



## MEAL PATTERNS AND CONSUMPTION OF PRO AND ANTI-INFLAMMATORY FOODS BY INDIAN WOMEN DURING THE COVID-19 LOCKDOWN.

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**ABSTRACT** The COVID-19 pandemic lockdown of March-May 2020 affected lifestyles, availability of commodities, and dietary habits. This study examined the effect of lockdown on meal patterns and consumption of pro and anti-inflammatory foods by women. An online survey was conducted on 1545 women aged 18 and above, residing in India. Dietary changes before and during lockdown were assigned numerical scores. Data were analyzed using non-parametric statistical tests. Lockdown showed positive effects on diet patterns, with 37% increase in consumption of home-cooked meals, drastic decrease in ordering food via delivery apps from 49.9% pre-lockdown to 2.2%; decreased consumption of processed foods from 25.8 % to 11.4%; increased water intake (59.6%); increased consumption of anti-inflammatory foods like vegetables and fruits (48.4%) and nearly 40% decrease in consumption of pro-inflammatory foods like chaat, cakes, fried items. Three AYUSH guidelines were followed daily: 80.3% respondents used spices in cooking; 52.9% drank warm water and 37.2% drank "Golden" milk. The mean total score was  $50.4 \pm 12.6$  out of a maximum score of 112. The favorable changes in the dietary patterns of the women could be due to unavailability of pro-inflammatory food items and closing of food deliveries during lockdown.

**KEYWORDS :** anti-inflammatory foods; COVID-19 lockdown; dietary scores; meal patterns; pro-inflammatory foods

### INTRODUCTION:

The sudden, unprecedented COVID-19 pandemic lockdown imposed in India in response to the World Health Organisation's (WHO) recommendations<sup>[1]</sup> from March to May 2020, resulted in restrictions on people's movement, changes in daily routine, physical activity, and eating habits, work from home, limited income, limited availability of commodities, online purchase of commodities, limited/ no meal deliveries. Women especially working women had to balance their increased load of household work in the absence of house help with online professional work from home<sup>[2,3,4,5]</sup>. Lockdown was found to affect lifestyles and eating habits. Two studies<sup>[6,7]</sup> indicated that females were more anxious and disposed to consuming comfort food; 38.3% respondents reported a slight increase in physical activity. An online multi-nation survey<sup>[8]</sup> reported negative effects of the COVID-19 home confinement with increase in daily sitting time, unhealthy food consumption patterns, in terms of food selection, uncontrolled eating, snacking between meals, and increased number of meals; though alcohol bingeing decreased significantly.

An efficient immune system, can be ensured with optimal nutritional status and intake of foods rich in anti-inflammatory components and nutrients and could help cope with the SARS-CoV-2 infection<sup>[9,10]</sup>. Unprocessed or minimally processed foods are healthier than refined grains, alcohol, ultra-processed foods high in sugar, salt, fats especially trans fats, as they increase inflammation and oxidative stress.<sup>[11,12,13]</sup> During the pandemic, the Ministry of AYUSH, Government of India (Ayurveda, Yoga & Naturopathy, Unani, Siddha, and Homeopathy), issued special guidelines developed by experts in Ayurveda and Yoga for the management of mild COVID infection.<sup>[14]</sup> Thus, an online survey was conducted between April and June 2020 to determine whether the lockdown altered meal patterns, consumption of pro and anti-inflammatory foods and inclusion of selected AYUSH guidelines by Indian women.

### MATERIALS AND METHODS:

An online Google questionnaire was used to collect demographic information and record changes in the meal patterns, consumption of pro and anti-inflammatory foods before and during lockdown, and to find out how many respondents included AYUSH guidelines in daily routine using four question sets.

