Nutritional knowledge and immunity-boosting food consumption patterns before and after the COVID-19 pandemic lockdown periods in Osun State, Nigeria

Adekunle Folorunso1, Fareedah Olu-Lawal1 and Saheed Omoniyi2

Abstract
Background: A healthy diet can ensure a robust immune system that can resist any onslaught by viruses and bacteria. Aim: To assess the nutritional knowledge and consumption patterns of immunity boosting foods of adults before & after the COVID-19 pandemic lockdown periods and the effect of the lockdown on daily food intake among respondents in selected towns in Osun state. Methods: Cross sectional data was collected from six largest local governments areas purposively selected from the three senatorial districts of Osun State (n = 1000) using a well-structured, self-administered questionnaire and the data collected was analyzed using mean, standard deviation, and Pearson’s correlation test. The study assessed the food intakes of adults using a qualitative food frequency questionnaire. Results: The results indicated that the majority (89.8%) of the respondents had high knowledge of the occurrence of the COVID-19 pandemic. Daily food intake was affected by COVID-19 lockdown, consumption of healthy food among the respondents was high during lockdown as 77% strongly agreed that vitamins and minerals supplement can be considered healthy and immunity boosting, while there was a reduction in the consumption of healthy foods after the lockdown periods. The test of hypothesis showed that the occurrence of pandemic and nutritional knowledge had a significant relationship with the consumption of healthy foods. Conclusion: This study extends and confirms previous research on high nutritional knowledge of immunity-boosting foods in relation to COVID-19 among the respondents and a general reduction in the consumption of healthy foods after the COVID-19 lockdown periods.

Keywords
COVID-19, food intake, consumption patterns, lockdown period, nutritional knowledge

Introduction
Coronaviruses are a large family of viruses that are known to cause illnesses ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) (WHO, 2020). The body system is designed in such a way that the immune system is responsible for defending it against bacteria and diseases which could result in health risks. The immune system like all other systems in the body depends on and derives energy from nutrients gotten from the foods we consume. A proper and healthy diet can ensure a robust immune system that can resist any onslaught by viruses and bacteria (Aman and Masood, 2020). A certain amount of a particular nutrient saturates into cells and prevents any kind of nutritional deficiency. Individuals consuming well-balanced diets appear to be safer with better immune systems and lower occurrence of chronic diseases and infections (Aman and Masood, 2020).

Currently, the ongoing COVID-19 pandemic is likely to put many more individuals at risk of food insecurity and make consuming a healthy diet even more difficult. This

1 Department of Consumer Sciences and Hospitality Management, Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife, Nigeria
2 Department of Home Science and Management, Faculty of Agriculture, Federal University, Gashua, Nigeria

Corresponding author:
Adekunle Folorunso, Department of Consumer Sciences and Hospitality Management, Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria.
Email: kunlefolly2@yahoo.com
becomes increasingly likely if the infection risk-mitigation strategies do not include approaches to ensure essential supplies are effectively distributed and accessible, or if the pandemic affects the productivity of the agricultural sector (The Nutrition Source, 2021).

We have known for a long time that nutrition is intricately linked to immunity and the risk and severity of infections. Poorly nourished individuals are at a greater risk of various bacterial, viral, and other infections. Conversely, chronic or severe infections lead to nutritional disorders or worsen the nutritional status of affected people. Furthermore, the clinical course of COVID-19 disease tends to be more severe among older individuals and among people with chronic conditions, such as diabetes, hypertension, and cancer that are partly related to nutrition (WHO, 2020). Although data are not yet available, the design of human immune system is complex and influenced by an ideal balance of many factors, not just diet, and especially not by any specific food or nutrient. Factors such as exercise, low stress, adequate food intake; even distribution of food, good food preservation techniques, proper preparation of foods, food accessibility, and good sanitation in food environment most effectively primes the body to fight infection and disease. Healthily navigating the food environment for many people during the COVID-19 pandemic lockdown periods is a big challenge and makes people even more vulnerable to making unhealthy food decisions.

