key health behaviors such as smoking, physical activity, reduced alcohol consumption, diet and obesity[17]. Moreover, it is also clear that such behaviors have an impact on mental health. In Velten and al[18].’s study, it was reported that physical activity, alcohol consumption, smoking, body mass index and regularity of social interaction were all associated with specific mental health outcomes (i.e. depression, anxiety and stress).

There currently are very few studies providing data on how the confinement and the pandemic have affected the behaviors of the French population. The most important two are COVIPREV[19], led by Santé Publique France, and COCONEL[20]. Hartley et al[21] also conducted a study on the effects of confinement of the French population on sleep.

However, it is very important to understand the confinement-induced behavioral changes to be able to propose efficient public health policies and interventions to accompany and support the population in this difficult period but also in the following years to increase the level of preparedness of the citizens, healthcare systems and policymakers for and in case of a new quarantine. It is important as well to identify and understand confinement-induced behavior changes in order to guide policymakers into developing quick interventions to support population during the immediate post COVID-19 period.

The objective of this study was to understand what the determinants of the changes in participants’ behavior and mental state were during the confinement. Our hypothesis was that the confinement might have a different effect according to the participant’s characteristics and the behavior or mental state studied.

2. Materials and Methods

2.1. Recruitment and participants

1705 participants living in France and speaking French (as the questionnaire was written in french) participated in the online survey between April 23rd, 2020, and May 7th, 2020. They were recruited through promoted social media posts. The final sample included 1454 participants after limiting participation to 24- 65 year olds, to have a sizeable sample (participation was quite weak between 18 and 24 year olds and over 65 year olds) Indeed, 115 participants were younger than 25 and 136 older than 64 years old. The informed consent of participants was obtained. The survey was

strictly anonymous and no re-identification was possible, therefore participants' privacy was not at risk.

As the survey was not an interventional study, there was no need for an ethical consent according to French laws[22]. Participants' characteristics are described in Table 1 and Table 2.

2.2. Weighting

As the pandemic has not affected the whole country with the same intensity, based on the excess mortality observed between 1 March and 20 April 2020, in comparison with the same period in 2019, the INSEE created 5 groups of counties, ranked from highly affected (group 1) to not affected (group 5)[23].

For this study, Groups 4 and 5 will be unified because the distinction between very low and non-affected counties (with lower mortality in 2020 than in 2019) does not seem to make much sense because of the usual fluctuations in mortality from year to year at the county level.

The weighting of the sample was then based on three variables: gender, age, and the impact of the pandemic at the county level. The weights were therefore calculated so that the weighted sample corresponds to the distribution of the French population by age, gender, and impact of the pandemic.

2.3. Outcomes

Our survey asked respondents to evaluate the various components of their lifestyle and their situation in comparison with their status before the lockdown. The self-evaluation of the change during the lockdown of their diet (less balanced, no change, more balanced), sleep (worse quality, no change, better quality), physical activity (less, no change, more), alcohol consumption (more, no change, less), tobacco consumption (more, no change, less), tensions with the relatives (rise, no change), and the mental state indicator (0-to-3 score) were measured.

The mental health state indicator was created, as an additional score, using the addition of the answers to the question: "Since the beginning of the lockdown, are you feeling more..." anxious? Depressed? Irritable?". A score of 0 meant that the respondent had reported being more depressed, more stressed, and more irritable since the beginning of the lockdown. A score of 3 meant that the respondent did not notice any change.

Each outcome was ranked from the unhealthiest to the healthiest modality. Please find in supplementary materials, the questions asked to the participants in relation to the outcomes.

2.4. Independent variables

Demographic (age, sex), socioeconomic (diploma), health (obesity, hypertension, other risk factors, ALD-status) variables, behaviors (smoke, alcohol consumption), the composition of the household (alone, with children), housing (overcrowding, outside access), the impact of the pandemic (around the respondent in her/his county based on INSEE data, on the participant's and their relatives' health, on their work, on their incomes), mental state indicator (0-to-3 score).

The ALD status is an "Affection de Longue Durée" (ALD), a major or long-term illness for which the State accepts responsibility for an individual's health costs. It is defined in French law as a 'condition requiring long-term care and particularly costly treatment'.

