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ORIGINAL RESEARCH

How Did the COVID-19 Confinement Period Affect Our Physical Activity Level and Sedentary Behaviors? Methodology and First Results From the French National ONAPS Survey

Pauline Manon Genin, Céline Lambert, Benjamin Larras, Bruno Pereira, Jean-François Toussaint, Julien Steven Baker, Angelo Tremblay, David Thivel, and Martine Duclos

Background: The French National Observatory for Physical Activity and Sedentary Behaviors conducted a national survey aiming to evaluate the potential effects of confinement on the population's physical activity levels and sedentary behaviors. **Methods**: In close collaboration with the French Ministry of Sports and a selected expert committee, 3 different questionnaires investigating 3 subgroup populations were included in the survey: (1) children, (2) adolescents, and (3) adults. **Results**: Forty-two percentage of children, 58.7% of adolescents, 36.4% of adults, and 39.2% of older people had reduced physical activity levels. Particularly, active transportation and endurance practices showed a significant decrease, while domestic, muscular strengthening, and flexibility activities increased. Sitting time and screen time increased, respectively, in 36.3% and 62.0% of children, 25.5% and 69.0% in adolescents, 24.6% and 41.0% in adults, and 36.1% and 32.1% in seniors. **Conclusion**: The COVID-19 confinement period led to important modifications in individual movement behaviors at all ages, particularly favoring decreased physical activity and increased sedentariness. These findings suggest that the authors need to inform and encourage people to maintain and improve their physical activities and to change their sedentary time habits during postconfinement and during the period of a potential future lockdown.

***Keywords**:* lockdown, habits, pandemic, public health

The emergence of COVID-19 (coronavirus) at the end of 2019 in mainland China caused, in a few weeks, a global pandemic, as officially declared by the World Health Organization on March 11, 2020. In metropolitan France, the first 3 cases of COVID-19 were diagnosed on January 24, 2020, and the epidemic reached stage 3 level (corresponding to the free circulation of the virus on the national territory) on March 14. This led to the official decision to close, at a national level, all the public areas and places that were nonessential to the population's livelihood. This national strategy and process led (3 d after March 17, 2020, at noon) to the confinement of the population in order to stop the exponential spread of the coronavirus and to reduce, as much as possible, the number of people affected and the potential death rate, especially for the most vulnerable individuals.

The national containment, forming stage 3 of the fight against the spread of the COVID-19 epidemic, implies restriction of travel for only what is strictly necessary (food shopping, care, and work when teleworking is not possible, outings close to home, as well as the closure of the Schengen area borders). From that day on, and for an undetermined period, the displacement of the French people was then highly restricted, with only a few exceptions requiring specific certificates and authorizations: (1) travel from home to work when teleworking was not possible, (2) travel for basic necessities in listed local shops authorized by public authorities, (3) visits to health professionals for consultations and essential care that could not be postponed, (4) travel for compelling family reasons, and (5) time-limited travel within the limit of 1 hour/day with a perimeter of 1 km around the home, for individual physical activity (PA) or to ensure the natural needs of domestic pets.

On top of the COVID-19 crisis itself, such a lockdown of the population has been unfortunately accompanied by the emergence of other health, social, and economic issues, particularly, confinement restricting human activity and travel. This favors physical inactivity and sedentariness, and both of these variables have been, respectively, associated with almost 1 in 10 premature deaths (based on life expectancy estimates for world regions) from coronary heart disease and 1 in 6 deaths from any cause.[1] This is related to poor health profiles of any age group and is independent of the level of PA.[2] Importantly, sedentary behaviors may not be only defined by a lack of PA, as people can achieve recommended levels of physical exercise and yet spend large amounts of their time remaining inactive.[3,4] These long periods of sedentary behavior increase the risks for cardiovascular diseases, type 2 diabetes, cancers, obesity,[2] stress, and anxiety, even in individuals reaching

Genin, Larras, Thivel, and Duclos are with the National Observatory for Physical Activity and Sedentary Behaviors (ONAPS), Clermont-Ferrand, France. Genin and Thivel are also with the Laboratory of the Metabolic Adaptations to Exercise under Physiological and Pathological Conditions (AME2P), Clermont Auvergne University, EA 3533, Clermont-Ferrand, France. Lambert and Pereira are with the Biostatistics Unit (DRCI), Clermont-Ferrand University Hospital, Clermont-Ferrand, France. Toussaint is with the IRMES, INSEP, Paris, France; EA 7329, Paris University, Paris, France; and the CIMS, Hôtel-Dieu, Public Assistance—Paris Hospital, Paris, France. Baker is with the Faculty of Sports Science, Ningbo University, Ningbo, China; and the Department of Sport, Physical Education and Health, Centre for Health and Exercise Science Research, Hong Kong Baptist University, Kowloon Tong, Hong Kong, China. Tremblay is with the Institute of Nutrition and Functional Foods (INAF), University of Laval, Quebec City, Quebec, Canada. Thivel and Duclos are also with the INRAE, UNH, CRNH Auvergne, Clermont-Ferrand, France. Duclos is also with the UFR Medecine, Clermont University, University of Auvergne, Clermont-Ferrand, France; and the Department of Sport Medicine and Functional Explorations, Clermont-Ferrand University Hospital, G. Montpied Hospital, Clermont-Ferrand, France. Genin (p.genin@onaps.fr) is corresponding author.