Snowball sampling was used for data collection. The link to the online questionnaire was shared via email and social media groups for three

months (April -June 2020). Working and non-working women above the age of 18 years and residing in India were included in the survey. Scores were assigned to responses to each question set and scores for practices before and during lockdown were calculated. Question set 1 consisted of 9 questions to examine changes in meal patterns and water intake. Question sets 2 and 4 assessed changes in consumption of pro and anti-inflammatory foods. Question set 2 consisted of 14 foods that were identified based on reports in the literature about their pro and anti-inflammatory properties<sup>[15,16,17,18,19,20,21,22,23]</sup> (Table 1). In Question set 4, choices of 18 food items (eleven pro and seven anti-inflammatory foods) before the lockdown were studied.

**Table 1: List Of Anti-inflammatory and Pro-inflammatory Foods Included in The Question Sets**

Question set	Anti-inflammatory foods	Pro-Inflammatory Foods
2	Fruits, Vegetables	Ready-to-cook foods e.g., instant noodles, instant pasta, bread, biscuits, <i>pav</i> (local bun); cakes, pastries; chocolates, candies; fried foods; energy bars, <i>chikkis</i> (nuts brittle), roasted, fried nuts; non-vegetarian snacks; Indian sweets; wafers, <i>Farsan</i> (savory mixture of nuts ;crispiess made from pulses), <i>chaat</i> (roadside sweet, tangy snacks) items; Tea/coffee (sugar)
4	Grocery items (wheat flour, rice, legumes, pulses, nuts, oils, sugar); milk; milk products; fruits; vegetables; eggs, meat, fish, chicken	biscuits, bread, <i>Khari</i> (a crisp croissant-like product); instant noodles, pasta; ready mixes; packed fruit juices, soft drinks; chocolate, <i>chikkis</i> , energy bars; frozen desserts, ice cream; packed breakfast cereals; ketchup, jam; wafers / chips; frozen ready to cook foods; <i>papad</i> (thin, round wafer-like made from pulses), pickles

In Question set 3, six out of eleven AYUSH guidelines were included<sup>[14]</sup>. The guidelines recommended daily use of various Indian herbs and spices containing anti-inflammatory components<sup>[24,25]</sup> in different forms to safeguard against COVID-19. A score of 5 was assigned to each of the following guidelines as these were specially designed for

management of the COVID-19 infection.

- Drink warm water throughout the day.
- Spices like Turmeric, Cumin seeds, Coriander seeds, and Garlic are recommended in daily cooking.
- Take 10gm (1tsp full) in the morning *Chyavanprash* (a cooked mixture of sugar, honey, ghee, Indian gooseberry, sesame oil, , various herbs and spices.). Diabetics should take sugar-free *Chyavanprash*.
- Drink herbal tea/decoction (*Kadha*) made from Holy Basil leaves, Cinnamon, Black pepper, Dry Ginger, and Raisins - once /twice a day. Jaggery and/or fresh lemon juice could be added, if needed.
- Golden Milk- Half a teaspoon turmeric powder in 150 ml hot milk - once or twice a day.
- Steam inhalation with fresh Mint leaves or Caraway seeds could be practiced once a day.

A scoring pattern was used for each set of questions. For question sets 1 and 2, scores assigned were -1 for negative change, +1 for no change and +2, for positive change. For set 3, for each practice a score of 5 points if the guideline was followed and 0 if not. Scores for question set 4 were for pro-inflammatory foods- 0 for food items not available,+1 for food items consumed, +2 for food items not consumed. For anti-inflammatory foods, 0 for food items not available,+2 for food items consumed,+1 for food items not consumed. The maximum possible scores were: Set 1-18, Set 2-28, Set 3-30, and Set 4-36, with the maximum total possible score being 112 for all 47 questions.

A higher score indicated positive change in meal pattern, increased intake of anti-inflammatory and decreased intake of pro-inflammatory foods during the lockdown.

**Statistical Analysis:**

Data were analyzed using SPSS version 25. Since the data were not normally distributed, the median, and non-parametric tests- Fisher's Exact Test, were applied.