Three variables measuring concerns due to the situation were added as independent variables: concern for one's health, for the health of one's relatives, for one's financial situation. These variables were ranked on a 1-to-10 scale, 10 being the highest concern, and were included as continuous variables in the model.

2.5. Model

Ordinal logistic regressions were used, except for tensions with relatives where a logistic regression was used. Observations were weighted to correspond to the French population by age, sex, and impact of the pandemic in the county. As all the outcomes were ordered from the

unhealthiest to the healthiest modality, for each model, an odds-ratio superior to 1 was a protective factor and an odds-ratio inferior to 1 was a risk factor.

All the sample was used (N=1454), except for two models.

In the alcohol consumption model, people who declared no alcohol consumption before and during the lockdown were excluded. For tobacco consumption, people who declared no tobacco consumption before and during the lockdown were excluded.

. For tobacco consumption, people who reported no tobacco consumption before the lockdown were excluded. In this model, the mental state variable was divided into two (negative change or no change), due to sample size.

The selection of the independent variables was first made a priori. Health variables were only used in the diet and the physical activity models. Then we used a stepwise forward selection, with a p-value inferior to 5% criteria for each model.

Table 5 presents the results of the multivariate analysis. The variables which were significantly associated with none of the outcome variables were excluded from Table 5.

3. Results

3.1. Descriptives

Participants' characteristics are described in Table 1. A majority of them were women (63.5%) and had studied 2 years or more after the Baccalauréat (84.3%). Most of them also had access to a private outside place during the confinement (80.0%). 41.3% of the participants were living in a territory where COVID-19 was very present.

Table 1. Participants' characteristics.

| | N* (%) |
|---|--------------|
| Age | |
| - 25-34 | 392 (27.0%) |
| - 35-44 | 427 (29.4%) |
| - 45-54 | 410 (28.2%) |
| - 55-64 | 225 (15.5%) |
| Gender | |
| - Female | 924 (63.5%) |
| - Male | 523 (36.0%) |
| - Other | 7 (0.5%) |
| Health issues putting the participant at risk of a severe form of COVID 19 | |
| - Obesity | 103 (7.1%) |
| - Hypertension | 97 (6.7%) |
| - Other risk factors | 259 (17.8%) |
| - ALD status | 189 (13.0%) |
| At-risk behavior previous from the COVID pandemics | |
| - Smoking (no precision on the amount) | 403 (27.7%) |
| - Drinking (no precision on the amount or frequency) | 1076 (74.0%) |
| Diploma | |
| - Less than 2 years of study after the Baccalauréat | 229 (15.7%) |
| - 2 years of study after the Baccalauréat | 218 (15.0%) |
| - More than 2 years of study after the Baccalauréat | 1007 (69.3%) |
| Impact of the crisis on the income | |

| | | | |
|--|--------------|-------------|---------------|
| - Yes | 498 (34.3%) | | |
| - No | 956 (65.7%) | | |
| Composition of the household during confinement | | | |
| - Living alone | 287 (19.7%) | | |
| - Living with children | 615 (42.3%) | | |
| - Living with a vulnerable person | 214 (14.7%) | | |
| Characteristics of the place of residence during confinement | | | |
| - Overcrowded | 81 (5.6%) | | |
| - Access to a private outside place (garden, balcony...) | 1163 (80.0%) | | |
| Breakdown of the participants between groups based on the impact of COVID-19 on their territory of residence during confinement | | | |
| - Group 1 | 601 (41.3%) | | |
| - Group 2 | 373 (25.7%) | | |
| - Group 3 | 168 (11.6%) | | |
| - Group 4 | 312 (21.5%) | | |
| Mental state indicator | | | |
| - 0 | 150 (10.3%) | | |
| - 1 | 205 (14.1%) | | |
| - 2 | 381 (26.2%) | | |
| - 3 | 718 (49.4%) | | |
| Concern about COVID-19's impact | | | |
| - Concerns about one's health | | Mean | IC 95% |
| - Concerns about one's relatives | 4.6 | | [4.5-4.7] |
| - Concerns about one's financial state | 6.5 | | [6.4-6.6] |
| | 4.7 | | [4.5-4.8] |
| Total: N = 1454 | | | |

A comparison of our sample with INSEE data shows that those who participated in the study have a level of education on average much higher than the French population[24] (Table 2). The variable was then recoded into three categories so that each category has a sufficient number of observations: Diploma less than Baccalauréat +2 (N=229, 15.7%), Baccalauréat +2, Superior to Baccalauréat +2.

