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Original Research Article

Change in the trend of diet and lifestyle patterns among Indian children during COVID-19 confinement: a cross-sectional study

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ABSTRACT

Background: To assess the change in the trend of diet and lifestyle behaviours during the COVID-19 pandemic in children and their association with various COVID-19-related consequences.
Methods: A cross-sectional study that employed a structured 22-item questionnaire through teledentistry to 1500 children who previously visited the dental department of a tertiary hospital in Delhi. The dietary habits lifestyle changes (DHLC-COVID19) questionnaire, which was customized and validated for the study, and their COVID-19 related consequences were administered.
Results: A statistically significant decreased intake of certain types of foods, high-carbohydrate snacks with a lower trend in snacking frequency was observed in children during COVID-19. The study investigated the association of variation of food intake in children i.e., 'no consumption' and 'decreased consumption' in relation to family members who lost their job during COVID-19 and depicted significant relation w.r.t families who got infected, lost their life during COVID-19. Determinants of these perceived changes were examined in multivariable regression models, Chi-square test and Mc Nemar test. Moreover, a significant change in lifestyle behaviours was also observed in children during COVID-19. The comparison of weight assessment during COVID-19 and performing/ engaging in physical activity during the period depicted that there was a statistically significant difference in proportion ($p<0.05$).
Conclusions: This study provides evidence of the detrimental effects of COVID-19 be taken into consideration when developing and implementing public health policies to protect children's health both during and after the pandemic, especially among vulnerable youngsters on the social spectrum.

Keywords: COVID-19, Dietary habits, Lifestyle, Paediatric dentistry, Teledentistry

INTRODUCTION

Since December 2019, the world is plagued by a new disease (coronavirus disease 2019 (COVID-19)), caused by the severe acute respiratory syndrome coronavirus 2 (SARS- CoV-2). The world health organisation (WHO) officially designated COVID-19 as a global pandemic on 11th March 2020. To stop the spread of the virus, many countries implemented emergency measures.[1,2] In India, one of the most affected countries, the government decreed on March 2020 with the closure of schools and establishing mandatory home confinement for children.[3]

Considering that COVID-19 has no definitive pharmacological management, it is important to highlight that leading a healthy balanced nutrition and lifestyle strengthens the immune system and for prevention from various viral infections.[4,5] It stated that a healthy diet influenced cytokine gene expression levels, which are responsible for inflammation and oxidative stress. One of the key factors in terms of the severity of pulmonary manifestations of COVID-19 that leads to a so-called 'cytokine storm' causing acute respiratory distress syndrome and multiple organ failure is due to inflammation.[6] Previous reviews of various studies have

depicted two adverse collateral effects of COVID-19 on dietary and lifestyle behaviour. Researchers have quoted that stress and boredom lead to overeating especially towards 'comfort foods such as high simple carbohydrates and high sugary content. This may increase the risk of having dysfunctional eating or emotional eating with the increased probabilities of risk of various systemic conditions such as obesity and cardiovascular disorders that have been demonstrated to increase the severity of COVID-19.[6,7] On the other hand, the COVID-19 pandemic has also increased the incidence of malnutrition which may also lead to various severe forms of coronavirus disease.[8] Additionally, physical activity improves the effectiveness of vaccines and helps in overcoming various mental health-related issues.[1]

Moreover, the economic crisis caused unprecedented job loss that led to unexpected disruptions in everyday routine. Disruption in access to nutrition services exposing towards food insecurity among children. At the onset of the COVID-19 pandemic, The United Nations children's fund (UNICEF) predicted a possible 30% reduction in the coverage of essential nutritional services in low-income and middle-income countries. School feeding programs such as mid-day meals have also been disrupted due to the closure of schools during the lockdown. Studies reporting the indirect effects of the COVID-19 impact on dietary and lifestyle behaviour in children are still scarce and were mainly carried out in high- or middle-income countries. To deeply understand diet, nutrition, lifestyle changes, and COVID-19, it underlines the importance of nutritional assessment in children, particularly in the times of the COVID-19 pandemic. Therefore, we aimed to assess the variation in dietary and lifestyle behaviours during the COVID-19 pandemic in children and their association with various COVID-19-related consequences.

METHODS

Ethical approval and informed consent

The study was carried out in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The institutional ethical committee of the university college of medical sciences and Guru Teg Bahadur hospital in Delhi, India, provided its approval (IEC-HR-2020/PG/46/80-R1). Informed consent included Telephonic consent on a preapproved proforma (recording through telephonic conversations) which was taken from one parent of all children. Verbal assent for children 7-12 years. Assent form was done for the children aged 12-14 years on the phone and a telephonic recording was made. For both paediatric verbal assent and informed consent, Hindi; the local language, was used. Parents were telephone interviewed via teledentistry. Parents/guardians and study participants were informed about the study's goals and the methodology.

Study design and data collection

A cross-sectional observational study through a telephonic interview questionnaire (tele-questionnaire) during November 2020 to August 2021 in accordance with the STROBE guidelines was conducted by department of pediatric and preventive dentistry, university college of medical sciences and GTB Hospital, Delhi. The inclusion criteria were the following: Old paediatric patients previously registered in the department of pedodontics and preventive dentistry, GTB Hospital Delhi and those children whose parents were proficient in vernacular language i.e., Hindi. Parents of the children who were not able to provide consent to participate were excluded in the study.