**RESULTS:**

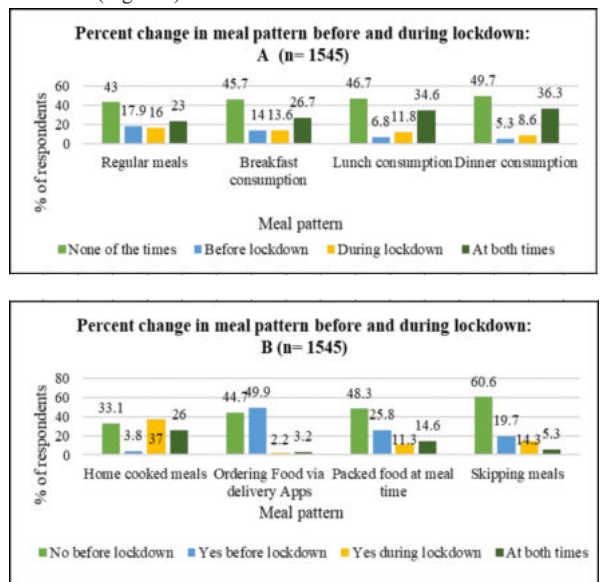
1545 women from 24 states in the country responded to the survey with 194 women not disclosing their state of residence. The largest number were from Maharashtra state (n=984; 63.7%), followed by Gujarat (n=105; 6.8%), Assam (n= 72; 4.7%) and Kerala (n= 41; 2.7%). Smaller numbers from other states participated in the survey viz New Delhi (n=29; 1.8%); Tamil Nadu (n= 21, 1.4%); Uttar Pradesh (n= 18;1.2%); Rajasthan (n=14; 0.9%); Madhya Pradesh (n= 13; 0.8%); Chhattisgarh (n=9; 0.6%); West Bengal and Karnataka (n= 8 each, 0.5% each); Nagaland, (n=6; 0.5%); Telangana and Goa ( n=5 each); Uttarakhand (n=3); Punjab and Arunachal Pradesh (n= 2 each); and one each from Mizoram, Meghalaya, Jammu and Kashmir, Himachal Pradesh, Haryana and Chandigarh, respectively.

**Demographic Profile Of The Respondents-** The ages of the respondents varied from 18 to 81 years( mean 30.84 ±12.09 years). Women aged 18 to 35 years constituted the majority of the sample (n=1089, 70.5%), one-fourth of the respondents (n=399,25.8%) were middle-aged (36 to 55 years) and a very small percentage (n=57, 3.7%) were ≥56 years of age. A small percentage (10%) had completed secondary /higher secondary schooling whereas 89.6% of women were graduates/ post-graduates. Forty-five percent were working women. Among non-working women, 16.1% were homemakers and 39% were students. Monthly family income varied between INR 25,000 - 1,00,000 for 45.7% of the respondents, 36.6% had monthly family income above INR 100,000/- per month but 17.7% had family income < INR 25,000/ month. One-fifth (21%) of the working women spent 2 hours daily doing office work from home; 12% women spent 2-4 hours and 11% spent 4-6 hours and 15% women spent > 6 hours on office work. Time spent on doing household chores, varied from 2 hours/day (27%) to 2 - 4 hours/day (21%) , 24% spent 4 - 6 hours; and 21% spent > 6 hours. Only 6% women (mostly young women) did not do any household work.

About one-fifth (19.6%) respondents reported being under home isolation; 6.3% had a family member/neighbor in isolation or hospitalized for COVID-19 treatment and 20.8% reported their residence was in a containment zone.