3.9% of respondents have received a COVID-19 diagnosis from their doctor, 0.8% have seen this result confirmed by a test and 12.1% think they were contaminated but weren't diagnosed.

Table 2. Participants' level of education.

| | N | % (sample) | % (weighted) | % (INSEE) |
|--|------|------------|--------------|-----------|
| Diploma | | | | |
| - No diploma or certificate of general education | 26 | 1.8% | 2.2% | 19.6% |
| - CAP, BEP or equivalent | 52 | 3.6% | 3.8% | 24.6% |
| - Baccalauréat or equivalent | 151 | 10.4% | 10.6% | 17.7% |
| - Baccalauréat + 2 | 218 | 15.0% | 16.7% | 14.6% |
| - > Baccalauréat + 2 | 1007 | 69.3% | 66.8% | 23.2% |
| Total: N = 1454 | | | | |

The majority of participants reported a decrease in mental state (50,6%), with 10,3% being at the same time more stressed, anxious, and depressed since the beginning of the confinement. Concerning sleep, physical activity, alcohol consumption, and tobacco consumption, the percentage of participants who reported a negative change was higher than the percentage of participants who reported a positive change. Nutrition was the only outcome where the percentage of participants who reported a positive change was superior to the percentage of participants who reported a negative change. Indeed, 28.7% reported having a more balanced diet, against 17.1% who reported having a less balanced diet since the beginning of the confinement.

Among the 418 participants who reported eating a more balanced diet, 70.8% had more time for cooking (N=296), 41.4% ordered less take-out or used fewer delivery services (N=173), and 17.2% snacked less during work (N=72).

Among the 249 people who report eating less balanced, 58.6% snacked (N=146), 43.8% considered eating more because they were stressed or sad (N=109), 26.5% were not motivated to cook (N=66). It is interesting to note that 39.4% reported that they had more time to cook (N=98).

Moreover, 22.7% of respondents reported an increased alcohol consumption, as opposed to only 12.2% reporting a decrease and 11.2% of respondents increased their tobacco consumption, while 6.3% decreased it. (Table 3) Also, 24.6% of the participants reported an increase in the tensions with their relatives, and in particular with their partner (14.3%). Finally, 50.6% of the participants reported being more depressed, stressed, or irritable since the beginning of the lockdown.

Table 3. Outcomes.

| | N* (%) |
|--|--------------|
| Diet | |
| - More balanced | 418 (28.7%) |
| - Unchanged | 787 (54.1%) |
| - Less balanced | 249 (17.1%) |
| Tension with relatives | |
| - Increased | 357 (24.6%) |
| - Unchanged | 1097 (75.4%) |
| Sleep quality since the beginning of confinement | |
| - Decreased | 527 (36.2%) |
| - Unchanged | 737 (50.7%) |
| - Increased | 190 (13.1%) |
| Physical activity | |
| - Decreased | 506 (34.8%) |
| - Started to practice physical activity during confinement | 132 (9.1%) |
| - Increased | 248 (17.1%) |
| - Stopped practicing physical activity during confinement | 216 (14.9%) |
| - Unchanged | 352 (24.2%) |
| Alcohol consumption | |
| - Decreased | 178 (12.2%) |
| - Unchanged | 568 (39.1%) |
| - Increased | 330 (22.7%) |
| - Do not drink | 378 (22.7%) |

| | |
|-------------------------------|--------------|
| Tobacco consumption | |
| - Decreased | 91 (6.3%) |
| - Unchanged | 149 (10.2%) |
| - Increased | 163 (11.2%) |
| - Do not smoke | 1051 (72.3%) |
| Mental state indicator | |
| - 0 | 150 (10.3%) |
| - 1 | 205 (14.1%) |
| - 2 | 381 (26.2%) |
| - 3 | 718 (49.4%) |
| Total: N = 1454 | |

3.2. Multivariate analysis

Table 4 shows the results of the ordinal logistic regression after the stepwise forward selection of the independent variables, for each outcome. Age was associated with the changes in diet, alcohol consumption, tensions with relatives, and mental state. An age range of 25-34 years old was a protective factor for both diet and alcohol consumption changes. An age range of 55-64 years old was also a protective factor for adverse diet changes. Increasing age was a strong protective factor against tensions with relatives and adverse mental state changes.

