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A Study on the Dietary Consumption Pattern of Adolescents and Intake of High Salt Foods and Frequency of Mealtimes during the Coronavirus Disease-19 Lockdown

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Abstract

Background: The lockdown restrictions due to coronavirus disease (COVID)-19 led to increased level of stress and reduced physical activity. The relationship between sodium intake and arterial blood pressure (BP) values in adolescence is well studied. The intake of high-sodium processed foods has increased globally, especially during lockdown. **Objectives**: The present study aimed to analyze the dietary pattern of adolescents during the COVID-19 lockdown and to assess the changes in the consumption pattern of adolescents for high salt foods and the risk of overweight during the COVID-19 lockdown. **Methodology:** A food frequency questionnaire was prepared to obtain a general idea about the adolescent population's dietary pattern with relation to high salt foods. Due to the lockdown and social distancing, an online form was created using Google Forms. Seventy-five samples participated in the study and all of them belonged to middle to high socioeconomic status. **Results:** It was reported that all the subjects added salt in their meals. Adolescents reported consuming 1–3 servings of frozen ready-to-eat foods, papads, pickles, and ready-to-eat packaged foods which are high in sodium content. There was no significant difference observed between salt intake and body mass index (BMI) in the adolescents ($P = 0.56$), except for the consumption of packaged crisps ($P = 0.04$). A highly significant correlation was obtained ($P = 0.00$) between the increase in the frequency of meals and the risk for metabolic syndrome. **Conclusion**: It was concluded that excess consumption of salt in the long term may cause hypertension and increases the risk of metabolic syndrome. Staying at home and direct access to food during the COVID -19 lockdown has led to the increase in the frequency of meals consumed and which had a direct effect on BMI.

Keywords: Adolescents, Coronavirus disease-19, high salt foods, Lockdown, Mealtimes, Overweight

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Introduction

Coronaviruses are enveloped RNA viruses that are distributed broadly among humans, other mammals, birds, and that cause respiratory, enteric, hepatic, and neurologic diseases. These viruses were not considered to be highly pathogenic to humans until the outbreak of severe acute respiratory syndrome in 2002 and 2003 in Guangdong Province, China, because the coronaviruses that circulated before that time in humans mostly caused mild infections in immunocompetent people.[1] In late December 2019, a cluster of patients was admitted to hospitals with an initial diagnosis of pneumonia of an unknown etiology. These patients were epidemiologically linked to a seafood and wet animal wholesale market in Wuhan, Hubei Province, China.[2] The most common symptoms at onset of coronavirus disease (COVID)-19 illness are fever, cough, and fatigue, while other symptoms include sputum production, headache, hemoptysis, diarrhea, dyspnea, and lymphopenia. The WHO acknowledged this crisis and declared COVID-19 as a pandemic.[3]

Nutritional intake during adolescence (the transition period from childhood to adulthood) is important for growth, long-term health promotion, and the development of lifelong eating behaviors. Total nutrient needs are higher in adolescence than during any other time in the life cycle because of rapid growth and development. Nutritional intake during this period may have long-term health effects. For example, being overweight as an adolescent is associated with being overweight as an adult.[4] Excessive weight during childhood which increases the risk of non-communicable diseases has risen overtime. This imposes a great public health problem and tackling it is very essential. Excessive weight during childhood can be prevented by enhancing physical activity and promoting healthy eating, such as increased consumption of fruits and vegetables. Mostly, adolescents eat less fruits and vegetables than the minimum 400 g/d recommended by the WHO and the FAO.[5] The early development and maintenance of healthy lifestyles are advocated as important precursors for reduction of nutrition-related diseases and disorders, such as cardiovascular diseases.[6] That's why a change made at this age can greatly influence and improve the quality of life of the future adult population.