An optimal nutrition plays an important role in maintaining good health among people with such infections. A healthy diet, as depicted by the Healthy Eating Plate, emphasizes fruits, vegetables, whole grains, legumes, and nuts, moderate consumption of fish, dairy foods and poultry, and limited intake of red and processed meat, refined carbohydrates and sugar. Such a diet will provide appropriate amounts of healthy macronutrients and essential minerals and vitamins. Eating high-quality sources of protein, fat, and carbohydrate can help maintain a healthy weight and good metabolic state; this is not a time for highly restrictive, crash diets (Aman and Masood, 2020; The Nutrition Source, 2021).

Therefore, this study examines the nutritional knowledge of respondents, the extent to which people eat healthy before the pandemic lockdown periods and their consistency after the pandemic lockdown.

**Methods**

**Study area**

The study was carried out in the three (3) senatorial districts of Osun State. Osun is an inland state in south-western Nigeria. It was created in 1991 from the old Oyo state, south-western Nigeria. Its capital is Osogbo. It is bounded in the north by Kwara State, in the east partly by Ekiti State and partly by Ondo State, in the south by Ogun State and in the west by Oyo State. The population stands at 3,423,535 (NPC, 2006).

The three (3) senatorial districts of Osun state are Osun Central, Osun West and Osun East and each Senatorial district consists of 10 Local Government Areas. Senatorial zones in Nigeria are typically made up of groups of local government areas in a particular state and are represented by Senators at the National House of Assembly.

**Population and sample size**

For the population of the study, two local governments were purposively selected from each of the three senatorial districts of Osun Central, West and East making up six LGAs. The population of adult males or females, employed or unemployed, literate or illiterate were randomly selected.

The local governments selected for the study include:
- For Osun Central: Osogbo local Government and Olorunda Local Government areas.
- For Osun West: Iwo Local Government and Ede North Local Government areas.
- For Osun East: Ife Central Local Government and Ilesa West Local Government areas.

The sample size was determined from the total population using the Taro Yamane formula;

\[ n = \frac{N}{1 + \left( \frac{E^2}{n} \right)} \]

where:
- \( n \) = Sample Size
- \( N \) = 3,423,535 (NPC, 2006)
- \( E \) = marginal error (0.025)

Calculating the sample size:

\[ n = \frac{3,423,535}{1 + \left( \frac{0.025^2}{3,423,535} \right)} \]

\[ n = 991.7 \]

This was rounded up to 1002, to make up for natural attrition.

The sample size calculated was then divided by 3 for each senatorial district

\[ n = \frac{1000}{3} \]

\[ n = 333 \]

Two local governments were purposively selected from each senatorial district; the population size was then once again divided by 2.

\[ n = \frac{333}{2} \]

\[ n \approx 167 \]

**Research instrument**

A well-structured and self-administered questionnaire was used for the study. Section one measured the sociodemographic characteristics of the respondents; Section two measured the respondents knowledge of the occurrence of the COVID-19 pandemic; Section three measured the nutritional knowledge of the respondents; Section four measured their food consumption before COVID-19; Section five measured the effect of COVID-19 on the ability of the respondents to select healthy and immunity-boosting foods during the COVID-19 lockdown periods; and Section six measured their food consumption after the COVID-19 lockdown periods.
Measurement of variables