Table 4. Regression results (N=1454). The outcomes are ranked from the unhealthiest to the healthiest and the stepwise forward method was used. OR>1 is a protective factor and OR<1 is a risk factor.

| | Nutrition | Sleep | Physical activity | Alcohol consumption* | Tobacco consumption** | No tensions | Mental state |
|--|---------------------|---------------------|--------------------------|-----------------------------|------------------------------|---------------------|---------------------|
| Age | | | | | | | |
| 25-34 yo | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 35-44 yo | 0.68 [0.50-0.93] | 1.06 [0.77-1.45] | 0.96 [0.71-1.31] | 0.52 [0.37-0.74] | 2.06 [1.18-3.60] | 2.24 [1.53-3.27] | 1.78 [1.34-2.36] |
| 45-54 yo | 0.71 [0.52-0.96] | 0.86 [0.63-1.17] | 1.07 [0.80-1.43] | 0.67 [0.47-0.94] | 1.07 [0.62-1.85] | 2.63 [1.81-3.83] | 2.35 [1.76-3.14] |
| 55-64 yo | 0.93 [0.69-1.25] | 1.16 [0.86-1.57] | 0.97 [0.72-1.29] | 0.78 [0.55-1.10] | 2.07 [1.18-3.62] | 3.55 [2.39-5.27] | 2.71 [2.02-3.64] |
| Gender | | | | | | | |
| Male | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Female | 0.97 [0.79-1.18] | 0.95 [0.77-1.17] | 1.17 [0.96-1.43] | 0.71 [0.56-0.90] | 0.96 [0.66-1.40] | 0.98 [0.75-1.27] | 0.77 [0.63-0.94] |
| ALD | | | | | | | |
| Yes | | | 1.45 [1.10-1.92] | | | | |
| No | | | 1 | | | | |
| Other risk factors of severe COVID form | | | | | | | |
| Yes | 1.34 [1.03-1.74] | | | | | | |
| Non | 1 | | | | | | |
| Drank alcohol previously | | | | | | | |
| Yes | | | 1.71 [1.36-2.15] | | | | |
| Non | | | 1 | | | | |
| Impact on work | | | | | | | |
| Telework | 1 | | | 1 | | 1 | |
| Not working | 0.85 | | | 1.71 [1.23-2.37] | | 1.24 | |

| | | | | | |
|-------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | [0.65-1.12] | | | | [0.85-1.79] |
| Works normally | 0.58 [0.42-0.82] | | | 1.19 [0.80-1.78] | 0.74 [0.49-1.13] |
| Others | 0.62 [0.48-0.85] | | | 1.25 [0.92-1.70] | 0.72 [0.51-1.00] |
| Household | | | | | |
| Living alone | 0.64 [0.48-0.85] | 0.75 [0.56-1.00] | 0.73 [0.55-0.97] | 0.44 [0.25-0.76] | 4.08 [2.43-6.87] |
| Living with children | 0.86 [0.66-1.10] | 1.14 [0.89-1.47] | 0.81 [0.64-1.03] | 0.69 [0.44-1.09] | 0.44 [0.32-0.59] |
| Others | 1 | 1 | 1 | 1 | 1 |
| Overcrowded dwelling | | | | | |
| Yes | | | | 0.57 [0.32-0.99] | |
| No | | | | 1 | |
| Mental state indicator | | | | | |
| 0 | 0.39 [0.27-0.57] | 0.12 [0.08-0.18] | 0.47 [0.33-0.68] | 0.65 [0.44-0.96] | |
| 1 | 0.63 [0.46-0.86] | 0.24 [0.17-0.32] | 0.63 [0.47-0.86] | | |
| 2 | 0.85 [0.67-1.09] | 0.39 [0.30-0.50] | 1.01 [0.79-1.28] | | |
| 3 (No change) | 1 | 1 | 1 | 1 | |
| Diploma | | | | | |
| < Baccalauréat +2 | | 1.55 [1.17-2.05] | | | 1.33 [1.00-1.77] |
| Baccalauréat +2 | | 1.28 [0.96-1.71] | | | 0.83 [0.63-1.09] |
| > Baccalauréat +2 | | 1 | | | 1 |
| Concerns | | | | | |
| for one's health | | | | | 0.84 [0.81-0.88] |
| for one's relatives | | | | 1.09 [1.04-1.15] | |
| For one's finances | | | | 0.93 [0.89-0.97] | 0.89 [0.85-0.93] |

