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Research Article

Impact of COVID-19 on lifestyle-related behaviours- a cross-sectional audit of responses from nine hundred and ninety-five participants from India



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ABSTRACT

Background and aims: The impact of measures taken to contain COVID-19 on lifestyle-related behaviour is undefined in Indian population. The current study was undertaken to assess the impact of COVID-19 on lifestyle-related behaviours: eating, physical activity and sleep behaviour.

Methods: The study is a cross-sectional web-based survey. A validated questionnaire to assess the changes in lifestyle-related behaviour was administered on adults across India using a Google online survey platform.

Results: A total of 995 responses (58.5% male, mean age 33.3 years) were collected. An improvement in healthy meal consumption pattern and a restriction of unhealthy food items was observed, especially in the younger population (age <30 years). A reduction in physical activity coupled with an increase in daily screen time was found especially among men and in upper-socio-economic strata. Quarantine induced stress and anxiety showed an increase by a unit in nearly one-fourth of the participants.

Conclusions: COVID-19 marginally improved the eating behaviour, yet one-third of participants gained weight as physical activity declined significantly coupled with an increase in screen and sitting time. Mental health was also adversely affected. A detailed understanding of these factors can help to develop interventions to mitigate the negative lifestyle behaviours that have manifested during COVID-19.

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1. Introduction

COVID-19 is a global burden which continues to redefine daily lifestyle-related habits in a significant manner as the pandemic progresses through its different phases. Public health recommendations and government measures taken to abate infection have indirectly impacted food availability, dietary quality, normal daily activities, access to recreational public settings, social activities,

work and financial security [1]. These factors compound over time to radically change lifestyle-related behaviours, especially daily eating, activity and sleep behaviours that are known to be independent risk factors for metabolic complications such as obesity, diabetes and cardiovascular disorders [2,3].

Few preliminary studies from the west have highlighted a negative impact on various lifestyle-related behaviours as a potential implication of COVID-19. However, these studies were done during the complete lockdown phase and suffer from methodological limitations like less representative sample and non-validated tools for data collection. Moreover, the interplay of the severity of COVID-19 infection with different social, economic and cultural constructs in determining the extent of changes in

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lifestyle-related behaviours might vary from country to country.

There is a lack of evidence that evaluates the effect of COVID-19 on lifestyle-related behaviours in India. It is important to investigate some key questions such as which lifestyle behaviours are most affected, how severe is the impact of COVID-19 on these behaviours, what are the reasons for these changes and which demographic section is the most impacted. Considering these questions, we undertook this study to evaluate the overall impact of COVID-19 on lifestyle changes experienced by individuals during the pandemic. The answers to these questions will establish a fundamental basis to develop appropriate recommendations for lifestyle modifications during this time.

2. Material and methods

2.1. Study design and rationale

A web-based cross-sectional study was conducted on the general population to assess the impact of COVID-19 on daily lifestyle-related practices such as dietary, activity and sleep pattern using a validated questionnaire. The study was approved by the Institutional Ethics Committee, All India Institute of Medical Science, New Delhi.

This study was a rapid, large cross-sectional online survey conducted during the unlock phase (August 15, 2020 to August 30, 2020) across various cities, towns and villages in India. The data were collected using Google Form web survey platform and telephonic interview. A standard study invitation message along with the link to the online survey was shared through personal and social contacts of the research group members via email, Facebook, Instagram, and WhatsApp. We also asked the participants to share the study link to increase study participants, which allowed us to conduct a nationwide survey, especially during the pandemic situation. In cases, where participants had limited literacy levels or technical knowledge to fill the Google Form by themselves, the investigators conducted a telephonic interview and filled the form on their behalf.

A brief description of the study, its objectives and the declaration of anonymity and confidentiality were given to the participants before administering the questionnaire shared via Google Form. Informed consent was taken from all the participants at the time of enrollment. Participants were also requested to be honest in their responses. Following this, the participants answered differential questions on the changes experienced in their lifestyle before and during the pandemic. During the survey, participants were able to stop study participation and leave the questionnaire at any stage before the submission process; in doing so, their responses would not be saved. Responses were saved only by clicking on the “submit” button provided at the end of the questionnaire.

2.2. Study participants

The principle of maximum diversity was followed to recruit a representative sample for this study. Quota sampling technique was used to identify the quotas based on different demographic variables such as age, gender, socio-economic strata and place of residence. The number of participants in each quota was compared with the prevalence of different categories in Indian population and efforts were made to sustain maximum representativeness.

A total of 1058 responses were collected using the Google Form link and telephonic survey, after excluding responses that met exclusion criteria such as younger participants (age <18 years), duplicates and invalid entries. The final data included 995 participants (as shown in [Supplementary Fig. 1](#)).

2.3. Survey questionnaire

The electronic survey questionnaire was designed to assess changes in multiple lifestyle-related behaviors such as eating, physical activity, sleep and other health related behaviours during the COVID-19 outbreak. The differential questionnaire used in this study was developed and validated as an extension of a short version lifestyle related practices questionnaire in Indian adults [4]. The questionnaire has three sections assessing socio-demographic details, changes in lifestyle related behaviour and COVID-19 specific reasons for the changes in these behaviors. Section A comprises questions relating to general information and demographic data, self-reported anthropometric data and one question on change in weight status during COVID-19. Section B consists of two parts with 24 items in each. Part A (A1 to A24) assesses the baseline lifestyle-related behaviours and Part B (B1 to B24) evaluates changes in different lifestyle related behaviors such as eating habits, physical activity and sleep pattern during the pandemic. The domain on eating behaviour consists of 12 items on meal pattern, portion size, frequency of meals, food group consumption pattern, emotional eating and intake of high fat, salt and sugar (HFSS) foods and sugar-sweetened beverages (SSB) consumption. The domain on physical activity pattern has six items focusing on different components of activity such as aerobic exercise, involvement in household chores, leisure related activity, sitting and screen time. Two items are for assessment of sleep patterns, one item for daily stress levels and two items for stress related addictive behaviours such as smoking and alcohol consumption. The five point Likert-response choices are as follows: ‘not routinely’, ‘one to two times a week’, ‘three to four times a week’, ‘five to six times a week’ and ‘almost daily’. The magnitude of the responses ranges from 5 (most acceptable behaviour) to 1 (least acceptable behaviour). Section C has 6 items assessing the perceived COVID-19 specific reasons for changes in lifestyle-related behaviours.