For the socio-demographic characteristics of the respondent; Gender was coded as Male = 1, Female = 2, Age was coded as 18–21 = 1, 22–43 = 2, 44–65 = 3, 66 and above = 4, highest educational qualification was coded as SSCE = 1, OND = 2, HND = 3, BSc = 4, MSc = 5, PhD = 6; Work sector was coded as Self Employed = 1, Employed = 2, Unemployed = 3, Student = 4, Others = 5; Marital status was coded as Single = 1, Married = 2, Widowed = 3, Divorced = 4, Separated = 5; Religion was coded as Christianity = 1, Islam = 2, Others = 3; Household type was coded as Nuclear = 1, Extended = 2 and monthly income range was coded as <25,000 = 1, 25,000–50,000 = 2, 50,000–100,000 = 3, 100,000–200,000 = 4 and >200,000 = 5. Yes and No questions were used to measure the respondents’ knowledge on COVID 19 pandemic, with the questions in the section both positive and negative. The positive questions were scored Yes = 3, No = 2, Not sure = 1 while the negative questions were scored Not sure = 3, No = 2, Yes = 1.

Assessment of nutritional knowledge of respondents was measured using a 4-likert scale using strongly agree, agree, disagree and strongly disagree with the questions in the sections. A mix of both positive and negative questions, the positive questions were scored as strongly agree = 4, agree = 3 disagree = 2 strongly disagree = 1 and the negative questions were scored as strongly agree = 1, agree = 2, disagree = 3, strongly disagree = 4. Food consumption before and after the COVID-19 pandemic was measured using a 5-likert scale using always, often, occasionally, rarely and never with the questions in the section a mix of positive and negative questions, the positive questions were scored as Always = 5, Often = 4, Occasionally = 3, Rarely = 2, Never = 1 and the negative questions were scored as Never = 5, Rarely = 4, Occasionally = 3, Often = 2, Always = 1.

Statistical analysis

The data collected was analyzed using the statistical Package for Social Sciences version 24.0 (SPSS). Descriptive statistical analysis such as percentages and measures of central tendency were also used in the analysis. The hypothesis was subjected to correlation.

Results

Socio-Demographic characteristics

The result from Table 1 shows that 65.7% of the respondents were females while 34.3% of the respondents were males. The age category of 18–21 years and 22–43 years had the highest percentage of 44.3%, 10.5% of the respondents were in the age category 44–65 while 1% of the respondents were 66 years and above. 37.8% of the respondents were married people with 3.5% were divorced. 76.8% of the respondents lived in nuclear family households while 23% lived in extended family households. 54.3% of the respondents were Christians while 45.3% were Muslims with 0.5% being of other religions. 38.5% of the respondents were students, 33% of the respondents were employed with 19.5% being self-employed and 7.5% being unemployed while 0.5% chose others.

Table 1. Socio-demographic characteristics of respondents.

| Characteristics          | Frequency(1000) | Percentage (%) |
|--------------------------|-----------------|----------------|
| Gender                   |                 |                |
| Male                     | 343             | 34.3           |
| Female                   | 657             | 65.7           |
| Age                      |                 |                |
| 18–21                    | 442             | 44.2           |
| 22–43                    | 443             | 44.3           |
| 44–65                    | 105             | 10.5           |
| 66 and above             | 10              | 1.0            |
| Household type           |                 |                |
| Nuclear                  | 768             | 76.8           |
| Extended                 | 232             | 23.2           |
| Marital status           |                 |                |
| Married                  | 348             | 34.8           |
| Divorced                 | 42              | 4.2            |
| Widowed                  | 47              | 4.7            |
| Single                   | 563             | 56.3           |
| Highest educational qualification |            |                |
| SSCE                     | 378             | 37.8           |
| OND                      | 74              | 7.4            |
| HND                      | 130             | 13.0           |
| BSc                      | 285             | 28.5           |
| MSc                      | 95              | 9.5            |
| PhD                      | 38              | 3.8            |
| Employment status        |                 |                |
| Self-employed            | 195             | 19.5           |
| Employed                 | 330             | 33.0           |
| Unemployed               | 75              | 7.5            |
| Student                  | 385             | 38.5           |
| Others                   | 15              | 1.5            |
| Religion                 |                 |                |
| Christianity             | 543             | 54.3           |
| Islam                    | 453             | 45.3           |
| Others                   | 4               | 0.4            |
| Range of monthly income  |                 |                |
| Less than 25,000         | 450             | 45.0           |
| 25,000–50,000            | 175             | 17.5           |
| 50,000–100,000           | 160             | 16.0           |
| 100,000–200,000          | 135             | 13.5           |
| More than 200,000        | 80              | 8.0            |
Respondents earning less than #25,000 had the highest percentage with 45%, followed by 17.5% earning between #25,000- #50,000 and 16% earning #50,000—#100,000, 13.5% of the respondents earned #100,000—#200,000 with 8% earning more than #200,000 monthly.