Sample size

Phone numbers of previously registered paediatric patients were available in the department of paedodontics and preventive dentistry. A total of 1800 paediatric patients' phone numbers were searched to collect information of 1500 children. This was done to adjust the parents who did not want to participate in the study. A convenience sampling technique was employed.

Structuring the questionnaire

A customized structured tele- questionnaire "DHLC-COVID19 questionnaire" was developed by the primary investigator under guidance following a review of related literature and under the guidance of guide and co-guides in the field. A pilot study was performed to verify the reliability and functionality of the questionnaire. For the pilot study, 121 participants were randomly selected from the previously visiting patient records and interviewed telephonically. Internal consistency (Cronbach's alpha which addressed the reliability and validity of the questionnaire data was 0.65. A tele- questionnaire was prepared in accordance with the STROBE guidelines. The questionnaire analyzed the immediate impact on dietary habits and lifestyle changes among children during COVID-19.

DHLC-COVID19 questionnaire includes dietary habit questions: (a) change in child's eating habits (b) daily consumption of certain foods according to Indian diet meals like fruits, vegetables, roti, rice, pulses, milk, nuts, eggs, chicken, meat sweets and dairy products in dichotomous options yes/no or response options of "increased intake" "decreased intake", "same as before" "do not consume" respectively. (c) snacking frequency and snacking in between meals before and during COVID-19. (d) lifestyle habits information: child's hunger and satiety during COVID-19, changes in weight of child, physical activity, screen time, playing and hours of sleep. (e) Specific questions about the immunity booster diet administered during the COVID-19 pandemic.

Interview through tele-dentistry

Once the questionnaire was pretested, a list of 1800 children was prepared from previously visiting patient records at the department of pedodontics and preventive dentistry. The primary investigator started calling them one by one through telephonic interviews. Prior to the beginning of the questionnaire, a pre-approved introduction written and approved in the vernacular language i.e., Hindi was narrated to each participant. This included details of what was the purpose and nature of the interview process. The participant's willingness to participate was assessed and the informed consent and assent were recorded telephonically.

Each participant was interviewed for a duration of five minutes and 20-30 patients could be completed in a session of approximately three hours. Among the phone calls made, few did not respond. These participants were given a call at different times. This was done to maximize the rate of responses. Few respondents wanted to reschedule the time of the interview; those participants were called at their appointed time. Moreover, some of the contact numbers were also turning out as unavailable. During the tele -questionnaire interview, most of the parents were understanding the questions and were able to respond. Some of the parents did not understand some questions and for them, an effort was made to make them understand in a simpler way by repeating, them 2-3 times with further explanation. If due to some reason communication still failed, then the child was excluded from the study. After excluding the non-responders, poor -responders and those who did not give consent, the interview process was repeated with the remaining subjects in a proper manner.

RESULTS

In total, 1500 children participated in this descriptive observational study, comprises of the age range of 0-14 years, with a mean age of males determined to be 9.18±2.6 and 8.78±2.4 was observed in females respectively. The demographic breakdown and anthropometric characteristics of the participants are presented in Table 1. According to the modified Kuppuswamy Scale 2020, participants were distributed according to their socioeconomic class, with the majority 42.2% falling into the "upper-lower" category. Regarding the financial status of parents during the COVID-19 pandemic, it was observed that most families disclosed a reduction in income with 834 respondents having reported a drastic reduction in their income during the COVID-19 pandemic. In the categorisation of participants according to COVID-19-related consequences and it was observed that a high percentage of 60.2% have lost their job due to COVID-19. 78.3% of participants' family members got infected from COVID-19 in which 44.3% got hospitalized and 17.1% lost their life from COVID-19 (Table 1).

While analyzing the different types of foods, it was observed that overall decreased intake in certain types of foods during COVID-19. A large number of children did not consumption of various food items such as fruits, nuts, and meat during COVID-19. The food items that showed decreased intake were vegetables, bread, rice, pulses, milk, dairy products, eggs, and chicken. (Figure 1). The study also investigated the association of variation of food intake in children i.e., 'no consumption' and 'decreased consumption' in relation to family members who lost their job during COVID-19. It depicted that many children could not consume certain foods at all for example 87.6% did not consume nuts, 67.5% did not consume meat and 60.7% did not consume fruits. The other food items which reduced consumption were dairy products, followed by sweets, eggs, rice, bread/roti, pulses, vegetables, milk, chicken, meat, and nuts in the children from families where a job was lost during COVID-19. ($p<0.001$*) A similar pattern was observed amongst families infected with COVID-19 or where life was lost. ($p<0.001$*) (Table 2). The consumption of servings of high carbohydrates snacks (biscuits, chips, chocolates etc) observed in children before and during the COVID-19 period depicted that before COVID-19 there is a high percentage of 51.7% of consumption in two serving categories which got decreased to 8.3% during COVID-19. Similarly, three or more serving categories before COVID-19 depicted 37.5% which got severely decrease to 0.1% during COVID-19. Moreover, one serving category before COVID-19 reported 10.3% which got increased to 39% during COVID-19. There was an increasing percentage of 52.6% of children not consuming high carbohydrate snacks (biscuits, chips, chocolates etc.) during COVID-19 as compared to 0.55 before COVID-19. (Fig.2a). The multivariate logistic regression model was applied to identify significant covariates for high intake of carbohydrates snacking before and during COVID-19. It was depicted that covariates such as sex of child, medical history, occupation, educational status and income of the parents, loss of job in the family during COVID-19, the incidence of COVID-19 infection and loss of life due to COVID-19 demonstrated statistically significant predictors of higher carbohydrate intake before COVID-19 ($p<0.05$). While only in 3 servings or more a small amount of association was present with other covariates however this association was not significant with covariates under the investigation during COVID-19 ($p>0.05$) (Table 3).