2.4. Data and statistical analysis

Descriptive statistics of the participants’ baseline characteristics and responses were provided as frequency and percentage for categorical variables. Continuous variables were reported as mean and standard deviation or median and range/interquartile range according to the distribution. The responses for before-COVID-19 lifestyle scores and during-COVID-19 lifestyle scores were assessed and these scores were subtracted for each item giving the mean difference scores which were associated with demographic variables. The association between the categorical variables was assessed using Chi-squares test or Fisher’s Exact test. The differences of continuous variables between two groups were assessed using *t*-test or Wilcoxon test. While comparing more than two groups ANOVA with bonferroni correction was done. For all analyses, $P \leq 0.05$ was considered as statistically significant. All statistical analyses were performed by using STATA/SE version 14.2 (StataCorp LP, College Station, TX, USA).

3. Results

3.1. Sample description

The demographic details of the included participants ($n = 995$) is shown in [Table 1](#). The sample has slightly higher male participation (58.5%) with the mean age of 33.3 (14.5) (range, 18–85) years. The representation from different socio-economic strata (according to Kuppuswamy scale) and place of residence was fairly equal, with slightly greater number of participants from metropolitan cities (43.1%). The mean self-reported body mass index

(BMI) was $24.8 \pm 4.7 \text{ kg/m}^2$. Almost one-third participants reported a gain in weight during COVID-19 pandemic.

3.2. Responses from the survey

Responses for differential items assessing the changes in lifestyle-related practice before and during COVID-19 is given in Table 2. The habit of consuming meals routinely at regular intervals has slightly increased during COVID-19 (42.5% vs 49.7%). The participants refraining from unhealthy eating behaviours such as consumption of fast food (64.1% vs 81.6%), fried food (44.3% vs 62.6%) and junk food (53.2% vs 67.6%) also increased. Participants reported marginal improvement in the frequency of consumption of different food groups such as fruits and vegetables (34 vs 38%), milk and its products (38.1% vs 40%) and pulses, meats and egg (18.3% vs 24.1%) during COVID-19.

In the physical activity domain, an increase in participants not routinely exercising for 30 min was observed (38.5% vs 50.5%). Although, participants exercising more than three days a week (45.4% vs 45.2%) before the pandemic maintained the habit of exercising during the pandemic as well. Participants refraining from routinely involvement in leisure-related physical activity also increased by more than double (29.4% vs 65.9%). One-third participants reported a daily screen time of 4–5 hours during COVID-19 (13.2% vs 32.6%). Participants reporting more than 8 hours of sleep increased (10.2% vs 27.8%) but the overall quality of sleep marginally declined (49.9% vs 45.8%) and overall stress amongst participants increased (25% vs 38.3%).

3.3. Impact of COVID-19 on lifestyle-related behavior: before and during COVID-19 comparison

The comparison of mean scores of lifestyle related behaviours before and during COVID-19 is shown in Table 3. There was a significant increase in routine consumption of meals at regular intervals during COVID-19 (0.3 [1.73], $P < 0.001$). There was

significant improvement in healthy eating in terms of frequency of your fruits and vegetables intake (0.15[1.41], $P < 0.05$) and consumption of pulses, egg or meat and consumption of balanced diet (0.14[1.21], $P < 0.05$). The intake of unhealthy food items such as fast food (0.26 [0.86], $P < 0.001$), fried food (0.24[0.93], $P < 0.001$), junk food (0.22[1.00], $P < 0.001$) and sugar sweetened beverages SSB (0.20[1.11], $P < 0.001$) significantly declined during COVID-19.

Participation in moderate intensity aerobic exercises declined significantly ($-0.20[1.61]$, $P < 0.05$). The overall participation in household chores significantly increased (0.27[1.48], $P < 0.001$), whereas participation in leisure related activities significantly decreased ($-0.49[1.49]$, $P < 0.001$).

Other health-related behaviours such as daily sleeping hours (0.20[0.58], $P < 0.001$) and screen time ($-0.45[0.93]$, $P < 0.001$) and sitting time at work ($-0.12[1.37]$, $P < 0.001$) significantly increased. The stress levels during COVID-19 also significantly increased ($-0.23[1.01]$, $P < 0.001$) but smoking (0.02[0.03], $P < 0.05$) and alcohol consumption (0.07[0.49], $P < 0.001$) significantly decrease. Social support extended by family and friends to maintain healthy lifestyle-related behaviours also significantly increased (0.09[0.85], $P < 0.001$).

