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Assessing the Impact of COVID-19 on Food Consumption Preferences

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Abstract

The COVID-19 pandemic outbreak was declared by the World Health Organization (WHO) in Wuhan city, China in December 2019 causing several countries to go into lockdown. The lockdown imposed on people affected the country's men's feeding habits and had a financial impact over the globe, especially in the context of developing countries. This study assessed the effects of the COVID-19 epidemic on people's food consumption preferences post the COVID-19 pandemic in Kira Municipality, Wakiso District, Uganda.

A closed-ended questionnaire was given to households of the selected municipality. Data was analyzed using an independent chi-square test and represented on tables and graphs.

The results showed that food availability, accessibility and utilization were greatly affected by the pandemic leading to change in food consumption preferences and the number of meals per day. The study also found that food consumption preferences were affected by age, marital status, level of education and employment status. Due to limited funding, only a single district was included in the study; therefore, we recommend further studies on food consumption preferences in Uganda for an expanded geographical scope.

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1.0. Introduction

The human infecting coronavirus disease (COVID-19) is a severe acute respiratory syndrome caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Lauren, 2021). The surfacing of SARS-CoV-2 was first observed when cases of unexplained pneumonia were noted in the city of Wuhan, China in 2019 (Harapan et al., 2020). COVID-19 was then declared a pandemic in early 2020 by the World Health Organization (WHO) (Ratzan, Sommarivac, and Rauh, 2020). Globally, the **coronavirus** COVID-19 has affected **228 countries and territories** causing 6,618,223 deaths worldwide as of November 2022 (Worldometer coronavirus, 2022).

By the 7th of April, 2020, Africa had registered approximately 10,018 cases and 484 deaths (Kemitare and Kibekityo, 2021). In Uganda, the first case was a 36-year-old Ugandan who travelled from Dubai (Wemesa et al., 2020). A COVID-19 model by Mbabazi, et al, 2020, projected that the third wave might have twice the number of people being admitted in the second wave. Incidentally, the numbers of COVID-19 escalated in the country and called for government and Ministry of Health intervention. Due to a scare in the country, all educational institutions were closed and gatherings were suspended for one month on March 20^{th,} 2020 by the president of Uganda (Monitor, 2020). Public gatherings and cultural meetings were suspended for 32 days and a 42 days COVID-19 lockdown was imposed to curb the rising cases of COVID-19 as the country experienced the second wave of the pandemic (Athumani, 2021, Monitor, 2021). According to the press statement by the Ministry of Health (MOH) after the 42 days of the second lockdown, there was a consistent drop in daily cases reported for the newly-confirmed infected and the number of death cases.

Globally, the COVID-19 pandemic has put significant pressure on the food system. The far-reaching measures established to contain its spread created serious impediments to economic activity including agro-food systems and, accordingly, to livelihoods and food security (Workie et al., 2020). Lockdowns and movement restrictions within countries and across borders have disrupted national and local food, agricultural output and input markets and have caused sharp reductions in overall economic activity internationally (Tripathi et al., 2021). In developing countries, disruptions have additionally exacerbated the feebleness of systems including agro-food systems and livelihoods (Workie et al., 2020). These feelings had an impact on the consumer-food relationship. Consumers were preoccupied with impulsive purchasing and hoarding of non-perishable food items in various countries (Hassen and Bilali, 2022).

The COVID-19 pandemic has been heartbreaking. Some people have died, others have lost their jobs, but most importantly, the food systems of the entire world's inhabitants have been disrupted (Thiesset and Vlachos, 2022,). Food systems are at the heart of human, economic, and environmental health, ignoring what people prefer to eat puts the economy at risk of a larger health and financial shock as the population grows in response to climate change.

Food consumption preferences are described as evaluative attitudes espoused by people toward foods, including how

they qualitatively evaluate them and how much they like or dislike specific foodstuffs (Głąbska, Skolmowska and Guzek, 2021). Some of these consumer preferences are acquired right from childhood while others are made for personal reasons or as a result of influence from the social environment.

In most countries, fruits, vegetables, legumes and pulses were consumed more and people ate less fast food during the COVID-19 pandemic (AlTarrah et al., 2021). Ugandans primarily consumed plantain, also known as matooke, starchy roots such as cassava, sweet potatoes, and cereals such as maize, millet, sorghum, pulses, nuts, and green leafy vegetables. Additionally, a few months into the lockdown the government decided to provide food (posho and beans) to the citizens (Acayo, 2020). But this food could not sustain the population as even those who needed it the most got less. Celik, Ozden, and Dane (2020) evaluated family views toward the COVID-19 pandemic outbreak and lockdown in terms of food intake and shopping preferences. They examined the types of consumption before and after the COVID-19 pandemic and discovered that the first and second choices for food intake were meat and bakery items prior to the outbreak, whereas fruits and vegetables were the first and second preferences after the outbreak. A mixed methods study by Filimonau, Beer and Ermolaev, 2022, explored the effect of COVID-19 on food consumption in English households at home and away. In the findings, it was revealed that there was increased food wastage in English households during the lockdown, predominantly attributed to over-cooking as a spillover effect of working/studying at home

The COVID-19 endemic has drastically condensed household purchasing power, impacting food consumption and nutrition. As a result, poor households, mostly those engaged in the informal sector, are dropping the number of meals they munch through from three to one or at most two days (Iranmanesh et.al., 2022).