* N = 1076; ** N = 403.

A negative change in mental state during the lockdown was a strong risk factor for negative changes in nutrition, sleep, physical activity, and alcohol consumption. Concerning changes to mental state, our model shows a strong protective effect of age. Indeed, as age increases, so does the likelihood of not reporting stress, depression, or particular irritability since the onset of confinement. Similarly, men report fewer problems with stress, depression, and irritability than women. There is also a protective effect related to low educational attainment.

We observed that concerns related to the crisis itself have a strong impact on stress, depression, and irritability. This result remains similar when we exclude stress from this mental state score. This relationship is therefore not due to a conceptual redundancy between the measures of anxiety and mental health. Two measures of anxiety related to the crisis emerge significantly from our model: anxiety about one's health, and anxiety about one's finances. In both cases, worry was a strong risk factor in reporting any particular changes in mental state.

Being a man was a protective factor for alcohol consumption and negative mental state changes. A low education level was a protective factor for sleep and negative mental state changes. Alcohol consumption before the lockdown was a protective factor for negative physical activity changes. Health issues putting the participant at “severe form of COVID-19 risk factors” other than obesity and hypertension were a protective factor for preventing negative diet changes.

The impact of the lockdown on the participant’s work situation had different effects depending on the outcome. Teleworking was a protective factor against negative diet changes. Participants who had to stop working or lost their incomes reported more tensions with their relatives and it was a risk factor for negative alcohol consumption changes.

The concern for one’s health was a risk factor for negative mental state changes. The concern for one’s relatives’ health was a protective factor for alcohol consumption. Finally, the concern for one’s financial situation was a risk factor for alcohol consumption, negative mental state changes, and the rise of tensions.

The composition of the household and a change in mental state during the lockdown were strongly associated with various outcomes. Living alone was a strong risk factor for diet, sleep, physical activity, and tobacco consumption. It was a protective factor for tensions. Living with children was a risk factor for tensions and overcrowding for alcohol consumption.

Our results show that confinement and the associated restrictive measures had a negative effect on every individual behaviors studied in this survey, except for nutrition. We also found that a negative change in mental state was strongly associated with adverse changes in nutrition, sleep, physical activity, and alcohol consumption. Also, living alone was a strong risk factor for diet, sleep, physical activity, and tobacco consumption.

In our survey, the decrease in physical activity was also related to a worsening of mental state. Being a woman was a risk factor for concerns and age was a strong protective factor against negative mental state changes.

4.1. Impact of confinement on mental state

Our results show that the older respondents are, the less likely they are to report having symptoms of anxiety, depression, or irritability and that younger people (25-34 years old) were more likely to present those symptoms. Those findings coincide with Huang and Zhao[25]’s preliminary publication but also Su et al[26]. results from the SARS epidemic. The deterioration of mental state has a negative effect on most behavioral indicators in our study (tobacco and alcohol consumption, physical activity and sleep).

Living alone was a strong risk factor for diet, sleep, physical activity, and tobacco consumption. This coincides with Bu et al[27] preliminary findings stating that people living alone are at higher risk of loneliness during the lockdown. In addition to quarantine, research into social isolation and loneliness indicate that these experiences are not only deleterious for mental health[28] but also have an impact on physical health so that Nelson et al. [2] suggest that secondary effects on mortality due to COVID-19 may be caused by increases in social isolation and loneliness. Those findings concur with ours.