3.4. Direction of change in lifestyle-related behaviors: improved, worsened or no change

The frequency distribution of per unit difference in lifestyle scores before and during COVID-19 is shown in Table 4. The change in scores was calculated by subtracting during-COVID-19 lifestyle scores from before-COVID-19 lifestyle scores. In the eating behaviour domain, half of the participants experienced no change in regular meal pattern, whereas for 29.8% participants this habit improved but for 18.56% this habit worsened. The intake of high protein foods such as pulses, egg and meats increased during COVID-19 (26.04%). The intake of unhealthy food items such as fast food (18.09%), junk food (18.99%), fried food (25.33%) and SSB (16.38%) improved by one unit. Participants experienced a reduction in physical activity by 9.5% after comparison to the improved participants (22.05%) and leisure-related physical activity (45.63%) was three times higher than that of the improved participants (15.68%). In addition to this, the daily sitting time increased for 33.07% participants. Besides, the time spent daily on screen time increased by one unit in one-third of the sample (30.65%) and overall sleeping hours increased in one-fourth of the sample (25.53%). Almost one-fourth (23.02%) participants reported an increase in stress level by one unit. Although, overall social support from the family and friends (20.8%) during COVID-19 improved as well.

3.5. Reasons for changes in lifestyle-related behaviour

The reasons for change in lifestyle related behaviour are given in Supplementary Table 1. Factors such as fear of coronavirus infection (43.8%), preferring home-cooked food (25.2%) and less involvement in eating out and socializing (23.6%) were the prime reasons for improvement in healthy eating and decline in junk food consumption. Although, some participants involved in physical activity by walking (28.9%), at-home workout sessions (18.9%) and yoga (16%); adverse changes in physical activity levels were reported due to lack of motivation (24.5%), time availability (25.3%) and restricted access to parks, dance and fitness centre (28.6%). Besides, participants' fear of getting infected by coronavirus (23.6%), worrying about their family (20.2%) followed by boredom and loneliness (18.2%) and financial loss (14.7%) were most commonly reported reasons for adverse changes in stress and anxiety levels during COVID-19.

Table 1
Demographic characteristics of participants.

Characteristics	Value
Gender	
Age (year)	33.33 ± 14.5
Male	583 (58.5)
Female	412 (41.4)
Type of residence	429 (43.1)
Metropolitan Cities	
Mid-Level Cities	350 (35.1)
Small Cities	216 (21.7)
Socio-economic status	207 (20.7)
Upper	
Upper middle	185 (18.6)
Lower Middle	272 (27.3)
Upper lower	220 (22.1)
Lower	84 (8.4)
Marital Status	
Married	483 (48.5)
Single	493 (49.5)
Family Status	
Nuclear	657 (66.0)
Extended	191 (19.2)
Joint	147 (14.7)
Anthropometric Parameters	
Self- reported BMI (kg/m ²)	24.8 ± 4.7
Weight gain during COVID-19	314 (31.5)
Weight loss during COVID-19	138 (13.8)
Stable weight during COVID-19	477 (47.9)
Values are presented as mean ± standard deviation or number (frequency %).	

Table 2
Frequency of participant's responses.

S.No.	Question	Before COVID	During COVID
EATING BEHAVIOR			
1	Consumption of regular meal pattern		
	Not routinely	261 (26.2)	190 (19.1)
	One to two times a week	105 (10.5)	89 (8.9)
	Three to four times a week	115 (11.6)	121 (12.2)
	Five to six times a week	91 (9.2)	100 (10.1)
	Almost Daily	423 (42.5)	495 (49.7)
2	Consumption of fast food		
	Not routinely	638 (64.1)	812 (81.6)
	One to two times a week	238 (23.9)	125 (12.6)
	Three to four times a week	84 (8.4)	37 (3.7)
	Five to six times a week	16 (1.6)	12 (1.2)
	Almost Daily	19 (1.9)	9 (0.9)
3	Consumption of fried food		
	Not routinely	441 (44.3)	623 (62.6)
	One to two times a week	385 (38.7)	251 (25.2)
	Three to four times a week	133 (13.4)	87 (8.7)
	Five to six times a week	18 (1.8)	23 (2.3)
	Almost Daily	18 (1.8)	11 (1.1)
4	Consumption of junk foods as snacks		
	Not routinely	530 (53.2)	673 (67.6)
	One to two times a week	289 (29.1)	207 (20.8)
	Three to four times a week	122 (12.3)	73 (7.3)
	Five to six times a week	25 (2.5)	23 (2.3)
	Almost Daily	29 (2.9)	19 (1.9)
5	Frequency of your fruits and vegetables intake		
	Not routinely	105 (10.5)	108 (10.9)
	One to two times a week	210 (21.1)	148 (14.9)
	Three to four times a week	214 (21.5)	208 (20.9)
	Five to six times a week	127 (12.8)	154 (15.5)
	Almost Daily	339 (34.1)	377 (37.9)
6	Consumption of balanced diet by including healthy ingredients (whole wheat, pulses, legumes, eggs, nut, fruits and vegetables)		
	Not routinely	121 (12.2)	128 (12.9)
	One to two times a week	148 (14.9)	110 (11.1)
	Three to four times a week	255 (25.6)	200 (20.1)
	Five to six times a week	135 (13.6)	174 (17.5)
	Almost Daily	336 (33.8)	383 (38.5)
7	Consumption of milk or its products (curd, chhachh, lassi, cheese, paneer etc)		
	Not routinely	158 (15.9)	172 (17.3)
	One to two times a week	176 (17.7)	156 (15.7)
	Three to four times a week	178 (17.9)	162 (16.3)
	Five to six times a week	104 (10.4)	107 (10.7)
	Almost Daily	379 (38.1)	398 (40.0)
8	Consumption of one or more servings of pulses, egg or meat in a day		
	Not routinely	201 (20.2)	206 (20.7)
	One to two times a week	261 (26.2)	210 (21.1)
	Three to four times a week	234 (23.5)	239 (24.0)
	Five to six times a week	117 (11.8)	100 (10.1)
	Almost Daily	182 (18.3)	240 (24.1)
9	Daily Consumption of sugar/honey/jaggery		
	Zero teaspoons per day, I don't add sugar in my meals/beverages	144 (14.5)	151 (15.2)
	One to two teaspoons per day	438 (44.1)	435 (43.7)
	Three to four teaspoons per day	287 (28.9)	269 (27.0)
	Five to six times teaspoons per day	90 (9.0)	105 (10.6)
	More than 6 teaspoons per day	34 (3.4)	35 (3.5)
10	Consumption of sugar sweetened beverages		
	Not routinely	541 (54.3)	653 (65.6)
	One to two times a week	252 (25.3)	218 (21.9)
	Three to four times a week	141 (14.1)	73 (7.3)
	Five to six times a week	26 (2.6)	20 (2.0)
	Almost Daily	35 (3.5)	31 (3.1)
11	Consumption of foods with high sugar		
	Not routinely	499 (50.1)	514 (51.7)
	One to two times a week	348 (34.9)	329 (33.1)
	Three to four times a week	112 (11.2)	110 (11.1)
	Five to six times a week	26 (2.6)	25 (2.5)
	Almost Daily	10 (1.0)	17 (1.7)
12	Emotional Eating (boredom/distress/disappointment)		
	Not routinely	662 (66.5)	715 (71.9)
	One to two times a week	226 (22.7)	180 (18.1)
	Three to four times a week	79 (7.9)	67 (6.7)
	Five to six times a week	14 (1.4)	18 (1.8)
	Almost Daily	14 (1.4)	15 (1.5)

