Change in eating habits after 2 years of pandemic restrictions among adolescents living in a city in northern Italy: results of the COALESCENT Observational Study (Change amOng ItAlian adoLESCENTs)

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ABSTRACT

Background Lockdown measures during the recent pandemic, due to the novel COVID-19, affected several other aspects of lifestyle, but little is known about their long-term impact, especially among adolescents. Our study aimed to assess the long-term consequences of changes in diet, exercise and screen activity levels, sleep quality, smoke, smartphone addiction and emotional distress among a sample of Italian adolescents, 2 years after the beginning of the pandemic.

Methods We submitted an online survey to high-school students in the province of Brescia, a city in Northern Italy, investigating changes in food consumption and in physical and screen activities, cooking skills, sleep duration and quality, emotional distress, smartphone addiction and nutrition knowledge. We assigned an Eating Habit Index (EHI) score from 0 to 54, reflecting a current worsening (lower score) or improvement (higher score) in overall diet quality, compared with the pre-pandemic period. The χ^2 test or Fisher's exact probability test and Mann-Whitney test were used as appropriate; a binary logistic regression model was carried out, with EHI score≥33 as the dependent variable.

Results We collected 1686 questionnaires. Consumption of healthy foods increased, as it was for ultraprocessed foods (UPFs). EHI score>33 (75° percentile value) was associated with female gender (OR 1.81, p<0.0001), better nutrition knowledge (OR 1.54, p=0.001), better cooking skills (OR 1.43, p=0.01), lower consumption of UPFs before the pandemic (OR 2.19, p<0.0001), self-perception of healthier diet quality (OR: 4.05, p<0.0001) and no smartphone addiction (OR: 1.35, p=0.02).

Conclusions Considering the profound impact of lifestyle on both physical and mental health, our results could be relevant to understand how to promote healthy eating practices among young people.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Social and physical restrictions during COVID-19 pandemic deeply affected lifestyle among people; children and adolescents during lockdown periods faced periods of school closure with different degree and extension, according to national regulations. A great body of evidence assessed the change in dietary habits and physical activities during the confinement periods, but little is known about long-term impact of such change among adolescents.

WHAT THIS STUDY ADDS

⇒ To our knowledge, this is the first Italian research investigating the long-term consequences of COVID-19 pandemic restrictions, among a large cohort of adolescents, on several aspects of their lifestyle, including diet, exercise and screen activity levels, sleep quality, smoke, smartphone addiction and emotional distress, during a period of 'return to normal'.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The results of this research could better address public health interventions aimed to improve or correct lifestyle among the next generation.

INTRODUCTION

During the COVID-19 pandemic avoiding close contacts was one of the first recommendations that the WHO identified as crucial to limit human-to-human transmission, to slow down the spread of the SARS CoV-2.[1 2] Italy was also the first, among Western countries, to enforce strict national restrictions.[3] Initially, lockdown was limited to the Lombardy region, but few days later the restrictions became national.[4 5] During the following 2

years, Brescia and Bergamo districts, both in Lombardy region, in Northern Italy, remained the two cities with the highest alert level and with the strictest isolation measures. Concerns grew about their economic and social costs of these measures. It is well known that social relationships are an important determinant of health, alongside education, lifestyle, environment, employment and working conditions.[6]

Adolescents are particularly at risk, given that this period of development is pivotal for psychological and biological changes and can be decisive in setting individual behavioural trajectories which influence adulthood.[3 6–8] According to a recent review by Mignogna *et al*, during the first pandemic wave, dietary changes in children/adolescents were heterogeneous, noting that there was an increase in the consumption of unhealthy food together with an improvement in the consumption of fresh fruits, nuts and legumes.[9] According to this review, a general improvement in diet quality was observed in Europe, especially in Mediterranean countries.

When focusing on the influence of restriction policies on physical activity and mental health, data are less conflicting. The results of the meta-analysis by Neville *et al* showed that during the COVID-19 pandemic there was a significant reduction in physical activity among children and adolescents.[10] At the same time, an increase in psychological distress, especially during the early stages of the pandemic, and a high prevalence of COVID-19 related fear were noted among children and adolescents.[11 12] Several authors explored changes in physical activity, mental health, sleep quality and eating behaviour, but most of the studies were cross sectional and reported data, even among people aged 12–20 years or 15–20 years, but strictly limited to the more rigid periods of restrictions, at the beginning of the pandemic and mainly among athletes.[13 14] During the last year, some authors explored the impact of lifestyle changes in the long term, with particular focus on specific population categories. The study by Taheri *et al* was conducted among a large cohort of elite and subelites athletes, from 14 different countries, and assessed the long-term consequences of confinement measures, after 2 years from the beginning of the pandemic. The study compared mental health and nutritional practices between the two groups of athletes, in order to develop efficient strategies to prevent mental and eating disorders among athletes, in possible next similar scenarios.[15]

In summary, most of these surveys were limited to assessing change during the lockdown period or to explore long-term consequences but mainly among athletes, without exploring the impact of these changes in the long run in less selected populations.