In this study, we assess the effects of the COVID-19 pandemic on the food consumption preferences of the residents of Kamuli C village, Kira municipality in Wakiso District, Uganda. The study aimed at addressing the null hypothesis, which states that there is no association between people's food consumption preferences and socio-demographic characteristics as a result of the COVID-19 pandemic and the alternative hypothesis that there is a significant association between people's food consumption preferences and socio-demographic characteristics as a result of the COVID-19 pandemic.

In section 2, we provide the methodology, section 3 gives the statistical analysis, section 4 discusses the results, and section 5 presents the recommendation and conclusion.

2. Materials and Methods

Close-ended questionnaires were given to households. The questionnaires were made available to participants through the local council chairperson and some of his associates in various areas, who were able to collaborate with the researchers in printing, distributing and collecting questionnaires.

2.1 Scope

The scope of the study was Kamuli C village, found in Kireka Parish in Kira Municipality. Kira Municipality is located in

Wakiso district in the central region of Uganda, approximately 10 km from Kampala City and has an elevation of 1179 meters to Namugongo. The coordinates are 0.3972^0N, 32.6387^0E. In terms of topography, it is composed of heaving terrain of flat-topped hills. From the East, Kira Municipality borders Mukono Municipality.

Figure 1. A map showing Kira municipality location (From Google maps)

2.2. Population Description

Seventy respondents participated in this study, of which 11 (eleven) held a certificate, 18 (eighteen) a diploma, 30(thirty) a bachelor's degree, 7(seven) a master's degree, and only 4 with no formal education (didn't attend school) as shown in Figure. 2.

54.3% of the respondents were male and 45.7% were female. This means that the study was male-dominated. The majority 38(54.3%) of the respondents were between 20 to 30 years of age, followed by 12(17.1%) between 31 to 40 years of age and the least number 1(1.4%) of respondents were below 20 years as shown in figure 3, therefore most of the respondents in this study were youths. Regarding marital status, majority 36(51.4%) of the respondents were single (not married), 33(47.1%) were married and 1(1.4%) separated.

Regarding occupation, the majority 40(57.1%) of the respondents were non-public servants, whereas 16(22.9%) were students and the least 14(20.0%) were public servants, implying that most of the respondents were not being paid by the

government. Concerning working experience, the majority 38(54.3%) of the respondents had worked for less than 5 years, followed by 16(22.9%) of the respondents who had worked for over 15 years, and 16 (22.8%) of the respondents had worked for a period between 6 to 15 years. This implies that the study was dominated by respondents who had little working experience.

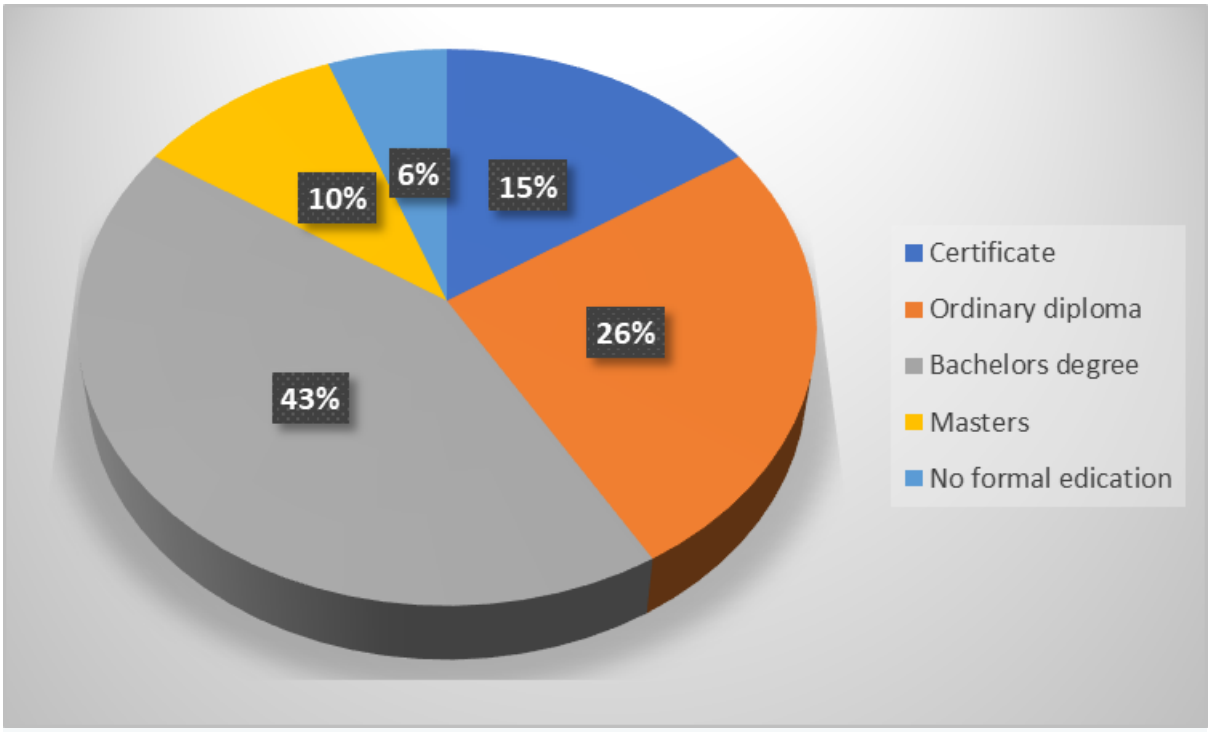

Figure 2. Level of Education of participants.