**Respondents” knowledge of the COVID – 19 pandemic**

The result in Table 2 shows that 87.2% of the respondents agreed that COVID-19 is caused by a virus, 11.8% of the respondents disagreed and 1% were not sure. A majority (89.8%) agreed that COVID-19 is transmitted through droplet in air, 7.3% of the respondents disagreed while 2.8% said they were not sure. Majority (98.8%) of the respondents agreed that COVID-19 is transmitted by infected persons and 1.3% were not sure. 91% of the respondents agreed that COVID-19 mortality rate is higher in elderly, 4.5% were not sure while 4.5% disagreed. 95.3% of the respondents agreed that COVID-19 has a greater effect on people with underlying illness, 3.9% disagreed while 0.8% were not sure. 89.5% of the respondents agreed that COVID-19 can be prevented by wearing masks, 4.3% were not sure while 6.2% disagreed. 59.5% of the respondents agreed that COVID-19 can be prevented by balanced nutrition, 21.5% disagreed while 19.0% were not sure. 81.8% of the respondents agreed that sufficient vitamins and minerals are important in COVID-19 treatment and prevention, 8.9% were not sure while 9.3% disagreed. 43.3% of the respondents agreed that there was no drug treatment for COVID-19, 43.3% disagreed while 13.4% were not sure. 59.8% of the respondents agreed that COVID-19 can be prevented by vaccine, 38.2% disagreed while 2% were not sure.

**Nutritional knowledge of respondents**

The result from Table 3 shows that the majority of the respondents (54.9%) strongly agreed that milk and dairy products are healthy and immunity boosting foods, 41.8% strongly disagreed with this while 1.5% and 1.8% agreed and disagreed respectively. 46.7% of the respondents strongly disagreed that cereals, legumes, tubers and roots should be considered healthy foods, followed by 42.5% that strongly agreed that these foods can be considered healthy and immunity boosting while 8.8% and 2.0% agreed and disagreed respectively. A Majority of the respondents (77%) strongly agreed that vitamins and minerals supplement can be considered healthy and immunity boosting, 2.3% agreed with this while 2.8% and 17.9% disagreed and strongly disagreed respectively. 57.4% agreed that cake, doughnut, meat pie and pizza can be considered healthy, followed by 26.6% which strongly disagreed with 10% and 6% of the respondents disagreeing and strongly agreeing respectively. 47% of the respondents strongly disagreed that meat, poultry, fish and their products can be considered healthy and immunity boosting foods, 43% of the respondents strongly agreed that the mentioned foods can be considered healthy and immunity boosting while 8.3% and 1.7% of the respondents agreed and disagreed respectively. 49.5% of the respondents agreed that carbonated and sugary drinks can be considered healthy while 9.8% strongly agreed. 40% of the respondents strongly disagreed that fat and oil can be considered healthy and immunity boosting foods, followed by 32.3% which agreed that fat and oil can be considered healthy food while 15.5% strongly agreed with this and 12% disagreed. Majority of the respondents (78.7%) strongly agreed that vegetables, green food, fruit and fruit juice are healthy and immunity boosting foods followed by 17.5% which