To assess the extent of long-term changes in several aspects of lifestyle, with a focus on eating habits, we designed a web-based survey addressed to adolescents, 2 years after the COVID-19 pandemic, during a period of slow 'return to normal'. The main issue we addressed was whether the lifestyle changes previously documented during the lockdown period were transient or permanent among adolescents. Investigating these aspects among adolescents can contribute to address public health actions to prevent the development of non-communicable diseases during adulthood.

METHODS

Study design

We conducted a cross-sectional observational study using a web-based survey. The study was designed with the supervision of the Territorial School Service of Brescia District; we submitted the online survey proposal to all high school headmasters in the Brescia district, 39 state schools and 18 state-authorised private schools. The survey was administered during school hours in a supervised classroom setting. Participants were assured that all their responses would be used only for the aims of the study and would be treated according to criteria of anonymity and confidentiality. The only inclusion criterion was the willingness to participate in the survey. The data collection period was from December 2021 to February 2022, a period with no planning of remote learning.

The questionnaire

After several adjustments, the final version of the questionnaire consisted of 110 questions, divided into 8 sections (A–H). All but one questions were multiple-choice. One question was optional and in open format. Detailed description of the survey can be found in the online supplemental file 1.

We assigned participants an Eating Habit Index (EHI) score ranging from 0 to 54 based on changes in consumption of different foods, both healthy and unhealthy. This score reflected a current worsening (lower score) or improvement (higher score) in overall diet quality, compared with the pre-pandemic period. The scoring algorithm is reported at the end of online supplemental file 1.

Statistical analysis

The analyses included descriptive statistics (ie, frequencies and percentages for categorical variables and mean values with SD for continuous variables). Comparisons between groups were made using the χ^2 test or Fisher's exact probability test for categorical variables and Mann-Whitney test for continuous variables. EHI score variable was used as categorical using the value of EHI at 75th percentile as cut-off. A binary logistic regression model was carried out, with EHI score≥33 as the dependent variable. The covariates to be included into the final model were selected on the basis of univariate analysis with a univariate p value<0.05 as the main criterion. Then, using a backward selection process, statistically non-significant variables were excluded. To check for collinearity among variables, the Spearman correlation test was used. The results of logistic regression are reported with adjusted ORs and 95% CIs. A p-value less than 0.05 was considered

as statistically significant for all analyses. Statistical analyses were performed using STATA (Stata Statistical Software: Release 16.0 College Station, TX: Stata Corporation). Graphs and figures were made with Microsoft Excel (2016) and Canva's free platform (2023).

RESULTS

Out of 57 schools, 8 agreed to participate in the study, 4 state and 4 state-authorised private schools, totalling 4866 students. Among them, 1686 students returned the online questionnaire (34.6% response rate). Table 1 shows the main sociodemographic characteristics of the student sample.

Changes in eating habits compared with the pre-pandemic period

Thirty-eight per cent of our sample, reported no change in eating behaviour, 26% reported improvement, 12% reported worsening and 26% reported a change, but without a clear opinion on its quality (figure 1A). About 63% reported no change in meal planning during the day and 17% an increase in snacking; overall, 26%, 23% and 34% perceived an increase, a decrease and no change, respectively, in the total amount of food consumed during the pandemic period (figure 1B). As shown in the figure 1C, there was an increase in the regular intake of snacks and a doubling of irregularity in meal planning. About 18% of the students reported being involved in meal preparation, as compared with 8% before the pandemic.

Changes in food and beverage intake, compared with the pre-pandemic period

Most of the sample reported no change in the consumption of individual foods; among the students who reported changes in the intake of individual foods, we reported the main changes in figure 2. For all healthy foods, the rate of students who reported an increase in consumption, compared with those who reported a decrease, was higher. Concerning unhealthy foods, the rate of students reporting an increase in consumption, compared with those reporting a decrease, was higher for four foods, out of the nine considered. Focusing on the intake of ultraprocessed foods (UPFs), 45.6% of the sample reported daily intake before the pandemic, increasing to 48.1% during the pandemic. In particular, students consuming UPFs three times per day or more increased from 16.2% to 22.7% (figure 1D).

Changes in overall diet quality, compared with the pre-pandemic period

The mean and median score of the EHI were 28.6 (SD±6.0) and 28 (range 12–49), respectively.