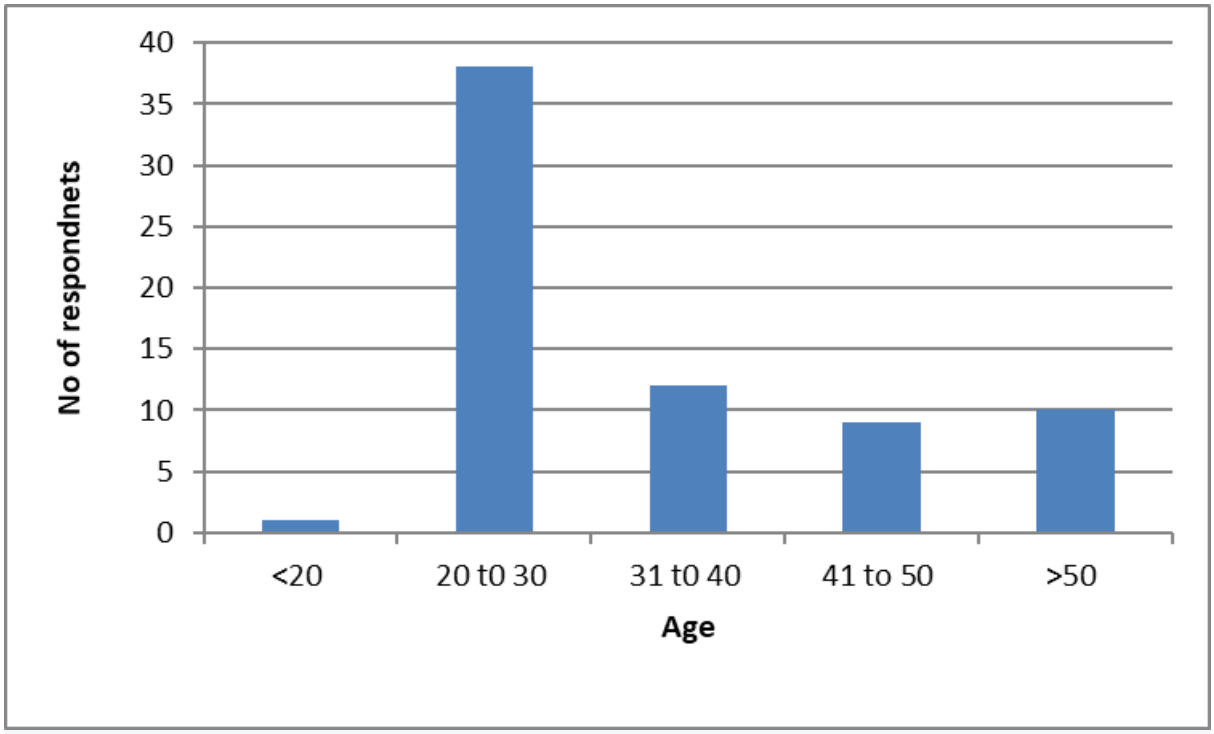

Figure 3. Age category of participants

3.0. Statistical Analysis

3.1. Food consumption preferences during the pandemic

Preference of food was rated in relation to sex, marital status, level of education, age and working experience (social-demographic characteristics of respondents). The food samples included posho, millet, meat, fish, vegetables, beans, peas, ground nuts, fruits, milk, eggs, black tea, and porridge. Table 1 and Figure 4 give the details of food consumption preference in percentages during the pandemic.

Table 1. Foods consumed at various levels during the pandemic

Type of food	level of food consumption preference					Ranks
	don't know	Low	normal	high	very high	
	(n, %)	(n, %)	(n, %)	(n, %)	(n, %)	
Posho and millet	0, 0.0	10, 14.3	17, 24.3	12, 17.1	31, 44.3	2
Meat	4. 5.7	32, 45.7	19, 27.1	13, 18.6	2, 2.9	13
Fish	2, 2.9	39, 55.7	19, 27.1	6, 8.6	4, 5.7	11
Vegetables	0, 0.0	9, 12.9	20, 28.6	19, 27.1	22, 31.4	5
beans, peas and g – nuts	0, 0.0	3, 4.3	12, 17.1	25, 35.7	30, 42.9	3
cassava, yams, sweet potatoes	0, 0.0	15, 21.4	23, 32.9	9, 12.9	23, 32.9	4
Pasta	21, 30.0	26, 37.1	10, 14.3	9, 12.9	4, 5.7	11
bread, cake and biscuits	8, 11.4	26, 37.1	22, 31.4	7, 10.0	7, 10.0	10
Fruits	0, 0.0	14, 20.0	21, 30.0	16, 22.9	19, 27.1	7
Milk	2, 2.9	23, 32.9	24, 34.3	9, 12.9	12, 17.1	9
Eggs	1, 1.4	22, 31.4	23, 32.9	10, 14.3	14, 20.0	8
black tea	0, 0.0	7, 10.0	20, 28.6	9, 12.9	34, 48.6	1
Porridge	2, 2.9	16, 22.9	19, 27.1	13, 18.6	20, 28.6	6
Total	**40, 4.4**	**242, 26.6**	**249, 27.4**	**157, 17.3**	**222, 24.4**	

