

# Impact of COVID-19 Lockdown on Dietary Behavior Related to Oral Health in Teesside, United Kingdom

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## ABSTRACT

**Diet is well established as a significant etiological factor in oral diseases, particularly dental caries, and dental erosion. During the COVID-19 pandemic, the stay-at-home orders (lockdown) impacted people's well-being. Emotional distress affects food preferences and consumption. Therefore, this study aimed to understand the dietary changes due to lockdown in Teesside and consequently its impact on oral health.**

**Method:** An online survey was developed based on the World Health Organization Adult Oral Health Survey. After obtaining ethical approval, the survey was distributed among residents  $\geq 18$ y living in Teesside. The questions addressed dietary choices before and during the lockdown. Participants were also invited to a semi-structured interview to understand the influence of lockdown on dietary choices.

**Results:** The frequency of consuming daily fresh fruit decreased by 3.2%. Participants consuming cakes and biscuits 2-3 times daily doubled from 5.4% to 10.6%. The daily consumption of sweets increased from 8.6% to 14.9%. Drinking alcohol four or more times per week increased from 7.1% to 12.5%. The most common explanations were reliance on online grocery shopping, lack of social interaction, and working from home.

**Conclusion:** Support strategies are needed for communities to maintain healthy nutritional choices during periods of significant upheaval.

**Keywords:** COVID-19, diet, lockdown, oral diseases.

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## I. INTRODUCTION

Diet is well established as a significant etiological factor in oral diseases, particularly dental caries and dental erosion [1]. Dental caries occurs due to dental biofilm (plaque) metabolizing sugars in the diet into organic acids, which cause the demineralization of tooth enamel. Similarly, dietary acids found in fruit, fruit juice and carbonated beverages lead to a progressive and permanent erosion of tooth enamel [1], [2]. In addition, frequent alcohol consumption, especially when combined with tobacco intake, is associated with an increased risk of oral and oropharyngeal cancer [3]. The COVID-19 pandemic led to all non-essential businesses, including dental clinics, being ordered to close, and people told to “stay at home” [4]. The closure of businesses led to panic buying, with many essential products quickly becoming unavailable [5]. The stay-at-home orders (lockdown) were in place for three months, with many businesses shifting to a work from home model. The pandemic and lockdown had a serious effect on people's mental health and wellbeing due to the isolation, uncertainty and stress [6]. Stress has long been associated with “comfort eating”, that is, the consumption of high fat, high sugar, high-calorie foods and drinks in response to negative emotions [7].

The Institute for Fiscal Studies [8] used data from

supermarkets, restaurants, and other sources to assess the dietary changes of the United Kingdom (UK) population during the lockdown. Their findings showed that on average, people were consuming 15% more calories than normal, and this remained 10% higher than average for the rest of 2020 [8]. A comparison of nutritional habits between the UK, United States of America and New Zealand found that participants in the UK consumed significantly more saturated fats and experienced the most challenges finding ingredients for food preparation compared with the other countries [5]. These studies all report on the potential impact on obesity; however, no studies are available that explore the effect of dietary changes due to lockdown on oral health.

Teesside is a county in the Northeast of England with among the highest levels of health deprivation in the UK [9], [10]. Communities in the Teesside have a lower-than-average life expectancy, and a significantly higher number of deaths due to suicide than the UK average. Teesside also has a high number of hospital admissions due to alcohol-related conditions and almost double the national average male deaths due to oral cancer [10]. The burden of oral diseases in this area is among the highest in the UK [11] and dental attendance is between 53% and 83% of adults attending a routine visit in the last two years [11].

Understanding the impact of the COVID-19 lockdown on

oral health is critical for the future planning and commissioning of oral healthcare and public health services. Therefore, this study aimed to understand the dietary changes that occurred in this region due to the pandemic and lockdown and consequently its impact on oral health.

## II. METHOD

This study followed a mixed-method approach utilizing a sequential exploratory design.

This study received ethical approval from the Teesside University School Research Ethics Sub-Committee (SRESC; # 2021 Mar 2703 ENGLAND).

### A. Quantitative Survey

An online questionnaire (see supplementary material) was developed from the World Health Organization (WHO) Oral Health Questionnaire (OHQ) for adults [12]. The WHO-OHQ has been already tested for validity and reliability and used globally to collect oral health data [13]-[17]. The online questionnaire included data about the participants' demographics and dietary habits before and during the lockdown.

Gatekeepers of community social media groups in Teesside were approached and asked to distribute the online questionnaire. Residents  $\geq 18$ y living within Teesside were invited to participate in the survey. The survey was open from 12<sup>th</sup> March – 12<sup>th</sup> June 2021. Participation was voluntary, and the questionnaire's submission was considered valid consent; no financial reward was offered for participation.