We assessed the association between several variables and EHI equal or greater than 33, the value of EHI at 75th percentile, by performing both univariate and multivariate analyses (data shown in table 2).

Table 1 Main sociodemographic characteristics of the student sample

Gender	n	%
Females	846	50.2
Males	786	46.6
Not declared	54	3.2
	Mean	**SD**	**Range**
Age (years)	15.8	1.6	13–21
BMI (kg/m^2)	**Mean**	**SD**	**Range**
Females (846)	20.6	3.0	13.2–36.1
Males (786)	21.7	3.8	14.6–55.6
Not declared (54)			
School characteristics	**n**	**%**	
State school	1295	76.8	
Private school	391	23.2	
Family Composition	**n**	**%**	
2 family members	72	4.3	
3–4 family members	1216	72.1	
5 or more family members	398	23.6	
Housing	**n**	**%**	
One-room apartment	27	1.6	
Two-room apartment	101	6.0	
Three-room apartment	508	31.1	
Four or more rooms	1050	62.3	
Gardens			
No garden	391	23.2	
Private garden	1092	64.8	
Shared garden	203	12.0	
Balconies			
No balconies	232	13.8	
Private balconies	1424	84.5	
Shared balconies	30	1.8	
Parents education	**n**	**%**	
Mother			
Secondary school	305	18.1	
High school	735	43.6	
University	476	28.2	
Father			
Secondary school	451	26.8	
High school	678	40.2	
University	361	21.4	

Other relevant aspects of lifestyle

Before the pandemic, students who engaged in at least 60 min of light, moderate or intense physical activity per day were 33.6%, 30.42% and 25.7% of the sample, respectively. The level of light, moderate and intense physical activity remained the same or even increased in 79.3%, 80.6% and 81.2% of the sample, respectively, compared
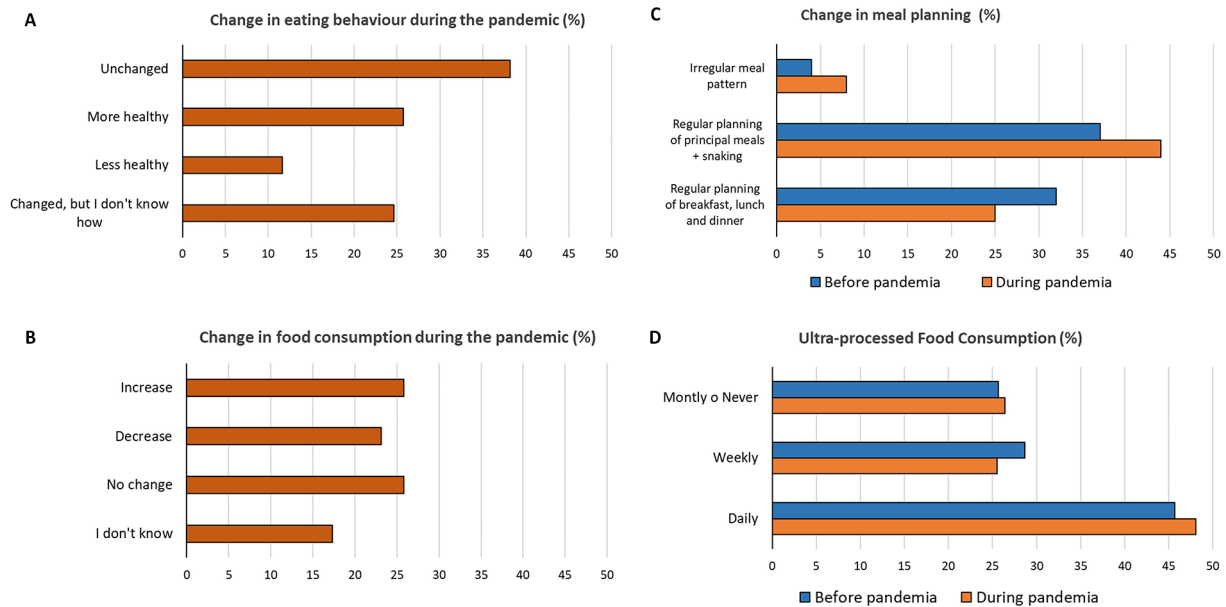
Figure 1 Comparison before and during the pandemic period of: panel (A) eating behaviour; panel (B) food quantity consumption; panel (C) meal planning; panel (D) ultraprocessed food consumption.

with the pre-pandemic period (figure 3, panels A and B). Overall, combining the answers, 30% of adolescents resulted active based on WHO recommendations. Active students had a better EHI score compared with inactive students (30% vs 23%, p=0.004).