According to the change in frequency of snacking as reported by parents in their children during the COVID-19 period, it was reported that mainly it showed a lower trend in snacking frequency i.e., 66.7% and about 20.6% showed a higher trend in snacking frequency (Figure 2 B) More than half of the children, 78.7% consumed only home-based food during the COVID-19 pandemic (Figure 2 C). Based on the number of intakes of daily meals and snacks observed in children during COVID-19 it showed that there was a huge variation i.e., 66.9% of

children observed a change in the number of daily meals consumed. Furthermore, it was observed that there was an increase in the percentage of 48.4% who had missed one or more main meals and only 18.7% reported adding one or more snacks in between meals during COVID-19. (Figure 2 D and E). The multivariate logistic regression for factors affecting the change in the number of daily meals depicted that medical history, Occupation of a parent, educational status of parent loss of job in the family during COVID-19, incidence of COVID-19 infection in the family and loss of life due to COVID-19 in the family was significantly associated with the number of daily meals of which loss of life due to COVID-19 in the family had the highest association ($p<0.05$) (Table 4).

Changes in lifestyle behaviours during the COVID-19 lockdown were also inquired through the DHLC-COVID-19 questionnaire. The majority of parents (82%) observed of change in child's hunger and satiety during COVID-19. Furthermore, it is more towards the increase in appetite i.e., 49.9% whereas only 32.3% reported a decrease in appetite. According to the changes in weight assessment reported by parents in their children, it was represented that 43.8% of parents do not know their child's weight, and 25.5% have a perception of decreased in the weight of their child during COVID-19. Around 15.9% observed no change in their child's weight assessment and only 14.9 % reported weight gain in their children during this pandemic period. According to the representation on hours of sleeping pattern in children before and during COVID-19 it was observed that before COVID-19 most children 99.5% were sleeping 7-9 hours at night. This number declined to one-third during COVID-19 when only 33.9% were sleeping for 7-9 hours against 99.5% in the pre COVID-19. Many of the children during COVID-19 started sleeping for more than 9 hours. There was 150 times increase in children sleeping more than 9 hours. When comparison of the hours of sleep before and during COVID-19 was done it was found that there was a significant difference in the proportion of sleep before and during COVID-19 ($p<0.05$) (Table 5).

With regards to physical activity observed in children during COVID-19, it presented that more than half of the children 89.8% showed no physical activity and only 10.2% reported presence of physical activity in their children's daily routine. The comparison of weight assessment during COVID-19 and performing/ engaging in physical activity during the period depicted that there was a statistically significant difference in proportion ($p<0.05$) (Table 5).

Regarding the child's activity pattern in the whole day as reported that 67.07% observed decrease in their studying period, 28.87% of children have stopped their studies and only 3.67% and 0.4% reported no change or less in their child's study pattern. During this pandemic, there was a huge rise in usage of electronic media in children as it reported 79.8% of children spend most of the time on various electronic media. There was also an increase in napping time in children during COVID-19 about 61.27% reported an increase in their napping time, 32.27% reported the same as before and 5.6% reported less napping time during COVID-19 pandemic (Figure 3 A). According to the data representation on the pattern of screen time it was observed that almost all the children i.e., 98.27% were on their screen watching television. Only 55.40% of children were attending online classes. Out of 1500 children, 809 (53.93%) were playing games on the screen. Out of 1500 children, 613 (40.87%) were using the screen for some other educational purposes (Figure 3 B).

Statistical analysis

Data were entered on an Excel sheet and analyzed using the SPSS software, version 25.0, IBM Corp. Chicago, USA. Whereas continuous nonparametric data were presented as median and interquartile range, continuous parametric data were reported as mean and standard deviation. There were percentages provided for the category data. Using the chi-square test, categorical data was compared between groups. The study employed a multivariate multinomial logistic regression model to examine the relevant factors associated with eating habits and lifestyle modifications during the COVID-19 pandemic.