High blood pressure (HBP) in childhood due to increased intake of sodium chloride (salt) not only predisposes children to hypertension in adulthood, it also increases their risk for the early development of cardiovascular diseases such as myocardial infarction, cardiac failure and stroke, ventricular hypertrophy, and

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proteinuria but also osteoporosis, stomach cancer, and death. High-sodium intake and overweight/obesity are recognized as risk factors for hypertension in adults as well as in children. Studies have revealed that high-sodium intake is positively associated with systolic blood pressure (SBP) and risk for pre-HBP/HPB among the US children and adolescents, and this association may be stronger among those who are overweight/obese.[7]

Evidence in children has suggested that a high dietary sodium intake may be associated with obesity risk, mediated by increased sugar-sweetened beverage (SSB) consumption. After the ingestion of dietary sodium, there is a subsequent rise in plasma sodium, and to maintain fluid homeostasis, thirst is stimulated, which promotes fluid consumption. Because SSBs are readily available and form part of a usual diet for many children and adolescents, it has been proposed that a high-sodium intake may drive greater consumption of SSBs. However, this may not always be the case because other studies have reported a positive relationship between dietary sodium intake and obesity independent of energy intake and SSB consumption. Furthermore, it is possible that other mechanisms exist by which high dietary sodium intake may be linked to obesity.[8,9] Due to their impact on disease prevention and maintenance of the health status, international nutritional goals have been set for fruit and vegetable consumption (400 g/day), and sodium chloride (<5 g/day) or sodium (<2 g/day).[10]

The consumption of salt in children and adolescents is increasing worldwide because of the increased intake of high-sodium processed foods instead of natural foods, which are low in sodium and high in potassium. A study on adolescents aged 11–18 years, the mean intake of sodium from snacks was 1.4 g/day and the average total sodium intake was 3.1 g/day and was significantly higher in individuals belonging to the highest quartile of SBP and diastolic blood pressure. Sodium intake from snacks was almost half of the average daily sodium consumption and was significantly associated with BP values in adolescents.[11]

The aim of the study is to observe the changes that the COVID-19 lockdown has brought on the intake of high salt foods and the no. of meals consumed in a day by adolescents and risk of overweight due to changed dietary patterns in this category.

Materials and Methods

Subjects for the study were selected through purposive convenience sampling from across India. The samples consisted of both girls and boys of the adolescent age criteria. The age of girls was 11–18 years and boys of age 13–20 years were selected for the study. The samples consisted of adolescents generally from medium-high socioeconomic status as due to lockdown and social distancing, contact with adolescents from low socioeconomic status was not possible.

Consent was taken from each subject before their participation into the study and was promised complete confidentiality for the data which they provided to be included into the study. Data from the participants were collected through an online form prepared on Google Forms which contained two sections. The first section collected background data of the participants and the second section asked questions related to their dietary intake in the form of a food frequency questionnaire.

The data collected with the help of food frequency questionnaires included:

- Intake of high salts foods
- Added salt intake
- Processed and ultraprocessed food intake
- The no. of meals consumed in a day.

The questions contained information about the portion sizes according to which the participants were expected to select the frequency of that food they consumed.

Results and Discussion

The analysis of Figure 1 revealed that 5.3% of the respondents never consumed packaged crisps/fried chips, followed by 22.7% were found to consume 1–3 servings a month, 25.3% for once a week, 17.3% for 2–3 times a week, 13.3% for 4–5 times a week, 12% for once a day, 2.7% for 2–3 times a day, and 1.3% for more than 3 servings of packaged crisps/fried chips a day. Significantly, half of the respondents consumed chips once a week and others reported a very high intake of chips. Packaged crisps/fried chips contain large amounts of acrylamide which is formed when food high in carbohydrates and low in proteins are cooked at high temperature or undergo thermal processing at temperatures of 12°C or higher. It is formed by a Maillard reaction, in which the free amino acid asparagine is decarboxylated and deaminated in the presence of reducing sugars or other carbonyl compounds during heating. Acrylamide has been classified as a probable human carcinogen and is an effective clastogen. According to a study by Normandin *et al*.,[12] on the basis of the 2-day food diary, median total daily intake of acrylamide was estimated at 0.29 mcg/kg bw/d, as compared to 0.17 mcg/kg bw/d on the basis of the food frequency questionnaire. These results indicate the need to reduce dietary acrylamide intake by adolescents.