Data on sleep revealed that 62.7% of the sample had a sleep duration of less than 8 hours per night and 40.1% slept less than before pandemic, with 28.9% of the adolescents reporting a deterioration in sleep quality (figure 3C).

Compared with the pre-pandemic period, the use of digital devices increased for study, for fun and out of boredom in 75.1%, 59.6% and 56.8% of the sample. The test for smartphone addiction revealed a risk of addiction in 45.9% of the adolescents (figure 3D). During the last 2 weeks prior to the completion of the online survey, 65.1% of the sample reported experiencing a high level of stress, anxiety or unhappiness or having difficulties coping with everyday activities. Among them, 77% reported that such feelings created a moderate-to-high level of interference in their quality of life, mainly due to school pressure.

On multivariate analysis, higher EHI was statistically associated with older age, female gender, lower consumption of UPFs, high level of cooking skills, good nutrition knowledge and absence of smartphone addiction.

DISCUSSION

To the best of our knowledge, this is the first article exploring the change in the eating habits and lifestyle of a cohort of Italian adolescents, assessing the impact of 2 years of social restrictions of various kinds, due to the COVID-19 pandemic, and not only during or immediately after the strict lockdown period.

From a previous Italian study, with data collected from March to April 2020, we learnt that adolescents (aged between 12 and 17 years) had an increased intake of several unhealthy foods during the lockdown period, compared with the older population: they consumed more packaged sweets, industrial baked goods, soda beverages, salty snacks and sauces, and had a lower adherence to the Mediterranean diet.[16] In our study, the median score of our EHI, close to the middle of the range, revealing neither a worsening nor an improvement in the overall quality of the diet, was due to the balance between the proportion of adolescents consuming more unhealthy foods and the proportion of those consuming more healthy foods. Moreover, the relative majority of the sample reported no variation in the consumption of each food category.

A multicentre study, including Italian adolescents, reported an increase in the daily consumption of sweets, fried foods and, in particular, of UPFs, during the lockdown period, compared with the previous period.[17] One of the emerging concerns about diet quality, at any age, is the consumption of UPFs, since several epidemiological studies have reported an association between the extent of their consumption and increased incidence of chronic diseases and even overall mortality.[18] Over a 2-year period, in our sample, the percentage of adolescents who reported consuming UPFs daily increased, with a greater relative increase in the rate of adolescents consuming these foods more than thrice a day (from 16.2% to 22.7%). This is one of the most worrying long-term consequences of the change in food habits: excessive consumption of UPFs has detrimental consequences on energy intake and weight gain even in a short period, as demonstrated in a recent randomised clinical trial.[19] Increase in UPFs consumption among adolescents is a matter of concern, since adolescence is a crucial period of life for the creation of stable lifestyle attitudes and eating habits choice.[20]