Where: **(n, %)***– is the number & row percentages of respondents reporting a given level of food preference respectively.*

Source: Primary data 2022

Black tea was the most popular food during the pandemic, with the majority of the population consuming it at extremely high levels 34 (48.6%) followed by 20 (28.6%), who consumed it regularly, 9 (12.9%) consumed it highly and 7(10.0%) reporting low consumption.

Posho and millet followed black tea with 31 (44.3%), an extremely high rate of consumption as shown in Figure 1.

Fruits were favored after porridge where 14 (20.0%) respondents expressed a weak taste for fruits, and 16 (22.9%) respondents claimed to have a high intake preference for them. In terms of consumption preferences during the pandemic, eggs lagged behind fruits, with 14 (20.0%) respondents having a very high rate of preference for eggs and 10 (14.29%) reporting only a high preference. Only 1 (1.1%) respondent talked of being unsure of the degree of egg consumption preference, while 23 (32.9%) reported having a normal preference for eggs and 22 (31.4%) reported having a low preference.

In terms of consumption preferences levels during the pandemic, milk followed eggs, with 12 (17.1%) respondents having a very high level for milk, and only 9 (12.9%) respondents reported a high level. In addition, 24 (34.3%) respondents had a normal preference for milk drinking while 23 (32.9%) respondents had a low desire and 2(2.9%) respondents were unsure about their degree of milk consumption preference.

Bread, cake, and biscuits came in second behind milk, with 14 (20.0%) respondents having a high level of preference. Whereas 22 (31.4%) respondents claimed to have had a normal preference for bread, cake and biscuits, 26 (37.1%) claimed to have had a low preference for bread, cake, and biscuits, and 8 (11.4%) were unsure about their level of bread, cake, and biscuit preference during the pandemic.

Following bread, cake, and biscuits in terms of consumption preference levels were fish and pasta, with the same percentage of 4 (5.7%) respondents reporting to have had a very high preference level for the foods, according to Table 1. Only 2 (2.9%) people reported having a very high level of preference for meat, making it the least preferred food. However, 19 (27.1%) of the respondents claimed to have preferred eating meat and fish regularly.

From Table 1 above, during the pandemic, the majority of respondents resorted to eating inexpensive foods (like black tea, posho, and millet) and nutritious natural foods (like cassava, yams, sweet potatoes, and vegetables), while avoiding processed foods (like pasta, biscuits, bread, and others) and very expensive foods (like meat and fish).