The data were coded and descriptively analyzed using Statistical Package for the Social Sciences (SPSS) 25.0.24. Categorical variables were summarized and reported as frequency and percentage.

### B. Qualitative Survey

Respondents to the quantitative survey were invited to contact the researcher to take part in a semi-structured interview. Consent was recorded verbally and stored on a password protected server at Teesside University. Semi-structured interviews between 25-60 minutes in length were conducted via Microsoft Teams.

The interview guide (see supplementary material) was developed after the closing date of the quantitative survey to develop the interview guide based on the results. The interview guide contained 15 open ended questions relating to oral hygiene, nutritional choices, and access to oral

healthcare during lockdown. The interview guide was pilot tested with two participants.

The data were collected utilizing a grounded theory method to identify emerging patterns from the participants thoughts and opinions. The interviews were transcribed verbatim and analyzed using NVivo12 software to identify common language among the participants which could be coded into themes and sub-themes (see supplementary material).

## III. RESULTS

TABLE I: DEMOGRAPHIC DATA QUANTITATIVE

Demographic data	Number (%)
Sex	
Male	26 (12.8)
Female	177 (87.2)
Race and Ethnicity	
White -English / Welsh /Scottish / Northern Irish/British	179 (88.2)
Any other ethnic background / Asian/ Black / Caribbean / Arab	24 (11.8)
Age Group	
18-29 years	34 (21.0)
30-39 years	33 (20.0)
40-49 years	42 (26.0)
50-59 years	30 (18.0)
60 and above years	24 (14.0)
Education Level	
GCSE's/ Vocational training/A-levels or equivalent	64 (31.7)
Undergraduate degree	72 (35.6)
Postgraduate degree	64 (31.7)
Income Level	
<£16,000	63 (31.0)
£16,000-£29,999	70 (34.5)
£30,000-£59,999	38 (18.7)
£60,000- and above	7 (3.5)
Rather not answer	22 (10.8)

The cross-sectional quantitative survey received 203 responses. Table I presents the demographic data of the responses. Most respondents were female (87.2%), white ethnicity (88.2%), aged <50years (67.0%), with an annual income < £29,999 a year (65.5%) and holding an undergraduate or postgraduate degree (65.5%). Tables II, III, IV present the effect of the pandemic on the frequency of consumption of fresh fruit; cakes and biscuits; sweets; sugar free gum; carbonated beverages; tea or coffee with sugar; fruit juice and smoothies; squash; water and alcohol.

TABLE II: FOOD CHOICES BEFORE AND DURING COVID-19 LOCKDOWN N (%)

	Fresh fruit		Cakes		Sweets		SF gum	
	Before	During	Before	During	Before	During	Before	During
2-3 times a day	55 (27.2)	41 (20.5)	11 (5.5)	21 (10.6)	5 (2.5)	9 (4.6)	7 (3.5)	7 (3.6)
Every day	62 (30.7)	55 (27.5)	38 (18.9)	50 (25.3)	17 (8.6)	29 (14.9)	16 (8.1)	8 (4.1)
Several times a week	50 (24.8)	44 (22.0)	79 (39.3)	55 (27.8)	53 (27.8)	57 (29.2)	22 (11.1)	20 (10.2)
Once a week	20 (9.9)	27 (13.5)	33 (16.4)	31 (15.7)	37 (18.7)	30 (15.4)	7 (3.5)	10 (5.1)
Several times a month/Seldom never	15 (7.4)	23 (11.5)	40 (19.9)	41 (20.7)	85 (42.9)	38 (19.5)	143 (72.2)	146 (74.5)
Rather not answer					1	1	3	
Total (n)	202	200	201	198	198	195	198	196

TABLE III: BEVERAGE CHOICES BEFORE AND DURING COVID-19 LOCKDOWN N (%)

	Carbonated drinks		Tea with sugar		Coffee with sugar		Fruit juice/smoothies		Squash	
	Before	During	Before	During	Before	During	Before	During	Before	During
2-3 times a day	14 (7.1)	16 (8.1)	11 (5.7)	14 (7.3)	12 (6.1)	14 (7.3)	2 (1.0)	3 (1.6)	26 (13.3)	38 (19.5)
Every day	21 (10.6)	28 (14.2)	6 (3.1)	7 (3.6)	9 (4.6)	10 (5.2)	13 (6.5)	16 (8.2)	42 (21.4)	39 (20.0)
Several times a week	30 (15.2)	25 (12.7)	12 (6.2)	8 (4.1)	7 (3.6)	9 (4.7)	23 (11.6)	20 (10.0)	27 (13.8)	25 (12.8)
Once a week	26 (13.1)	24 (12.2)	4 (2.1)	2 (1.0)	1 (0.5)	2 (1.0)	16 (8.0)	19 (9.5)	12 (6.1)	11 (5.6)
Several times a month	107 (50.0)	104 (52.8)	159 (82.1)	161 (83.4)	166 (84.3)	157 (81.3)	144 (72.4)	132 (68.0)	87 (44.4)	81 (41.5)
RNA				1	2	1	1	3	2	1
Total	198	197	194	193	197	193	199	194	196	195