recommended PA levels (PALs). Through its beneficial effects on overall health, regular PA is key in the primary prevention of at least 35 chronic conditions,[5] with exercise being the first-line treatment of 26 chronic diseases.[6] Besides its effects on health-related physical fitness, PA is also recognized for its benefits on mental health, with many studies showing that regular PA reduces depression and anxiety symptoms, improves mood, and helps with stress management.[7–9]

In line with international guidelines, the French public health recommendations for adults include a minimum of 150 minutes of moderate to vigorous exercise per week, but more than a third of the population aged 18–79 years are considered inactive.[10] In addition, French working adults spent an average of 12 hours/day sitting during workdays (with 4.17 h/d in work sitting); and 9 hours/day sitting during nonworkdays.[11] The same study reported that being sedentary at work was associated with more sedentary time outside work. While these national data figures were alarming prior to the COVID-19–related confinement, the specific situation induced by the virus pandemic may have strongly favored these sedentary behaviors, limiting PA, as most French people were required to stay at home for a period of 8 weeks.

In this context, the French National Observatory for Physical Activity and Sedentary Behaviors (ONAPS) gathered national experts in the field of PA and health to create an adapted survey, questioning the real impact of the coronavirus-induced lockdown on the population's PALs and sedentary behaviors.

Methods

Composition of an Expert Panel

In a few hours following the governmental announcement of a confinement, the ONAPS, in close collaboration with the French Ministry of Sports, formed an expert committee whose aim was to determine, at the national level, key indicators to identify, understand, and evaluate the changes induced by this lockdown on the population's PA and sedentary behavior. Members of this committee represented the public health, academic, scientific, governmental, and medical areas collectively.

Elaboration of the Survey

Three different questionnaires following the same internal structure have been designed and composed for the survey: (1) children (6- to 10-y old), (2) adolescents (11- to 17-y old), and (3) adults (18 y old and over). For the survey analysis, the adults were then separated into 2 categories, adults aged 18–64 and adults over 65 (seniors). The questionnaires and their methodology have been adapted and inspired from the IPAQ[12] (International Physical Activity Questionnaire) and ONAPS-Q (in progress) questionnaires in adults and the Youth Risk Behavior Surveillance System investigation in children and adolescents.[13] Briefly, the internal structure of the validated questionnaires have been developed using the same type of questions and structure of possible answers (for instance, time being active over a period of 7 d, screen time per day, etc). Using these different questionnaires, we were able to design a common version suitable for the 3 categories. Briefly, the survey initially gathered information regarding the geographical location, sociofamilial characteristics, and health status of the participants before covering the main dimensions of PALs, sitting time, and screen time. Not only were the questionnaires concerned with different behaviors during the confinement, but also whether the participants increased or decreased their time devoted to physical activities and sedentary behaviors compared with their prelockdown habits. More precisely, the participants were asked to declare their (or their children's) PA and sedentary habits at the time of the confinement (when they completed the questionnaires) and retrospectively, what they were doing before the confinement. The parents were asked to fill in the questionnaires for children under 10 years old. The final elaboration of these questionnaires resulted from a back-and-forth consultation between the members of the expert committee, until a consensus was reached.

Launch and Relaunch of the Questionnaires

From the first of April, 15 days after the announcement of the confinement, the survey (see Supplementary Material 1 [available online]) was made available online on the website of the ONAPS (http://www.onaps.fr/), and its promotion has been completed using social media and other networks. On a regular basis (April 6, 16, 24, 28, May 6 [the last day of the confinement]), the operational office of the ONAPS made relaunches in order to optimize the success of the questionnaires. This survey was closed on May 6 (36 d after it officially started), 1 week before the end of the confinement, in order to rapidly obtain the first results that are presented in this paper. In the context of COVID-19 confinement, particular efforts were deployed to reach a large and representative sample. To do so, several types of online media were used to disseminate the survey, targeting different kinds of professional, associative, demographical, and geographical networks and areas.