| Table 2. Respondents knowledge on COVID-19 pandemic. |
|-----------------------------------------------|
| Question                          | Yes(%) | No(%) | Not sure(%) |
| COVID-19 is caused by a virus         | 87.2   | 11.8  | 1.0         |
| COVID-19 is transmitted through droplets in air | 89.8   | 7.3   | 2.8         |
| COVID-19 is transmitted by infected persons | 98.8   | 0     | 1.2         |
| COVID-19 mortality rate is higher in elderly | 91.0   | 4.5   | 4.5         |
| COVID-19 has greater effect on people with underlying illness | 95.3   | 3.9   | 0.8         |
| COVID-19 can be prevented by wearing masks | 89.5   | 4.3   | 6.2         |
| COVID-19 can be prevented by balanced nutrition | 59.5   | 21.5  | 19.0        |
| Sufficient vitamins and minerals are important in COVID-19 treatment and prevention | 81.8   | 8.9   | 9.3         |
| No drug treatment is available for COVID-19 | 43.3   | 43.3  | 13.4        |
| COVID-19 can be managed by vaccine    | 59.8   | 38.2  | 2.0         |

| Table 3. Nutritional knowledge of respondents on healthy and immunity boosting foods. |
|-----------------------------------------------|
| n = 1000 | SA(%) | A(%) | D(%) | SD(%) |
| Milk and dairy products                      | 54.9  | 1.5  | 1.8  | 41.8  |
| Cereals, legumes and tuber/roots            | 42.5  | 8.8  | 2.0  | 46.7  |
| Vitamins and minerals supplement             | 77.0  | 2.3  | 2.8  | 17.9  |
| Cake, doughnut, meat pie, pizza             | 6.0   | 57.4 | 10.0 | 26.6  |
| Meat, poultry, and fish                     | 43.0  | 8.3  | 1.7  | 47.0  |
| Carbonated and sugary drinks                | 9.8   | 49.5 | 27.0 | 13.7  |
| Fat and oil                                | 15.5  | 32.3 | 12.0 | 40.2  |
| Vegetables, green food, fruits and fruit juice | 78.7  | 2.5  | 1.3  | 17.5  |
| Alcohol, liquor                            | 6.5   | 23.7 | 63.3 | 6.5   |
| Chocolate and sweet confectionary           | 6.4   | 47.0 | 32.3 | 14.3  |

SA = Strongly Agree  A = Agree  SD = Strongly Disagree  D = Disagree
strongly disagreed while 2.5% and 1.3% agreed and disagreed respectively. 63.3% of the respondents which is the highest disagreed that alcohol and liquor can be considered healthy, followed by those who agreed represented by 23.8%, while 6.5% strongly disagreed and 6.5% strongly agreed. 47% of the respondents agreed that chocolate and sweet confectionery can be considered healthy, followed by 32.3% which disagreed with this while 14.3% and 6.4% strongly disagreed and strongly agreed respectively.

Food consumption pattern before COVID-19 pandemic lockdown periods

The result from Table 4 shows that 50.8% of respondents always consumed milk and dairy products, followed by another 29% who often consumed them. 14.3% of the respondents occasionally consumed milk and dairy products while 5.5% rarely consumed them before the COVID-19 pandemic. The Majority of the respondents (66.3%) always consumed cereals and tubers while 26.5% often consumed them. 4.7% of the respondents occasionally consumed them with 2.5% rarely consuming them before the COVID-19 pandemic. 48% of the respondents often consumed legumes and nuts, followed by 25.8% who always consumed them. 19.8% of the respondents occasionally consumed legumes and nuts with 4.8% rarely consuming them. The result shows 36.5% of the respondents occasionally take vitamin and mineral supplements. 28% of the respondents always took vitamin and mineral supplements while 28% often consumed the supplements. Only 7.5% of the respondents rarely took the supplements. Table 4 shows that 39.5% of the respondents often ate cake, doughnuts and other snacks, 28.3% also occasionally ate the snacks. 21% of the respondents always consumed the snacks while 9.8% rarely consumed them and 1.4% never consumed them.