Figure 2 depicts that 37.3% consumed fried foods 1–3 times a month, 20% consumed once a week, another 20% consumed 2–3 times a week, 8% consumed 4–5 times a week, 2.7% consumed once a day, 2.7% consumed 2–3 times a day, and 1.3% consumed more than 3 servings of fried foods in a day.

The results in Figure 3 show that 45.3% of the respondents consume one to three servings of ready-to-eat frozen meals in a month, 16% consume once a week, 10.7% consume 2–3 times a week, 2.7% consume 4–5 times a week, and 4% consume them once a day. About 21.3% of respondents reported no consumption of ready-to-eat frozen meals.

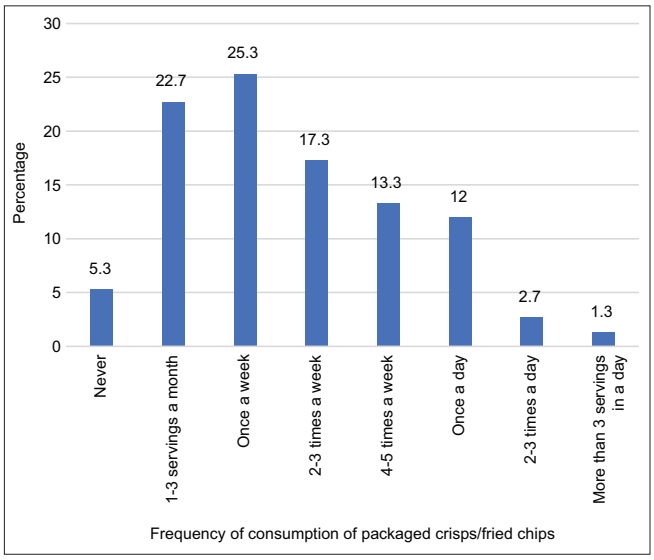

Figure 1: Frequency of consumption of packaged crisps/fried chips

Figure 4 reveals that 32% of the respondents consumed one to three servings of papad in a month, 16% consumed once a week, 10.7% consumed 2–3 times a week, 8% consumed 4–5 times a week, 5.3% consumed papad once a day, and 28% reported no consumption of papads.

Frequency data from Figure 5 show that 37.3% of the respondents never consumed pickles during the lockdown, 20% of the respondents reported 1–3 servings a month, 16% reported once a week, 4% reported 2–3 times a week, 1.3% reported 4–5 times a week, 16% reported once a day, 4% reported 2–3 times a day, and 1.3% reported more than 3 servings in a day.

Rendering to the results, 9.3% of the respondents reported no consumption of ready-to-eat packaged foods, 41.3% and 25.3% reported consuming ready-to-eat packaged foods at least once a week, 16% reported 2–3 times a week, 1.3% reported 4–5 times a week, 5.3% reported once a day, and 1.3% reported consuming more than 3 servings in a day.

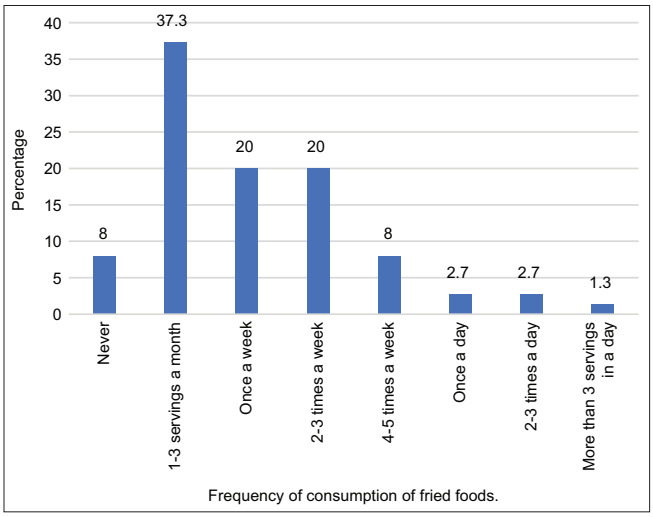

Figure 2: Frequency of consumption of fried foods.