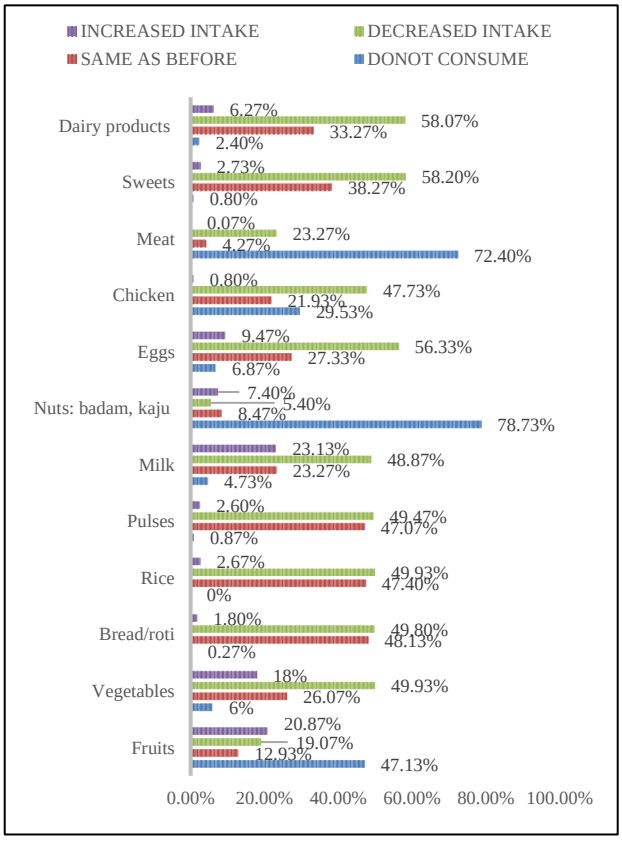

Figure 1: Detailed feeding pattern of various foods during COVID-19.

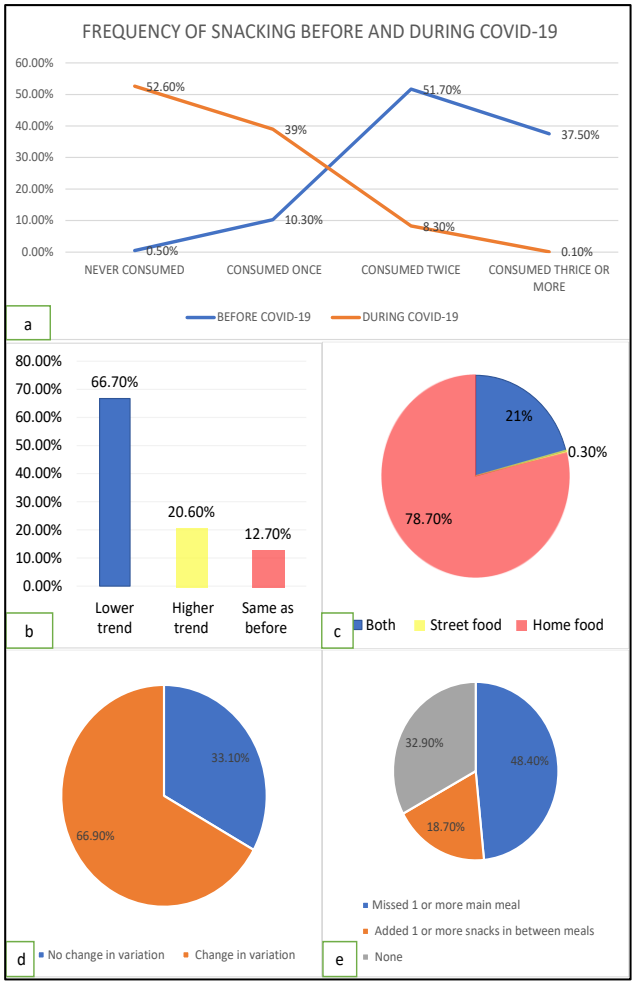

Figure 2 (A-E): High carbohydrate intake before and during COVID-19, snacking frequency during COVID-19, showing of consumption of home food and street food during COVID-19, pie chart showing variation in number of intakes of daily meals and snacks observed in children during COVID-19 and showing variation in consumption of daily meals in children during COVID-19.

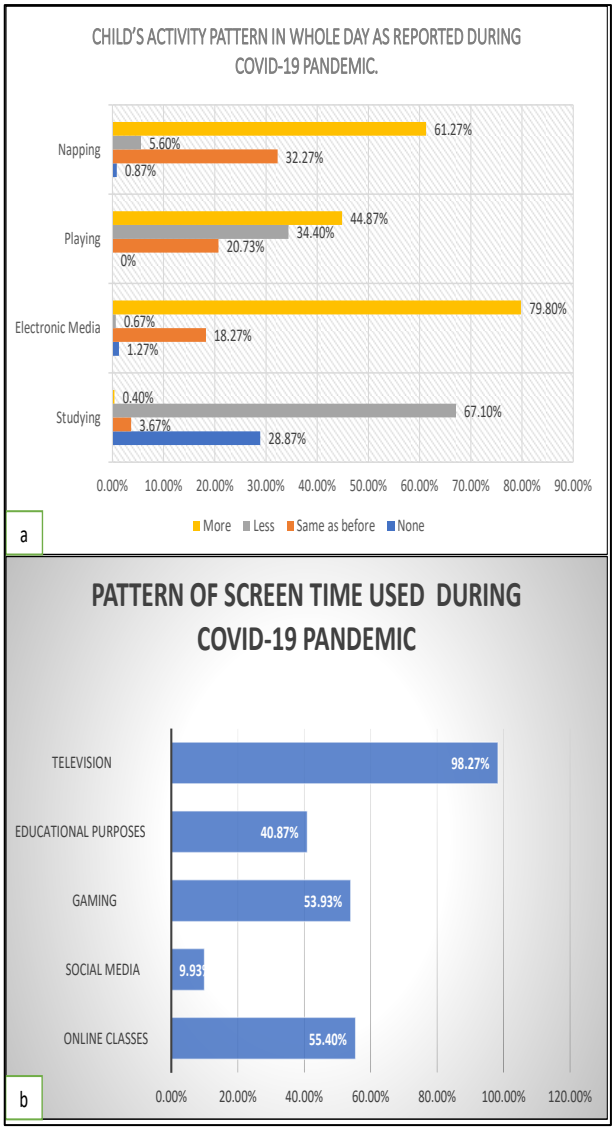

Figure 3 (A and B): Child's activity pattern in whole day as reported during COVID-19 pandemic. Pattern of screen time during COVID-19 pandemic.

