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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
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 participation, 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 COVID-19. 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 ≤ 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
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 reported marginal improvement in the frequency of consumption 62.6%) and junk food (53.2%

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 given 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 18.5% this habit worsened. The intake of high protein foods such as pulses, egg and meats increased during COVID-19 (26.0%). The intake of unhealthy food items such as fast food (18.0%), junk food (18.9%), fried food (25.3%) and SSB (16.38%) was three times higher than that of the improved participants (15.6%). 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 per participant in one-third of the sample (30.6%) and overall sleeping hours increased in one-fourth of the sample (25.5%). 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 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 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) |
| 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                                                   | 313 (31.5)   | 27 (2.7)     |
|       | Three to four days a week                                                | 112 (11.3)   | 158 (15.9)   |
|       | Five to six days a week                                                  | 59 (5.9)     | 49 (4.9)     |
|       | 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                                                   | 305 (30.6)   | 301 (30.0)   |
|       | Three to four days a week                                                | 305 (30.6)   | 277 (27.8)   |
|       | Five to six days a week                                                  | 135 (13.6)   | 137 (13.8)   |
|       | 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)   | 301 (30.0)   |
|       | 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 (0.0)      | 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)   |
|       | **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 (1.0)     | 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)   |
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 worsened 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 < 0.001). 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 pattern 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,
| S.No. | Question                                                                 | Total Improvement | Total Decline |
|------|-------------------------------------------------------------------------|------------------|--------------|
| 1    | Consumption of regular meal pattern                                      | 71 (7.14)        | 57 (5.73)    |
| 2    | Consumption of fast food                                                | 180 (18.09)      | 664 (66.73)  |
| 3    | Consumption of fried food                                               | 252 (25.33)      | 547 (54.97)  |
| 4    | Consumption of junk foods as snacks                                      | 189 (18.99)      | 599 (60.20)  |
| 5    | Frequency of your fruits and vegetables intake                           | 154 (15.48)      | 457 (45.93)  |
| 6    | Consumption of balanced diet                                            | 151 (15.18)      | 459 (46.13)  |
| 7    | Consumption of milk or its products                                     | 109 (10.95)      | 545 (54.77)  |
| 8    | Consumption of one or more servings of pulses, egg or meat in a day      | 70 (7.04)        | 538 (54.07)  |
| 9    | Daily Consumption of sugar                                             | 113 (11.38)      | 698 (70.29)  |
| 10   | Consumption of sugar sweetened beverages                                | 163 (16.38)      | 579 (58.19)  |
| 11   | Consumption of foods with high sugar                                    | 153 (15.38)      | 622 (62.51)  |
| 12   | Emotional Eating                                                        | 142 (14.27)      | 666 (66.93)  |
| 13   | Participation in moderate intensity aerobic exercises                    | 91 (9.15)        | 482 (48.44)  |
| 14   | Participation in household chores (cooking, laundry, cleaning)          | 102 (10.25)      | 498 (50.05)  |
| 15   | Participation in leisure related activities (grocery shopping, walking in park, gardening) | 73 (7.34)        | 385 (38.69)  |
| 16   | Daily sitting time at work                                               | 236 (23.72)      | 674 (67.74)  |
| 17   | Breaks from sitting                                                     | 236 (23.72)      | 674 (67.74)  |
| 18   | Daily screen time                                                        | 18 (1.81)        | 490 (49.25)  |
| 19   | Daily hours of sleep                                                    | 18 (1.81)        | 490 (49.25)  |
| 20   | Quality of sleep                                                        | 143 (14.37)      | 598 (60.10)  |
| 21   | Level of stress or anxiety                                              | 121 (12.16)      | 513 (51.56)  |
| 22   | Smoking                                                                 | 11 (1.11)        | 968 (97.29)  |
| 23   | Alcohol Consumption                                                     | 92 (9.25)        | 848 (85.23)  |
| 24   | Social support                                                          | 162 (16.28)      | 679 (68.24)  |

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

### Table 5

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

| Characteristics          | Eating Behavior | Physical Activity | Sleep Pattern | Other Behaviors | Overall lifestyle score |
|--------------------------|-----------------|-------------------|---------------|----------------|------------------------|
| Age                      |                 |                   |               |                |                        |
| (1) ≥30                  | 2.44 (6.49)     | <0.001*           | <0.001*       | 0.251 (2.00)   | 0.228*                 |
| (2) >30 to ≤45           | 0.62 (4.44)     | 1vs2<0.05         | 1vs2<0.05     | 0.04 (1.01)     | 0.226                  |
| (3) >45                  | 0.88 (4.44)     | 1vs3<0.05         | 1vs3<0.05     | 0.20 (1.45)     | 0.28 (0.82)            |
| Gender                   |                 |                   |               |                |                        |
| (0) Male                 | 1.86 (5.66)     | 0.156             | 0.002         | 0.17 (1.01)     | 0.334                  |
| Type of residence        |                 |                   |               |                |                        |
| (1) Metropolitan cities  | 0.88 (5.51)     | 0.176             | 0.015*        | 0.313*         | 0.22 (9.27)            |
| (2) Mid-level cities     | 1.41 (6.05)     | 0.089             | 0.03 (1.71)   | 0.13 (0.98)     | 0.63 (8.76)            |
| (3) Small towns and villages | 1.36 (5.09) | 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*           | 0.015*        | 0.294*         | 0.133*                 |
| (2) Upper middle         | 2.42 (5.88)     | 1vs4<0.05         | 1vs5<0.05     | 0.14 (0.90)     | 2.29 (8.93)            |
| (3) Lower Middle         | 1.15 (5.67)     | 0.096             | 0.04 (1.73)   | 0.23 (1.05)     | 0.27 (8.74)            |
| (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*           | <0.001*       | 0.19 (0.97)     | 0.018                  |
| (2) Single               | 2.53 (6.56)     | 0.66 (4.07)       | 0.26 (2.00)   | 0.23 (1.05)     | 0.045 (6.72)           |
| (3) Other                | 0.15 (5.36)     | 0.73 (3.19)       | 0.68 (2.23)   | 0.42 (1.12)     | 0.52 (8.52)            |
| Family Status            |                 |                   |               |                |                        |
| (1)                      | 1.74 (5.86)     | 0.044             | 0.003         | 0.18 (1.97)     | 0.437                  |
| (2)                      | 2.17 (5.26)     | 2vs3<0.05         | 0.013 (1.37)  | 0.41 (1.08)     | 1.57 (8.69)            |
| (3)                      | 0.63 (5.41)     | 0.093             | 0.11 (1.05)   | −0.17 (7.14)    |

* Overall p value.
oilseed, milk and products) and transform them into healthy meals. It has been already seen in China that level of lockdown and socioeconomic 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 advises [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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