Table 2 (continued)

S.No.	Question	Before COVID	During COVID
Physical Activity Behavior			
13	Participation in 30 min of moderate intensity aerobic exercises/sports		
	Not routinely	383 (38.5)	502 (50.5)
	One to two days a week	159 (15.9)	43 (4.3)
	Three to four days a week	144 (14.4)	144 (14.5)
	Five to six days a week	103 (10.3)	103 (10.3)
	Almost Daily	206 (20.7)	203 (20.4)
14	Participation in household chores (cooking, laundry, cleaning)		
	Not routinely	330 (33.2)	378 (38.0)
	One to two days a week	222 (22.3)	22 (2.2)
	Three to four days a week	112 (11.3)	158 (15.9)
	Five to six days a week	46 (4.6)	87 (8.7)
	Almost Daily	285 (28.6)	350 (35.2)
15	Participation in leisure related activities (grocery shopping, walking in park, gardening)		
	Not routinely	293 (29.4)	656 (65.9)
	One to two days a week	313 (31.5)	27 (2.7)
	Three to four days a week	199 (20.0)	154 (15.5)
	Five to six days a week	59 (5.9)	49 (4.9)
	Almost Daily	131 (13.2)	109 (10.9)
16	Daily sitting time at work		
	Less than 2 h	127 (12.8)	131 (13.2)
	2–4 h	222 (22.3)	173 (17.4)
	4–6 h	229 (23.0)	239 (24.0)
	6–8 h	226 (22.7)	209 (21.0)
	More than 8 h	191 (19.2)	243 (24.4)
17	Breaks from sitting (such as standing up, or stretching or taking a short walk)		
	0 breaks	82 (8.2)	82 (8.2)
	1–2 breaks	305 (30.6)	308 (31.0)
	3–4 breaks	305 (30.6)	277 (27.8)
	5–6 breaks	135 (13.6)	137 (13.8)
	More than 6 breaks	168 (16.9)	191 (19.2)
18	Daily screen time		
	0–1 h	207 (20.8)	147 (14.8)
	1–2	355 (35.7)	217 (21.8)
	3–4 h	302 (30.3)	307 (30.8)
	4–5 h	131 (13.2)	324 (32.6)
	>5 h	0 (0.00)	0 (0.0)
Sleep Pattern			
19	Daily hours of sleep		
	<6 h	163 (16.4)	136 (13.7)
	6–8 h	730 (73.4)	582 (58.5)
	>8 h	102 (10.2)	277 (27.8)
20	Quality of sleep		
	Excellent	8 (0.8)	24 (2.4)
	Very good	48 (4.8)	85 (8.5)
	Good	449 (45.1)	371 (37.3)
	Bad	316 (31.8)	298 (29.9)
	Very bad	174 (17.5)	217 (21.8)
21	Level of stress or anxiety		
	Not at all	212 (21.3)	202 (20.3)
	A little	534 (53.7)	412 (41.4)
	Much	178 (17.9)	241 (24.2)
	Very much	56 (5.6)	100 (10.1)
	Extremely	15 (1.5)	40 (4.0)
Other Behaviors			
22	Smoking		
	No	939 (94.4)	948 (95.3)
	Yes, 1–3 cigarettes per day	37 (3.7)	39 (3.9)
	Yes, 4–6 cigarettes per day	10 (10.0)	5 (0.5)
	Yes, 7–9 cigarettes per day	7 (0.7)	0 (0.0)
	Yes, >10 cigarettes per day	2 (0.2)	3 (0.3)
23	Alcohol Consumption		
	No	789 (79.3)	880 (88.4)
	Yes, on special occasions	140 (14.1)	66 (6.6)
	Yes, on weekends	48 (4.8)	0 (0.0)
	Yes, more than once in a week	12 (1.2)	44 (4.4)
	Yes, almost daily	6 (0.6)	5 (0.5)
24	Social support		
	Always (more than 90% times)	42 (4.2)	41 (4.1)
	Most of the times (approx. 75% times)-	51 (5.1)	50 (5.0)
	Sometimes (approx. 50% times)	118 (11.9)	88 (8.8)
	Occasionally (approx. 25% times)	284 (28.5)	252 (25.3)
	Rarely (approx. 10% times)	500 (50.3)	564 (56.7)

Table 3
Comparison of mean scores of lifestyle related behavior before and during COVID-19.