**Changes In Meal Patterns And Consumption Of Pro And Anti-inflammatory Foods-** Question set 1: Small changes were seen for questions related to regular meal consumption and in consumption of the main meals (breakfast, lunch, and dinner) before and during

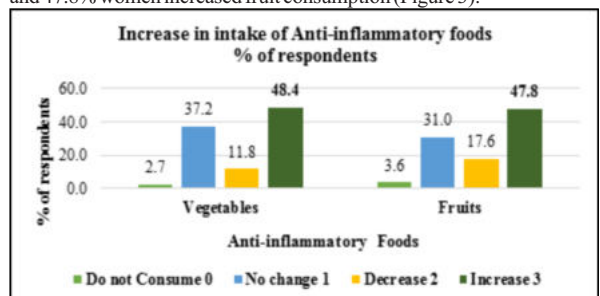
lockdown (Figure 1).



**Figure 1:** Changes in Meal Pattern of Respondents Before and During Lockdown (n=1545)

Only 26% women were consuming home-cooked food for every meal before and also during lockdown. During the lockdown, 37% women reported consumption of home-cooked food (Figure 1). A large percentage of women (60.6%) were not skipping meals before lockdown, although 19.7% of women had done so . Another 5.3% reported skipping meals before and during lockdown. However, during the lockdown, only 14.3% respondents skipped meals (Figure 1). Greater changes were seen in practices like food ordering, consuming packed foods during meals, and water intake. One of the reasons for the increase in home-cooked meal consumption could be non-availability of food delivery services and complete closure of food outlets. This was reflected in the drastic reduction in home food delivery from 49.9% among all respondents before the lockdown, to only 2.2% during lockdown (Figure 1). Similarly, overall consumption of processed food decreased from 25.8% before lockdown to 11.3% during lockdown (Figure 1). An increase in water consumption during lockdown was reported by 60% of women. Significantly more water intake was reported during the lockdown than before by all respondents (2-tailed p=0.004). Thus the overall mean score for Question set 1 was 8.8 ±2.9 i.e. 50% of the maximum score of 18 as changes were seen for five out of the nine practices in this Question set.

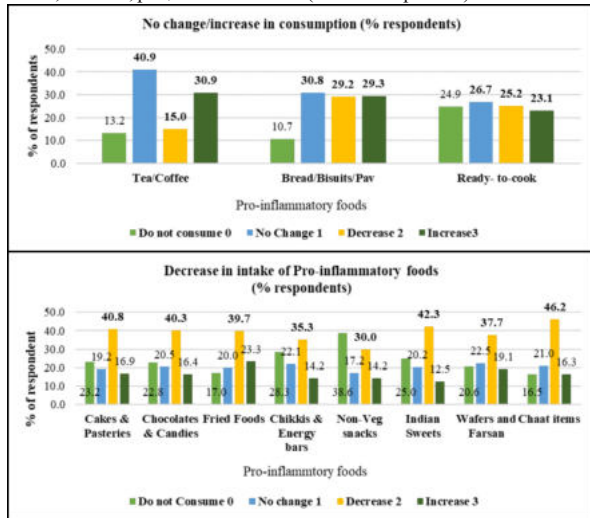
For Question set 2, consumption of anti-inflammatory foods increased significantly during the lockdown (Fischer Exact test, two-tailed p=0.000), 48.4% women reported an increase in vegetable consumption and 47.8% women increased fruit consumption (Figure 3).



**Figure 3:** Percent Increase In Women Consuming Anti-inflammatory Foods During Lockdown (n= 1545)

Fruits and vegetables are known to decrease inflammatory markers such as CRP and tumor necrosis factor<sup>[26]</sup>. Among the ten pro-inflammatory groups of food included in the question set, 30.9% reported an increase in tea/coffee consumption. No change was reported by 26.7% of women, and increased consumption by 25.2%. However, 23.1% decreased consumption of ready-to-cook foods (RTC) eg instant noodles, instant pasta during

lockdown. A similar trend was seen for consumption of bread, biscuits, and *pav* (Figure 4). However, the difference between before and during lockdown was significant for consumption patterns of tea/coffee; bread, biscuits, *pav*; and RTC foods (two-tailed  $p=.000$ ).