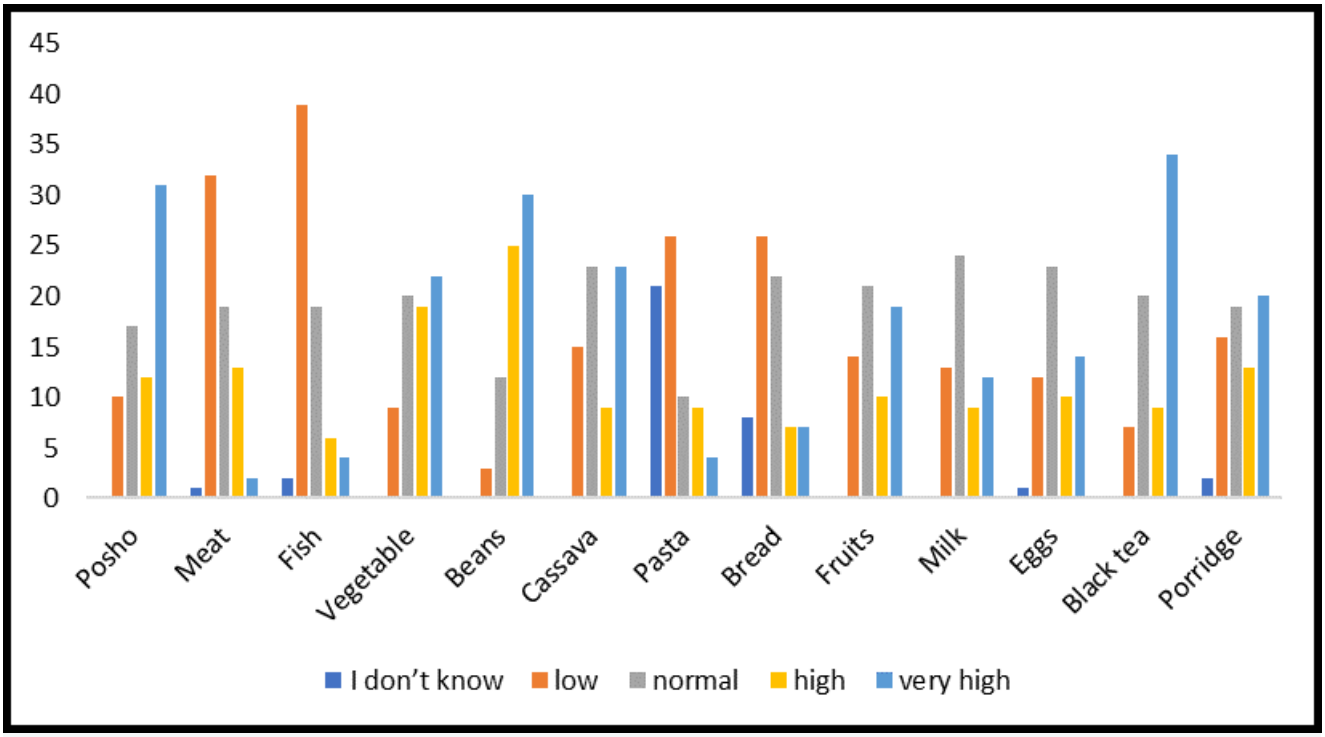

Figure 4. Food preference during the pandemic

IBM SPSS software was used for a chi-square test of independence for the association between the socio-demographic characteristics of respondents and their food consumption preferences after the outbreak of COVID-19 (February 1st, 2020 to January 31st, 2022) (See Table 2). There was a statistically significant change in food preference with reference to age, marital status, level of education and occupation ($p = 0.032$, 0.017, 0.002 and 0.000 respectively) as given in table 2.

Table 2. Chi–square table for the association between socio-demographic characteristics of respondents and Food consumption levels (February 1st, 2020 to January 31st, 2022).

	How has your overall food consumption preference changed between February 1st, 2020 and January 31st, 2022?			Test Statistic (df)	p – Value
Characteristics	**Increased**	**Decreased**	**Stayed the same**		
Age Category	**(n, %)**	**(n, %)**	**(n, %)**		
< 20 years	0, 0	1, 3.6	0, 0	**Likelihood ratio = 16. 824 (8)**	**0.032**
20 – 30 years	22, 66.7	10, 35.7	6, 66.7		
31 – 40 years	6, 18.2	4, 14.3	2, 22.2		
41 – 50 years	4, 12.1	4, 14.3	1, 11.1		
> 50 years	1, 3.0	9, 32.1	0, 0.0		
Gender					
Male	16, 48.5	18, 64.3	4, 44.4	**Likelihood ratio = 1.945 (2)**	**0.378**
Female	17, 51.5	10, 35.7	5, 55.6		
Marital Status					
Married	12, 36.4	18, 64.3	3, 33.3	**Likelihood ratio = 12.031 (4)**	**0.017**
Single	21, 63.6	10, 35.7	5, 55.6		
Separated	0, 0	0, 0	1, 11.1		
Highest Education Level					
Certificate	6, 18.2	5, 17.9	0, 0	**Likelihood ratio = 19.947 (8)**	**0.002**
Ordinary diploma	8, 24.2	8, 28.6	2, 22.2		
Bachelor's degree	15, 45.5	9, 32.1	6, 66.7		
Master's degree	2, 6.1	5, 17.9	0, 0.0		
No formal education	2, 6.1	1, 3.6	1, 11.1		
Occupation					
Public servant	7, 21.2	7, 25.0	4, 44.4	**Likelihood ratio = 28.646 (4)**	**0.000**
Non – public servant	24, 72.7	21, 75.0	5, 55.6		
Student	2, 6.1	0, 0.0	0, 0.0		
Work Experience					
< 5 years	20, 60.6	13, 46.4	5, 55.6	**Likelihood ratio = 8.450 (6)**	**0.207**
6 – 10 years	2, 6.1	3, 10.7	3, 33.3		
11 – 15 years	5, 15.2	3, 10.7	0, 0.0		
> 15 years	6, 18.2	9, 32.1	1, 11.1		
Total	**33, 47.1**	**28, 40.0**	**9, 12.9**		

Where: **(n, %)***– is the number & column percentages of respondents reporting a given level of food consumption respectively*

3.2. Food consumption levels during the pandemic.

Table 2 above, provides several results from the Chi-square test of independence. There is a strong relationship between age and food preference as a result of the pandemic where the estimated statistic (likelihood ratio) with 8 degrees of freedom was 16.824 and a statistically significant p-value of 0.032.

47.1% of the respondents observed an increase in food consumption during the pandemic, based on age and most of them were between 20 to 30 years. 28 (40.0%) respondents reported a drop-in food consumption where 10 respondents fell into the same age group (20 to 30 years).

Food preference by gender was not a significant factor based on results from the statistical test. The estimated statistic (likelihood ratio) with two degrees of freedom was 1.945, with a p-value of 0.378. Implying food intake levels did not depend on the respondent's gender.