Ethical Consideration

This work received ethical agreement from the appropriate authorities (CPP Sud est VI. reference 2020/CE 27).

Data Management

The survey has been administrated online using the LimeSurvey (version 2.67.3, Jason Cleeland, Melbourne, Australie) software. Data have been collected anonymously, and none of the provided answers potentially allowed identification of the participants. All the data were directly stored and saved into an Excel sheet once the participants validated their questionnaires. A total of 22,895 questionnaires were completed (all age ranges included). Three indicators (PALs, sitting time, and screen time) have been transformed into quantitative data by taking the central value of each class (eg, <30 min/wk were encoded as 15 min of PA per week). Originally, we had chosen to propose qualitative values in order to avoid inconsistent values and data entry errors. The data were then gathered into an Excel sheet before being analyzed by our biostatistical team (C.L. and B.P.).

Statistical Considerations

Statistical analysis was performed using Stata software (version 15; StataCorp, College Station, TX). All tests were 2-sided, with a type I error set at 0.05. Categorical parameters were expressed as percentages, and times (PA time, sitting time, and screen time) as median [interquartile range]. The evolution of these 3 quantitative times between before and during the confinement were evaluated using linear mixed models, with the subject considered as a random effect. A logarithmic transformation was proposed when appropriate to achieve normality. Effect sizes (ES) were also calculated and presented with their 95% CIs. The interpretation

was conducted according to the recommendations of Cohen,[14] who has defined ES boundaries as follows: small (ES: 0.2), medium (ES: 0.5), and large (ES: 0.8).

Results

A total of 22,895 questionnaires were completed, with 1588 answers from children, 4903 from adolescents, 15,226 from adults, and 1178 from seniors. Sixty-eight percent of the respondents were female. Forty percentage of the whole sample lived in the countryside, 36.5% in cities, and 23.2% in peri-urban areas. In addition, 70.5% declared that they had a garden or an individual courtyard, 7.1% a garden or a collective courtyard, 14.4% a balcony but no garden, and 8.0% no outdoor area. Fifteen percentage of the whole population declared that they had a chronic disease.

Physical Activity

Children who reported doing <2 hours or >5 hours 30 minutes of PA per week before lockdown increased this practice time during the confinement period. Conversely, the proportion of children who practiced between 2 hours and 5 hours 30 minutes of PA per week reduced their practice during confinement. Supplementary Material 2 (available online) details the changes for PA times per week for each age category, from before to during the confinement.

Figure 1A confirms these results by classifying the participants into 2 categories: those who reached the recommendations of PA and above and those who were below. The 5 hours 30 minutes threshold was chosen for children because it is the highest range proposed in the questionnaire, even if we know that, for children and adolescents, the recommendations are 1 hour/day, that is to say, 7 hours/week. Thus, according to Figure 1A, 48.9% of the children who practiced <5 hours 30 minutes of PA per week before confinement increased their duration of practice during the confinement period. In general, 42.0% of children decreased their level of PA, while it remained stable in 21.3% and increased in 36.7% (Table 1). Of note, the fact that our questionnaire could not identify PAL above 5 hours 30 minutes/week explains the absence of initially active children and adolescents who increased their PAL in Figure 1A.

The results obtained are more marked in adolescents who decreased their PALs during the lockdown (Figure 2: ES [95% CI]: −0.52 [−0.55 to −0.50]). The proportion of adolescents who were engaged in more than 5 hours 30 minutes of PA per week before confinement decreased, while the proportion of all those who practiced up to 5 hours 30 minutes/week, importantly, increased (see Supplementary Material 2 [available online]). Figure 1A shows that 65.9% of adolescents who practiced more than 5 hours 30 minutes of activity per week decreased this practice during confinement. On average, 58.7% of adolescents decreased their level of PA, 21.8% did not change, and only 19.6% increased (Table 1).

The results displayed in Figure 1A for adults and seniors used the actual recommendations of 2 hours 30 minutes of PA per week (150 min). Although Supplementary Material 2 (available online) might only indicate some slight changes in the PALs of seniors during the confinement (ES [95% CI]: −0.12 [−0.18 to −0.06]), Figure 1A shows that 61.1% of those who did not reach the recommendations before the lockdown increased their PAL during lockdown. In adults, the proportion in each category was only slightly modified during the confinement period (Figure 2: ES [95% CI]: 0.11 [0.09 to 0.12]), with an increase in PAL of those