Table 1: The demographic and anthropometric characteristics of participants with COVID-19-related consequences.

Age (In years)	**Sex**	**N**	**Mean**	**SD**	**Std. error mean**
	Male	635	36.60	5.397	0.214
	Female	865	34.44	4.558	0.155
Socioeconomic status (Kuppuswamy scale 2020)			**Total**	**Sex**	
				Male	**Female**
Lower		N	237	161	76
		%	16	67.9	32.1
Upper lower		N	634	351	283
		%	42.2	55.4	44.6
Lower middle		N	537	349	188
		%	35.8	65	35
Upper middle		N	92	61	31
		%	6.1	66.3	33.7
Upper		N	0	0	0
		%	0	0	0

Continued.

Socioeconomic status (Kuppuswamy scale 2020)		Total	Sex	
			Male	Female
Income				
Complete loss of income	N	172	102	70
	%	11.4	59.3	40.7
Drastically reduced	N	834	515	319
	%	55.65	61.8	38.2
Slightly reduced	N	367	229	138
	%	24.40	62.4	37.6
Not affected	N	127	76	51
	%	8.46	59.8	40.2
Increased	N	0	0	0
	%	0	0	0
Total	N	1500	922	578
	%	100	61.5	38.5
COVID-19 related consequences		**Number of family members with either consequence**		**Percentage (%)**
Family member lost their job during COVID-19		903		60.2
Family members get infected from COVID-19		1175		78.3
Family members get hospitalized due to COVID-19		664		44.3
Family member lost their life from COVID-19		257		17.1

Table 2: Detailed association between consumption of certain types of food amongst children with their family member had loss their job, had COVID-19 infection and those who lost their life due to COVID-19.

Category of food items	Number of children not consuming these foods at all		Number of children consuming these foods in decreased pattern		Number of children consuming these foods in same pattern		Number of children consuming these foods in an increased pattern	
	N	%	N	%	N	%	N	%
Loss of job during COVID-19, (n=903)								
Fruits	548	60.7	172	19	86	9.53	96	10.64
Vegetables	67	7.4	587	65	161	17.85	87	9.65
Bread/roti	1	0.1	608	67.4	290	32.15	3	0.33
Rice	0	0.0	609	67.5	286	31.71	7	0.78
Pulses	10	1.1	604	66.9	282	31.26	6	0.67
Milk	59	6.5	583	64.6	145	16.08	115	12.75
Nuts	791	87.6	42	4.6	46	5.10	23	2.55
Eggs	91	10	641	71	137	15.19	33	3.66
Chicken	276	30.6	526	58.3	95	10.53	5	0.55
Meat	609	67.5	263	29.1	29	3.22	1	0.11
Sweets	9	1	649	71.9	239	26.50	5	0.55
Dairy products	28	3.1	684	75.8	180	19.96	10	1.11
P value	0.001*, sig							
Infected with COVID-19, (n=1175)								
Fruits	625	53.1	231	19.6	136	11.5	183	15.5
Vegetables	87	7.4	672	57.1	269	22.8	147	12.5
Bread/roti	3	0.26	680	57.8	474	40.3	18	1.5
Rice	0	0.0	683	58.1	472	40.1	20	1.7
Pulses	6	0.51	677	57.6	470	40	22	1.8
Milk	58	4.94	657	55.9	247	21.0	213	18.1
Nuts	986	83.9	66	5.6	64	5.4	59	5.0
Eggs	75	6.38	740	62.9	273	23.2	87	7.4
Chicken	320	27.2	609	51.8	237	20.1	9	0.7
Meat	825	70.2	304	25.8	46	3.9	0	0.0
Sweets	7	0.59	873	74.3	402	34.2	27	2.3
Dairy products	13	1.1	775	65.9	340	28.9	47	4.0
P value	0.001*, sig							

Continued.

Category of food items	Number of children not consuming these foods at all		Number of children consuming these foods in decreased pattern		Number of children consuming these foods in same pattern		Number of children consuming these foods in an increased pattern	
	N	%	N	%	N	%	N	%
Loss their life due to COVID-19								
Fruits	209	81.3	31	12	1	0.3	16	6.2
Vegetables	23	8.9	189	73.5	28	10.8	17	6.6
Bread/roti	0	0.0	209	81.3	48	18.6	0	0
Rice	0	0.0	210	81.7	47	18.2	0	0
Pulses	1	0.3	209	81.3	47	18.2	0	0
Milk	21	8.1	196	76.2	19	7.3	21	8.1
Nuts	239	93	6	2.3	11	4.2	1	0.3
Eggs	12	4.6	211	82.1	31	12	3	1.1
Chicken	41	15.9	183	71.2	33	12.8	0	0
Meat	130	50.5	123	47.8	4	1.5	0	0
Sweets	2	0.7	210	81.7	45	17.5	0	0
Dairy products	3	1.1	210	81.7	38	14.7	6	2.3
P value	0.001*, sig							

Chi square test, level of significance set at p<0.05, ns: non-significant, sig: *statistically significant

Table 3: Multivariate logistic regression model in identifying covariates of high carbohydrate intake before and during COVID-19.