TABLE IV: ALCOHOL CONSUMPTION BEFORE AND DURING COVID-19 LOCKDOWN N (%)

	Before	During
4 or more times a week	12 (7.1)	21 (12.5)
2-3 times a week	33 (19.6)	34 (20.2)
Monthly or less	42 (25)	30 (17.9)
2-4 times a month	41 (24.4)	34 (20.2)
I do not drink	16 (9.5)	16 (9.5)
Never	24 (14.2)	30 (17.9)
Total	168	168

In total nine participants agreed to be interviewed for the qualitative survey: 7 females and 2 males, aged between 26 and 50 years. Eight identified as White and one Black African. Thematic content analysis revealed themes and statements which explained the dietary choices the participants made during lockdown:

#### A. Consumption of Fresh Fruit

The frequency of participants consuming fresh fruit (Figure 1) regularly decreased 2-3 times per day (-1.7%), everyday (-3.2%) and several times a week (-2.8%). Meanwhile, increased in the once per week (+3.6) and seldom never (+4.1%).

P6: "Oh, probably got quite a lot of freezer stuff. Probably not so much fresh stuff because I don't like buying so much online because you can't see it... they tend to give you the stuff that's going to go out of date the next day"

#### B. Cakes and Biscuits

Participants consuming cakes and biscuits 2-3 times daily doubled during lockdown from 5.4% to 10.6%, similarly those consuming them daily increased by 6.6%. Consumption several times per week decreased by 11.5%.

When describing the change to working from home multiple participants mentioned the increased consumption of sweet foods and snacking throughout the day to compensate

for the lack of social interaction, they would normally have in their work environment.

P3: "The fridge is just downstairs for me. So, you're like fridge picking buying more snacks because I was working from home just, I probably eat more at home during the day than I did at work"

#### C. Sweets

The daily consumption of sweets almost doubled during lockdown, increasing from 8.6% to 14.9% and 2-3 times daily from 2.5% to 4.6%. Meanwhile, seldom/never decreased by 6%.

P1: "So now obviously I've cut down a lot more. I've had to because I don't wanna get any bigger so I have lost half a stone, just by not eating sweets and stuff."

#### D. Sugar-Free Chewing Gum

Daily consumption of sugar-free chewing gum decreased by 50% from 8.1% to 4.1%.

#### E. Carbonated Drinks

The daily consumption of carbonated drinks increased from 10.6% to 14.2%.

Several participants noted that they consumed more carbonated beverages during lockdown and partly attributed this to working from home.

P8: "I mean I have tended to drink a lot fizzier juice and you know and in the past by I'm trying to cut it down because I know that is probably a large contribution towards my, my weight gain will be fizzy juice. If I were to cut it out it probably would lose a fair amount."

#### F. Tea or Coffee with Sugar

Frequent daily consumption (2-3 times) of tea with sugar increased from 5.7% to 7.3% and coffee with sugar increased from 6.1% to 7.3%.

Participants discussed drinking more tea and coffee while working from home due to feeling tired and lethargic.

P3: "I think as I do a lot of team meetings and you know, yes, I've drank more coffee. So much more coffee. We go through a coffee so fast at the moment. I mean, that's, I feel

more lethargic.”

### G. Fruit Juice and Smoothies

The daily consumption of fruit juice or smoothies increased from 6.5% to 8.2%.

Participant 5 discussed the adverse effect of drinking smoothies and the advice they received to eat fruits whole.

*“Sometimes I make a smoothie, but I tend to eat my fruit whole. I only realized that it's not good for you quite recently, to be honest.”*

### H. Squash (with or without added sugar)

The most significant change in the consumption of squash 2-3 times daily, increasing from 13.3% to 19.5%.

P6 mentioned their attempts to exchange carbonated beverages for water or squash: *“it might be three or four sort of glasses this sort of size glass (holds up glass). Yeah, okay. Trying to have the same sort of amount of like water or like squash.”*

### I. Alcohol

The most concerning result from the survey revealed that drinking alcohol >4 times per week increased from 7.1% to 12.5%. The number of alcoholic drinks consumed 1-2 times daily increased from 34.4% to 36.8%. Participants drinking 7-9 drinks per sitting decreased from 3.7% to 2.7%, and those drinking heavily (>10 per day) remained unchanged.