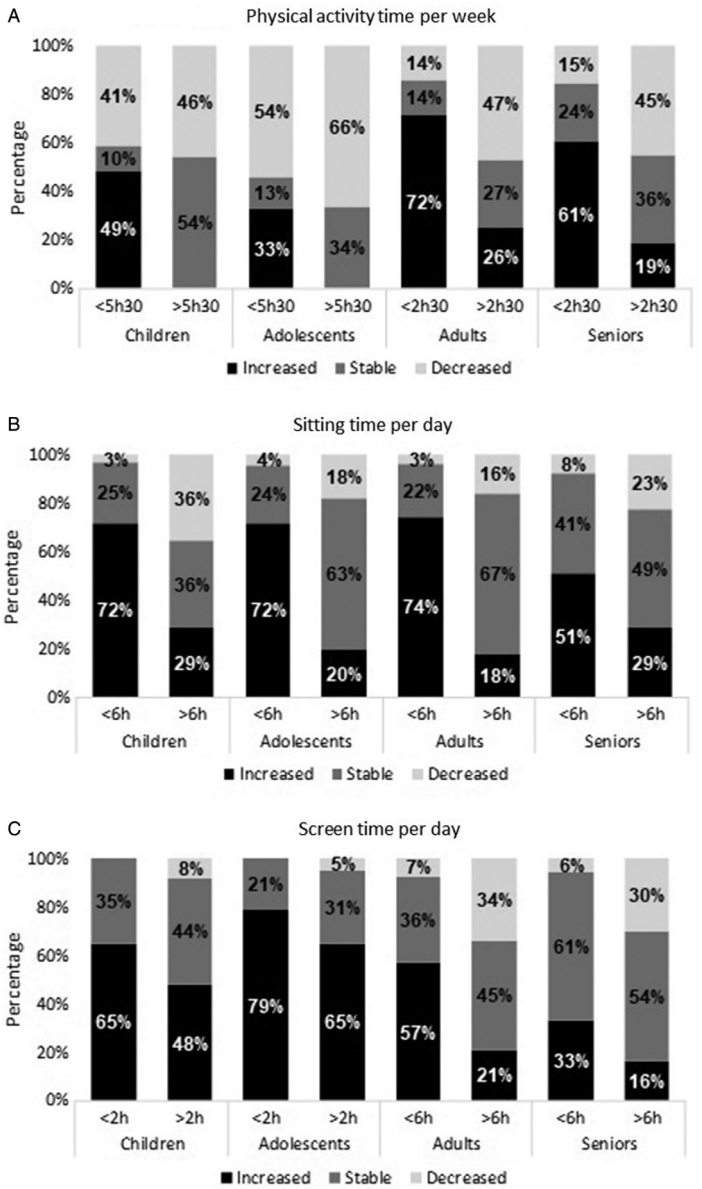

Figure 1 — Evolution between before and during confinement of physical activity time (A), sitting time (B), and screen time (C), according to before-confinement values categorized based on recommendations. (Detailed results are presented in Supplementary Material 2 [available online]).

who did not reach 30 minutes of PA per week before the confinement (see Supplementary Material 2 [available online]). It should be noted that 71.7% of adults who practiced <2 hours 30 minutes of activity per week increased this practice time (see Supplementary Material 2 [available online]). Table 1 shows that, in total, more than 40.5% of adults increased their time spent in PA.

Interestingly, the present analysis also shows a difference in the type of PA practiced by individuals during the lockdown, as illustrated by Figure 3. In general, we observed a decrease in endurance practices, as well as active transportation, with a significant increase in domestic activities (especially in children) and in muscular strengthening and flexibility activities. There is also a slight increase in outdoor play, especially among children and adolescents.

Table 1 Change Between Before and During Confinement of PA Time, Sitting Time, and Screen Time According to Age and Sex Results Are Expressed as Percentages

	PA, %			Sitting time, %			Screen time, %		
	Men	Women	Total	Men	Women	Total	Men	Women	Total
Children (n = 1588)									
Decrease	43.8	39.9	42.0	30.0	29.3	29.7	1.8	1.0	1.4
Stable	21.9	20.6	21.3	34.9	33.0	34.0	34.9	38.6	36.6
Increase	34.3	39.5	36.7	35.1	37.7	36.3	63.3	60.4	62.0
Adolescents (n = 4903)									
Decrease	57.1	59.7	58.7	18.8	14.3	16.0	3.0	3.3	3.2
Stable	26.7	18.6	21.8	53.4	61.6	58.5	30.1	26.4	27.8
Increase	16.2	21.7	19.5	27.8	24.1	25.5	66.9	70.3	69.0
Adults (n = 15,226)									
Decrease	39.8	35.2	36.4	14.6	14.1	14.3	16.0	19.9	18.9
Stable	29.5	20.7	23.1	61.1	61.2	61.1	44.4	38.6	40.1
Increase	30.7	44.1	40.5	24.3	24.7	24.6	39.6	41.5	41.0
Seniors (n = 1178)									
Decrease	36.3	42.0	39.2	18.6	16.8	17.7	6.4	7.6	7.0
Stable	38.4	28.8	33.5	49.4	43.3	46.2	63.7	58.2	60.9
Increase	25.3	29.2	27.3	32.0	39.9	36.1	29.9	34.2	32.1

Abbreviation: PA, physical activity. Note: Results are expressed as percentages.