4.2. Impact of confinement on diet

In our survey, confinement had a positive effect on diet. However, these results apply only to people with a higher education level and probably depends on income. This concurs with the results of Deschasaux-Tanguy and al[29] which showed that improvements in the nutritional quality of diets were observed in a part of the studied population : increased AHEI-2010 score for diet quality, decreased proportion of ultra-processed foods, increased intakes of fruit and vegetables, legumes or nuts, decreased intakes of red meat or alcohol. These favorable behaviors mostly clustered participants with higher incomes and education levels, which matches our sample.

4.3. Impact of confinement on sleep

When asked if their sleep has been better or worse since the beginning of the confinement, respondents reported a decrease in sleep quality rather than an improvement, which is consistent with the findings of COCONEL[20] and COVIPREV[19], although in both of those studies, the prevalence of sleep disorders was higher than in ours.

We found a significant difference between men and women, which concur with Hartley et al[21] study but runs counter to Huang and Zhao[25]'s preliminary publication. However in Hartley et al[21]. findings, sleep-related factors were strongly associated with impaired sleep perception with 90% of participants reporting shorter sleep, whereas in our survey the proportion of people for whom confinement resulted in an increase in sleep appears similar to the proportion of people for whom it resulted in a decrease, meaning that participants do not necessarily associate quality and quantity of sleep. During confinement, two things can decrease sleep pressure: a decrease in physical activity and an increase in anxiety that act directly on wakefulness systems[30].

4.4. Impact of confinement on tobacco consumption

Our results show that confinement had a negative effect on tobacco consumption, as the proportion of participants who increased their consumption is double the proportion of those who decreased it. We found that living alone is a major risk factor of tobacco consumption during the confinement, which isn't highlighted by COVIPREV[19]. But also, participants who reported negative effects of confinement on their mental state were less likely to have decreased their use, or more likely to have increased it, which this time coincides with COVIPREV[19].

4.5. Impact of confinement on physical activity

Participants were more likely in our survey to report a decrease in their physical activity during confinement than to report an increase. Those results are consistent with the findings of Meyer and al[31]. We observed a strong association between physical activity and mental state. People who have reduced their physical activity are at greater risk of experiencing a deterioration in their mental health. On the other hand, there is no difference between those who did not change their physical activity habits and those who increased their activity.

4.6. Impact of confinement on alcohol consumption

Our results concerning alcohol consumption were much higher than COVIPREV[19] results, as 22.7% of our respondents reported an increased consumption, versus only 11% of their respondents. On the same trend, 12.2% of our respondents reported a decrease in their consumption, versus 24% of their respondents. The change in alcohol consumption since the start of confinement follows a U-shaped relationship with age in our survey. Indeed, 25-34 year old respondents decreased their consumption much more often than 35-54 year olds. The questionnaire does not allow us to be completely positive about the cause of this result. Nevertheless, the 25-34 year old participants who had reduced their consumption mentioned much more regularly (61.0%) the fact that they only drink alcohol when they go out than the other populations (32.3%) ($p < 0.01$). The 55-64-year-olds increased their drinking much less often than the 35-54-year-olds. These results are in opposition with COVIPREV[19] findings that alcohol consumption increased in the 50+ population. Finally, there are contradictory trends between concerns about COVID-19 and changes in alcohol consumption in our survey. People who were worried about their relatives were more likely to decrease their consumption or not to increase it. On the opposite end, respondents who worried about their finances tended to increase their consumption or not to decrease it. This result may seem contradictory with the fact that not working seems to be a protective factor, all other things being equal. This shows that it is not the fact of not working per se that affects drinking, but the financial worry generated by the situation.

4. Discussion

This survey has been run in a short timeframe and has allowed the analysis of a large number of respondents (n=1454). As there are very few data yet on the behavioral changes of the French population during the confinement, our survey is important. Moreover, we analyzed various behaviors, whereas most of the few existing studies focused on sleep issues. Also, our survey was completed during the confinement, which makes it more precise than a retrospective study, but not immediately after its beginning, allowing effects on behavior to show.

However, several limitations have to be mentioned, such as the online recruitment of the participants which implies a bias in the representativeness of the general population. We observed for instance that our sample included people mostly having a rather high educational profile or being located in specific geographic areas (in particular Paris and Great East regions) strongly affected by the crisis of Covid-19. Therefore, the respondents are reporting an astonishing high-level of compliance (99.3%) with preventive measures decided by the French government and local authorities. All territories were thus affected by confinement in the same way.