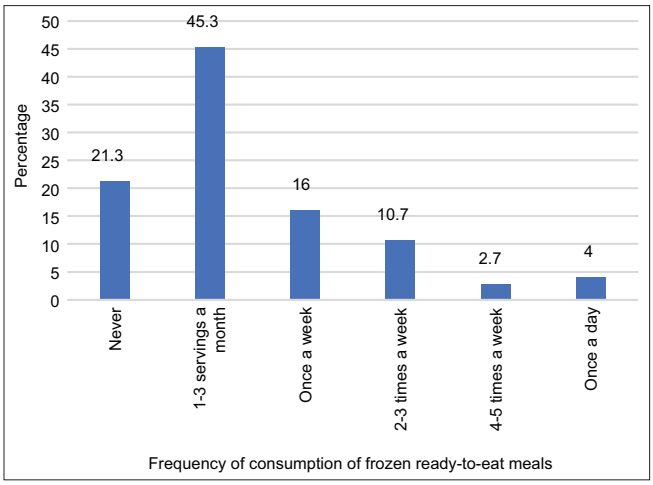

Figure 3: Frequency of consumption of frozen ready-to-eat meals

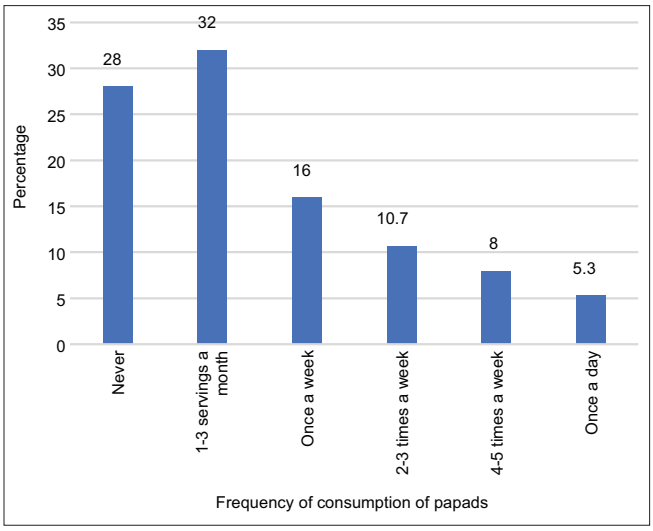

Figure 4: Frequency of consumption of papads

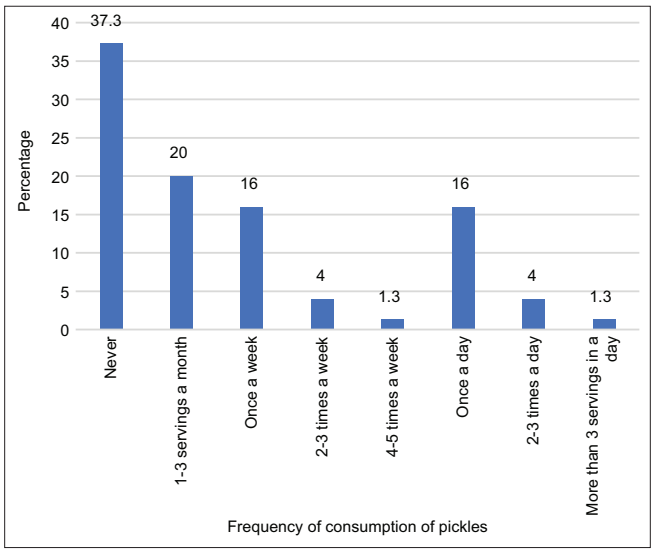

Figure 5: Frequency of consumption of pickles

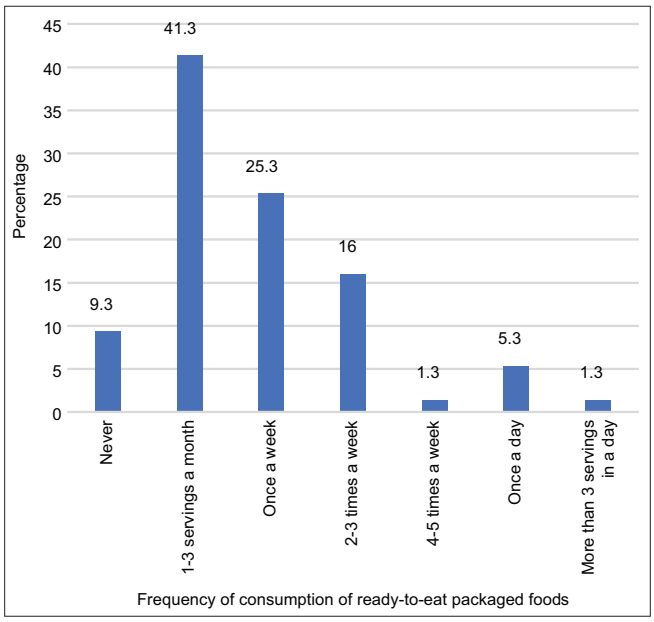

Figure 6: Frequency of consumption of ready-to-eat packaged foods

Data from Figures 1-6 represent high salt foods. Since these are also ready-to-eat foods, they contain preservatives too. Adding preservatives are the easiest way to increase the shelf life of a food product. Preservatives, especially the artificial variety, have been linked with many harmful effects such as causing cancer, causing heart problems, and breathing problems. One of the most harmful effects of preservatives on food items is their ability to transform into carcinogen agents. Some of the food items consist of nitrosamines, a preservative which has nitrites and nitrates, which mix with the gastric acids and form cancer-causing agents.[13]

When salt consumption becomes exceeds than to what is physiologically needed by the body, the result is a general rise in blood pressure and other risks to health. A rise in blood pressure damages the arteries and it's the major cause of strokes and heart attacks, the leading cause of death throughout the world. Recent trials and cohort studies showed that the effects of high salt intake in blood pressure start early in infancy and its impacts remain in adulthood.[14] Another risk of high salt intake is that it can cause calcium losses through the urine which can lead to bone demineralization and significantly increase the risk of osteoporosis, a bone condition causing fragility and breakage. Although osteoporosis is most common among older people, studies have shown that the effect of salt on calcium metabolism can be detected in children and continue in to adult life.[15]