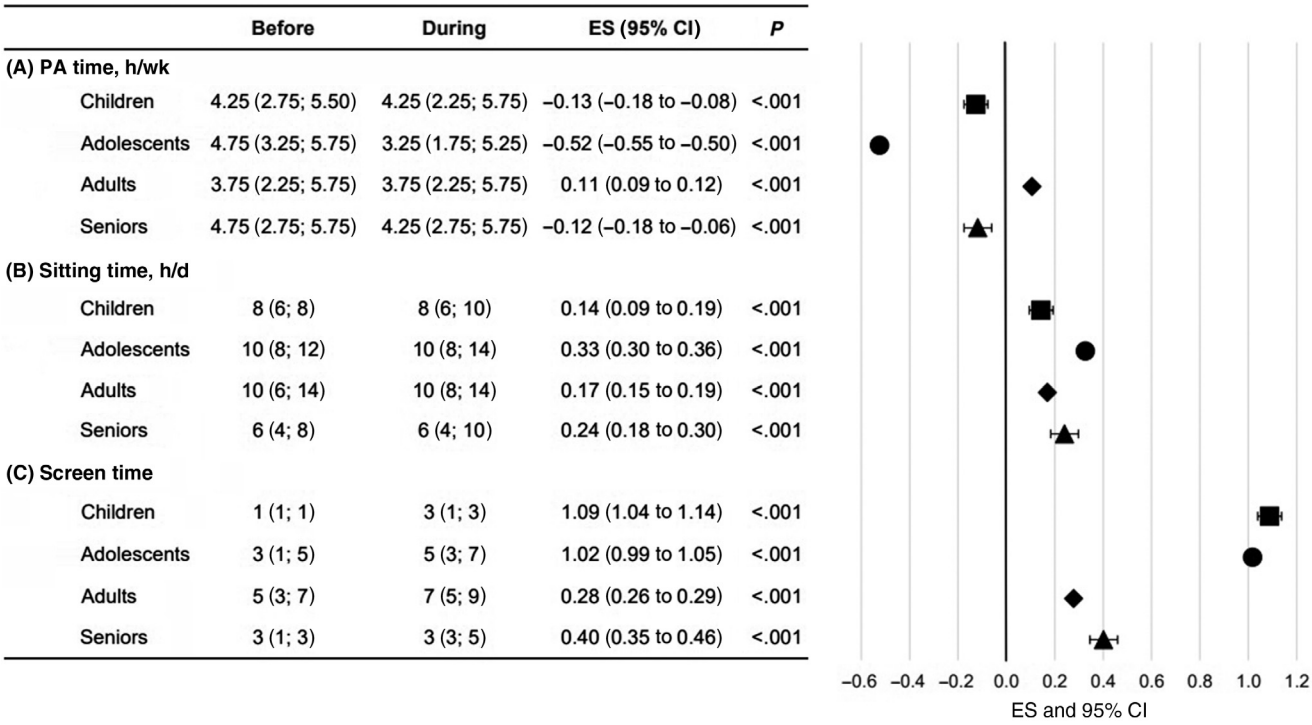

Figure 2 — Evolution between before and during confinement of PA time, sitting time, and screen time, for each age category. Times are expressed as median [interquartile range], and ESs are presented with their 95% CIs. CIs indicate confidence intervals; ES, effect size; PA, physical activity.

Sitting Time

The time spent sitting for children before and during confinement varied slightly (see Supplementary Material 2 [available online]). It should be noted that, among children who spent more than 6 hours seated per day before confinement, 35.5% decreased this time, 36.0% remained stable, and 28.5% increased. The proportions are also different for children who were seated <6 hours/day, with 71.7% having increased (see Supplementary Material 2 [available online]). Table 1 shows that 29.7% of the children decreased their time spent sitting, and 36.2% increased it.