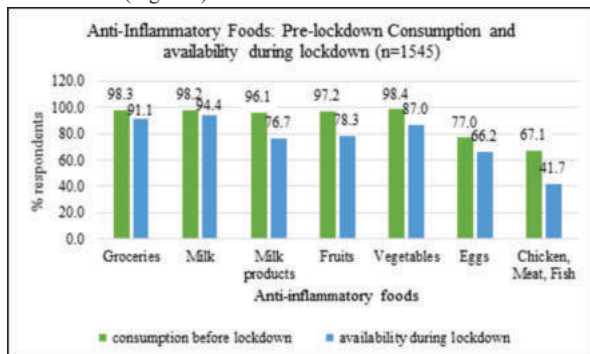


**Figure 4:** Changes in Consumption of Pro-inflammatory Foods During Lockdown (n= 1545)

Intake of the seven pro-inflammatory foods, clearly decreased during the lockdown. The greatest decrease was seen for consumption of foods like *chaat* items (46.2%); Indian sweets (42.3%); cakes/ pastries (40%); chocolates/ candies (40%) (Figure 4). The mean score for Question set 2 was  $16.5 \pm 8.1$  i.e. 59% of the total score of 28.

In Question set 3, three AYUSH guidelines were followed : daily use of spices in cooking (80.3%), consuming warm water throughout the day (52.9%), and drinking “Golden Milk” at least once a day (37.2%). The mean score was  $11.3 \pm 7.4$  i.e. only 38%. from a possible score of 30. Respondents scored less than 50% for this Question set as, AYUSH guidelines were not included in their daily routines by majority of the respondents.

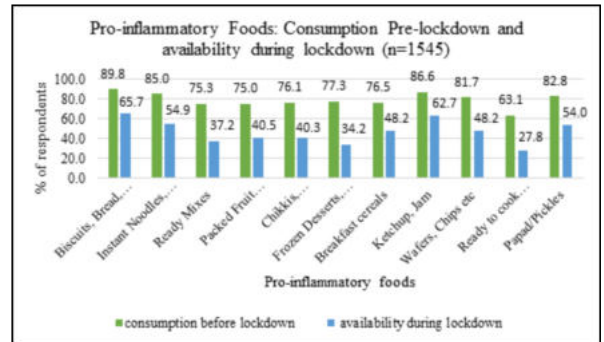
Question set 4 examined the availability of different food commodities during the lockdown and the respondents' food choices before the lockdown. Ninety-eight percent respondents had been consuming whole grains, pulses, milk, and vegetables before lockdown. These foods were also available during the lockdown. The availability of milk during the lockdown was reported by 94.4% of all respondents, followed by groceries (91.1%) and vegetables (87%) (Figure 5). Though majority of respondents were consuming fruits and milk products pre-lockdown, their availability during lockdown was reported by only 78.3% and 76.7% respondents. Eggs were consumed by 77% respondents, however, only 66.2% reported availability of eggs during lockdown. The least consumed foods were chicken, meat, fish (67.1%), and availability was reported by 41.7% women during the lockdown (Figure 5).



**Figure 5:** Pre-lockdown Consumption and Availability of Anti-inflammatory Foods During Lockdown (% respondents, n=1545)

Before the lockdown, the most commonly consumed processed and ultra-processed pro-inflammatory food items, were biscuits, bread, *Khari* (89.8% respondents); followed by ketchup and jam (86.6%);

instant noodles, and pasta (85%); *papad* and pickles (82.8%); wafers and, chips (81.7%). The least consumed were ready-to-cook frozen food items by 63.1 % respondents. Availability of these food items during the lockdown was reported by a lesser percent of respondents as compared to the anti-inflammatory foods. The most available foods reported were biscuits, bread, *Khari* (65.7%) ketchup and jam (62.7%), and instant noodles and pasta (54.9%). Only 27.8% respondents reported availability of ready-to-cook frozen foods. The reported availability for other foods varied between 34% to 48%. Thus, lesser availability was a constraint in the consumption of these foods during lockdown. (Figure 6).