Moreover, ready-to-eat foods are processed, which reduces most essential nutrients, making them devoid of any real nutritional benefits. These foods are empty calories, which not only provides no health benefits, but also does not keep one satiated for too long.[16] In the long term, high salt diets may cause a rise in blood pressure and increase the risk of stomach cancer, heart disease, and premature death. However, more research is needed to determine if these effects apply equally to everyone.

The above f-test in Table 1 shows that there is no significant difference observed between salt intake and body mass index (BMI) in the adolescents, $P < 0.05$. The results suggest that there was no positive correlation between increased consumption of salt and BMI. However, studies have suggested that salt intake is positively associated with BMI and the prevalence of overweight/obesity. Salt intake directly does not cause weight gain, but foods which contain increased amounts of salts are calorie dense, and increased salt intake causes increased thirst which increases fluid intake. Adolescents prefer SSB and high salt intake could cause overweight/obesity. Tables 3 and 4 also show that the average consumption of salt by the respondents was 2 teaspoons per day which is approximately 10 g of salt per day and 4 g of sodium. The WHO recommends an intake of 5 g of salt and 2.3 g of sodium per day and as mentioned in the interpretation of Table 1. The salt intake of adolescents is double than that recommended and increases furthermore with the consumption of high salt foods such as packaged food and foods loaded with preservatives which are known to be enjoyed by adolescents in their snacking time. In a study by Ponzo *et al*.,[11] it was found that the mean sodium intake from snacks was 1.4 g/day with an increasing frequency of salty snack consumption. It was concluded that sodium intake from snacks was almost half of the average daily sodium consumption and was significantly associated with BP values in adolescents. However, the correlation of salt consumption with body weight was insignificant as $P = 0.328$.