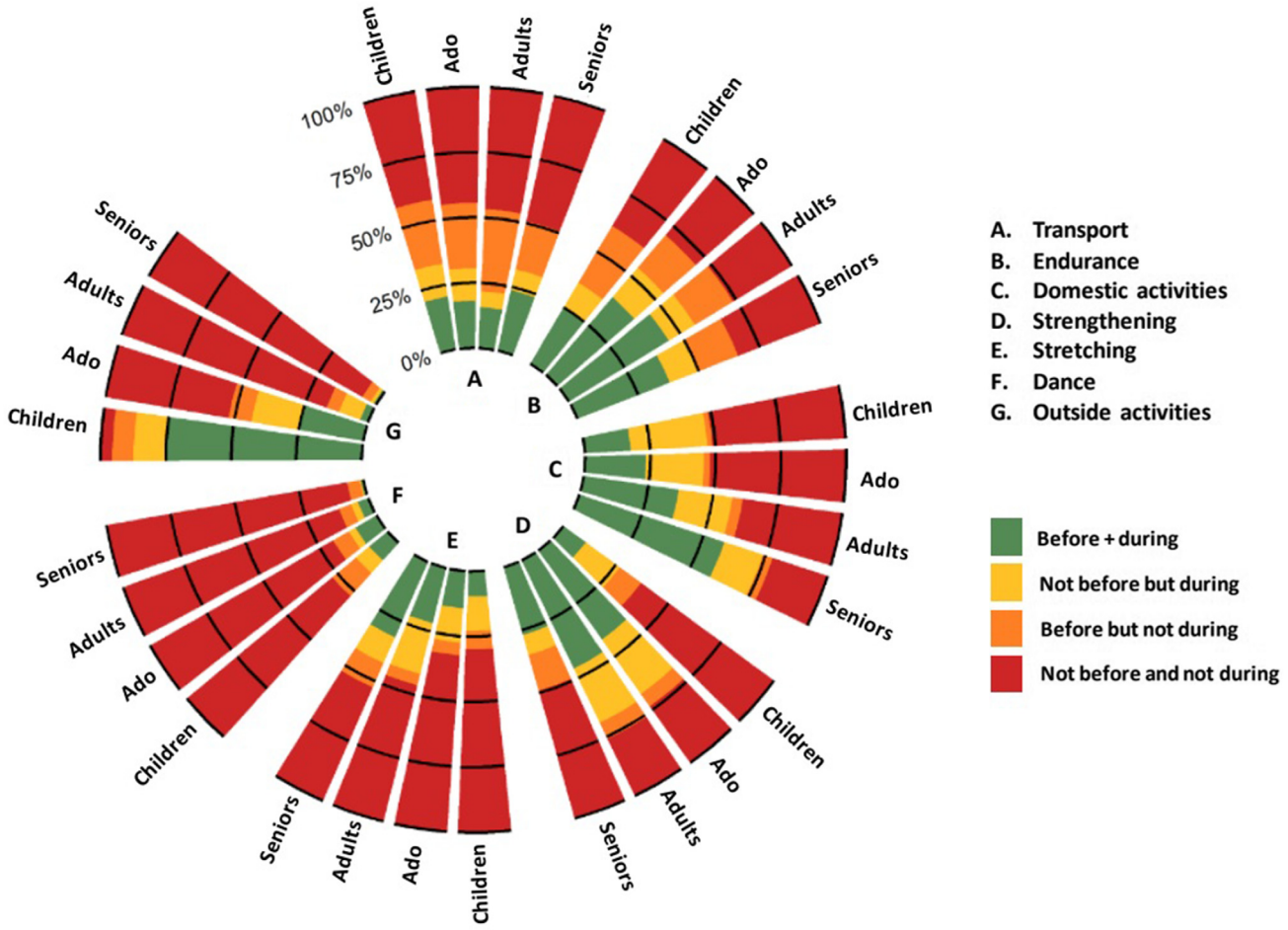

Figure 3 — Evolution of the type of PA during confinement for each age category. Before + during: those who practiced before and during confinement. Not before but during: those who did not practice before but who practiced during confinement. Before but not during: those who practiced before but no longer during confinement. Not before and not during: those who did not practice either before or during confinement. Ado indicates adolescents; PA, physical activity.

Among adolescents, the differences are also marked (see Supplementary Material 2 [available online]). The proportion of those who spent <6 hours seated per day before confinement decreased significantly during this period, while the number of children who sat for more than 10 hours/day increased sharply. Conversely, the proportion of adolescents who spent between 6 and 10 hours seated per day remained stable. Figure 1B confirms these results by showing that 72.1% of adolescents who spent <6 hours seated per day increased this duration, while 17.5% of those who spent more than 6 hours seated per day decreased this time. In total, 16.0% of adolescents decreased their time sitting, 58.4% remained stable, and 25.5% increased it (Table 1).