S.No.	Question	Before COVID-19 Score Mean (SD)	During COVID-19 Score Mean (SD)	Δ Change (Dur-Bef) [§] Mean (SD)	P value
1	Consumption of regular meal pattern	3.31 (1.69)	3.62 (1.60)	0.3 (1.73)	<0.001
2	Consumption of fast food	4.47 (0.86)	4.73 (0.67)	0.26 (0.86)	<0.001
3	Consumption of fried food	4.22 (0.87)	4.46 (0.83)	0.24 (0.93)	<0.001
4	Consumption of junk foods as snacks	4.27 (0.97)	4.50 (0.87)	0.22 (1.00)	<0.001
5	Frequency of your fruits and vegetables intake	3.39 (1.40)	3.55 (1.40)	0.15 (1.41)	0.001
6	Consumption of balanced diet	3.42 (1.40)	3.58 (1.42)	0.15 (1.42)	0.002
7	Consumption of milk or its products	3.37 (1.52)	3.41 (1.55)	0.03 (1.39)	0.542
8	Consumption of pulses, egg or meat	2.82 (1.37)	2.96 (1.45)	0.14 (1.21)	0.001
9	Consumption of sugar	3.57 (0.96)	3.56 (0.99)	0.00 (0.68)	0.268
10	Consumption of sugar sweetened beverages	4.24 (1.02)	4.45 (0.94)	0.20 (1.11)	<0.001
11	Consumption of foods with high sugar	4.31 (0.85)	4.30 (0.89)	0.00 (0.85)	0.782
12	Emotional Eating	1.48 (0.81)	1.43 (0.82)	- 0.05 (0.86)	0.021
13	Participation in moderate intensity aerobic exercises	2.59 (1.57)	2.46 (1.64)	- 0.12 (1.61)	0.002
14	Participation in household chores (cooking, laundry, cleaning)	2.73 (1.63)	3.01 (1.74)	0.27 (1.48)	<0.001
15	Participation in leisure related activities (grocery shopping, walking in park, gardening)	2.42 (1.32)	1.92 (1.41)	- 0.49 (1.49)	<0.001
16	Daily sitting time at work	2.87 (1.31)	2.74 (1.35)	- 0.12 (1.37)	0.001
17	Breaks from sitting	3.00 (1.20)	3.05 (1.24)	0.04 (1.13)	0.060
18	Daily screen time	3.64 (0.95)	3.19 (1.05)	- 0.45 (0.93)	<0.001
19	Daily hours of sleep	1.94 (0.51)	2.14 (0.63)	0.20 (0.58)	<0.001
20	Quality of sleep	3.60 (0.86)	3.60 (1.00)	0.00 (0.93)	0.873
21	Level of stress or anxiety	3.88 (0.86)	3.64 (1.04)	- 0.23 (1.01)	<0.001
22	Smoking	4.91 (0.41)	4.94 (0.32)	0.02 (0.30)	0.004
23	Alcohol Consumption	4.70 (0.67)	4.78 (0.70)	0.07 (0.49)	<0.001
24	Social support	4.15 (1.09)	4.25 (1.08)	0.09 (0.85)	<0.001

§: Difference of score from during COVID-19 and before COVID-19 for each item.

3.6. Association of lifestyle related behavior with demographics

The association of mean difference of during-COVID-19 domain-wise lifestyle scores from before-COVID-19 domain-wise lifestyle scores was studied with respect to different demographic groups as shown in Table 5. In the age category, a significant improvement in overall eating behaviour during COVID-19 (2.44[6.49], P < 0.001) was seen in the younger age group (≤30 years). Besides, the overall physical activity worsen in all age groups (P < 0.001). Also, the overall physical activity worsened in both the genders, but men experienced a greater significant reduction in their activity status (-1.14[3.56], P < 0.05) in comparison to females (-0.51[3.82], P < 0.05). The upper socio-economic groups (3.09 (6.58), P < 0.001) significantly improved overall eating behavior in comparison to lower socio-economic groups (0.53[4.45], P < 0.001), but the lower socio-economic groups experienced significantly lower reduction in activity status (-0.21 [3.85], P < 0.05) when compared with upper socio-economic status (-1.19 [3.47], P < 0.05).

4. Discussion

The outbreak of COVID-19 and measures of its containment has evident impact on the lifestyle related behaviors in the population [5]. Experts believe that lifestyle related predictors of weight gain and cardiometabolic risk are modifiable and should be screened and addressed during COVID-19 to prevent obesity and maintain general wellbeing [6]. The current study is a cross sectional web-based survey conducted to understand the impact of COVID-19 on different lifestyle behaviors, severity of this impact across different demographic sections and COVID-19 specific reasons for changes in lifestyle. We recruited a representative sample of 995 participants across India to complete a pre-validated questionnaire on lifestyle related behaviors using a web-based platform. The data collected was subjected to rigorous statistical analysis to generate

robust inferences regarding the impact of COVID-19 on lifestyle related behaviors in terms of both magnitude and direction.

The key findings of the survey divulge certain trends in the eating habits and physical activity behaviour. Firstly, a healthy eating trend was observed in terms of slight improvement in routine consumption of meals at regular intervals and consumption of protein-rich foods such as pulses, eggs and meat along with restricted intake of high fat, sugar, salt (HFSS) food items, especially in the younger population (age <30 years). Secondly, there was a significant reduction in moderate intensity aerobic exercises as well as leisure related activities coupled with an increase in daily screen and sitting time. Overall, physical inactivity was comparatively higher in men and participants belonging to upper socio-economic groups. Thirdly, quarantine induced stress and anxiety increased by a unit in almost one-fourth of the participants.