The result from Table 4 shows a higher percentage of the respondents (61.5%) always consuming meat, poultry and fish product. 21.8% often consumed them while 12.4% occasionally consumed the products. 3.5% of the respondents rarely consumed them with 0.8% never consuming them. Table 4 shows that 30.8% always consumed carbonated and sugary drinks, followed by 26.4% who occasionally consumed them. 25.3% of the respondents often consumed them while 15% rarely did and 2.5% never consumed them before the COVID pandemic lockdown. The results also show that 38.5% of the respondents often consumed fat and oil in their diet, followed by 31.5% who always consumed it. 25% occasionally consumed it while

| Table 4. Food consumption patterns before COVID-19 pandemic lockdown periods. |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Milk and dairy                  | 50.8            | 29.0            | 14.3            | 5.5             |
| Cereals, tubers/ roots (e.g., rice, yam, garri, amala) | 66.3 | 26.5 | 4.7 | 2.5 |
| Legumes and nuts (e.g., beans and groundnut) | 25.8 | 48.6 | 19.8 | 4.8 |
| Vitamins and mineral supplement | 28.0 | 28.0 | 36.5 | 7.5 |
| Cake, doughnut, meat pie, pizza | 21.0 | 39.5 | 28.3 | 9.8 |
| Meat, poultry and fish          | 61.5 | 21.8 | 12.4 | 3.5 |
| Carbonated and sugary drinks (coke, fanta) | 30.8 | 25.3 | 26.4 | 15.0 |
| Fat and oil (palm oil, butter)  | 31.5 | 38.5 | 23.0 | 4.0 |
| Vegetables, green food, fruits and fruit juice | 33.3 | 32.8 | 28.3 | 5.6 |
| Alcohol, liquor                 | 8.3  | 2.3  | 4.8  | 6.8 |
| Chocolate and sweet confectionary| 6.8  | 50.3 | 16.3 | 18.0 |

| Table 5. Food consumption pattern after the COVID −19 lockdown periods. |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Milk and diary                  | 43              | 22.3            | 15.5            | 12.3            |
| Cereals, tubers/ roots (e.g., rice, yam, garri, amala) | 48.8 | 22.0 | 15.3 | 11.5 |
| Legumes and nuts (e.g., beans and groundnut) | 23.8 | 39.5 | 23.3 | 11.8 |
| Vitamins and mineral supplement | 28.8 | 30.0 | 22.8 | 16.3 |
| Cake, doughnut, meat pie, pizza | 17.5 | 20.0 | 38.8 | 19.0 |
| Meat, poultry and fish          | 48.0 | 21.8 | 16.3 | 11.1 |
| Carbonated and sugary drinks (coke, fanta) | 16.0 | 19.3 | 22.5 | 38.3 |
| Fat and oil (palm oil, butter)  | 21.3 | 24.0 | 27.5 | 24.8 |
| Vegetables, green food, fruits and fruit juice | 34.5 | 30.8 | 20.8 | 13.0 |
| Alcohol, liquor                 | 2.8  | 12.3 | 13.3 | 13.8 |
| Chocolate and sweet confectionary| 15.3 | 7.3  | 21.3 | 41.3 |
4% rarely consumed fat and oil in their diet. The result from Table 4 shows that 33.3% always consumed vegetables, green food, fruits and fruit juice, followed by 32.8% who often consumed the food. 28.3% and 5.5% occasionally and rarely consumed them respectively.

The results show that the majority (77.8%) of the respondents never consumed alcohol or liquor, 8.3% always consumed, followed by 6.8% who rarely consumed and 4.8% and 2.3% occasionally and often consumed them respectively. Table 4 shows that 50.3% of the respondents often consumed chocolates and sweet confectioneries, followed by 18% who rarely consumed with 16.3% who occasionally consumed the confectionaries. 9.0% of the respondents never consumed the sweet confectionaries while 6.8% always consumed them before the COVID-19 pandemic lockdown periods.