Variables		B	Exp (B)	P value
Covariates of high carbohydrate intake before COVID-19				
1 serving	Age of child	5.267		0.000
	Sex of the child	1.026	2.789	0.015
	Medical history	2.401	11.036	0.020
	Occupation of parent	-0.935	0.392	0.000
	Educational status of parent	-1.253	0.286	0.000
	Income of the parent	2.842	17.145	0.000
	Loss of job in family during COVID-19	-1.744	0.175	0.000
	Incidence of COVID-19 infection in the family	0.729	2.073	0.161
	Incidence of hospitalization with COVID-19	0.204	1.226	0.703
	Loss of life due to COVID-19 in the family	1.003	2.727	0.144
2 servings	Age of child	5.028		0.000
	Sex of the child	1.116	3.053	0.005
	Medical history	2.189	8.927	0.028
	Occupation of parent	-0.584	0.558	0.000
	Educational status of parent	-1.270	0.281	0.000
	Income of the parent	2.642	14.044	0.000
	Loss of job in family during COVID-19	-1.621	0.198	0.000
	Incidence of COVID-19 infection in family	1.250	3.492	0.010
	Incidence of hospitalization with COVID-19	-0.221	0.802	0.665
	Loss of life due to COVID-19 in the family	0.882	2.416	0.183
3 servings or more	Age of child	2.897		0.007
	Sex of the child	0.976	2.653	0.015
	Medical history	2.439	11.467	0.015
	Occupation of parent	-0.478	0.620	0.004
	Educational status of parent	-1.066	0.344	0.000
	Income of the parent	2.859	17.443	0.000
	Loss of job in family during COVID-19	-1.766	0.171	0.000
	Incidence of COVID-19 infection in family	1.092	2.980	0.025
	Incidence of hospitalization with COVID-19	0.128	1.136	0.803
	Loss of life due to COVID-19 in the family	1.323	3.754	0.045

Continued.

Covariates of high carbohydrate intake during COVID-19		B	Exp(B)	Sig.
1 serving	Age of child	0.057		0.874
	Sex of the child	-0.486	0.615	0.000
	Medical history	-0.158	0.854	0.598
	Occupation of parent	0.168	1.183	0.001
	Educational status of parent	-0.221	0.802	0.001
	Income of the parent	0.220	1.247	0.058
	Loss of job in family during COVID-19	-0.503	0.604	0.001
	Incidence of COVID-19 infection in the family	0.170	1.186	0.291
	Incidence of hospitalization wit COVID-19	-0.205	0.814	0.145
	Loss of life due to COVID-19 in the family	-0.697	0.498	0.000
2 servings	Age of child	-15.319		0.974
	Sex of the child	-0.697	0.498	0.003
	Medical history	-0.160	0.852	0.837
	Occupation of parent	0.145	1.156	0.153
	Educational status of parent	-0.005	0.995	0.968
	Income of the parent	-0.405	0.667	0.100
	Loss of job in family during COVID-19	-1.635	0.195	0.000
	Incidence of COVID-19 infection in family	-0.316	0.729	0.366
	Incidence of hospitalization with COVID-19	0.276	1.318	0.335
	Loss of life due to COVID-19 in the family	1.352	3.866	0.000
3 servings or more	Age of child	-66.181		0.967
	Sex of the child	-14.904	3.368E-007	0.981
	Medical history	17.357	34515705.435	0.922
	Occupation of parent	-1.047	0.351	0.635
	Educational status of parent	0.675	1.964	0.738
	Income of the parent	3.336	28.093	0.310
	Loss of job in family during COVID-19	23.226	12221292496.872	0.932
	Incidence of COVID-19 infection in family	7.621	2040.192	0.986
	Incidence of hospitalization with COVID-19	13.856	1041264.975	0.979
	Loss of life due to COVID-19 in the family	-12.218	4.938E-006	0.993

Table 4: Multivariate logistic regression model in identifying covariates in change in number of daily meals in your children during COVID-19.

Covariates in change in number of daily meals in your children during COVID-19		B	Exp (B)	Sig.
Yes	Age of child	0.310		0.407
	Sex of the child	-0.114	0.892	0.361
	Medical history	-0.712	0.491	0.017
	Occupation of parent	-0.267	0.765	0.000
	Educational status of parent	0.180	1.197	0.007
	Income of the parent	0.072	1.075	0.530
	Loss of job in the family during COVID-19	0.928	2.529	0.000
	Incidence of COVID-19 infection in the family	0.359	1.432	0.028
	Incidence of hospitalization with COVID-19	0.108	1.114	0.464
	Loss of life due to COVID-19 in the family	1.031	2.804	0.000

Table 5: Changes in lifestyle activity during COVID-19 pandemic.