There was a strong correlation between marital status and food consumption levels as a result of the pandemic. The null hypothesis that food consumption levels between February 1st, 2020 and January 31st, 2022 are independent of marital status was rejected (see Table 2). Out of the 33 (47.1%) respondents who said their food consumption had increased, 21 of them were single and 12 were married. While only 10 of individuals who reported a drop-in food consumption during the pandemic were single, the majority of these, 18 were married. This suggests that the respondent's marital status may have had an impact on their food consumption levels during the pandemic.

The educational level contributed to the differences in food preference as well, with a statistical p-value of 0.002. 15 (45.5%) of the 33 respondents who reported an increase in food consumption levels, were bachelor's degree holders, followed by 8 (24.2%) who held an ordinary diploma. In addition, 9 (32.1%) of the 28 respondents (40%) who reported a decline in food intake levels held a bachelor's degree, followed by 8 (28.6%) respondents with an ordinary diploma.

Furthermore, the study showed that employed respondents were able to have an increase in food consumption due to a steady income. In Table 2, the likelihood ratio with four degrees of freedom was 28.646 with a p-value of 0.000.

For the respondents who had an increase in food consumption attributed it to the low prices of food during the pandemic, food security in the country, employment, gender, level of education and marital status. However, due to the lockdown, some food items were expensive to some people and scarce in some areas including Kira Municipality.

3.3. Food sources before and after the pandemic

Further, the respondents were asked to indicate their food sources before and after the pandemic. The responses are presented in Table 3 below.

Table 3. Sources of food before and after the pandemic

Source of Foods	Before Pandemic	After Pandemic
Markets	55	18
Home Gardens	15	40
Donation	0	12

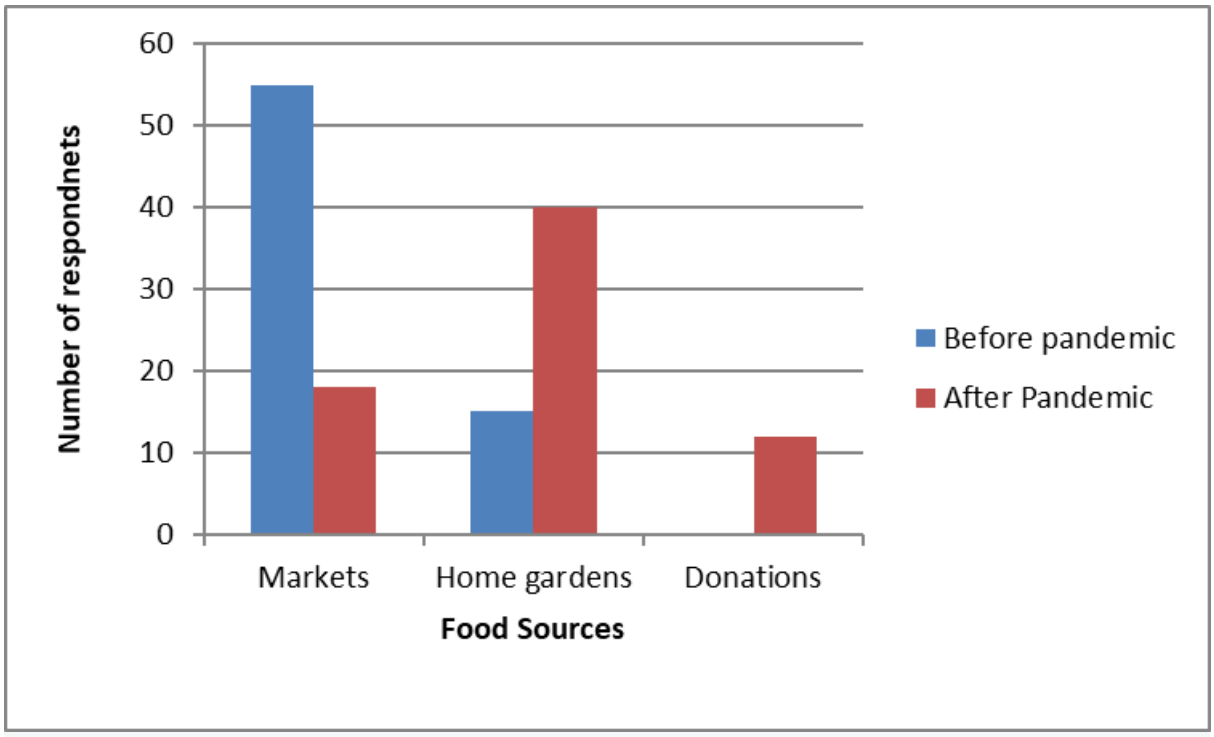

Figure 5. Food sources before and after the pandemic.

Table 3 above regarding foodstuffs acquisition before the pandemic shows that the majority of 55 (78.57%) respondents reported to have been buying food from the markets and the rest, 15 (21.4%) of the respondents reported to have been growing their own food at home. This indicates an urban setting where food is only obtained from the market which is also a representative of high purchasing power parity (PPP) among respondents.