The findings indicate that the participants improved slightly in terms of consuming meals at regular intervals on routinely basis. Regular meal pattern as a construct is often described as an individual's eating patterns at the level of a 'meal', such as a main meal (for example, breakfast, lunch or dinner) or a smaller-sized meal (for example, supper or snack) [7]. The consumption of nutritionally balanced small and frequent meals is associated with better dietary quality and is a common clinical recommendation for weight loss and reduction in metabolic comorbidities [8]. Certain experts believe that a proportion of individuals may have marginally improved metabolism and other health outcomes during the COVID-19 pandemic by adhering to the following dietary behaviors: (i) reducing meal frequency, (ii) consuming regular (i.e., breakfast (about 40% of daily total energy)), lunch (30% of daily total energy) and dinner (30% of daily total energy) and having good quality meals (e.g., more fresh vegetables, good quality protein source, avoiding refined and high glycemic foods) [9]. The participants in our study also reported higher consumption of protein-rich foods such as pulses, eggs and meat. This is, however,

Table 4
Participants responses and frequency of change in score (during COVID-19 lifestyle scores subtracted from before COVID-19 scores).

S.No.	Question	4	3	2	1	0	-1	-2	-3	-4	Total Improvement	Total Decline
EATING BEHAVIOR												
1	Consumption of regular meal pattern	72 (7.24)	54 (5.43)	78 (7.84)	93 (9.35)	513 (51.56)	71 (7.14)	57 (5.73)	25 (2.51)	32 (3.22)	29.86	18.54
2	Consumption of fast food	8 (0.80)	11 (1.11)	57 (5.73)	180 (18.09)	664 (66.73)	57 (5.73)	13 (1.31)	3 (0.30)	2 (0.20)	25.73	7.54
3	Consumption of fried food	8 (0.80)	10 (1.01)	48 (4.82)	252 (25.33)	547 (54.97)	98 (9.85)	23 (2.31)	9 (0.90)		31.96	16.27
4	Consumption of junk foods as snacks	12 (1.21)	18 (1.81)	53 (5.33)	189 (18.99)	599 (60.20)	92 (9.25)	19 (1.91)	11 (1.11)	2 (0.20)	27.34	12.47
5	Frequency of your fruits and vegetables intake	20 (2.01)	47 (4.72)	82 (8.24)	154 (15.48)	457 (45.93)	137 (13.77)	64 (6.43)	21 (2.11)	13 (1.31)	23.72	23.62
6	Consumption of balanced diet	25 (2.51)	39 (3.92)	86 (8.64)	151 (15.18)	459 (46.13)	135 (13.57)	67 (6.73)	18 (1.81)	15 (1.51)	30.25	23.62
7	Consumption of milk or its products	21 (2.11)	35 (3.52)	65 (6.53)	109 (10.95)	545 (54.77)	117 (11.76)	51 (5.13)	32 (3.22)	20 (2.01)	23.11	22.12
8	Consumption of one or more servings of pulses, egg or meat in a day	14 (1.41)	31 (3.12)	70 (7.04)	144 (14.47)	538 (54.07)	132 (13.27)	44 (4.42)	15 (1.51)	7 (0.70)	26.04	19.9
9	Daily Consumption of sugar	2 (0.20)	4 (0.40)	18 (1.81)	113 (11.38)	698 (70.29)	142 (14.30)	14 (1.41)	2 (0.20)	0	13.79	15.91
10	Consumption of sugar sweetened beverages	16 (1.61)	17 (1.71)	72 (7.24)	163 (16.38)	579 (58.19)	101 (10.15)	28 (2.81)	15 (1.51)	4 (0.40)	26.94	14.87
11	Consumption of foods with high sugar	1 (0.10)	7 (0.70)	29 (2.91)	153 (15.38)	622 (62.51)	141 (14.17)	30 (3.02)	11 (1.11)	1 (0.10)	19.09	18.4
12	Emotional Eating	5 (0.50)	8 (0.80)	31 (3.12)	142 (14.27)	666 (66.93)	105 (10.55)	28 (2.81)	7 (0.70)	3 (0.30)	18.69	14.36
13	Participation in moderate intensity aerobic exercises	30 (3.02)	34 (3.42)	64 (6.43)	91 (9.15)	482 (48.44)	145 (14.57)	70 (7.04)	32 (3.22)	47 (4.72)	22.02	29.55
14	Participation in household chores (cooking, laundry, cleaning)	36 (3.62)	56 (5.63)	93 (9.35)	102 (10.25)	498 (50.05)	145 (14.57)	38 (3.82)	4 (0.40)	23 (2.31)	28.85	21.1
15	Participation in leisure related activities (grocery shopping, walking in park, gardening)	15 (1.51)	19 (1.91)	49 (4.92)	73 (7.34)	385 (38.69)	255 (25.63)	119 (11.96)	31 (3.12)	49 (4.92)	15.68	45.63
16	Daily sitting time at work	13 (1.31)	27 (2.71)	60 (6.03)	144 (14.47)	422 (42.41)	196 (19.70)	80 (8.04)	43 (4.32)	10 (1.01)	24.52	33.07
17	Breaks from sitting	4 (0.40)	15 (1.51)	67 (6.73)	185 (18.59)	499 (50.15)	146 (14.67)	54 (5.43)	19 (1.91)	6 (0.60)	27.23	22.61
18	Daily screen time	0	10 (1.01)	12 (1.21)	58 (5.83)	490 (49.25)	305 (30.65)	102 (10.25)	18 (1.81)	0	8.05	42.71
19	Daily hours of sleep	0	0	18 (1.81)	236 (23.72)	674 (67.74)	64 (6.43)	3 (0.30)	0	0	25.53	6.73
20	Quality of sleep	2 (0.20)	5 (0.50)	50 (5.03)	143 (14.37)	598 (60.10)	144 (14.47)	38 (3.82)	13 (1.31)	2 (0.20)	20.1	19.8
21	Level of stress or anxiety	2 (0.20)	12 (1.21)	22 (2.21)	121 (12.16)	513 (51.56)	229 (23.02)	76 (7.64)	16 (1.61)	4 (0.40)	15.78	32.67
22	Smoking	0	4 (0.40)	6 (0.60)	11 (1.11)	968 (97.29)	4 (0.40)	1 (0.10)	0	1 (0.10)	2.11	0.6
23	Alcohol Consumption	1 (0.10)	3 (0.30)	11 (1.11)	92 (9.25)	848 (85.23)	33 (3.32)	5 (0.50)	2 (0.20)	0	10.76	4.02
24	Social support	3 (0.30)	6 (0.60)	36 (3.62)	162 (16.28)	679 (68.24)	72 (7.24)	22 (2.21)	11 (1.11)	4 (0.40)	20.8	10.96