A

B
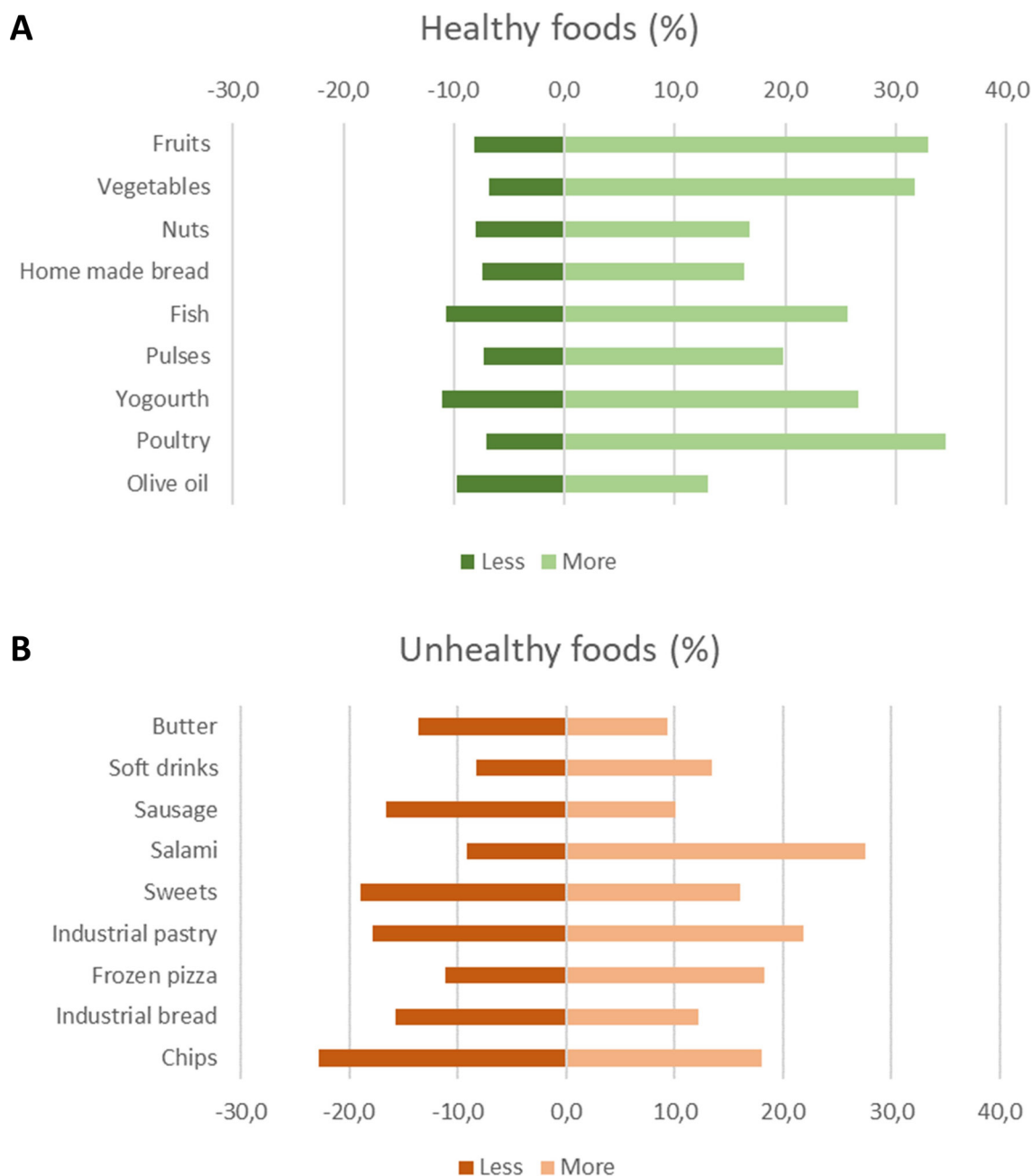
Figure 2 Change in consumption of single foods among students reporting a variation, compared with the period before the pandemic. Panel (A) change in the consumption of healthy foods; panel (B) change in the consumption of unhealthy foods. The foods selected are the same as for the calculation of the Eating Habit Index. Numbers in line refer to the rates of students reporting a positive (at the right of zero) or a negative (at the left of zero) change in the consumption of the item reported in the column.

In contrast with the data about UPFs, an emerging positive attitude towards our adolescents' involvement in meal preparation was detected: the percentage increased from 8% to 18% of the sample. As supported by other studies, the periods of home confinement created the opportunity to have more time for meal preparation and to learn some traditional or family recipes from their parents.[21] Interestingly, the EHI score above 33, corresponding to the 75th percentile, was positively associated with both higher cooking skills, lower UPFs consumption and better nutrition knowledge, that is fundamental in translating theory in good diet practices,.[22] We explored further association of cooking skills elsewhere.[23]

Concerning physical activity, most of the adolescents reported an unchanged or even an increased level in their physical activities. Despite the restriction of physical education and other recreational activities during school closure periods, this attitude does not seem to be long-term among the adolescents in our survey, although we found a high drop-out rate from sports clubs.

Approximately one-third and two-fifths of the sample reported an overall self-perceived worsening of sleep

Table 2 Univariate and multivariate analyses between predictors and Eating Habit Index (EHI)