As a result of the pandemic, the majority 40 (57.1%) of the respondents resorted to obtaining food from their own gardens/ plantations, followed by 18 (25.7%) of the respondents who probably continued purchasing from the market. The least number, 12 (17.1%) of respondents reported to be getting food in form of donations through well–wishers or sympathizers. This implies that respondents started diversifying such that they become food secure to hedge themselves from similar pandemics in the future.

3.4. Coping strategies (formulation of food preference chain)

3.4.1. Strategies for food scarcity

Respondents were asked to suggest strategies for coping with food scarcity or curbing food scarcity after a pandemic. Their responses are presented in Table 4 below.

Table 4. Strategies for food scarcity situations

Strategies to be done to ensure food doesn't become scarce	Frequency	Percent (%)
Encourage people to grow food at home	3	4.3
Put reserves to cater for food shortages	16	22.9
Encourage modernised farming practices	35	50.0
Setting up home granaries for food scarcity	11	15.7
Regulate or curb inflation	5	7.1
Total	**70**	**100.0**

Source: Primary data 2022

Table 4 above, shows the different strategies suggested by the respondents to ensure that food doesn't become scarce. 35 (50%) of the respondents reported that there is a need for government to encourage modernised farming practices. This was followed by 16 (22.9%) respondents who suggested that there is a need to put reserves in place to keep excess food produced so as to cater for food shortages in future. These were followed by 11 (15.7%)respondents who suggested that people should start setting up home granaries for excess production in their homes. 5 (7.1%) respondents suggested that the government should regulate or curb inflationary tendencies that affect food production, accessibility and affordability. People should be encouraged to grow food at home, according to the fewest respondents 3 (4.3%). These findings suggest that if agriculture is modernized, it indicates regular and timely food production, and thus food abundance.

3.4.2. Solutions to improve food abundance

Respondents suggested the following strategies to increase food productivity in case of any other form of a pandemic in Kira Municipality, Wakiso District, Uganda in Table 5 below.

Table 5. Solutions to improve food abundance

Solutions to improve food abundance	Frequency	Percent (%)
Encourage homesteads to get involved in farming or home gardening.	19	27.1
Facilitating and investing in commercial farmers and rural farmers	25	35.7
Government to set up more storage facilities	20	28.6
Research should be done on farming	6	8.6
Total	**70**	**100.0**