**Figure 6:** Pre-lockdown Consumption and Availability of Pro-inflammatory Foods During Lockdown (% respondents, n=1545)

The median score for the study group (n= 1545) was 13.8 or 39% out of the maximum score of 36 The mean total score of all respondents (n=1545), was  $50.4 \pm 12.6$  that is 45% of the maximum score of 112.

**DISCUSSION:**

The COVID-19 lockdown influenced food intake, availability, and food choices both favorably and unfavorably throughout the world. In a scoping review of 4322 studies, on the impact of lockdown during the COVID-19 outbreak on dietary habits in various population groups, Bennett, et al. [27] identified dietary patterns, dietary habits (favorable), dietary habits (unfavorable), and others (including physical activity levels, weight gain) as important by from . Negative impacts such as increases in the number of snacks consumed, number of meals, comfort foods including sweets, fried food, snack foods, processed foods, alcohol during the quarantine, and a reduction in consumption of fresh produce, in physical exercise and weight gain an increase in were reported in eight studies. Eleven studies reported favorable changes in dietary habits with an increase in fresh produce and home cooking and reductions in comfort food and alcohol consumption.

The present study found that the lockdown favorably influenced some of the practices related to meal patterns, and consumption of pro and anti-inflammatory foods by the 1545 women who participated in the study. However, one limitation of the present study was that it was conducted online and the questionnaire was in English. We were unable to reach women who may be proficient in Indian regional languages but not in English.

More women reported a reduction in skipping meals and a considerable decrease in ordering food via food delivery Apps. This could be because all food outlets were not operational and home delivery was not possible during the first lockdown. Consequently, more women began consuming home-cooked meals. Comparative consumption of pro and anti-inflammatory foods before and during lockdown indicated a significant difference. Increased consumption of vegetables, fruits, and water was reported by the respondents whereas a decrease in consumption of many pro-inflammatory foods like cakes, pastries, chocolates, candies, wafers, farsan, Indian sweets, chaat items was reported.

Many foods from the anti-inflammatory list were consumed by most women before lockdown and during the lockdown, consumption was not affected for foods such as milk, groceries, and vegetables as they were available. However, availability of fruits, milk products, eggs, meat, fish, chicken was lower. Before the lockdown, all participants used to consume pro-inflammatory foods; During lockdown, pro-inflammatory foods viz cakes, pastries, chocolates, soft drinks, were less available resulting in reduced consumption. However, since

bread, biscuits, *Khari*, pav were available during the lockdown, their consumption remained similar to pre-lockdown times. The AYUSH guidelines recommended for mild COVID infection and as a preventive measure against moderate and severe infection were followed partially by a considerable percentage of the women. Similar results were reported in other studies<sup>28,29,30</sup> which examined the impact of the COVID-19 lockdown on dietary habits and health of Indian population.

### SUMMARY AND CONCLUSIONS:

This study on 1545 educated middle-income women from 24 different Indian states aged 18 to 81 years examined changes in meal patterns, consumption of pro and anti-inflammatory foods, food availability and choices before and during the lockdown. The study showed that the lockdown brought some positive changes in meal patterns with more women consuming home-cooked foods at all meals, fewer women skipped meals during the lockdown. Percentage of women consuming vegetables and fruits increased significantly during the lockdown as compared to before lockdown, along with a decrease in consumption of some pro-inflammatory foods. The greater availability of foods from the anti-inflammatory list as compared to less availability of pro-inflammatory foods, closure of food outlets, and non-availability of food delivery services could have altered the food choices during lockdown. Also, women had to cope with work from home and do housework. This required them to be in a state of good health and nutritional status, to build up stamina and resistance to prevent the COVID-19 infection. Eating behavior may have relapsed post-lockdown, however, this aspect was not within the scope of the present study.

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