Table 6. Factors affecting ability to select healthy and immunity boosting foods.

| Factor                         | Percentage (%) | Frequency (1000) |
|--------------------------------|----------------|-----------------|
| Financial reason               | 22.8%          | 228             |
| Food unavailability            | 20%            | 200             |
| Allergies                      | 6%             | 60              |
| Personal preference            | 29.0%          | 290             |
| No knowledge of food to be taken | 7.2%          | 72              |
| Health, culture or religious beliefs | 10%           | 100             |
| Movement Constraints           | 5.0%           | 50              |

The result from Table 5 shows that after the COVID-19 lockdown periods, 43% of the respondents continued to always consumed milk and dairy products, followed by 22.3% who often consumed them. 15.5% of the respondents occasionally consumed milk and dairy products while 12.3% rarely consumed them and 0.9% never consumed them after the lockdown. The table shows that after the COVID-19 lockdown periods, 48.8% of the respondents always consumed cereals and tubers while 22% often consumed them. 15.3% of the respondents occasionally consumed them with 11.5% rarely consuming them after the COVID-19 lockdown periods.

The result from Table 5 shows that 39.5% of the respondents, often consumed legumes and nuts even after the COVID-19 pandemic, followed by 23.8% who always consumed them. 23.3% of the respondents occasionally consumed legumes and nuts with 11.8% rarely consuming them after the COVID-19 lockdown periods.

The result from Table 5 shows that 30% of the respondents often take vitamin and mineral supplements even after the COVID-19 lockdown. 28.8% of the respondents always took vitamin and mineral supplement while 22.8% occasionally take them. Only 16.3% of the respondents rarely took the supplements. Table 5 shows that 38.8% of the respondents occasionally ate cake, doughnuts and other snacks after the COVID-19 lockdown, 20% also often ate the snacks. 19% of the respondents rarely consumed the snacks while 17.5% always consumed with...
12.3% never consuming it. The result shows that 48% of the respondents always consumed meat, poultry and fish products after the COVID-19 lockdown. 21.8% often consumed them while 16.3% occasionally consumed the products. 11.1% of the respondents rarely consumed them, with 2.8% never consuming it even after the COVID-19 lockdown. The result from Table 5 shows that 38.3% rarely consumed carbonated and sugary drinks after the COVID-19 lockdown, followed by 22.5% who occasionally consumed them. 19.3% of the respondents often consumed them while 16% always did and 3.9% never consumed them.

The results from Table 5 show that 27.5% of the respondents occasionally consumed fat and oil in their diet, followed by 14.8% who rarely consumed it. 24% often consumed it while 21.3% rarely consumed fat and oil and 2.8% never consumed it in their diet even after the COVID-19 lockdown periods. The table shows that 34.5% always consumed vegetables, green foods, fruits and fruit juice, followed by 30.8% who often consumed the foods. 30.8% and 13% occasionally and rarely consumed them respectively even after the COVID-19 lockdown periods. The results from Table 5 show that 57.8% of the respondents never consumed alcohol or liquor even after the COVID-19 lockdown, 13.8% rarely consumed, followed by 13.3% who occasionally consumed while 12.0% and 2.8% often and always consumed them respectively. The result from Table 5 shows 41.3% of the respondents rarely consumed chocolates and sweet confectionary, followed by 21.3% who occasionally consumed them and 7% often consuming the confectionaries. 15.3% of the respondents always consumed the sweet confectioneries while 12.8% never consumed them even after the COVID-19 lockdown periods.

Factors affecting ability to select healthy and immunity boosting foods

The result from Table 6 shows that 22.75% of the respondents chose financial reason as a factor affecting their choice in selecting healthy and immunity boosting foods. The result shows that 20% of the respondents chose food unavailability as a factor affecting their choice in selecting healthy and immunity boosting foods. The result shows that 20% of the respondents chose food unavailability as a factor affecting their choice in selecting healthy and immunity boosting foods, while 6% of the respondents

![Figure 2](image-url). Summary of food consumption of respondent before and after COVID lockdown. CB = Before Lockdown, CA = After Lockdown.
chose allergies as factor affecting their choice in selecting healthy and immunity boosting foods (Figure 1).