Table 5
Association of demographic variables with mean difference between During-COVID lifestyle related scores and Before-COVID lifestyle related scores.

Characteristics	Eating Behavior Mean (SD)	P value	Physical Activity Mean (SD)	Sleep Pattern Mean (SD)	P value	Other Behaviors Mean (SD)	p	Overall lifestyle score Mean (SD)	P value	
Age										
(1) ≤30	2.44 (6.49)	<0.001 ^a	-0.64 (4.06)	<0.001 ^a	0.251 (2.00)	0.360 ^a	0.24 (1.09)	0.228 ^a	2.29 (9.71)	<0.001 ^a
(2) >30 to ≤45	0.62 (4.44)	1vs2<0.05 2vs3<0.05	-1.41 (3.16)	1vs2<0.05	-0.44 (1.69)	0.04 (1.01)			-1.19 (6.82)	1vs2<0.05 2vs3<0.05
(3) >45	0.88 (4.44)	1vs3<0.05	-0.89 (3.25)	1vs3<0.05	-0.29 (1.45)	0.20 (1.45)		0.28 (0.82)		1vs3<0.05
Gender										
(0) Male	1.86 (5.66)	0.156	-1.14 (3.56)	0.002	-0.04 (1.80)	0.646	0.17 (1.01)	0.334	0.84 (8.03)	0.765
(1) Female	1.38 (5.76)		-0.51 (3.82)		-0.26 (1.91)		0.24 (0.90)		1.07 (8.82)	
Type of residence										
(1) Metropolitan cities	2.02 (5.51)	0.176 ^a	-0.90 (3.66)	0.595 ^a	-0.15 (1.86)	0.081 ^a	0.28 (1.01)	0.207 ^a	1.14 (8.09)	0.264 ^a
(2) Mid-level cities	1.41 (6.05)		-0.89 (3.66)		-0.03 (1.71)		0.13 (0.98)		0.63 (8.76)	
(3) Small towns and villages	1.36 (5.09)		-0.84 (3.84)		0.19 (2.01)		0.16 (1.11)		0.86 (8.97)	
Socio-economic status										
(1) Upper class(1)	3.09 (6.58)	<0.001 ^a	-1.19 (3.47)	0.015 ^a	-0.053 (1.89)	0.294 ^a	0.37 (1.15)	0.133 ^a	2.22 (9.27)	0.010 ^a
(2) Upper middle	2.42 (5.88)	1vs4<0.05	-0.55 (4.00)	1vs5<0.05	0.27 (2.09)		0.14 (0.90)		2.29 (8.93)	1vs4<0.05
(3) Lower Middle	1.15 (5.67)	1vs5<0.05	-0.96 (3.72)	4vs5<0.05	-0.04 (1.73)		0.23 (1.05)		0.37 (8.74)	2vs4<0.05
(4) Upper Lower	0.75 (4.44)		-1.2 (3.53)		-0.20 (1.71)		0.13 (0.91)		-0.52 (7.02)	
(5) Lower	0.53 (4.45)		-0.21(3.85)		-0.12 (1.87)		-0.02 (1.14)		0.13 (6.90)	
Marital Status										
(1) Married	0.84 (4.52)	<0.001 ^a	-1.17 (3.28)	0.003 ^a	-0.31 (1.60)	<0.001 ^a	0.19 (0.97)	0.018 ^a	-0.45 (6.72)	<0.001 ^a
(2) Single	2.53 (6.56)	1vs2<0.05	-0.66 (4.07)	1vs2<0.05	0.26 (2.00)	1vs2<0.05	0.23 (1.05)		1vs3<0.05	2.36 (9.83)
(3) Other	-0.15 (5.36)		0.73 (3.19)	1vs3<0.05	-0.68 (2.23)	2vs3<0.05	-0.42 (1.12)		2vs3<0.05	-0.52 (8.52)
Family Status										
(1)	1.74 (5.86)	0.044 ^a	-0.95 (3.78)	0.607 ^a	-0.003 (1.90)	0.566 ^a	0.21 (1.00)	0.437 ^a	1.00 (8.74)	0.204 ^a
(2)	2.17 (5.26)	2vs3<0.05	-0.61 (3.63)		-0.18 (1.97)		0.21 (1.08)		1.57 (8.69)	
(3)	0.63 (5.41)		-0.93 (3.44)		0.013 (1.37)		0.11 (1.05)		-0.17 (7.14)	

^a Overall p value.

contrary to the findings of another study conducted in the west, which found that daily consumption of regular meals had marginally lower contribution to the overall improvement in eating behavior during COVID-19 (10). A possible reason for this difference could be higher focus on home cooked food in the Indian households.