Among adults and seniors, the differences are less marked (as detailed in Supplementary Material 2 [available online]). However, Figure 1B shows that 74.2% of adults who spent <6 hours seated per day before confinement increased this time spent seated. For those who spent >6 hours hours seated per day before this period, 15.8% decreased at the same time. This includes 22.6% among seniors. Table 1 summarizes these results by showing that 14.3% of adults and 17.7% of seniors decreased their time spent sitting, respectively, 61.1% and 46.2% remained stable, and finally, 24.6% and 36.1% increased. Figure 2 confirms these results with ESs that are not significant clinically, either in adults or in seniors (respectively, ES [95% CI]: 0.17 [0.15 to 0.19] and 0.24 [0.18 to 0.30]).

Screen Time

While 82.5% of children spent <2 hours/day in front of a screen before the confinement, the figures were only 30.0% during confinement. The proportion of children in the 5 other categories increased during confinement (data are detailed in a Supplementary Material 2 [available online]). Figure 1C reinforces these results by showing that 65.0% of children who spent less than the 2 recommended hours per day in front of screens increased this time, as well as 47.8% of children who previously spent more than 2 hours/day in front of screens. The results displayed in Table 1 show that 1.4% of children have reduced their screen time, while it remained stable in 36.6% and increased in 62.0% (Figure 2: ES [95% CI]: 1.09 [1.04 to 1.14]).

Similar results, although more pronounced, are observed in adolescents. Indeed, the proportion of adolescents who spent between 0 and 4 hours/day watching screens decreased, while the proportion of those who spent between 4 and more than 10 hours has, importantly, increased (see Supplementary Material 2 [available online]). Figure 1C indicates that 78.7% of the teenagers who looked

at screens <2 hours/day increased this time. Among those who looked at screens >2 hours/day before the confinement, 64.8% increased this time during the confinement. Overall, 68.9% of adolescents increased their screen time during the lockdown (Table 1 and Figure 2: ES [95% CI]: 1.02 [0.99 to 1.05]). As for PAL, as our questionnaire could not identify screen time below 2 hours/day, it is impossible to detect whether the children and adolescents initially below these 2 hours/day decreased their screen time during the confinement (Figure 1C).

The results of the study are less marked in adults and seniors (see Supplementary Material 2 [available online]). We nevertheless note that 41.0% of adults and 32.1% of seniors increased their screen time during confinement (Table 1).

Discussion

The confinement imposed on the general population to minimize the effects of the COVID-19 virus and avoid its propagation had a drastic impact on our daily routines and activities, deeply modifying our active and sedentary behaviors. In order to better identify and understand these impacts and consequences, and to propose effective and adapted recommendations for the deconfinement phase and a potential new lockdown, the French National Observatory for Physical Activity and Health launched a national survey during the lockdown, questioning PA and sedentary behaviors of the overall population (aged 6- to 99-y old) and their modifications during this period.

A total of 22,895 participants filled in the online survey, including 5691 children and adolescents, 15,226 adults, and 1178 senior individuals. This important level of participation is among the highest worldwide to our knowledge; only a Brazilian survey that gathered about 38,853 adult participants was larger.[15,16] According to our results, a significantly higher proportion of our sample decreased its overall PAL. When analyzed by age groups, 42.0% of children, 58.7% of adolescents, and 39.2% of the older participants effectively reduced their PALs. These results were, however, less pronounced in adults, with a decreased PA observed in 36.4% as opposed to 40.5% who declared an increase (23.1% PAL remained stable according to the survey). Regarding sedentary behaviors, while higher percentages of adolescents, adults, and seniors declared an unchanged sitting time during the quarantine, dramatic proportions of children (62.0%) and adolescents (68.9%) increased their screen time.

These results are in agreement with observations in other countries among adults and the elderly,[15–31] as well as children and adolescents.[32–36] Although such observations remain related to this unique COVID-19-related lockdown, they are consistent with previously published studies that describe a decline in PA and an increase in sedentary behavior as a result of social isolation caused by natural events including wars, earthquakes, and epidemics.[37–39]