Chi-square test was applied to find the relationship between the no. of meals consumed in a day and BMI which is represented in Table 2. $P = 0.00$ indicates a highly significant association between the no. of meals and BMI. The respondents who were consuming more no. of meals in a day were in the overweight and obese category. From all the respondents who were underweight, 55.6% consumed 3 meals in a day, 27.8% consumed 4 meals in a day, 5.6% consumed 5 meals in a day, and only 11.2% consumed 6 meals a day. Almost half of the respondents who consumed 3 meals in a day were underweight representing a strong relationship between no. of meals consumed in a day with BMI. Moreover, majority of the respondents (70.8%) in the normal category consumed 4 meals in

Table 1: Relationship between salt intake and BMI of the respondents

BMI and salt intake	*No. of respondents*	*Mean±Std. deviation*	*df*	*F*	*P*
<0.25 tsp	2	28.47±0.98	6	0.823	0.556
0.25 tsp	3	18.76±6.83	68		
0.5 tsp	6	23.74±5.20	74		
1 tsp	12	24.56±6.43			
2 tsp	6	23.02±7.80			
More than 2 tsp	12	23.17±7.16			
Do not know	34	22.16±4.90			
Total	75	22.93±5.83			

BMI: Body mass index

Table 2: Relationship between the no. of meals consumed in a day and BMI

No. of meals consumed in a day	*Underweight*	*Normal*	*Overweight*	*Obese*	*Total*	*P*
3 meals in a day						
Count	10	2	0	0	12	0.000
% within R_BMI BMI	55.6%	8.3%	0.0%	0.0%	16.0%	
4 meals in a day						
Count	5	17	4	6	32	
% within R_BMI BMI	27.8%	70.8%	40.0%	26.1%	42.7%	
5 meals in a day						
Count	1	2	3	13	19	
% within R_BMI BMI	5.6%	8.3%	30.0%	56.5%	25.3%	
6 meals in a day						
Count	2	3	2	4	11	
% within R_BMI BMI	11.1%	12.5%	20.0%	17.4%	14.7%	
More than 6 meals in a day						
Count	0	0	1	0	1	
% within R_BMI BMI	0.0%	0.0%	10.0%	0.0%	1.3%	
Total						
Count	18	24	10	23	75	
% within R_BMI BMI	100.0%	100.0%	100.0%	100.0%	100.0%	

BMI: Body mass index

AQ1

Table 3: ???

	Mean ± Std. Deviation	*No. of respondents*
What is your daily average consumption of salt?	5.52 ± 1.74	75

AQ1

Table 4: ???

	What is your daily average consumption of salt?
Weight in kg	
Pearson Correlation	-0.115
Sig. (2-tailed)	0.328
N	75

*Correlation is significant at the 0.05 level (2-tailed)

a day representing those adolescents who consumed 4 meals in a day had normal BMI. From the group of adolescents who consumed 5 meals in a day, 30% and 56.5% were overweight and obese, respectively, making it clear that as the no. of meals increased, BMI increased. Staying at home and having direct access to food during the COVID-19 lockdown has increased the no. of meals consumed by adolescents and this has had a direct effect on BMI because as more meals are consumed, more calories are consumed which makes an individual overweight and overtime obese.

Conclusion

Sodium intake from the various foods selected represented almost half of the average daily consumption of sodium but was not significantly associated with BMI. The study showed that salt intake and BMI are independent of each other. Furthermore, evidence-based interventions that help participants reduce their sodium intake, increase their physical activity, and attain or maintain a healthy weight may help reduce the greater than expected prevalence of HBP and other cardiovascular disease risk factors among adolescents.

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