Variables			Sleep duration during COVID-19 (at night)			Total	McNemar value	P value
			<7/ hours	7-9/ hours	>9 hours			
Sleep duration before COVID-19 (at night)	<7/ hours	N	5	1	0	6	976.275	0. 000
		%	83.3	16.7	0.0	100		
	7-9/ hours	N	928	507	57	1492		
		%	62.2	34	3.8	100		
	>9 hours	N	0	2	0	2		
		%	0.0	100	0.0	100		
Total		N	933	510	57	1500		
		%	62.2	34	3.8	100		

Continued.

Variables			Physical activity during COVID-19		Total	P value
			No	Yes		
Weight assessment during COVID-19	No, weight is stable	N	575	82	657	0.003
		%	87.5	12.5	100	
	No, I think my child lose weight	N	207	31	238	
		%	87	13	100	
	Yes. I think my child gain weight	N	350	32	382	
		%	91.6	8.4	100	
	I don't know	N	215	8	223	
		%	96.4	3.6	100	
Total		N		151	1500	
		%		10.1	100	

DISCUSSION

The present study is a population-based observational study to assess the alteration of dietary habits and lifestyle patterns in children during the COVID-19 confinement period. Globally, the COVID-19 pandemic had a deleterious effect on various public health consequences, economic crises, and social and psychological well-being.[9,10] With the complete pandemonium worldwide, India had been experiencing a massive surge in COVID-19 cases and deaths with the deadly situation during the second wave of COVID-19 leaving devastating impacts on people's lives.

The present study revealed changes in eating tendencies in children with reduced intake of the number of daily meals on a daily basis. No such report on decreased meals was found in the literature. The decrease in meals can be explained based on economic loss to certain families in lockdown.

Dietary patterns

While analyzing the different types of foods, it was observed that overall decreased intake of certain types of foods during COVID-19. A large number of children did not consumed of various food items such as fruits, nuts, and meat during COVID-19. The food items that showed decreased intake were vegetables, bread, rice, pulses, milk, dairy products, eggs, and chicken. Contrary to our findings Pietrobelli 2020 in Italy showed that there were no changes in vegetable intake, or increase in intake of fruits which was in absolute contrast with children of our study wherein there was no consumption of fruits and decreased intake of vegetables.[11] Consumption of certain food items was lost in families where there was a death. This can be possibly because of economic loss or possible basis of emotional disturbance i.e., mental health. Drastic loss of consumption was seen in nuts, meats, and fruits.

Regarding the decrease in meal frequency, it was observed 48.4% missed one or more main meals during the COVID-19 in our study. In no study, main meals decreased in any part of the world like Kuwait, Italy, Denmark or Spain according to literature.[9,12-14] Change in dietary habits was also observed in an Italian study by Renzo et al on adults.[12] He found that the snacking frequency increased in Italy. The people also tried to eat more organic foods. This indicates that Italians better off in their economic conditions during COVID-19. It is to be noted that the Indian children of our study probably had economic problems in their families as a large number of them had COVID-19 infected family members also. A study by Husain et al in Kuwait also reported an increase in snacking frequency late at night.[9] There was a shift away from fast food similar to our study. They depended more on home food for their main meals. This trend was also similar to our study. Husain et al 2020 [9] also reported no change in main meal frequency. This frequency was probably maintained because of economic stability during COVID-19. In our study, a generalized decrease in the consumption of sweets and a decreased trend in snacking frequency were reported by parents in their children during the COVID-19 period. A decrease in snacking frequency and sugar consumption with the decrease in the number of meals could be explained due to the economic crisis during the lockdown. A Danish and Spanish study observed an increase in snacking frequency and eating more.[13-15] This contrasted with our study. Economic conditions in India were probably not so vast. In accordance with various studies, malnutrition may have a deleterious and worst prognosis towards COVID-19 especially highest among the paediatric population.[16-18] Furthermore, poor diet and inadequate nutrition in infancy and early childhood may have serious life-long repercussions as it is a vital period of their learning for healthy eating habits that will remain throughout their lives.[19]

Before COVID-19, the number of children consuming high carbohydrates snacks (biscuits, chips, chocolates, etc) was 1338 (89.2%) children consuming two-three times daily. During COVID-19, it depicted that these children were reduced to only 126 out of 1500 participants which is 8.4%. The association of snacking in between meals (biscuits, chips, chocolates, etc) observed in children before-COVID-19 and during the COVID-19 period concerning socioeconomic status

depicted that upper-lower socioeconomic category was among the highest among other socioeconomic categories with a p=0.001*. This decline in the frequency of high carbohydrates snacks intake may be explained due to decline in the economy. Contrary to our study, an Italian study showed increased intake of high carbohydrates and sugary drinks during the lockdown.[20] Moreover, it was reported by Husain. W 2020, Scarmozzino and Visioli 2020, Pietrobelli showed an increase consumption of sweet and comfort foods during COVID-19 among adults during the pandemic.[9,11,20]

More than half of the children, 78.7% consumed only home-based food during the COVID-19 pandemic. These results match those observed by an American and Kuwait study that found a rise in home cooking during COVID-19.[9,21]These findings were probably due to restricted food availability due to the closure of shops during pandemics and fear of contracting COVID-19 from outside food.