The results of this study highlight a significant but limited (mostly by one unit) improvement in quality of meals consumed by reduction in the consumption of calorie-dense fast food, fried food and SSBs. Contrary to our findings, some studies suggest that confinement increased intake of HFSS food items, which could be attributed to eating out of anxiety or boredom, a dip in motivation to maintain healthy eating or an increase in mood-driven eating [11,12]. However, in our study the participants reported less socializing and eating out, preference to home cooked meals, time availability for meal preparation, incorporation of immunity-boosting foods to maintain health and better family support in maintenance of healthy eating pattern as prime reasons for reduction in unhealthy eating behaviors. It can also be noted that socializing and eating out practices mostly governed unhealthy food consumption in our sample.

Despite recommendations that COVID-19 preventive measures should not hinder people from being physically active, present results show that there has been a decline in physical activity levels. A reduction in engagement in physical activity at all levels coupled with increase in daily sitting and screen time due to confinement was prominently found across the literature [10]. It is evident that government recommendations to limit outside movement and restrictions on social gathering (group sports and walking or exercise classes), availability (sports and gym facilities) and accessibility (public recreational spaces such as community centers, parks and sports grounds) is linked to decrease in active participation in exercise and normal leisure related activity such as walking, grocery

shopping and gardening etc. Despite counteracting measures taken to increase overall activity at home by offering online “at home physical activity classes” through various social media platforms, present results indicate that it has not been possible for individuals to adequately maintain their normal activity patterns with suggested home activities [13]. The decline in time spent in engaging in physical activity was accompanied by increased screen and sitting time. A substantial increment in the number of hours (4–5 hours) spent in front of the screen for the recreational or work purpose was seen in our study as well.

COVID-19 has limited day-to-day social engagements such as workplace interactions, participation in recreational activities, socializing and eating out which might lead to an increase in mental health distress. We found out that one-fourth of the participants reported an increase in stress and anxiety level by one unit due to fear of getting infected by coronavirus, boredom, loneliness and financial loss at work. Similar findings were reported by a number of studies showing moderate levels of quarantine induced stress and anxiety in Indian adults with more than 80% adults preoccupied with fearful thoughts of getting coronavirus infection [14,15].

The study also highlights the association of demographic variables with changes in lifestyle related behaviors due to COVID-19 pandemic. In our study, a significant improvement was observed in overall eating behavior in the younger age group (<30 years). Similar findings were reported in an Italian survey, where the highest compliance to a traditional Mediterranean diet (high in antioxidants from fruits and vegetables and MUFA from olive oil and fish) was exhibited by younger people (18–30 years) [12]. Eating behavior also significantly improved in upper socio-economic status but conversely the physical activity decreased. Despite decline in food availability, the upper strata of society had the economic means and time to procure and maintain access to healthier ingredients (such as fresh fruits and vegetables, nuts,

oilseed, milk and products) and transform them into healthy meals. It has been already seen in China that level of lockdown and socio-economic status defined level of physical activity [16]. The involvement of lower strata in delivering essential services to restore economic means for surviving the pandemic might have led to an increased daily overall activity level.

In addition, we also found out that changes in these lifestyle related behaviors led to weight gain in almost one-third of the sample. Since individuals with obesity and associated metabolic comorbidities such as diabetes and cardiometabolic disease are more prone to getting COVID-19 infection [17,18], the control on adaptation of negative lifestyle related behaviors becomes a crucial preventive step in containing the spread [19]. The findings also indicate that decline in physical activity and increase in stress outweighed marginal improvement in dietary behavior, which might have led to a positive calorie balance, further leading to weight gain in the sample.

4.1. Implications and future research

The results from this study are concurrent with western literature in establishing that adaptation of negative lifestyle related behaviors to abate coronavirus infection are one of the potential consequences of COVID-19 pandemic. To our knowledge, this is the first study in India to understand the extent of changes in lifestyle related behaviors and its underlying COVID-19 specific reasons, in order to counteract these changes for maintenance of optimal health status at individual and community level. Human behaviour is a product of a combination of environmental, cultural, economic and social variables, since all these variables are known to vary with changing situations during COVID-19 pandemic, there is a need for further research to identify the correlated that has maximum impact on these behaviors to develop effective public health promotion strategies. The increase in usage of information and communication technology during pandemic should be used to our advantage in devising 'one stop lifestyle applications' to disseminate knowledge, change pandemic driven attitude and provide specific action points to manage healthy lifestyle habits amidst pandemic. The information on demographic variation in lifestyle practice during COVID-19 can help to devise user-friendly behavioral support interventions using fitness applications, video streaming and motivation support.

This is the first pan-India study which aimed to recruit a representative sample for collection of data using a pre-validated questionnaire to study the impact of COVID-19 on lifestyle related behaviors. Some limitations of the study are possibilities of reporting bias, due to e-survey and telephonic survey and validity of answers is a general problem of online surveys, which the researcher tried to combat using differential approach as described in the methods section.

In conclusion, the results of the study indicate a mixed effect of the preventive measures adopted to control coronavirus on the lifestyle related behavior with a significant improvement in regular meal consumption pattern and healthy eating behavior and reduction in unhealthy food intake as positive indicators and significant reduction in physical activity and increase in sitting time, screen time and stress as negative indicator. Even though there were improvements in eating behaviors, but its affect was limited. The negative effect of lifestyle related behaviors might outweigh the positive effect of one unit correction in eating behavior, which can lead to higher incidents of weight gain and associated metabolic complications. These observations have potential implications

that could aid the development of physical activity and nutritional recommendations to maintain health during the COVID-19 pandemic. Regular assessment of these behaviors by some validated tool will be useful to develop management advices [20].

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.dsx.2020.09.034>.

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