Source: Primary data 2022

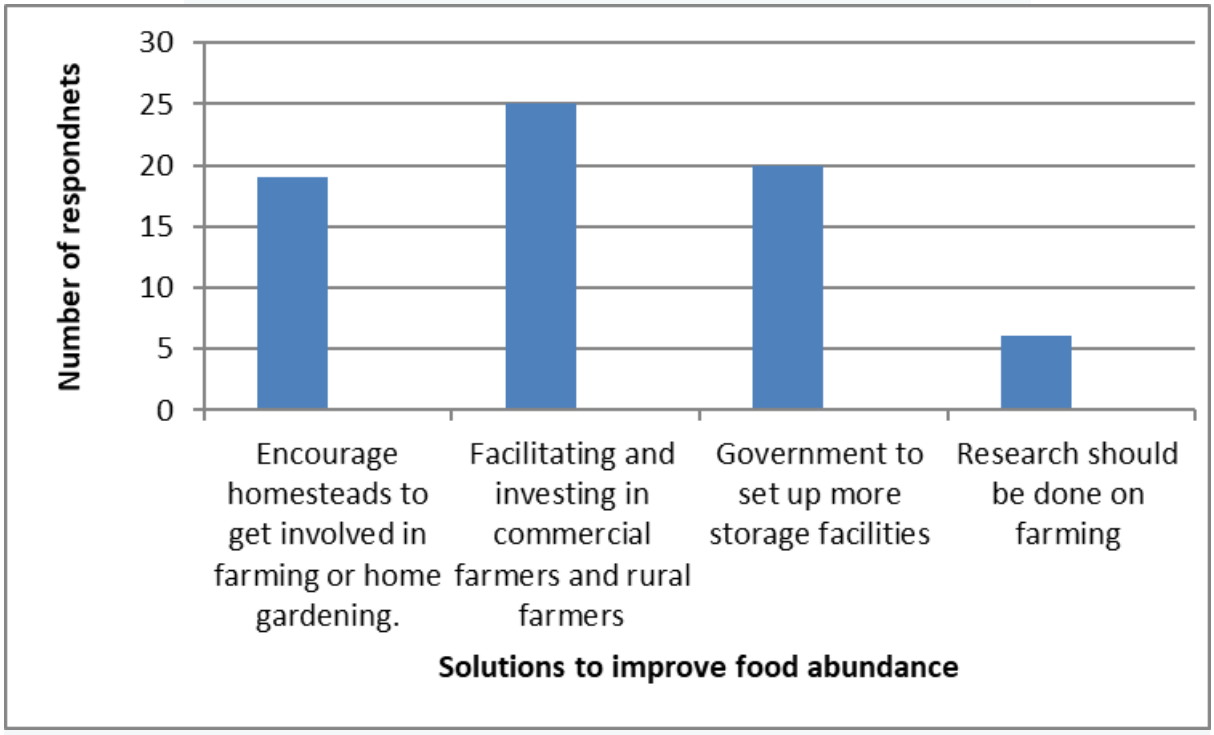

Figure 6. Solutions to improve food abundance

Table 5 above reveals that 25 of the 70 respondents believed that if the government facilitates and invests in both commercial farmers and rural farmers, then food scarcity can be dealt with. This was followed by 20 (28.6%) respondents that advised the government to set up more storage facilities that keep excess foods produced. 19 (27.1%) of the respondents proposed that people need to be encouraged to do farming at their homesteads using backyard gardens and the least number, 6 (8.6%) respondents suggested that more research should be done in farming to perhaps come up with fast ways of enabling continuity in food production. These suggestions are not any different from those in the preceding section, hence coming up with a general or common suggestion to handle food scarcity and improve abundance through practicing modern agriculture.

4. Discussion of findings

The findings of this study illustrate the associations between the socio-demographic factors of Kira municipality residents and food consumption preferences induced by the COVID-19 pandemic. The food consumption preference used in this study was “change in food consumption preference levels during the COVID-19 pandemic.” That is to say, whether the food consumption preference levels decreased, increased or remained the same. Whereas the socio-demographic characteristics in this study were the respondent’s gender, age category, education level, marital status, occupation and working experience.

The outcome demonstrates that age has a statistically significant impact on how people's food consumption preferences have altered during a pandemic. During the COVID-19 period, those who are older have formed a mindset in their choice of food consumption levels, and it is statistically significant at 5%. This result supports other studies that found that as people get older; their concerns about their health also get bigger. As a result, they tend to prioritize their health when eating more than younger people (Ares & Gámbaro, 2007; Bimbo et al., 2017; Herath, Cranfield, & Henson, 2008). In terms of education, the findings indicate that those who have attended school for a long time have changed their eating habits or consumed less food during the pandemic. This result supports the findings of Ozen et al. (2014), who found that eating habits are influenced by education. As a result of the COVID-19 pandemic, consumers who have completed more years of education have reduced their eating and shopping habits by 0.3% compared to the pre-pandemic period. Consumers with greater education are more sensitive to the COVID-19 epidemic, which results in a change in their eating and shopping patterns (Özen, del Mar Bibiloni, Pons, & Tur, 2014).

The study's findings showed that during the pandemic, there was a significant intake of black tea, Posho and millet, beans, peas, g-nuts, cassava, yams, and sweet potatoes along with vegetables. On the other hand, fewer people ate meat, spaghetti, bread, cake, and biscuits. Similar results were found in Spain by Rodrguez-Pérez et al. (2020), who found that adults consumed more fruits, vegetables, and legumes during the COVID-19 lockdown in Spain than they did on a regular basis, while they consumed less red meat, alcohol, fried food, and pastries(Rodríguez-Pérez et al., 2020). Further, according to a study done in Italy between April 5 and April 24, 2020, Di Renzo et al. (2020) found that people consumed more homemade bread, sweets, and pizza while consuming less processed meat, snacks, and beverages with added sugar (Di Renzo et al., 2020). This study concluded that modernizing agriculture in the country is the only way to address food abundance and scarcity following a pandemic.

5. Conclusion and Recommendation

The study demonstrates the relationships between the socio-demographic characteristics of Kira municipality people and changes in food choices brought on by the COVID-19 pandemic. The study found that, rather than being influenced by a person's gender or job history, dietary preferences as a result of the pandemic depend on age group, marital status, degree of education, and occupation. The study also demonstrated that access to and cost of food items have a major role in how people choose to eat as a result of the COVID-19 epidemic. While the decline in food preferences is primarily attributed to high inflation rates or the general increase in food product prices. The study's results also demonstrated that the pandemic results in a shortage of animal products (meat, milk, and eggs) and processed meals (bread, cake, biscuits,

and pasta) and an excess of plants and cereals (posho, maize, rice, millet, cassava) along with fruits and vegetables. The study also demonstrated that modernizing agriculture in the nation is the only way to address food plenty and shortages during a pandemic.

We recommend further studies on food consumption preferences in Uganda for an expanded geographical scope. The population is advised to carry out farming alongside their jobs to supplement their households at all times and not to wait for disasters of disease outbreak and rise in food prices.

Ethical Considerations

The values and the code of conduct that guided the research designs and practices were looked at. It is related to two groups of people; those conducting research, who should be aware of their obligations and responsibilities, and the participants, who have basic rights that should be protected. The study, therefore, was conducted with equality and justice by eliminating all potential risks. In other words, the respondents were aware of their rights when the research was conducted. Some of the ethical considerations that were considered include permission to conduct the study from the local council chairperson, respect for persons as autonomous individuals, confidentiality and anonymity, informed consent where children were supervised as they were carrying out the research, justice, and avoiding harm among others.

Data Availability

Data used in this work are included in this manuscript.

Conflicts of Interest

The authors declare that there are no conflicts of interest since this work was not conducted for commercial or financial purposes.

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