	EHI≥33 (75th percentile) N=423	P value	AdjOR (95% CI)	P value
	Univariate analysis		Multivariate analysis	
Age, mean±SD, (years)	16.0±1.5 versus 15.8±1.6	0.0007	1.11 (1.03 to 1.22)	0.008
Gender n (%)				
Male	253 (29.9)	<0.0001	Ref	
Female	164 (20.9)		1.33 (1.06 to 1.69)	0.015
Not declared	6 (11.1)		–	–
BMI				
Underweight	73 (21.3)	ns		
Normal weight	298 (26.3)			
Overweight	52 (24.9)			
Pre-pandemic meals management				
Mother/other	375 (24.2)	0.005	Ref	
Self-prepared	48 (35.0)		1.49 (0.97 to 2.27)	ns
Meals management during the pandemic				
Mother/other	333 (25.1)	ns		
Self-prepared	90 (30.1)			
Change in meal planning compared with pre-pandemic period				
No	246 (23.1)	<0.0001	Ref	
Yes, I eat more regularly	58 (42.0)		1.50 (1.00 to 2.26)	0.05
Yes, I sometimes skip meals or eat out of meals	119 (24.6)		1.03 (0.76 to 1.40)	ns
Change in food intake compared with pre-pandemic period				
I eat as before	136 (23.9)	<0.0001	Ref	
I eat more	84 (19.3)		0.76 (0.53 to 1.10)	ns
I eat less	136 (34.9)		1.04 (0.73 to 1.50)	ns
I don't know	67 (23.0)		0.81 (0.56 to 1.19)	ns
My weight is the same	154 (24.3)	<0.0001	Ref	
My weight has increased	91 (19.7)		0.90 (0.6 to 1.27)	ns
My weight has decreased	131 (36.1)		1.13 (0.79 to 1.63)	ns
I don't know/I prefer not to answer	47 (20.5)		0.83 (0.55 to 1.26)	ns
Ultraprocessed food consumption in the pre-pandemic period				
High	142 (18.4)	<0.0001	Ref	
Moderate	129 (26.7)		1.46 (1.09 to 1.96)	0.01
Low	152 (35.1)		2.20 (1.63 to 2.94)	<0.0001
Ultraprocessed food consumption during pandemic period*				
High	128 (15.8)	<0.0001		
Moderate	117 (27.2)			
Low	178 (40.0)			
Change in alcohol consumption compared with pre-pandemic period				
Wine				
I don't drink it	248 (26.1)	ns		
I drink as before	89 (22.3)			
I drink more	64 (23.0)			
I drink less	22 (36.7)			

Continued

Table 2 Continued

	EHI≥33 (75th percentile) N=423	P value	AdjOR (95% CI)	P value
Beer				
I don't drink it	260 (27.5)	0.001	Ref	
I drink as before	73 (19.0)		0.71 (0.49 to 1.03)	ns
I drink more	70 (23.0)		0.89 (0.60 to 1.32)	ns
I drink less	20 (37.7)		1.08 (0.54 to 2.16)	ns
Spirits				
I don't drink it	245 (26.8)	0.005	Ref	
I drink as before	72 (19.8)		1.21 (0.71 to 2.09)	ns
I drink more	76 (23.5)		0.74 (0.53 to 1.03)	ns
I drink less	30 (36.6)		0.59 (0.42 to 0.82)	0.002
Alcohol combined				
I don't drink it anything	189 (26.2)	ns		
I drink more wine and beer and spirits	22 (17.6)			
I drink less/as before wine or beer or spirits	212 (25.2)			
Cooking skills				
Moderate/low	127 (35.1)	<0.0001	Ref	
High	296 (22.4)		1.47 (1.11 to 1.95)	0.008
Physical activity				
Inactive	278 (23.2)	0.004	Ref	
Active	145 (29.9)		1.27 (0.97 to 1.66)	ns
Pre-pandemic smoking habits				
No smoker	365 (25.1)	ns		
Smoker	58 (25.1)			
Smoking habits during the pandemic				
No smoker	358 (25.6)	ns		
Smoker	65 (22.8)			
Nutrition knowledge				
Poor	176 (31.9)	<0.0001	Ref	
Good†	247 (21.8)		1.49 (1.15 to 1.92)	0.002
Sleep duration				
<8 hours	257 (24.3)	ns		
≥8 hours	166 (26.4)			
Perceived quality of sleep compared with pre-pandemic				
Improved	70 (24.1)	ns		
Deteriorated	141 (29.0)			
Unchanged	212 (23.3)			
Smartphone addiction				
Addicted	160 (20.7)	<0.0001	Ref	
Not addicted	263 (28.9)		1.33 (1.03 to 1.71)	0.03
Psychological distress				
No	184 (22.0)	0.003	Ref	
Possible presence	239 (28.2)		1.32 (1.02 to 1.72)	0.04