Interestingly, we also analyzed these evolutions depending on the initial level of PA and sedentary time of our participants. Our results indicate that, in children and adolescents, whatever their initial PAL, a higher proportion of them decreased their time devoted to physical activities during the lockdown. Indeed, 40.8% of children and 53.7% of adolescents who were initially determined as inactive, and, respectively, 45.6% and 65.9% of those with the initially highest PAL, showed a decline in their PAL during the quarantine. By contrast, in both adults and older people, a very large proportion of the participants who did not meet the PA recommendations before the confinement apparently increased their practice (71.7% and 61.1%, respectively) while 47.1% of adults and 45.1% of seniors who were initially active reduced their level of PA during the lockdown. While the present results are the first among children and adolescents to consider preconfinement PAL, they are in line with previously published data in adults, which also observed that the individuals with higher levels of PA before the COVID-19 pandemic were also those who showed the higher decline during the confinement, while those with a low or moderate PAL tended to increase their practice.[31] These results also echo the findings from Di Corrado et al, [23] who found that 32.9% of their Italian sample (n = 670) declared starting regular physical exercise during the lockdown. Husain and Ashkanani[17] also observed in Kuwait that 50% of their initially active subsample or their participants who were initially involved in walking decreased their PAL during the quarantine. Importantly, while these results suggest that both initially inactive and active individuals might have been concerned by a decreased PAL during the confinement; they do not precisely define whether the degree of this decline was similar between active *versus* inactive individuals. Chang et al[28] effectively concluded that the frequency of PA before the lockdown was a positive predictor of PA frequency in their Taiwanese sample during the confinement. In other words, although being active before the lockdown might not prevent people from reducing their PAL during the confinement, it might attenuate its negative impacts.

Regarding sedentary indicators, our results indicate that, whatever the age group studied, those who initially presented lower sitting time were also those who increased the most time spent seated during the confinement. Indeed, 71.7% of children, 72.1% of adolescents, 74.2% of adults, and 50.9% of the older participants increased their sitting time during the quarantine. Although similar trends are observed in adults and the elderly regarding screen time, alarming proportions of children and adolescents increased their time in front of computers, video games, TV, tablets, or smartphones during the lockdown, whatever their pre-COVID-19 screen time. These results agree with others obtained among Kuwaiti adults, showing a significantly increased screen time during the confinement in individuals declaring both a low (<2 h/d) or high (>6 h/d) screen time before the pandemic.[17]

Based on their Brazilian survey conducted among 38,353 adults, Werneck et al[15] conducted an interesting analysis, comparing the combined evolution of clustered movement behaviors, including PALs and sedentary time. According to their results, the confinement led to a significant increase in the unhealthy movement behavior cluster (mainly characterized by physical inactivity and screen time), especially among younger adults, higher academic status profiles, people who need more time to adhere to the quarantine dimensions, and individuals who had to work from home or lost their occupational activity during the lockdown.[15] Importantly, this increase in unhealthy movement behaviors was associated with loneliness, sadness, and anxiety.[15] Although not assessed in our French survey, many other studies have underlined this association between the observed decline of PA and increased sedentary behaviors due to the COVID-19-induced lockdown, and deteriorated well-being, optimism, and overall mental health in both adults[16,18,22,25,26,30] and youth.[32]

Although this work presents the methodology and the main results of one of the world's largest surveys questioning the impact of the recent COVID-19-induced confinement, some limitations must be considered when interpreting our results. As for all previously published works conducted by other countries, the online and self-reported nature of our data collection should be considered. Although this remains the best method available to collect data in a large sample size and in a relatively reduced amount of time, the

self-declared nature of the collected information might have led to an overestimation of the PA-related results, together with an underestimation of the sedentary behavior.[40] It must also be noted that the preconfinement PALs of our population was slightly different from what was observed in other national surveys, being lower in our adults (26% of active adults according to our results against 60% in the ESTEBAN survey) and children samples (25% of active kids against 67% in the ESTEBAN survey), while closer among adolescents (40% vs 30%). These discrepancies might be directly due to the use of different questionnaires and to the retrospective nature of our collected information. The relatively low percentage of responders who declared a chronic disease (15%) might also limit the representativeness of our sample since recent statistics show that about 37% of French individuals have chronic diseases.[41] Finally, while the design of this analysis, due to the particular situation induced by the confinement, did not allow the presence of a control group, the real causal effect of the quarantine on the observed changes could be questioned, which led us to also calculate and present appropriate ESs to strengthen our results and conclusions.

More detailed analyses should be conducted to better identify the profile of the individuals at risk of adopting unhealthy movement behaviors during lockdown, but also to determine effective strategies and recommendations to prevent the effects of a highly probable new confinement period that might be induced by a second wave of this COVID-19 pandemic. Beyond the particular context of a social quarantine, these results must alert the general population to the challenges of sedentary lifestyles and lack of PA; and the current period of postconfinement must be seen as an opportunity to support the adoption of healthy active behaviors. The time dedicated to transportation could be considered as a time of opportunity to engage in physical activities. Furthermore, the transformation of urban spaces and creation of active living environments for all, whether in local authorities, schools, or companies, should also be encouraged.

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