Only participant 3 reported increased alcohol consumption during lockdown, all other participants responded that they did not, or rarely drank alcohol.

P3: *“So yeah, we probably were drinking more during the week through lockdown because you know, that was sort of our escape?”*

## IV. DISCUSSION

The COVID-19 pandemic disproportionately affected the most disadvantaged communities. The Northeast of England suffered a 17% higher mortality rate due to COVID-19 compared with the rest of England and experienced longer lockdowns compared to the rest of the country, spending an additional 41 days in the harshest restrictions leading to a 55% increase in mental health disorders [18]. This study highlights the impact of COVID-19 lockdown on dietary choices made by individuals across the county.

A diet rich in varied fruit, vegetables, antioxidants, and vitamins is not a treatment for COVID-19, but it is a modifiable contributor towards noncommunicable diseases, which are highly associated with COVID-19 mortality and oral diseases [19]. When asked about the overall impact of lockdown on their oral health 37% of participants reported a negative effect. In contrast only 2.5% of participants reported an improvement in their oral health due to lockdown.

The pandemic induced a fear of food shortages, causing people to panic-buy and stockpile non-perishable food items with a longer shelf-life leading to a diet with poor nutritional value [20]. Results from this study demonstrate that participants reduced the frequency in which they were consuming fresh fruit and vegetables due to their reliance on supermarket delivery services, or relatives, understandably, the participants were anxious about visiting supermarkets unless it was essential. Additionally, unemployment in the

North was higher than the rest of the country during the pandemic and household income decreased from £543.90 to £541.30 per week [18] while the cost of fruit and vegetables were at an all-time high [21]. The demand for “food parcels” distributed by charitable organizations tripled in Teesside during the pandemic [22] although social support was provided by the government this should be distributed equitably to ensure the most deprived areas receive adequate support to maintain a basic standard of living.

The switch to unhealthy foods during the pandemic lockdown has been well documented [20]-[25] which is reflected in this study with participants increasing their daily consumption of sweets, cakes, and biscuits. Participants attributed this to the change in routine to working from home, and feelings of isolation working away from their colleagues where they have easy access to high carbohydrate snacks and drinks. Participants also discussed feelings of lethargy and linked this to their increased sugar consumption and poor diet leading to drinking more coffee during the day to stay awake. Dental biofilm converts available dietary sucrose into organic acids and when this process is frequently repeated leads to the demineralization of tooth enamel and eventually a cavity. Remineralization can occur through the washing action of saliva or chewing sugar free gum [26]. However, participants in this study also reported their daily intake of sugar free gum reduced, thereby creating an ideal intraoral environment for dental caries to occur. Although employers are increasingly aware of the need to address mental health issues, the lockdown presented new challenges in the way organizations support and communicate with their workers. Our research shows the need for remote digital support services and further research to encourage positive coping mechanisms.

A report by Public Health England indicated that alcohol related deaths increased by 20% during the lockdown as people turned to alcohol as a coping mechanism for stress, economic worries, and loneliness [27]. This study revealed that participants drank more frequently, however drank less in each sitting, whereas people drinking heavily >10 units per sitting remained unchanged. Alcohol misuse can lower immunity and increase the risk of severe COVID-19 infection [28], prolonged use, especially combined with tobacco consumption can increase the risk of oral and oropharyngeal cancer [3]. Therefore, it is essential that further research is conducted to understand which sociodemographic groups are increasing their alcohol use to create a targeted risk reduction strategy.

## V. LIMITATIONS

While this study provides unique insights through both quantitative and qualitative data, it does have some limitations. The participants were recruited via social media, which may introduce bias towards people who are familiar with using technology. Data were collected nine-months after the first lockdown ended which may introduce recall bias, additionally, interview participants may have provided socially desirable answers.

## VI. CONCLUSION

In summary, this research highlights the stark inequalities affecting Teesside which impacted upon the dietary choices made during the COVID-19 lockdown, which in turn can negatively affect oral health. The negative impact on oral and general health may be felt long after the return to “normality”. There is a critical need to support this community during the current pandemic and into the future. Interventions should be co-designed to facilitate accepted strategies to tackle the burden of noncommunicable disease, especially the regional burden of oral diseases. The use of digital technologies should be considered to provide mental health and social support to individuals and families in lockdown.

## CONTRIBUTION OF AUTHORS

Conceptualization RE, LN, VZ; methodology RE, LN, VZ; data collections RE; analysis RE; original draft preparation RE; review and editing RE; LN; VZ. All authors have read and agreed to the published version of this manuscript.

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## CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

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