The study investigated the association of variation of food intake in children i.e., 'no consumption' and 'decreased consumption' in relation to family members who lost their job during COVID-19. It depicted that many children could not consume certain foods at all for example 87.6% did not consume nuts, 67.5% did not consume meat and 60.7% did not consume fruits. The other food items with reduced consumption were dairy products, followed by sweets, eggs, rice, bread/roti, pulses, vegetables, milk, chicken, meat, and nuts in the children from families where a job was lost during COVID-19. (p<0.001*). A similar pattern was observed amongst families infected with COVID-19 or where life was lost. (p<0.001*). The literature did not reveal any such data correlating dietary patterns with loss of job, loss of life due to COVID-19 or even infection of a family member with COVID-19.

Lifestyle pattern

Change in weight as reported by parents

Regarding the changes in weight as reported by parents in their children, it was found that 382 i.e., 25.5% parents reported a decrease in the weight of their children. Most of the parents i.e., 43.8% could not confidently say or give definite answers about the weight of their children. Moreover, 223 i.e., 14.9% reported a gain in weight and around 238 i.e., 15.9% declares stable weight during this period. In contrast, a study by Renzo et al observed fewer decrease in weight (13.9%), a greater number of participants with weight gain (40.3%) and increase in the percentage of (37.2%) reported stable weight in the adults of Italian population as compared to our present study in children.[12]

Hunger and satiety

Considering the number of participants, 1230 parents i.e., 82 percent of parents observed a change in their child's hunger and satiety during this period. Around 745 parents i.e., 49.9 per cent reported increase in appetite and 485 parents i.e., 32.3% reported a decrease in appetite in their children during the COVID-19 pandemic. This is in accordance with studies in adults where they observed an increase in appetite during the pandemic.[12] These findings may be attributed due to overwhelming situations during COVID-19 emotions like fear and sadness, that are associated with more desire for food or less desire with lessened enjoyment during eating.[22,23]

Physical activity

With regards to physical activity observed in children during COVID-19, it presented that 1347 i.e., 89.8% showed no physical activity in their children's daily routine probably due to restrictions in movements, closure of schools and playgrounds. These results are in contrast to studies conducted on adults from Italy and Spain reported an increase in physical activity during the lockdown.[12,24] The Italian study showed increased exercise activity at home.[12] Our findings of reduced physical activities of children during COVID-19 are similar to results among adults of other studies.[9,15,25] These studies also had a decrease in activity because of lockdown restrictions like home confinement and reduced access to exercise spaces. Study by Pietrobelli reported a decrease in physical activity like our study.[11]

Various activities during a day

Based on the results of the child's activity, a decrease in their studying period, an increase in napping time, rise in the usage of electronic media in children were reported by parents. Regarding increased screen time (79.8%) it was observed that almost all the children were on their screen watching television. Half of the children were attending online classes or playing games on the screen. Some were using the screen for other educational purposes and very few were using social media activities. Moreover, there was a change in sleeping patterns and an increased number of dedicated sleep hours during this confinement period probably due to a lack of alternate physical activity. Sleep time increase was reported as an increase in daytime by Husain. W et al 2020 in Kuwait.[9]

The current study investigated the information on dietary and lifestyle behavioural changes in preregistered children during the period of COVID-19 using the DHLC-COVID-19 questionnaire. Considering that COVID-19 has no definitive pharmacological management, healthy and balanced nutrition is considered essential to boost the immune system and for prevention from various viral infections.[26,27] stated that a healthy diet influenced the gene expression levels of cytokines which are responsible for the processes of inflammation and oxidative stress. Inflammation is one of the crucial factors in the terms of severity of pulmonary manifestations of COVID-19 that leads to a so-called 'cytokine storm' causing acute respiratory distress

syndrome and multiple organ failure.[28] A review of various studies has depicted two adverse collateral effects of COVID-19 on dietary and lifestyle behaviour. Researchers have quoted that stress and boredom lead to overeating especially towards 'comfort foods' such as high simple carbohydrates and high sugary content. This may increase the risk of having dysfunctional eating or emotional eating with the increased probabilities of risk of various systemic conditions such as obesity and cardiovascular disorders that have been demonstrated to increase the severity of COVID-19.[28,29] On the other hand, the COVID-19 pandemic has also increased the incidence of malnutrition which may also lead to various severe forms of coronavirus disease.[16] To deeper understand diet, nutrition, lifestyle changes, and COVID-19, it underlines the importance of nutritional assessment particularly in the times of the COVID-19 pandemic.

Limitations

The main limitation was the self-reported questionnaire - all measurements, including dietary, weight, physical activity, and sleeping habits, were self-reported. Due to particular circumstances during the pandemic, we chose to adopt this method because it is both practical and important in these situations to gather data remotely via teledentistry or social networks as it was feasible and necessary in such cases. However, the poor informative status could amplify information bias. Secondly, the consumption substances that are specific dietary risk factors, such as fat, sodium were not collected. In addition, a telephonic based survey tool was used for its convenience during COVID-19 which may have led to selection bias. Furthermore, as a convenience sample was used in this study, the number of individuals who agreed to take part in the study may be one of the limitations.

CONCLUSION

It is apparent that the lockdowns and closures enacted by governments all over the world have had some effect on the dietary behaviour of a significant number of people, and the situation was similarly dire in India. Our findings should be used to help public health policymakers develop programmes that concentrate on sending appropriate nutritional advice to better aid in the management and prevention of the pandemic's effects because nutritional interventions may have an impact on COVID-19 infection and mortality rates.

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