Moreover, our sample was composed of a majority of women. Nevertheless, the fact that women respond more often than men to surveys is a well-known phenomenon and is therefore not specific to this survey. However, we used a weighting to avoid this issue. Our analysis showed that the impact of these biases was limited.

The biggest limit of this study is that we don't know the participants' behavior before the confinement. We can then only get results on their behavior changes, but cannot precisely define their habits. This is especially true in the case of alcohol and tobacco consumption. We don't have quantitative measurements but only the reported changes in consumption.

The proportion of respondents who think they have been contaminated is surprisingly high since the estimates of the proportion of the French population that has been contaminated by the virus are between 4 and 8% (of which a large proportion is asymptomatic). Nevertheless, the COCONEL study[20] had shown that 9% of French people thought they had been affected (1% had been diagnosed by a test or a doctor), which is not very far from our results, given that it was made in early April.

This survey has been based on self-evaluation by the respondents for changes in the different parameters we analyzed. The conclusions should take into account the subjectivity of these evaluations. Nevertheless, this survey aimed to capture the respondents' perception, their feelings, and their views on the impact of the pandemic and the associated lockdown situation. From this perspective, we assume that the answers are accurate.

It would be interesting to have information about the respondents' consumption of media content, its frequency, intensity and its level of quality (disinformation), whether it is via television, radio, newspapers or online content (social media) and to study whether this media consumption is linked or not to mental state and behavioral changes. We observed a clear higher sensibility of younger respondents (25-34 years old) in terms of psychological impact on the crisis and lockdown situation. We could formulate the hypothesis that the limitation of the social life related to the lockdown situation is an important factor leading to this result. Further research is needed to confirm this hypothesis.

Since the survey took place in April/May, the situation was completely new for the population and the effects were very strong. However, over time, we think that people might have developed strategies to cope with the effects of confinement (doing physical activity at home, socializing in other ways...), so the "time" and "experience gained" effect could not be taken into account in this study and future public health interventions will most likely have to adapt to this "learning curve" of individuals. People will most certainly behave differently in future confinements and should be more able to maintain a healthier lifestyle despite the situation. Services have emerged and should emerge to offer this maintenance of healthy behaviors.

It appears clearly that, except for the diet, all the analyzed health and wellbeing factors (sleep, physical activity, alcohol consumption, and tobacco consumption) have changed negatively since the beginning of the crisis. We observe a strong impact of the living conditions (living alone is a risk factor) and of the mental state, itself related to the level of concerns (in particular concerns for one's health or financial situation). But in the different models we have developed, the impact is

predominately mutual and our data doesn't allow us to determine the exact causality effect between these variables. We can legitimately conclude that these variables are correlated but we can't strictly define which variable is influencing the others. It seems sensible to understand all these variables as a system, setting the scene for a multi-variable interplay, the variables influencing and retro-influencing each other. With this approach, we can consider the presence of vicious and virtuous circles. This hypothesis should as well be confirmed by further research.

5. Conclusions

This approach leads us to think that multi-factor interventions are required to limit the impact of the crisis and the associated preventive measures (lockdown, physical distancing). Thus, the reported results suggest that comprehensive health and wellbeing programs might have a positive impact on the population's wellbeing during the crisis. These programs might include specific interventions around physical activity, sleep management, alcohol/tobacco consumption control/reduction. They should provide people with advice on activities and best practices adapted to this specific context, but as well increase the subjects' motivation, embedding behavior change techniques leveraging key cognitive biases (social norms, messages framing, use of messengers, healthier default choices, ego, affects...) potentially associated to incentives models (challenges and rewards).

The interventions could also involve some coaching or counseling services around mental health, for instance about stress or low spirits management and relationship management (to avoid tensions with relatives). Actions related to the improvement of the quality and validity of the information received by the population would certainly benefit also to the global state of mental health. Finally, the interventions deployed during and after the Covid-19 crisis would benefit from the use of cost-effective tools such as digital technologies[32], to deliver the above-mentioned components of the interventions in a timely, personalized, and remote manner.

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