*This variable was excluded from logistic model because of collinearity.
†At laest 4 out of 6 correct answers.
‡At least one parent with a university degree.
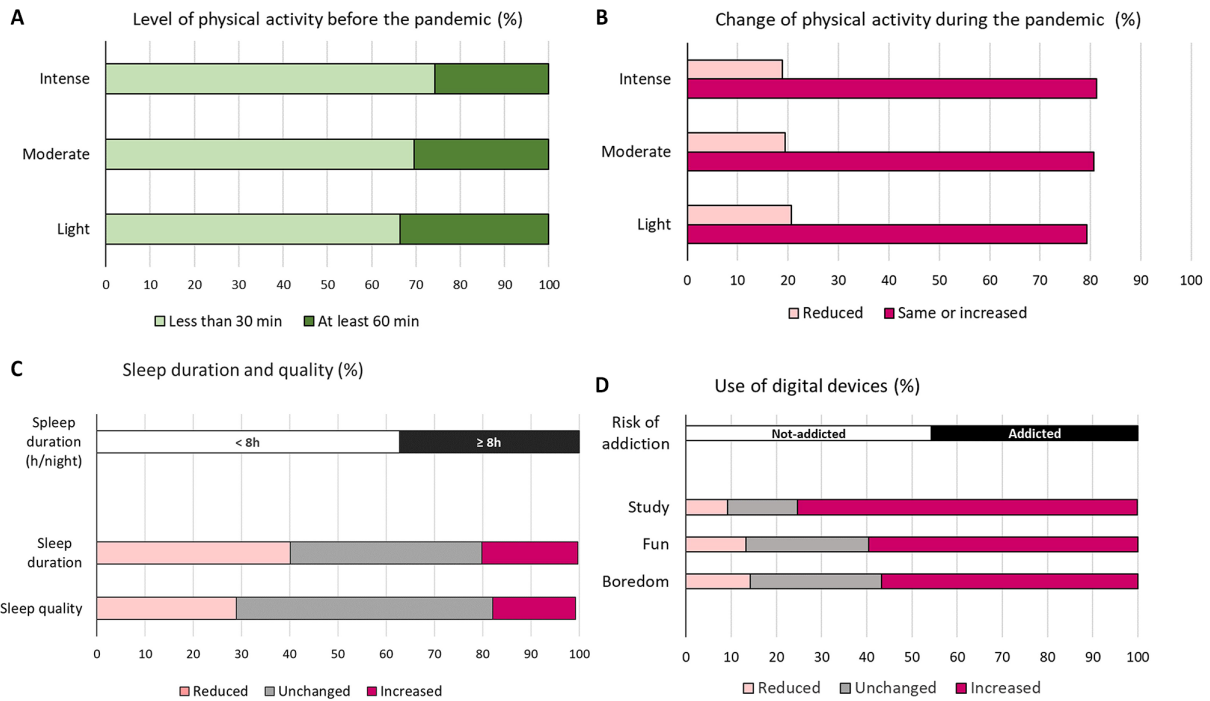
Figure 3 Comparison before and during the pandemic period of: panels (A) and (B), physical activity level; panel (C) sleep duration and quality; panel (D) use of digital devices and risk of addiction.

quality and a decrease in sleep duration, respectively, in comparison to the pre-pandemic period. This result, together with the data on digital device use, smartphone addiction and emotional distress, deserves attention because of the profound relationship between these aspects, particularly in adolescence, a crucial period for future mental health.[24]

We acknowledge some limitations that readers must consider, when interpreting our results.

One of the major limitations of the study is about its generalisability, since the survey was limited to one of the cities with the highest number of days of school closure. We can argue that we conducted the study where the long-term effect should be the worst among the country, but we hope that sharing these results and our methodology could be useful for other researchers to explore the same aspects in other Italian areas. We also acknowledge the limitation of the self-reported nature of the survey, with potential recall bias and subjectivity. Nevertheless, we found that scores of the EHI were significantly higher and lower among adolescents self-perceiving an improving and a worsening in their food quality, respectively, and we can argue that this correlation could be considered as a marker of internal concordance and reliability of the data obtained.

Another limitation was that our data about several aspects of lifestyle had a comparative value: we collected most of the data to assess a worsening or an improvement in lifestyle habits, compared with the pre-pandemic period, without an objective assessment of, for example, diet quality or physical activity. We acknowledge that this aspect could be severely criticised, but our main objective was to assess the impact of the pandemic and restriction measures on lifestyle and not an assessment of the actual diet quality and physical activity level among adolescents. Our results could be of value in case of future similar scenarios of confinements, in order to prevent shift to unhealthy behaviours.

The present study has several strengths. First, the sample size was one of the largest among adolescents in our country. Furthermore, the survey explored several aspects of daily life, including frequency of foods consumption, meal preparation and distribution throughout the day, cooking skills, food insecurity, physical and screen activity, sleep, alcohol and tobacco use, smartphone addiction and psychological distress, providing a unique contribution in the knowledge of the long-term impact of pandemic restrictions among adolescents. Being adolescence a crucial period of life for the development of lifestyle, a deep understanding of the changes due to the recent pandemic is of primary importance in planning health prevention strategies.

CONCLUSIONS

Among a large cohort of adolescents, the long-term consequences of COVID-19 pandemic restrictions on lifestyle are diverse and mixed. The overall quality of the diet seems to be unchanged in comparison to the pre-pandemic period, with some adolescents' positive attitude towards home cooking; nevertheless, a worrying increase in UPFs consumption may lead to both short-term and long-term detrimental health consequences and may deserve close monitoring. The influence of the pandemic on other aspects of lifestyle, such as physical activity, sleep quality, alcohol and tobacco use, and especially emotional

distress, needs further investigation because of its possible link to both physical and mental well-being of the next generation.