The result from Table 6 shows that 29% of the respondents chose personal preference as a factor affecting their choice in selecting healthy and immunity-boosting foods. The result shows that 7.25% of the respondents chose lack of knowledge of food to be taken as a factor affecting their choice in selecting healthy and immunity boosting foods and 10% of the respondents chose health, culture, or religious beliefs as factor affecting their choice in selecting healthy and immunity boosting foods. Restriction of movement accounted for 5%.

Summary of food consumption of respondent pattern before and after COVID-19 lockdown periods

Figure 2 gives the summary of the consumption patterns of healthy and immunity boosting foods taken by respondents in selected towns in Osun State. The figure shows the comparison in consumption patterns of healthy foods before and after the COVID-19 lockdown periods.

Therefore, there is a general reduction in the consumption of healthy and immunity-boosting foods among the respondent after the COVID-19 lockdown periods.

There is a significant relationship between the occurrence of pandemic and the consumption of healthy foods ($p < 0.001$). This implies that the occurrence of pandemic has significant increase in the consumption of healthy foods during and after the lockdown pandemic periods. There is also a significant relationship between nutritional knowledge and the consumption of healthy foods since the $p$ value $= 0.001$. This implies that a highly significant level was observed and this in turn implies that as nutritional knowledge increases, consumption of healthy foods also increases which means that an improvement in nutritional knowledge will lead to a further increase in the consumption of healthy foods, encouraging a healthy lifestyle.

Discussion

It was observed from the results that the respondents had high knowledge of the COVID-19 pandemic occurrence as well as high nutritional knowledge and the effect of these can be seen in their high consumption of healthy foods before and after the pandemic lockdown periods. This is in line with the study of Triches and Giugliani (2005) which stated that individual nutritional knowledge tends to favor healthy food consumption. But then, in another study, (Spronk et al., 2014) mentioned that knowledge rarely anticipates a behavioral change and this is supported by Barbosa et al. (2016) who also stated that the relationship between what people know and what they do can be considered to be very weak. The validity of these statements can be observed in the drastic reduction in the consumption of healthy foods by the respondents after the COVID-19 pandemic lockdown period. The respondents even though they had high nutritional knowledge stopped the consumption of healthy foods when they should have continued as a result of the change in their behavioral attitude toward the COVID-19 virus since the termination of the lockdowns and this is in agreement with the study of Amare et al. (2020).

Conclusions

This study demonstrates that daily food intake can be affected by certain factors including food availability, financial reasons, health, personal beliefs, and movement restrictions which could lead to a reduction in the consumption of healthy foods especially after the COVID-19 pandemic lockdown periods. There was a general reduction in the consumption of healthy foods by the respondents after the COVID-19 pandemic lockdown periods.

The majority of the respondents were females, single, lived in nuclear household, and were low income earners with high nutritional knowledge. The study also established that there was a significant relationship between the occurrence of pandemic and the consumption of healthy foods. It also showed that there was a significant relationship between nutritional knowledge and the consumption of healthy foods.

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Author contributions

AF conceived and designed the study. All authors equally contributed.

Consent for publication

All authors have reviewed, approved, and consent the final version for publication.

Declaration of conflicting interests

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Ethical statement

The study was conducted in accordance with the Obafemi Awolowo University Ile-Ife, Nigeria research policy and the protocol was approved by the Department of Family, Nutrition and Consumer Sciences Research Ethics Committee. All procedures involving research study participants were approved by the Research Ethics Committees of the Department (IRB/IEC/000553) (NHREC/ 27/02/2009a).

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ORCID iD

Adekunle Folorunso  
https://orcid.org/0000-0002-9890-765X
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