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Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval The study involved human participants, but being an anonymous online survey, the approval by an Ethics Committee was not mandatory. Participants gave informed consent to participate in the study before taking part.

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Data availability statement Data are available upon reasonable request.

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Supplemental material

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Description of the online survey

The online survey was designed for self-administration and was developed using the open-source software LimeSurvey (LimeSurvey GmbH, Hamburg, Germany). During the development of the survey, we administered a first online draft to a sample of 36 volunteer students (aged between 14-16) to test their level of understanding and estimate time for completion.

SECTION A (2 questions): the first question was digital informed consent; only students agreeing to study procedures could access the other survey questions. The second question in this section was about age. Participants aged less than 13 years old were automatically excluded from the survey.

SECTION B (4 questions): gender, high school attended, and self-reported weight (kg) and height (cm).

SECTION C (4 questions about housing): how many people living with the students in the same house, number of rooms, and presence of garden or terrace.

SECTION D (6 questions about parents' education and employment): education level and occupation with possible change in occupation during the pandemic, of mother, father and other working people living with the student.

SECTION E (56 questions about eating habits): attitudes about meal sharing and planning, with possible change during pandemic, food insecurity, frequency of ultra-processed food consumption, cooking skills and self-perception about change in the amount of food consumed, in diet quality and in weight during the pandemic. The main core of this section concerned the change in the frequency of consumption of 44 foods, compared to the pre-pandemic period. An example of questions in this core section was: "compared to the pre-pandemic period, your consumption of "fruit" has now: "increased", "decreased", "remained unchanged", or "I usually don't eat this food category".

SECTION F (26 questions about other aspects of lifestyle): change in type and duration of physical activity, sports activity, duration and quality of sleep, duration and type of screen activity (for school, out of boredom, for fun) and smoking. The level of physical activity was evaluated asking students how much time they dedicated to light, moderate and vigorous activity from the beginning of the pandemic. For each level the possible responses were "0-15 minutes", "16-30 minutes", "31-60 minutes", and "> 60 minutes". WHO recommends that children and adolescents should do at least an average of 60 minutes per day of moderate-

to vigorous-intensity, mostly aerobic, physical activity, across the week (WHO guidelines on physical activity and sedentary behaviour, 2020). Based on these recommendations, we combined the responses to create a binary variable where "active" refers to adolescents who met WHO recommendation. Smartphone addiction was evaluated using the Smartphone Addiction Scale - Short Version (SAS-SV) [1] that consisted of 10 items on a six-point Likert scale from 1 ("Strongly disagree") to 6 ("Strongly agree"). The total score ranges from 10 to 60, with higher scores reflecting higher problematic use of a smartphone. The Italian version was validated by De Pasquale et al. [2] maintaining the original cut-off score indicating probable smartphone addiction (31 for males and 33 for females).

SECTION G (6 questions about emotions): 3 questions of the Matthey Generic Mood Questionnaire (MGMQ-it) [16] were used. MGMQ is a brief questionnaire designed to screen for a wide variety of emotions, not just depression or anxiety in the last two weeks. The questions used were the Q1. Di-stress question: "Have you felt very stressed, anxious, or unhappy, or found it difficult to cope, for some of the time?' (response options: 'Yes', 'Possibly', 'No'); and the Q2. Impact question: 'How bothered have you been by these feelings?' (response options: 'Not at all'; 'A little bit'; 'Moderately'; 'A lot'). A response of 'Moderately' or 'A lot' to the Impact Question is considered a positive screening for a condition of clinical distress [3,4]. The third question is an open-ended and optional question of the survey, where students who were willing to express their own feelings could explain the reasons for their anxiety or depression.

SECTION H (6 questions about nutrition knowledge): 6 questions from the validated Italian version of the Moynihan questionnaire [5].

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Score assignment for calculation of Eating Habit Index (EHI).

Change in consumption frequencies	Eating Habit Index (EHI)	
	Healthy Foods	**Unhealthy Foods**
Do not consume	0	3
Unchanged	2	1
Reduced	1	2
Increased	3	0
Food List	Fruit	Chips
	Vegetables	Packaged industrial bread
	Nuts	Frozen pizza
	Home-made bread	Industrial pastry
	Fish	Sweets
	Legumes	Salami
	Yogurt	Sauces
	Poultry	Soft-drinks
	Olive Oil	Butter